I-64 / I-75 Widening

Item No. 7-8909.00

Fayette County, KY.

Value Engineering Report

Final Report

Prepared by:

HDR Engineering, Inc.

Lead Authors:

Ken L. Smith, PE, CVS®

Workshop Dates:

January 28-February 1, 2019

Disclaimer:

The information contained in this report represents the professional opinions of the team members during the Value Engineering Study. These opinions were based on the information provided to the team at the time of the workshop. As the project continues to develop, new information will become available, and this information will need to be evaluated on how it may affect the recommendations and findings in this report. All costs displayed in the report are based on best available information at the time of the workshop and are in 2019 dollars unless otherwise noted.

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VE Summary

Introduction

This value engineering (VE) report summarizes the events of the workshop conducted for the Kentucky Transportation Cabinet (KYTC) and facilitated by HDR Engineering, Inc.

The subject of the workshop was the I-64 I75 Widening Project. The workshop was conducted January 28–February 1, 2019 in Lexington, Kentucky.

Value Summary

Project Cost: *$64.5-$90.2 Million*

Number of Recommendations: *6*

Recommended Cost Avoidance:

$6.48-$13.75 Million

Total Number of Team Members: *12*

Facilitator: *Ken L. Smith, PE, CVS® - HDR*

Cost of the Study: *$50,000+/-*

The primary objectives of the VE workshop were to:

- Conduct a thorough review and analysis of the key project issues using a multidiscipline, cross-functional team
- Develop "Data driven decisions to data driven locations."
- Use a "fresh set of eyes" to search for new/innovative approaches to and corridor improvements.

Project Overview

The project is located in Fayette County between the splits of I-64/ I75. It includes the interstate, ramps, interchanges in this area.

The VE team was presented with four alternatives for the corridor.

Value Engineering Recommendations

The VE team generated 32 ideas during the brainstorming activity for alternative concepts.

These ideas were compared against the original alternatives. The ideas that performed the best were further developed by the VE team and resulted in 6 VE Recommendations.

The recommendations and alternatives developed by the VE team are shown in Table 1 below and are detailed in the Development Phase section of this report.

Table 1 Summary of Recommendations

Description	Alt. 1	Alt 2	Alt. 3	Alt. 4
Pavement	-$8.8M	-$8.60M	-$8.9M	-$8.8
Narrowing Shoulders at existing structures		-$1.90M	-$3.3M	
10' Inside Shoulders			-$2.5M	
Reduction of Right-of-Way Impacts	+$0.02M	-$0.17M	+$0.66M	+$0.02M
Lengthen merge/diverge areas at ramps where needed (Paris Pike)	+$2.30M	+$2.22M	+$2.25M	+$2.3M
Narrow Shoulders at Existing Bridge Piers		-$5.30M	-$5.30M	
Totals	**-$6.48M**	**-$13.75M**	**-$17.35M**	**-$6.48M**

To facilitate implementation, a Value Engineering Recommendation Approval Form is included within the Appendix. If the Project Manager elects to reject or modify a recommendation, please include a brief explanation of why on that form.

The VE team wishes to express its appreciation to the project design team and management for the excellent support they provided during the workshop. These recommendations and other design considerations provided will assist management with decisions necessary to move the project forward.

Ken L. Smith, PE, CVS®
VE Team Leader

Introduction

This report summarizes the events of the VE Study conducted for the Kentucky Transportation Cabinet, facilitated by HDR, Inc. The subject of the study was the I-64 / I-75 Widening, Item No. 7-8909.00, Fayette County, KY.

The purpose of the proposed project is to decrease congestion and improve safety, operations, and roadway traffic capacity on the combined I-75/I-64 interstate route around Lexington. The project is needed to address the increased traffic along the project corridor in recent years as well as anticipated continued population growth in Fayette and surrounding counties.

The VE team was challenged with developing “Data driven decisions to data driven locations.”

Value Engineering Approach

Value Engineering has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, oftentimes at the expense of overlooking the role that value analysis can play to improve project performance. To address this issue, a performance-based VE approach was used.

The primary objective of any VE study is to improve the value of the project. A simple way to think of value in terms of an equation is shown at right.

$$Value = \frac{Performance}{Cost}$$

While project costs are fairly easy to quantify and compare through traditional estimating techniques, performance is not so easily quantifiable.

The use of performance measures provides the cornerstone of the performance-based VE process by giving a systematic and structured way of considering the relationship of a project's performance and cost as it relates to value. Project performance must be properly defined and agreed on by the stakeholders at the beginning of the VE study. The performance attributes and requirements that are developed are then used throughout the study to identify, evaluate, and document alternatives.

The application of performance-based VE consists of the following steps:

1) Identify key project (scope and delivery) performance attributes and requirements for the project
2) Establish the hierarchy and impact of these attributes on the project
3) Establish the baseline of the current project performance by evaluating and rating the effectiveness of the current design concepts
4) Identify the change in performance of alternative project concepts generated by the study
5) Measure the aggregate effect of alternative concepts relative to the baseline project's performance as a measure of overall value improvement.

The following are the key project performance attributes that were used in this VE study:

- Mainline Operations
- Local Operations
- Maintainability
- Construction Impacts
- Environmental Impacts
- Project Schedule

Scope and Methodology of the VE Workshop

The scope of the VE Study was to verify or improve upon the concepts being proposed for I-64 / I-75 Widening project.

To accomplish this, the VE Team:

- Applied the principles and practices of the VE Job Plan (see Appendix page 133)
- Conducted a thorough review and analysis of the key project issues using a multidiscipline, cross-functional team (i.e. review the baseline design)
- Verified or improved upon the various concepts for the I-64 / I-75 Widening project
- Improved the value of the project through innovative measures aimed at improving the performance while reducing costs of the project
- Identified high risk areas in delivering this project
- Use a “fresh set of eyes” to search for new/innovative approaches

The VE team was presented with four competing concepts for the corridor.

To determine best value of the four concepts the VE team used the proven process of value equals performance divided by cost.

VE Workshop Timing

The study was conducted January 28th – February 1st 2019 at the HDR Lexington office 2517 Sir Barton Way Lexington, KY 40509

The project was at concept level of design at the time of the study.

VE Team Members

The list of team members for the VE workshop is provided below. Other attendees are identified on a sign-in sheet which is provided in the Appendix of this report. The team members included:

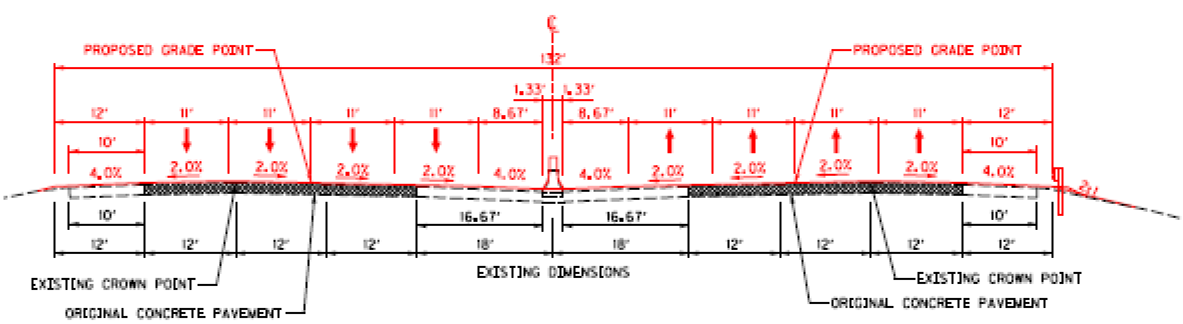
- Jody Barker - Roadway
- Joe Cochran- Roadway
- Jeff Cowan - Roadway
- Ben Edelen – Project Manager
- Jim Guinn - Roadway
- Wes Hagerman - Structures
- Adam Hedges - Traffic
- Matt Newman - Roadway
- Bob Nunley - Roadway
- Philip Pfaffenberger - Roadway
- Ken L. Smith – VE team leader
- Allison Westcote - Roadway

Project Description

The VE team was provided four alternatives that would increase capacity for approximately a seven mile section of the combined I-64 and I-75 between the splits. The following aerials illustrate the propose section of interstate.

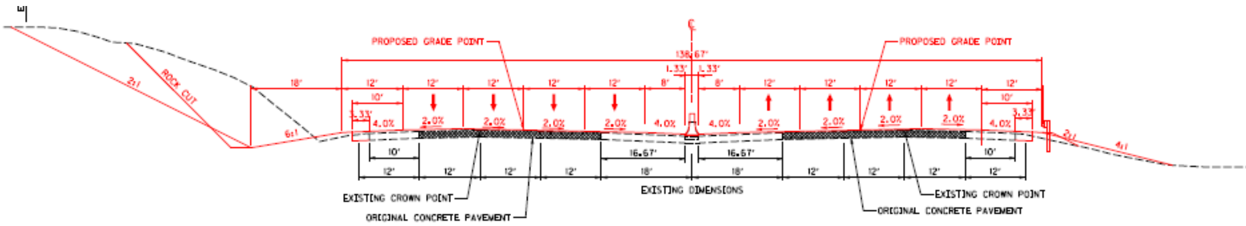
Alternative #1

- 4- 11’ lanes
- 8.7’ inside shoulder
- 12’ outside shoulder



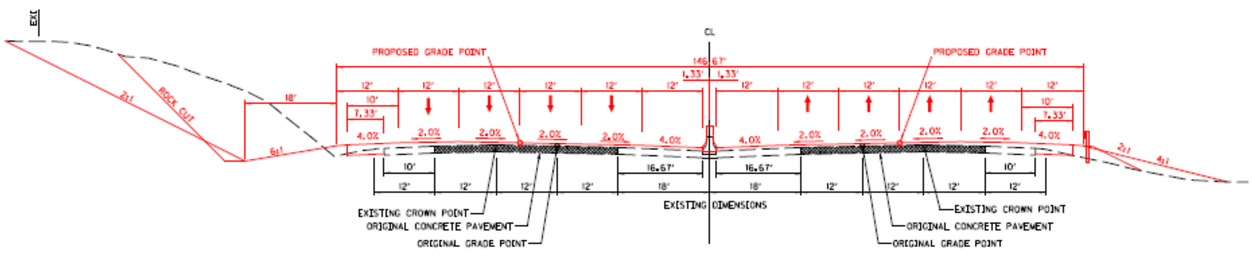
Alternative #2

- 4- 12’ lanes
- 8’ inside shoulder
- 12’ outside shoulder



Alternative #3

- 4- 12’ lanes
- 12’ inside shoulder
- 12’ outside shoulder



Alternative #4 Hard Shoulder Running

During Non-Peak hours

- 3- 12’ lanes
- 16.7’ inside shoulder
- 12’ outside shoulder

During Peak hours (not illustrated)

- 4- 12’ lanes
- 4.7’ inside shoulder
- 12’ outside shoulder

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Information Phase

Information Provided to the VE Team

The following project documents were provided to the Team for their use during the workshop:

Table 2 Information Provided to VE Team
Document
Value Planning estimate January 2019
I64/I-75 lane additional study March 2017
Typical roadway sections all alternative January 2019
Split lane diagrams (traffic data) January 2019
Google earth KMZ files for each alternative

Site Visit Observations and Constraints & Controlling Decisions

The first day of the workshop included a presentation from the project team and a virtual site visit using Google Earth. The following summarizes key project issues, project drivers and observations identified during these activities:

- Bridge Jacking up to 2.5' may cause impacts to utilities and cross streets
- Potentially $30M available 2022

Risks

Table 3 Project Risks

Risk	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Funding availability	✓	✓	✓	✓
Approval of Design Exceptions	✓	✓		✓
Debris in hard running shoulders –Maint. costs				✓
Condition of existing structures	✓	✓	✓	✓
Opportunity for roadway section (pavement depth)	✓	✓	✓	✓
Differential pavement settlement due to existing concrete	✓	✓	✓	✓
Added drainage risk for Maint.	✓	✓		✓
Operational/ crash performance of narrow shoulders/ lanes	✓	✓		✓
Phasing to meet available funds	✓	✓	✓	✓
Lane Balance	✓	✓	✓	✓

Cost Estimate

Rough Order of Magnitude (ROM) Costs were provided to the VE team for comparison purposes. Quantity take-offs were developed from the concept schematics for the following major construction elements:

- PAVEMENT
- NOISE WALL
- CONCRETE MEDIAN BARRIER 50" WALL
- STRUCTURES
- EARTHWORK
- LIGHTING
- GUARDRAIL
- DRAINAGE
- SIGNING
- ROW
- UTILITIES

In addition a 40 percent contingency was applied to cover the following:

- Mobilization (5%)
- Maintenance of Traffic (10%)
- Miscellaneous Item Allowance (10%)
- Design Contingency (5%)
- Construction Contingency (10%)

Table 4 Opinion of Probable Costs

CONSTRUCTION	ALT. 1	ALT. 2	ALT. 3	ALT. 4		FLYOVER OPTION	NORTHERN 3-LN OPTION
ROADWAY	$ 6,680,098	$ 7,786,360	$ 8,020,711	$ 6,556,648		$ 3,386,300	$ 1,443,487
NOISE WALL	$ 9,165,000	$ 9,165,000	$ 9,165,000	$ 9,165,000		$ -	$ -
PAVEMENT	$ 23,266,407	$ 31,660,371	$ 32,407,466	$ 23,266,407		$ 4,038,094	$ 7,158,861
DRAINAGE	$ 307,375	$ 610,870	$ 801,132	$ 752,375		$ 98,000	$ 177,220
STRUCTURES (Bridges)	$ 5,997,772	$ 10,865,398	$ 12,513,175	$ 5,997,772		$ 12,258,314	$ 6,748,150
LIGHTING	$ 437,500	$ 469,000	$ 469,000	$ 437,500		$ 91,000	$ 178,500
IT				$ 8,460,000			
SUBTOTAL	$ 45,854,152	$ 60,556,999	$ 63,376,484	$ 54,635,702		$ 19,871,707	$ 15,706,218
Contingency (40%)	$ 18,341,661	$ 24,222,800	$ 25,350,594	$ 21,854,281		$ 7,948,683	$ 6,282,487
TOTAL	**$ 64,196,000**	**$ 84,780,000**	**$ 88,727,000**	**$ 76,490,000**		**$ 27,820,000**	**$ 21,989,000**

RIGHT-OF-WAY	ALT. 1	ALT. 2	ALT. 3	ALT. 4		FLYOVER OPTION	NORTHERN 3-LN OPTION
Land Acquistion	$ 114,125	$ 574,750	$ 882,625	$ 114,125		$ 1,191,750	$ 167,000
SUBTOTAL	$ 114,125	$ 574,750	$ 882,625	$ 114,125		$ 1,191,750	$ 167,000
Contingency (40%)	$ 45,650	$ 229,900	$ 353,050	$ 45,650		$ 476,700	$ 66,800
TOTAL	**$ 160,000**	**$ 805,000**	**$ 1,236,000**	**$ 160,000**		**$ 1,668,000**	**$ 234,000**

UTILITIES	ALT. 1	ALT. 2	ALT. 3	ALT. 4		FLYOVER OPTION	NORTHERN 3-LN OPTION
Utility Placeholder	$ 100,000	$ 250,000	$ 250,000	$ 100,000		$ 100,000	$ 100,000
SUBTOTAL	$ 100,000	$ 250,000	$ 250,000	$ 100,000		$ 100,000	$ 100,000
Contingency (0%)	$ -	$ -	$ -	$ -		$ -	$ -
TOTAL	**$ 100,000**	**$ 250,000**	**$ 250,000**	**$ 100,000**		**$ 100,000**	**$ 100,000**

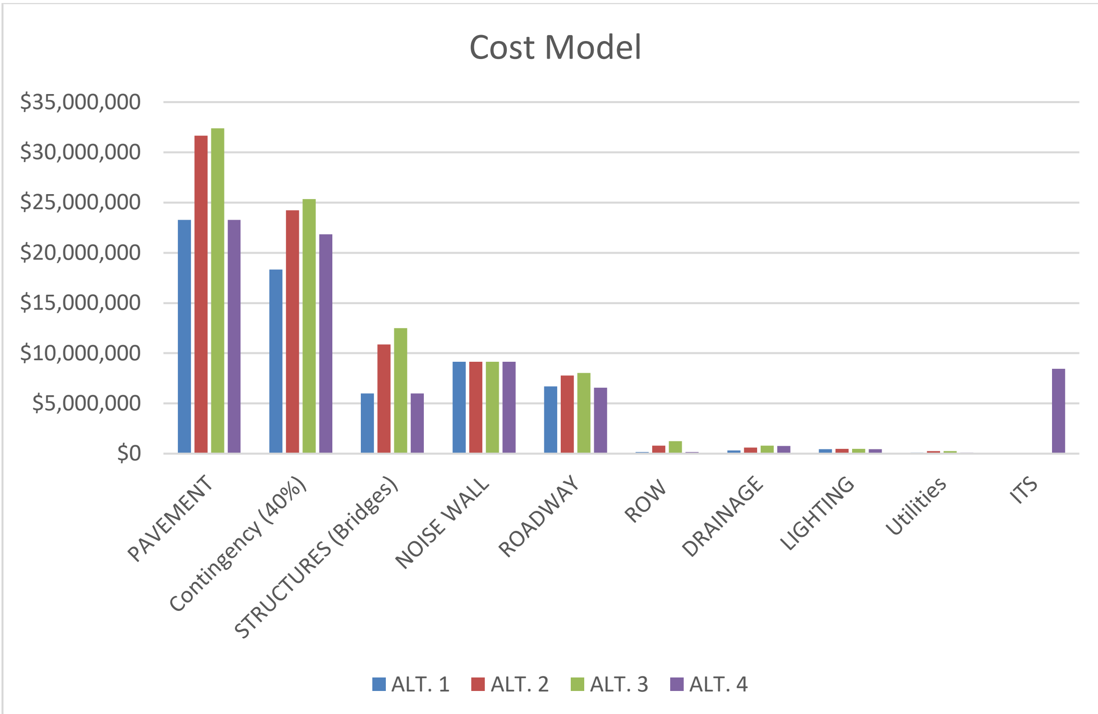
DESIGN	ALT. 1	ALT. 2	ALT. 3	ALT. 4		FLYOVER OPTION	NORTHERN 3-LN OPTION
Use 8% of Construction	$ -	$ -	$ -	$ -		$ -	$ -
SUBTOTAL	$ -	$ -	$ -	$ -		$ -	$ -
Contingency (0%)	$ -	$ -	$ -	$ -		$ -	$ -
TOTAL	**$ -**	**$ -**	**$ -**	**$ -**		**$ -**	**$ -**

PROJECT TOTALS	ALT. 1	ALT. 2	ALT. 3	ALT. 4		FLYOVER OPTION	NORTHERN 3-LN OPTION
Totals	**$ 64,456,000**	**$ 85,835,000**	**$ 90,213,000**	**$ 76,750,000**		**$ 29,588,000**	**$ 22,323,000**

Cost Models

The VE Team Leader prepared a cost model from the opinion of probable costs provided to the VE team. The cost model is organized to identify major construction elements or trade categories and the percent of total project cost for the significant cost items. Development of this cost model allows the team to focus on project elements with the highest degree of impact and utilize workshop time most effectively.

Construction cost estimates for each alternative are included in the appendix of this report.



Cost Model all Alternatives

The graphs above show project elements sorted from highest percentage of overall project cost to lowest.

Performance Attributes

The VE team, along with the Project Team, identified and defined the performance attributes for this improvement. Performance attributes are used to define a performance score for the value equation (value equals performance divided by cost).

Table 5 Performance Attributes

Performance Attribute	Description
Main Line Operations	An assessment of traffic operations and safety on the main line within the project limits. Operational considerations include level of service relative to the 20-year traffic projections, as well as geometric considerations such as design speed, sight distance, and lane and shoulder widths.
Local Operations	An assessment of traffic operations and safety on the local roadway infrastructure. Local Operations include frontage roads as well as cross roads. Operational considerations include level of service relative to the 20-year traffic projections; geometric considerations such as design speed, sight distance, lane and shoulder widths; bicycle and pedestrian operations and access.
Maintainability	An assessment of the long-term maintainability of the facilities and equipment. Maintenance considerations include the overall durability, longevity, and maintainability of structures and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.
Construction Impacts	An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours and delays; impacts to existing utilities; impacts to businesses and residents relative to access, visual effects, noise, vibration, dust, and construction traffic; environmental impacts.
Environmental Impacts	An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts; impacts to shore edge; impacts to cultural, recreational and historic resources.
Reduce Risk	An assessment of reducing project risks from concept through construction

Performance Attributes		
Evaluative Criteria Alternative 1		
Performance Attribute	**Description**	**Baseline**
Main Line Operations	An assessment of traffic operations and safety on the main line within the project limits. Operational considerations include level of service relative to the 20-year traffic projections, as well as geometric considerations such as design speed, sight distance, and lane and shoulder widths.	4-11 foot thru lanes 8.7 foot inside shoulder 12 foot outside shoulder Design exceptions - lane widths and inside shoulder Shoulders may be less under existing bridges Lane balance at northern split may require a design exception
Local Operations	An assessment of traffic operations and safety on the local roadway infrastructure. Local Operations include frontage roads as well as cross roads. Operational considerations include level of service relative to the 20-year traffic projections; geometric considerations such as design speed, sight distance, lane and shoulder widths; bicycle and pedestrian operations and access.	Sight distance at Bryan Station and Russell Cave if bridges are raised Structures not replaced may require approvals because of lack of pedestrian accessibility
Maintainability	An assessment of the long-term maintainability of the facilities and equipment. Maintenance considerations include the overall durability, longevity, and maintainability of structures and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.	Lane widening with concrete section to match existing with 6 inch Asphalt overlay Raising bridges at Russell Cave and Bryan Station and widening bridge northbound direction on Newtown Pike Narrow inside shoulders may require lane closures during maintenance activities Less pavement and drainage pipe for long term maintenance Requires more drainage inlets on inside shoulder
Construction Impacts	An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours and delays; impacts to existing utilities; impacts to businesses and residents relative to access, visual effects, noise, vibration, dust, and construction traffic; environmental impacts.	Raise structures at Bryan Station and Russell Cave, harden existing shoulder, multiple traffic shifts to develop pavement lifts, use temporary barrier, detours for side roads during bridge raising
Environmental Impacts	An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts; impacts to shore edge; impacts to cultural, recreational and historic resources.	Widening accomplished within existing ROW Noise walls assumed in areas of receptors Minimal addition of impervious surface Small slivers of additional ROW required around Newtown Pike Interchange for ramp

Evaluative Criteria Alternative 2		
Performance Attribute	**Description**	**Baseline**
Main Line Operations	An assessment of traffic operations and safety on the main line within the project limits. Operational considerations include level of service relative to the 20-year traffic projections, as well as geometric considerations such as design speed, sight distance, and lane and shoulder widths.	4-12 foot thru lanes 8 foot inside shoulder 12 foot outside shoulder Design exception - inside shoulder Shoulders may be less under existing bridges Lane balance at northern split may require a design exception
Local Operations	An assessment of traffic operations and safety on the local roadway infrastructure. Local Operations include frontage roads as well as cross roads. Operational considerations include level of service relative to the 20-year traffic projections; geometric considerations such as design speed, sight distance, lane and shoulder widths; bicycle and pedestrian operations and access.	New structures assumed to meet full standards Widening structure at Legacy Trail All over crossings widened
Maintainability	An assessment of the long-term maintainability of the facilities and equipment. Maintenance considerations include the overall durability, longevity, and maintainability of structures and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.	Lane widening with concrete section to match existing with 6 inch Asphalt overlay Replacing bridges at Russell Cave and Bryan Station and widening bridge both directions on Newtown Pike Narrow inside shoulders may require lane closures during maintenance activities Requires more drainage inlets on inside shoulder Widening impacts to all structures
Construction Impacts	An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours and delays; impacts to existing utilities; impacts to businesses and residents relative to access, visual effects, noise, vibration, dust, and construction traffic; environmental impacts.	Replace structures at Bryan Station and Russell Cave, harden existing shoulder, multiple traffic shifts to develop pavement lifts, use temporary barrier, shorter duration detours for side roads during bridge construction
Environmental Impacts	An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts; impacts to shore edge; impacts to cultural, recreational and historic resources.	Requires some ROW to accommodate interstate widening and realignment of Russell Cave and Bryan Station Noise walls assumed in areas of receptors Addition of impervious surface (less than 4 feet) Small slivers of additional ROW required around Newtown Pike Interchange for ramp 4f De-Minimus at Cold Stream Park

Evaluative Criteria Alternative 3		
Performance Attribute	**Description**	**Baseline**
Main Line Operations	An assessment of traffic operations and safety on the main line within the project limits. Operational considerations include level of service relative to the 20-year traffic projections, as well as geometric considerations such as design speed, sight distance, and lane and shoulder widths.	4-12 foot thru lanes 12 foot inside shoulder 12 foot outside shoulder Shoulders may be less under existing bridges Lane balance at northern split may require a design exception
Local Operations	An assessment of traffic operations and safety on the local roadway infrastructure. Local Operations include frontage roads as well as cross roads. Operational considerations include level of service relative to the 20-year traffic projections; geometric considerations such as design speed, sight distance, lane and shoulder widths; bicycle and pedestrian operations and access.	New structures assumed to meet full standards Widening structure at Legacy Trail All over crossings widened
Maintainability	An assessment of the long-term maintainability of the facilities and equipment. Maintenance considerations include the overall durability, longevity, and maintainability of structures and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.	Lane widening with concrete section to match existing with 6 inch Asphalt overlay Replacing bridges at Russell Cave and Bryan Station and widening bridge both directions on Newtown Pike Requires minimal addition to median drainage Widening impacts to all structures
Construction Impacts	An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours and delays; impacts to existing utilities; impacts to businesses and residents relative to access, visual effects, noise, vibration, dust, and construction traffic; environmental impacts.	Replace structures at Bryan Station and Russell Cave, harden existing shoulder, multiple traffic shifts to develop pavement lifts, use temporary barrier, shorter duration detours for side roads during bridge construction Longer overall construction duration
Environmental Impacts	An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts; impacts to shore edge; impacts to cultural, recreational and historic resources.	Requires ROW or walls to accommodate interstate widening and realignment of Russell Cave and Bryan Station Noise walls assumed in areas of receptors Addition of impervious surface (less than 8 feet) Small slivers of additional ROW required around Newtown Pike Interchange for ramp 4f De-Minimus at Cold Stream Park

Performance Attributes		
Evaluative Criteria Alternative 4		
Performance Attribute	**Description**	**Baseline**
Main Line Operations	An assessment of traffic operations and safety on the main line within the project limits. Operational considerations include level of service relative to the 20-year traffic projections, as well as geometric considerations such as design speed, sight distance, and lane and shoulder widths.	4-12 foot thru lanes 4.7 foot inside shoulder (when hard-shoulder running is open) 16.7 foot inside shoulder (when hard-shoulder running is closed) 12 foot outside shoulder Design exceptions - lane widths and inside shoulder Shoulders may be less under existing bridges Lane balance at northern split may require a design exception
Local Operations	An assessment of traffic operations and safety on the local roadway infrastructure. Local Operations include frontage roads as well as cross roads. Operational considerations include level of service relative to the 20-year traffic projections; geometric considerations such as design speed, sight distance, lane and shoulder widths; bicycle and pedestrian operations and access.	Sight distance at Bryan Station and Russell Cave if bridges are raised Structures not replaced may require approvals because of lack of pedestrian accessibility
Maintainability	An assessment of the long-term maintainability of the facilities and equipment. Maintenance considerations include the overall durability, longevity, and maintainability of structures and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.	Lane widening with concrete section to match existing with 6 inch Asphalt overlay Raising bridges at Russell Cave and Bryan Station and widening bridge northbound direction on Newtown Pike Wider inside shoulders during non-peak hours provides additional width for maintenance activities Less pavement for long term maintenance Requires more drainage inlets on inside shoulder Additional maintenance for ITS and coordination with LFUCG
Construction Impacts	An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours and delays; impacts to existing utilities; impacts to businesses and residents relative to access, visual effects, noise, vibration, dust, and construction traffic; environmental impacts.	Raise structures at Bryan Station and Russell Cave, harden existing shoulder, multiple traffic shifts to develop pavement lifts, use temporary barrier, detours for side roads during bridge raising
Environmental Impacts	An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts; impacts to shore edge; impacts to cultural, recreational and historic resources.	Widening accomplished within existing ROW Noise walls assumed in areas of receptors Minimal addition of impervious surface Small slivers of additional ROW required around Newtown Pike Interchange for ramp

Performance Attribute Matrix

A matrix was used to determine the relative importance of the individual performance attributes for the Project. The Project and VE Teams evaluated the relative importance of the performance attributes that would be used to evaluate the creative ideas.

These attributes were compared in pairs, asking the question: "Which one is more important to the purpose and need of the project?" The letter code (e.g., "A") was entered into the matrix for each pair.

Performance Attributes Criteria Matrix								
Paired Comparison							**Total points**	**% of Total**
Main Line Operations	**A**	**A**	**A**	**A**	**A**	**A**	**6.0**	**29%**
Local Operations		**B**	**C**	**B**	**B**	**B**	**4**	**19%**
Maintainability			**C**	**C**	**C**	**C**	**5.0**	**24%**
Construction Impacts				**D**	**D**	**D**	**3.0**	**14%**
Environmental Impacts					**E**	**E**	**2.0**	**10%**
Reduce Risk						**F**	**1.0**	**5%**
						Total	**21.0**	**100%**

Paired Comparison

After all pairs were discussed, they were tallied (after normalizing the scores by adding a point to each attribute) and the percentages calculated. These scores were then used as a weighting to calculate the value of each concept during the performance evaluation scoring team review for each Concept.

Performance Criteria Rating

Following are definitions and rating scales for the standardized performance criteria. The following rating criteria was provided to the VE team members prior to the scoring exercise.

Criteria	Definition	Rating Scale	Unit of Measure/Quantification
Mainline Operations	An assessment of traffic operations and safety on the mainline facility(s), including off-ramps, and collector-distributor roads. Operational considerations include level of service relative to the 20 year traffic projections as well as geometric considerations such as design speed, sight distance, lane widths and shoulder widths.	10	Free flow – excellent operation
		9	Full Design standards
		8	Stable flow – very good operation
		7	Minor design exceptions
		6	Stable flow – good operation
		5	Approaching unstable flow – fair operation
		4	Design exceptions (geometry, sight distance)
		3	Unstable flow – poor operation
		2	Major Design exceptions (weaving and merging)
		1	Traffic congestion

Criteria	Definition	Rating Scale	Unit of Measure/Quantification
Local Operations	An assessment of traffic operations and safety on the local roadway infrastructure, including on-ramps and frontage roads. Operational considerations include level of service relative to the 20 year traffic projections; geometric considerations such as design speed, sight distance, lane widths; bicycle and pedestrian operations and access.	10	Free flow – excellent operation
		9	Full Design standards
		8	Stable flow – very good operation
		7	Minor design exceptions
		6	Stable flow – good operation
		5	Approaching unstable flow – fair operation
		4	Design exceptions (geometry, sight distance)
		3	Unstable flow – poor operation
		2	Major Design exceptions (weaving and merging)
		1	Traffic congestion

Criteria	Definition	Rating Scale	Unit of Measure/Quantification
Maintainability	An assessment of the long-term maintainability of the transportation facility(s). Maintenance considerations include the overall durability, longevity and maintainability of pavements, structures and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.	10	Very low maintenance
		9	
		8	
		7	Similar maintenance to the existing facility when it was in like new condition
		6	
		5	
		4	Similar maintenance to the existing facility in existing condition
		3	
		2	Maintainability is significantly increased over the existing facility when it was in like new condition
		1	

Criteria	Definition	Rating Scale	Unit of Measure/Quantification
Construction Impacts	An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours and delays; impacts to businesses and residents relative to access, visual, noise, vibration, dust and construction traffic; environmental impacts.	10 9 8 7 6 5 4 3 2 1	No impacts Minor impacts (i.e., noise, vibration, dust, or visual, requiring limited mitigation effort) Minor impacts (i.e., minor traffic delays, occasional temporary nighttime lane closures, etc.) Ramp closures of up to 30 days with acceptable detours Moderate impacts (i.e., noise, vibration, dust, or visual, requiring significant mitigation efforts and/or inconveniences to the public) Moderate impacts (i.e., multiple minor traffic delays, lengthy detours for ramp closures up to 45 days, extended temporary night closures, etc.) Major impacts (i.e., noise, vibration, dust, or visual, requiring substantial mitigation efforts and/or inconveniences to the public with lengthy detours for ramp closures up to 60 days Major impacts (i.e., noise, vibration, dust, or visual, requiring substantial mitigation efforts and/or inconveniences to the public with lengthy detours for ramp closures up to 90 days Major impacts (i.e., noise, vibration, dust, or visual, requiring substantial mitigation efforts and/or inconveniences to the public with lengthy detours for ramp closures up to 120 days

Criteria	Definition	Rating Scale	Unit of Measure/Quantification
Environmental Impacts	An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts (i.e., environmental justice, business, residents); impacts to cultural, recreational and historic resources.	10	Major improvement upon existing environmental conditions
		9	
		8	Minor improvement upon existing environmental conditions
		7	No environmental impacts
		6	Negligible degradation - does not require mitigation
		5	Minor degradation - requires some mitigation
		4	Moderate degradation - requires significant on-site mitigation
		3	
		2	Severe degradation - requires significant off-site mitigation
		1	

Criteria	Definition	Rating Scale	Unit of Measure/Quantification
Reduce Risk	An assessment of reducing project risks from concept through construction	10	Eliminates project risk
		9	
		8	Mitigates risk with little residual cost or schedule risk
		7	
		6	
		5	Mitigates risk with added cost and schedule
		4	Added risk to cost and schedule
		3	
		2	Significantly adds cost and or schedule risk
		1	

Scoring Performance for Original Concepts

To develop the total performance score for each of the four concepts presented, the VE team used the weighting and scoring criteria to score each of the attributes.

Alternative 1		
PERFORMANCE MEASURES **Attributes and Rating Rationale**	**Performance**	**Score**
Mainline Operations ▪ Design exceptions – lane 11 ft ▪ Design exception – inside shoulder 8.7 ft ▪ Full outside shoulder ▪ Exceeds LOS C in design year	Rating	6
	Weight	28.6
	Contribution	171.6
Local Operations ▪ Russell Cave and Bryan Station – raising structures therefore no adjustments to lane or shoulder widths ▪ Does not Commitment satisfy commitment to provide bike and pedestrian access Russell Cave road	Rating	6
	Weight	19.0
	Contribution	114.0
Maintainability ▪ Similar maintenance to existing facility ▪ Maintenance has expressed concerns for inside shoulder maintenance activities – would require lane closures ▪ Raising structures built in late 60s may have additional maintenance	Rating	4
	Weight	23.8
	Contribution	95.2
Construction Impacts ▪ Maintain 2-3 lanes in each direction throughout construction with interim night closures	Rating	6
	Weight	14.2
	Contribution	85.2
Environmental Impacts ▪ Assumes noise walls where required ▪ Stays mostly within existing right of way	Rating	6
	Weight	9.5
	Contribution	57.0
Reduce Risk ▪ Risk of additional cost to repair existing structures ▪ Stays within existing roadway prism, minimizing risk to environmental, right of way and utilities ▪ Will require design exceptions for lane and shoulder widths ▪ Raising structures ▪ Does not address lane balance at northern split	Rating	5
	Weight	4.7
	Contribution	23.5
	Total Performance:	**547**

Alternative 2		
PERFORMANCE MEASURES **Attributes and Rating Rationale**	**Performance**	**Score**
Mainline Operations ▪ Design exception – inside shoulder 8 ft ▪ Full outside shoulder ▪ Exceeds LOS C in design year ▪	Rating	7.5
	Weight	28.6
	Contribution	214.5
Local Operations ▪ Russell Cave and Bryan Station – replaces structures with adjustments to lane or shoulder widths ▪ Accommodates Commitment satisfy commitment to provide bike and pedestrian access Russell Cave road	Rating	8
	Weight	19.0
	Contribution	152
Maintainability ▪ Similar maintenance to existing facility ▪ Maintenance has expressed concerns for inside shoulder maintenance activities – would require lane closures ▪ Replacing structures built in late 60s will have less maintenance	Rating	5
	Weight	23.8
	Contribution	119.0
Construction Impacts ▪ Maintain 2-3 lanes in each direction throughout construction with interim night closures	Rating	6
	Weight	14.2
	Contribution	85.2
Environmental Impacts ▪ Assumes noise walls where required ▪ Some right of way required ▪ Outside widening throughout ▪ Added shoulder or sidewalk on Russell Cave and Bryan Station	Rating	5
	Weight	9.5
	Contribution	47.5
Reduce Risk ▪ Risk of additional cost to repair existing structures ▪ Will require design exceptions for shoulder widths ▪ Widening outside of current right of way ▪ Does not address lane balance at northern split	Rating	5
	Weight	4.7
	Contribution	23.5
	Total Performance:	**646**

Alternative 3		
PERFORMANCE MEASURES **Attributes and Rating Rationale**	**Performance**	**Score**
Mainline Operations ▪ No design exception ▪ Full inside/outside shoulder ▪ Exceeds LOS C in design year ▪	Rating	9
	Weight	28.6
	Contribution	257.4
Local Operations ▪ Russell Cave and Bryan Station – replaces structures with adjustments to lane or shoulder widths ▪ Accommodates commitment satisfy commitment to provide bike and pedestrian access Russell Cave road	Rating	8
	Weight	19.0
	Contribution	152.0
Maintainability ▪ Similar maintenance to existing facility ▪ Replacing structures built in late 60s will have less maintenance	Rating	6
	Weight	23.8
	Contribution	142.8
Construction Impacts ▪ Maintain 2-3 lanes in each direction throughout construction with interim night closures ▪ May not require outside shoulder widening for stage 1 construction ▪ Added drainage/slope construction work on outside could add to construction duration	Rating	6
	Weight	14.2
	Contribution	85.2
Environmental Impacts ▪ Assumes noise walls where required ▪ Additional right of way required ▪ Outside widening throughout ▪ Added shoulder or sidewalk on Russell Cave and Bryan Station ▪ Potential 4f impacts will need to be mitigated	Rating	4
	Weight	9.5
	Contribution	38.0
Reduce Risk ▪ Risk of additional cost to repair existing structures ▪ Widening outside of current right of way ▪ Does not address lane balance at northern split	Rating	6
	Weight	4.7
	Contribution	23.5
	Total Performance:	**699**

Alternative 4		
PERFORMANCE MEASURES **Attributes and Rating Rationale**	**Performance**	**Score**
Mainline Operations ▪ Design exception – inside shoulder 4.7 ft during peak hours, 16.7 ft off peak ▪ Full outside shoulder ▪ Opening and closing of lanes could cause operational issues ▪ Reliability of ITS may affect lane operations ▪ Complicates merge on southern split ▪ May have inside shoulder reduction in areas of overhead signing (ITS)	Rating	4
	Weight	28.6
	Contribution	114.4
Local Operations ▪ Russell Cave and Bryan Station – raising structures therefore no adjustments to lane or shoulder widths ▪ Does not Commitment satisfy commitment to provide bike and pedestrian access Russell Cave road	Rating	6
	Weight	19.0
	Contribution	114.0
Maintainability ▪ Maintenance has expressed concerns for inside shoulder maintenance activities – would require lane closures ▪ Raising structures built in late 60s may have additional maintenance ▪ Maintaining ITS components significant ▪ Interim maintenance of hard shoulder running lane between peak hours	Rating	2
	Weight	23.8
	Contribution	47.6
Construction Impacts ▪ Maintain 2-3 lanes in each direction throughout construction with interim night closures	Rating	6
	Weight	14.2
	Contribution	85.2
Environmental Impacts ▪ Assumes noise walls where required ▪ Stays mostly within existing right of way	Rating	6
	Weight	9.5
	Contribution	57.0
Reduce Risk ▪ Risk of additional cost to repair existing structures ▪ Stays within existing roadway prism, minimizing risk to environmental, right of way and utilities ▪ Will require design exceptions for shoulder widths ▪ Raising structures ▪ Does not address lane balance at northern split ▪ Coordination and operation of ITS ▪ Opening and transitioning of inside lane on southern split	Rating	5
	Weight	4.7
	Contribution	23.7
	Total Performance:	**442**

To complete the value equation the concepts performance scores were divided by their respective opinions of probable costs

$$\text{Value} = \frac{\text{Performance} \uparrow}{\text{Cost} \downarrow}$$

Alternative Summary				
Alternatives		Performance (P)	Cost (C) $ millions	Value Index
1	Alternative 1	547	$64.5	8.48
2	Alternative 2	646	$85.8	7.53
3	Alternative 3	699	$90.2	7.75
4	Alternative 4	442	$78.1	5.65

Table 6 Value Index Alternative's 1 thru 4 Pre-VE

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Function Analysis Phase

Function analysis results in a unique view of the project. It transforms project elements into functions, which moves the VE team mentally away from the original design and takes it toward a functional concept of the project.

Functions are defined in verb-noun statements to reduce the needs of the project to their most elemental level. Identifying the functions of the major design elements of the project allows a broader consideration of alternative ways to accomplish the functions. The major functions identified by the team were:

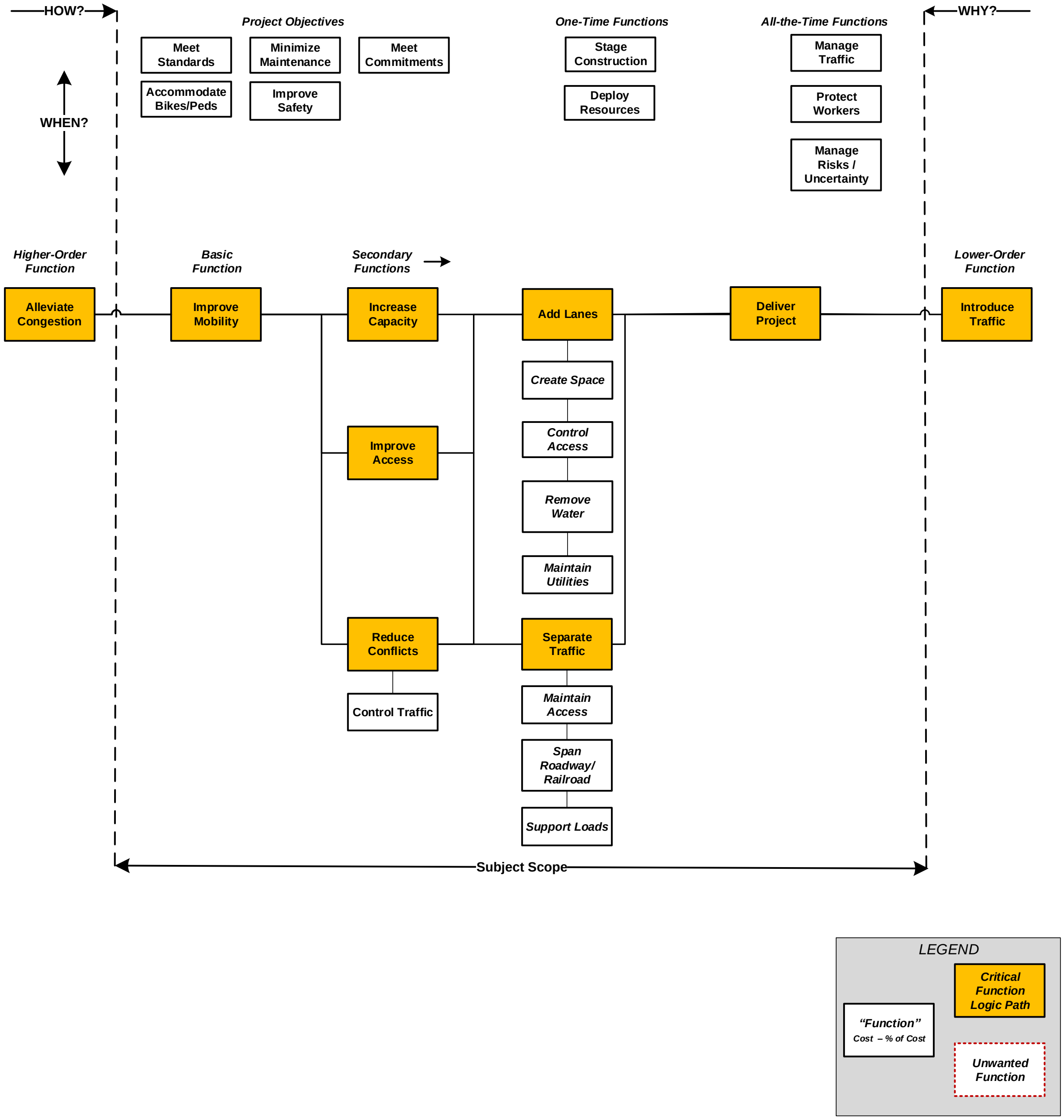
Table 7: Functions

Verb	Noun
Alleviate	Congestion
Improve	Mobility
Increase	Capacity
Improve	Access
Reduce	Conflicts
Add	Lanes
Separate	Traffic

FAST Diagram

The Function Analysis System Technique or FAST diagram arranges the functions in logical order so that when read from left to right; the functions answer the question “How?” If the diagram is read from right to left, the functions answer the question “Why?” Functions connected with a vertical line are those that happen at the same time as, or are caused by, the function at the top of the column.

The FAST Diagram for this project shows Improve Mobility as the basic function of this project. A key secondary function was Increase Capacity and Reduce Conflicts. This provided the VE team with an understanding of the project design rationale and which functions offer the best opportunity for cost or performance improvement.



FAST Diagram

Creative Phase

During the Creative Phase of the Value Methodology Job Plan, the VE team brainstormed ideas on how to achieve the various functions. These ideas were based on the available information given to them at the time of the workshop, taking into consideration the constraints and controlling decisions that were also defined for them. The ideas listed below coincide with each function being considered:

Function: Increase Capacity

- Toll lanes
- Advanced signing for lane choice
- Auxiliary lane between interchanges
- Flyover southern split
- Northern split 3 lane widening (I75N/I75S)
- 2 lane on ramp southbound from Newtown Pike
- Ramp metering at interchanges
- Narrowing shoulders at existing structures
- Lengthen merge/diverge areas at ramps where needed
- Only widen southbound
- Widen southbound from Newtown to southern split
- Reversible lane
- HOV

Function: Support Load

- Change 6 in overlay to 4.5 in mill/fill
- Break and seat existing concrete with overlay
- Do not overlay existing structures
- Widening without concrete base
- Only pave widened areas that have not recently been rehabbed

Function: Span Roadway

- Single span all bridges
- No median piers
- Current and future structures maintenance included with this project
- Bike lanes on overpass bridges
- Not raising the bridges
- Stub wall on legacy trail to avoid extending box culvert
- Concrete roadway section spanning legacy trail box culvert
- Steel beams for new bridge construction
- Raise substructure and superstructure

Function: Create Space

- Narrow ditches to reduce right of way
- Use sound wall combination cut/fill
- Small retaining walls to reduce right of way
- Guardrail/barrier to narrow footprint to reduce right of way

Function: Separate Traffic

- Encase existing median barrier with single slope

Evaluation Phase

Although each project is different, the evaluation process for each VE effort can be thought of in its simplest form as a way of combining, evaluating, and narrowing ideas until the VE team agrees on the proposals to be forwarded.

Taking into consideration the constraints and controlling decisions, the team discussed each idea and documented the advantages and disadvantages. Each idea was then carefully evaluated with the VE team reaching consensus on the overall rating of the idea (zero through three). Ideas rated three were developed further; those that need to be combined with other Ideas or was a future design consideration were (rated two); and low-rated ones (one or lower) were dropped from further consideration; however, the team provided a short description and justification to support the low rating. The rating values are shown below:

3 = Good Opportunity
2 = Design Consideration (Needs to be combined with other ideas to move forward)
1 = Major Value Degradation
0 = Fatal Flaw (unacceptable impact or doesn't meet the project purpose and need)
B/L = Baseline

Function: Improve Access

#	Idea	Advantages	Disadvantages	Alt 1	Alt. 2	Alt. 3	Alt. 4
1	Toll lanes	▪ Eliminate weave over the entire section ▪ Help fund the project	▪ Adding congestion to non-toll lanes ▪ Public acceptance ▪ Ingress and Egress points could cause issues in facility ▪ Additional cross section	*1*	*1*	*1*	*1*
2	Advanced signing / road markings for lane choice	▪ May eliminate weaves ▪ May eliminate side swipes ▪ Low cost	▪ Closely spaced interchanges reduces availability for space	2	2	2	2
3	Auxiliary lane between interchanges (Interim)	▪ Defer full project ▪ Compatible with ultimate alternatives 1-3	▪ Will not meet project purpose and need in interim condition	2	2	2	0
4	Flyover southern split	▪ Eliminates left exit ▪ Changes weave pattern ▪ Minor benefit over current condition	▪ Changes weave pattern ▪ Cost	1	1	1	2

#	Idea	Advantages	Disadvantages	Alt 1	Alt. 2	Alt. 3	Alt. 4
5	Northern split 3 lane widening (I75N/I75S)	▪ Fixes lane balance ▪ Continuity of 3 lanes on I75 from state line to state line	▪ Extends project limits and cost	2	2	2	2
6	2 lane on ramp southbound from Newtown Pike (assumed baseline)	▪ Reduces congestion on Newtown Pike ▪ Interim ▪ May improve local operations	▪ Potential impacts to ROW/golf course ▪ Doesn't improve mainline operations ▪ May require IMR	B/L	B/L	B/L	B/L
7	Ramp metering at interchanges	▪ Increases capacity on mainline ▪ Works best at Paris Pike southbound entrance ramp	▪ May add requirements to widening ramps ▪ Only one in KY	2	2	2	2
8	Narrowing shoulders at existing structures	▪ Cost ▪ Eliminates widening bridges nearing the end of their service life	▪ Doesn't correct vertical clearance issues on underpasses ▪ Introduces fixed object on existing shoulder width	3	3	1	3
9	Lengthen merge/diverge areas at ramps where needed (Paris Pike)	▪ Improves weaving distance	▪ May require additional road and bridge widening ▪ Added cost	3	3	3	3
10	Only widen southbound (interim)	▪ Interim ▪ Decreased cost ▪ Attacks most pressing problem ▪ May match available funding	▪ Will still require structure raising or replacements ▪ Replace median barrier wall	2	2	2	2
11	Widen southbound from Newtown to southern split	▪ Same as 10	▪	2	2	2	2

#	Idea	Advantages	Disadvantages	Alt 1	Alt. 2	Alt. 3	Alt. 4
12	Reversible lane	▪ Add capacity over existing	▪ Existing median piers could make this a challenge ▪ Added width on one side for buffers and extra barrier ▪ May not meet project purpose and need ▪ Added maintenance	0	0	0	0
13	HOV – High Occupancy Vehicle	▪ May reduce volume	▪ Not used in the area ▪ Egress/Degress bigger problem with trucks on southern end ▪ Added requirement for enforcement	1	1	1	0
14	Change 6 in overlay to 4.5 in mill/fill	▪ Reduces profile changes on mainline ▪ Eliminate bridge overlays/need to replace barriers ▪ Reduces side slope fills ▪ Reduces amount of raising required for vertical clearance ▪ Sustainability	▪ Reduces pavement structural depth ▪ May increase construction duration ▪ Additional haul ▪ Could expose unknown problems with existing concrete	3	3	3	3
15	Break and seat existing concrete with overlay	▪ Reduce profile ▪ Should reduce reflective cracking ▪ Eliminates concrete base	▪ Increase cost ▪ May increase construction duration ▪ Limited contractors	2	2	2	2
16	Do not overlay existing structures	▪ Reduce dead load ▪ Eliminate need to replace bridge rail ▪ Reduced cost	▪ Dive down to existing bridge deck profile ▪ May be bridge deck repair	3	3	3	3
17	Widening without concrete base	▪ May reduce cost and/or construction time	▪ Could have reflective cracking in the middle of lanes ▪ Differential settlement	2	2	2	2

#	Idea	Advantages	Disadvantages	Alt 1	Alt. 2	Alt. 3	Alt. 4
18	Only pave widened areas that have not recently been rehabbed	▪ Full service life over previous work ▪ Cost ▪ May shorten construction duration ▪ May eliminate phases of construction	▪ Ghost striping from temporary traffic shifts ▪ Does not accommodate crown shift	2	2	2	2
19	Single span bridges (Russell Cave and Bryan Station)	▪ Eliminate piers in median	▪ Increased structure depth ▪ Increase cost ▪ Higher profile changes on cross streets	1	1	1	1
20	No median piers (3 span structure) Russell Cave and Bryan Station	▪ Eliminates piers in median ▪ Eliminates bulb out around pier	▪ Increase cost ▪ Higher profile changes on cross streets		1	1	
21	Current and future structures maintenance included with this project	▪ Assume part of base	▪	2	2	2	2
22	Bike lanes/ sidewalks on overpass bridges	▪ Assume part of base	▪		2	2	
23	Not raising the bridges (replace)	▪ Can accommodate bike/peds ▪ Eliminate specialty construction ▪ Reduce risk	▪ May increase costs ▪	3			3
24	Stub wall on legacy trail to avoid extending box culvert	▪ Eliminate profile changes to trail ▪ Could apply to other drainage facilities as well	▪ Would require physical barrier		3	3	
25	Concrete roadway section spanning legacy trail box culvert	▪ Could help correct cross slope problems	▪ Added cost		1	1	
26	Steel beams for new bridge construction	▪ Can accommodate single/3 span options ▪ Reduce profile cross roads if median pier still incorporated	▪ Cost ▪		1	1	

#	Idea	Advantages	Disadvantages	Alt 1	Alt. 2	Alt. 3	Alt. 4
27	Narrow ditches to reduce right of way	▪ Reduce ROW	▪ Would require physical barrier due to clear zone	3	3	3	3
28	Use sound wall combination cut/fill	▪ Could reduce ROW	▪ May require physical barrier due to clear zone ▪ Addition of fixed object	3	3	3	3
29	Small retaining walls to reduce right of way	▪ Reduce ROW	▪ May require physical barrier due to clear zone ▪ Addition of fixed object	3	3	3	3
30	Guardrail/barrier to narrow footprint to reduce right of way	▪ Reduce ROW	▪ Addition of fixed object	3	3	3	3
31	Encase existing median barrier with single slope	▪ May reduce median pavement replacement ▪ May reduce cost of barrier replacement	▪ Median drainage work ▪ Hasn't been done in the area ▪ Constrained construction work area ▪ May reduce shoulder width ▪ Reduces options for median conduit	1	1	1	1
32	Raise substructure and replace superstructure Russell Cave Road and Bryan Station Road	▪ Can accommodate Bike and pedestrians on Russell Cave Road and Bryan Station Road	▪ Will require shoulder variance on main line to narrow shoulders to accommodate existing bridge piers		3	3	

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Development Phase

The VE Recommendations are presented as written by the team during the VE study. While they have been edited for the VE report to correct errors or better clarify the recommendation, they represent the VE team's findings during the workshop. The following table is a summary of all recommendations generated and their impact to the project.

Table 8 Summary of Recommendations

Description	Alt. 1	Alt 2	Alt. 3	Alt. 4
Pavement	-$8.8M	-$8.60M	-$8.9M	-$8.8
Narrowing Shoulders at existing structures		-$1.90M	-$3.3M	
10' Inside Shoulders			-$2.5M	
Reduction of Right-of-Way Impacts	+$0.02M	-$0.17M	+$0.66M	+$0.02M
Lengthen merge/diverge areas at ramps where needed (Paris Pike)	+$2.30M	+$2.22M	+$2.25M	+$2.3M
Narrow Shoulders at Existing Bridge Piers		-$5.30M	-$5.30M	
Totals	**-$6.48M**	**-$13.75M**	**-$17.09M**	**-$6.48M**

Note see table 9 page 92 for details on performance / cost.

The cost comparisons reflect a difference or delta between the baseline idea and the VE recommendation or alternative. As the project progresses, these values can be updated to reflect actual implemented results.

The values shown have been adjusted to reflect the additional ***cumulative*** costs of mobilization, sales tax, design allowance, change order contingency, and construction engineering.

FHWA Functional Benefit Criteria

Each year, State DOT's are required to report on VE Recommendations to FHWA. In addition to cost implications, FHWA requires the DOT's to evaluate each approved recommendation in terms of the project feature or features that recommendation benefits. If a specific recommendation can be shown to provide benefit to more than one feature described below, count the recommendation in *each category that is applicable*. These same criteria can be found on each of the individual recommendations that follow.

- **Safety:** Recommendations that mitigate or reduce hazards on the facility.
- **Operations:** Recommendations that improve real-time service and/or local, corridor, or regional levels of service of the facility.
- **Environment:** Recommendations that successfully avoid or mitigate impacts to natural and or cultural resources.
- **Construction:** Recommendations that improve work zone conditions, or expedite the project delivery.

- **Right-of-Way:** Recommendations that lower the impacts or costs of right-of-way.

Value Engineering Recommendation Approval

The Value Engineering Recommendation form is to aid in annual reporting of VE activities to FHWA. It is the intent that the project manager review and evaluate the VE team's alternatives included in this report. The Project Manager would then complete the Recommendation Approval form provided in the Appendix.

Each alternative that is not approved or is modified by the Project Manager should include a justification (a summary statement explaining the Project Manager's decision not to use the recommendation in the project).

The completed Value Engineering Recommendation Approval form, including justification for any recommendations not approved or modified, shall be sent to the KYTC Value Engineering Manager so the results can be included in the annual VE Report to the Federal Highway Administration (FHWA).

Recommendations

Based on the evaluation process, individual recommendations were developed. Each recommendation consists of a summary of the original concept, a description of the suggested change, a listing of its advantages and disadvantages, and a brief narrative that includes justification, sketches, photos, assumptions and calculations (where applicable) as developed by the VE team.

The recommendations were then incorporated into each of the alternatives. These alternatives was then evaluated for performance and cost to prove best value of the four alternatives evaluated.

Recommendation No. 1 Pavement	IDEA NO. 14,16

Baseline

The existing interstate pavement consist of 10” of concrete base and an assumed 4.5 inches of asphalt overlay. All baseline alternatives include a six-inch overlay (1.25” surface and 4.75” base) over the existing pavement, including a six inch concrete deck overlay over all structures carrying mainline I-75.

Recommendation

- Mill existing 4.5” of asphalt
- Refill with 4.5” of new asphalt (1.25” surface and 3.25” base)
- No concrete deck overlay on existing structures

Advantages	Disadvantages
• Reduces profile changes on mainline • Eliminates bridge overlays and the need to replace barriers • Reduces side slope fills and potentially reduces guardrail length • Reduces amount of structure raising required for vertical clearance • Sustainability • Reduces dead load on aging bridges • Eliminates need to replace bridge rail • Reduced cost	• Reduces pavement structural depth • May increase construction duration • Possible Additional haul/waste if not recycled • Could expose unknown problems with existing concrete • May still need bridge deck repairs

Summary of Cost Analysis

	Cost
Alternative 1	$ 8,800,000 Cost Avoidance
Alternative 2	$ 8,600,000 Cost Avoidance
Alternative 3	$ 8,900,000 Cost Avoidance
Alternative 4	$ 8,800,000 Cost Avoidance

Recommendation No. 1 Pavement	IDEA NO. 14,16

Comments/Justification Sketches

Since this project is in the early planning phases, no formal pavement design has been completed yet. The proposed six inch asphalt overlay value was initially chosen as a baseline for all alternatives, so that the alternatives can be compared with one another.

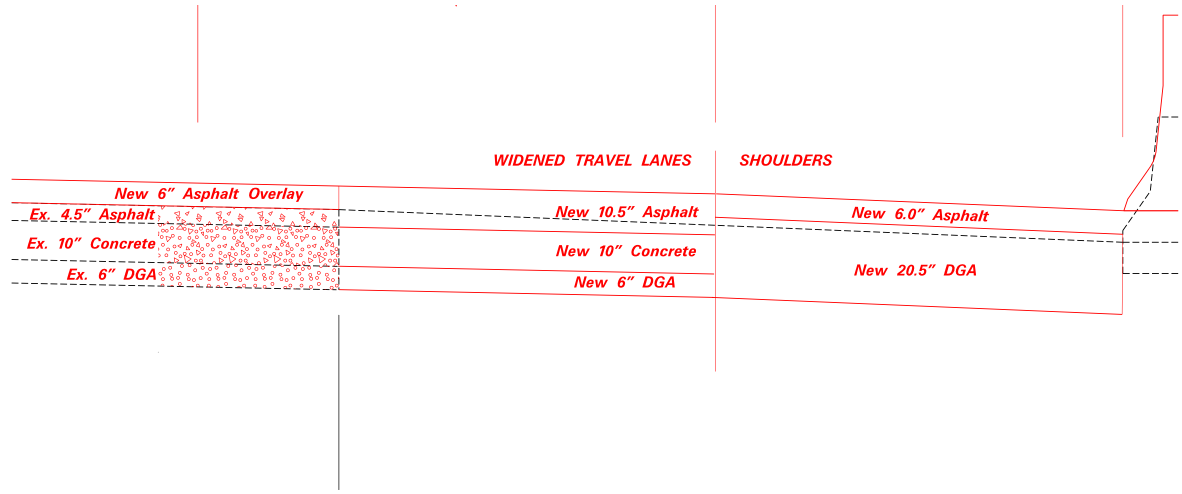
The District stated that they have been getting approximately 12 years of service life from the pavement on this stretch of interstate, and that the existing pavement is currently in good shape. They believe that a mill and fill approach may be prudent, pending a formal pavement design.

The biggest saving is in the new pavement depth across the new travel lanes and shoulders. Currently, the design is matching the bottom of the DGA under the existing concrete. By removing the 6" overlay over the existing – you are effectively reducing that thickness of pavement on the new travel lanes and shoulder.

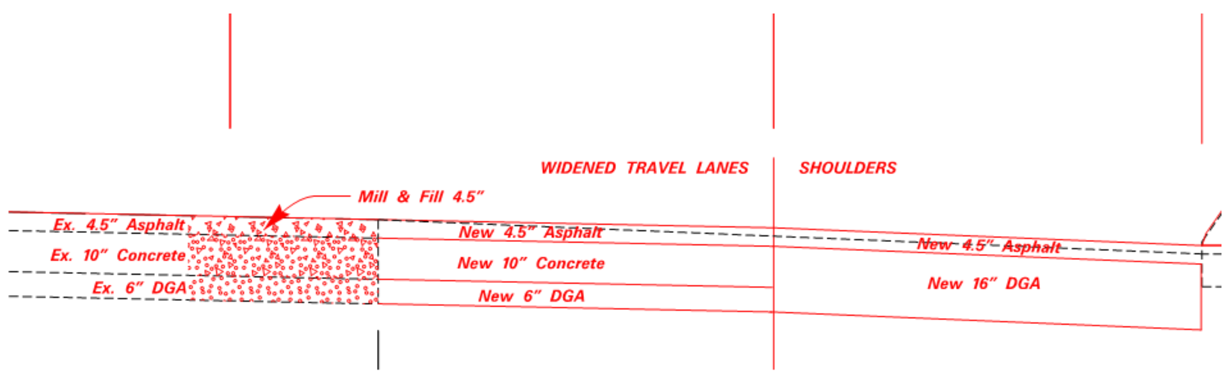
There is also significant cost avoidance with the structure cost. Most mainline bridges would have zero cost associated with them now in Alt 1 and 4, and costs are also reduced for Alts 2 & 3 with no deck overlay. More cost avoidance is observed with Alts 1 and 4 with respect to bridges as compared with 2 and 3 due to additional barrier wall savings. The barrier wall savings is not included in Alts 2 and 3 due to the fact that barrier wall is needed regardless of the overlay due to the proposed widening.

A formal pavement design is recommended to make sure this recommended pavement design is sufficient from a structural standpoint.

Recommendation No. 1 Pavement	IDEA NO. 14,16



Baseline Concept presented to the VE team



Recommended Concept

Recommendation No. 1 Pavement	**IDEA NO.** 14,16

Assumptions & Calculations

Alternative 1 – Cost Calculations:

7-8909 I64/I75 Split
Value Planning Meeting
Alternative 1

ITEM DESCRIPTION	UNIT	ORIGINAL QNT	REVISED QNT	DELTA QNT	UNIT PRICE	TOTAL
PAVEMENT						
SURFACE	TONS	31,832	32,903	1,071	$ 100.00	$ 107,100
BASE	TONS	130,740	81,439	-49,301	$ 85.00	$ (4,190,585)
JPC PAVEMENT	SQYD	63,509	63,509	0	$ 95.00	$ -
CRUSHED STONE BASE/DGA	TONS	108,776	87,071	-21,705	$ 27.00	$ (586,035)
MILLING	TONS		64,005	64,005	$ 16.00	$ 1,024,080
STRUCTURES						
CANE RUN CREEK	LS	$ 396,100.00	$ -	-396,100		$ (396,100)
NEWTOWN PIKE	LS	$ 1,949,550.00	$ 1,288,750.00	-660,800		$ (660,800)
RUSSELL CAVE RD	LS	$ 1,036,536.00	$ 1,036,536.00	0		$ -
I-75 OVER PARIS PIKE	LS	$ 1,579,050.00	$ -	-1,579,050		$ (1,579,050)
BRYAN STATION RD	LS	$ 1,036,536.00	$ 1,036,536.00	0		$ -
Subtotal						$ (6,281,390)
Contingency	*40%*					$ (2,512,556)
Total						**$ (8,793,946)**

Alternative 2 – Cost Calculations:

7-8909 I64/I75 Split
Value Planning Meeting
Alternative 2

ITEM DESCRIPTION	UNIT	ORIGINAL QNT	REVISED QNT	DELTA QNT	UNIT PRICE	TOTAL
ROADWAY						
EARTHWORK	CU YD	198,240	208,152	9,912	$ 12.00	$ 118,944
PAVEMENT						
SURFACE	TONS	35,467	36,495	1,028	$ 100.00	$ 102,800
BASE	TONS	147,535	90,175	-57,360	$ 85.00	$ (4,875,599)
JPC PAVEMENT	SQYD	95,717	95,717	0	$ 95.00	$ -
CRUSHED STONE BASE/DGA	TONS	240,003	216,508	-23,495	$ 27.00	$ (634,373)
MILLING	TONS		64,939	64,939	$ 16.00	$ 1,039,026
STRUCTURES						
CANE RUN CREEK	LS	$ 709,600.00	$ 430,000.00	-279,600		$ (279,600)
NEWTOWN PIKE	LS	$ 2,486,300.00	$ 1,937,500.00	-548,800		$ (548,800)
RUSSELL CAVE RD	LS	$ 2,675,780.00	$ 2,675,780.00	0		$ -
I-75 OVER PARIS PIKE	LS	$ 2,612,582.00	$ 1,528,532.00	-1,084,050		$ (1,084,050)
BRYAN STATION RD	SF	$ 2,381,136.00	$ 2,381,136.00	0		$ -
Subtotal						$ (6,161,653)
Contingency	*40%*					$ (2,464,661)
Total						**$ (8,626,314)**

Recommendation No. 1

Pavement

IDEA NO.
14,16

Alternative 3 – Cost Calculations:

7-8909 I64/I75 Split
Value Planning Meeting
Alternative 3

ITEM DESCRIPTION	UNIT	ORIGINAL QNT	REVISED QNT	DELTA QNT	UNIT PRICE	TOTAL
ROADWAY						
EARTHWORK	CU YD	217,703	228,588	10,885	$ 12.00	$ 130,622
PAVEMENT						
SURFACE	TONS	36,810	38,028	1,218	$ 100.00	$ 121,800
BASE	TONS	151,861	93,483	-58,378	$ 85.00	$ (4,962,105)
JPC PAVEMENT	SQYD	90,896	90,896	0	$ 95.00	$ -
CRUSHED STONE BASE/DGA	TONS	266,043	238,153	-27,890	$ 27.00	$ (753,038)
MILLING	TONS		64,831	64,831	$ 16.00	$ 1,037,298
STRUCTURES						
CANE RUN CREEK	LS	944,600	$ 665,000.00	-279,600		$ (279,600)
NEWTOWN PIKE	LS	2,946,300	$ 2,397,500.00	-548,800		$ (548,800)
RUSSELL CAVE RD	SF	2,769,997	$ 2,769,997.00	0		$ -
I-75 OVER PARIS PIKE	LS	3,385,490	$ 2,301,440.00	-1,084,050		$ (1,084,050)
BRYAN STATION RD	SF	2,466,788	$ 2,466,788.00	0		$ -
Subtotal						$ (6,337,874)
Contingency	*40%*					$ (2,535,150)
Total						**$ (8,873,024)**

Alternative 4 – Cost Calculations:

7-8909 I64/I75 Split
Value Planning Meeting
Alternative 4

ITEM DESCRIPTION	UNIT	ORIGINAL QNT	REVISED QNT	DELTA QNT	UNIT PRICE	TOTAL
PAVEMENT						
SURFACE	TONS	31,832	32,922	1,090	$ 100.00	$ 109,000
BASE	TONS	132,587	81,439	-51,148	$ 85.00	$ (4,347,580)
JPC PAVEMENT	SQYD	74,705	74,705	0	$ 95.00	$ -
CRUSHED STONE BASE/DGA	TONS	99,989	80,312	-19,677	$ 27.00	$ (531,279)
MILLING	TONS		64,005	64,005	$ 16.00	$ 1,024,082
STRUCTURES						
CANE RUN CREEK	LS	396,100	$ -	-396,100		$ (396,100)
NEWTOWN PIKE	LS	1,949,550	$1,400,750.00	-548,800		$ (548,800)
RUSSELL CAVE RD	LS	1,036,536	$ 1,036,536.00	0		$ -
I-75 OVER PARIS PIKE	LS	1,579,050	$ -	-1,579,050		$ (1,579,050)
BRYAN STATION RD	SF	1,036,536	$ 1,036,536.00	0		$ -
Subtotal						$ (6,269,727.40)
Contingency	*40%*					$ (2,507,890.96)
Total						**$ (8,777,618)**

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Recommendation No. 2 Narrowing Shoulders at existing structures	IDEA NO. 8

Baseline

Each of the four proposed baseline alternatives contain variable inside shoulders ranging between 4ft and 12ft along the entire length of the corridor and a constant 12ft (10ft paved) outside shoulder. These shoulders would also include the shoulders on the three existing bridge structures (Cane Run Bridge, Newtown Pike Bridge, and Paris Pike Bridge). Due to this width and the addition of a travel lane several of the alternatives require the widening of some of these bridges to accommodate the cross section(s).

Recommendation

Based upon AASHTO Interstate Guidelines, shoulders on existing structures can be reduced. In an effort to reduce the cost of the baseline of expanding these bridges, it is recommended to reduce these shoulders within the guidelines to utilize the existing bridge decking.

Advantages	Disadvantages
• Reduce bridge widening cost • Eliminates widening bridges nearing the end of their service life	▪ Doesn’t correct vertical clearance issues on Russell Cave and Bryan Station overpasses. ▪ Introduces fixed object and reduces existing shoulder width on structures ▪ Roadway will “hourglass” in and out across the bridges to accommodate the narrow shoulders on the bridge structures.

Summary of Cost Analysis

	Cost
Alternative 1	N/A
Alternative 2	$1,862,395 Cost Avoidance
Alternative 3	$3,259,116 Cost Avoidance
Alternative 4	N/A

Comments/Justification Sketches

The AASHTO guidelines designate the shoulder width based upon the structure length (long bridges >200ft and short bridges < 200ft), based on KYTC Design Memorandum 02-14 the KYTC standards are in concurrence with the long bridge standards but not specifically the short bridge standards proposed in the AASHTO guidance.

Based upon the AASHTO and KYTC guidelines these are the following requirements for shoulders on existing structures:

- Long Bridges:
  - Inside Shoulder: 3.5’
  - Outside Shoulder: 3.5’
- Short Bridges:
  - Inside Shoulder: 10’ (*AASHTO allows for 3.5’, but not explicitly stated in KYTC Design Memorandum so it was left as the standard width for this analysis)
  - Outside Shoulder: 10’

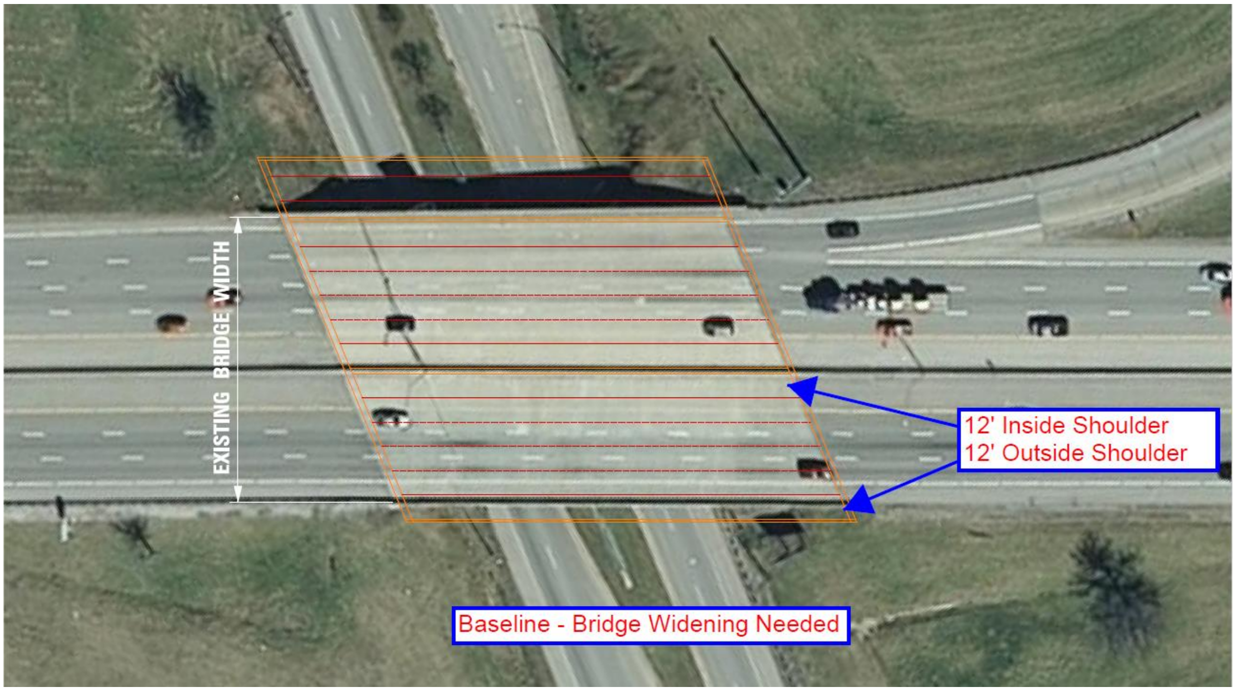
Based upon the evaluation of the three structures and the existing available roadway widths, it is proposed that the Paris Pike bridge (NB & SB) and the SB Newtown Pike bridge use existing width bridge decks.

The other structures – NB Newtown Pike, Cane Run bridges (NB & SB) cannot be accommodated by the narrow shoulders due to the short bridge requirements (Cane Run) and the needed build modifications to the NB Newtown Pike On-Ramp.

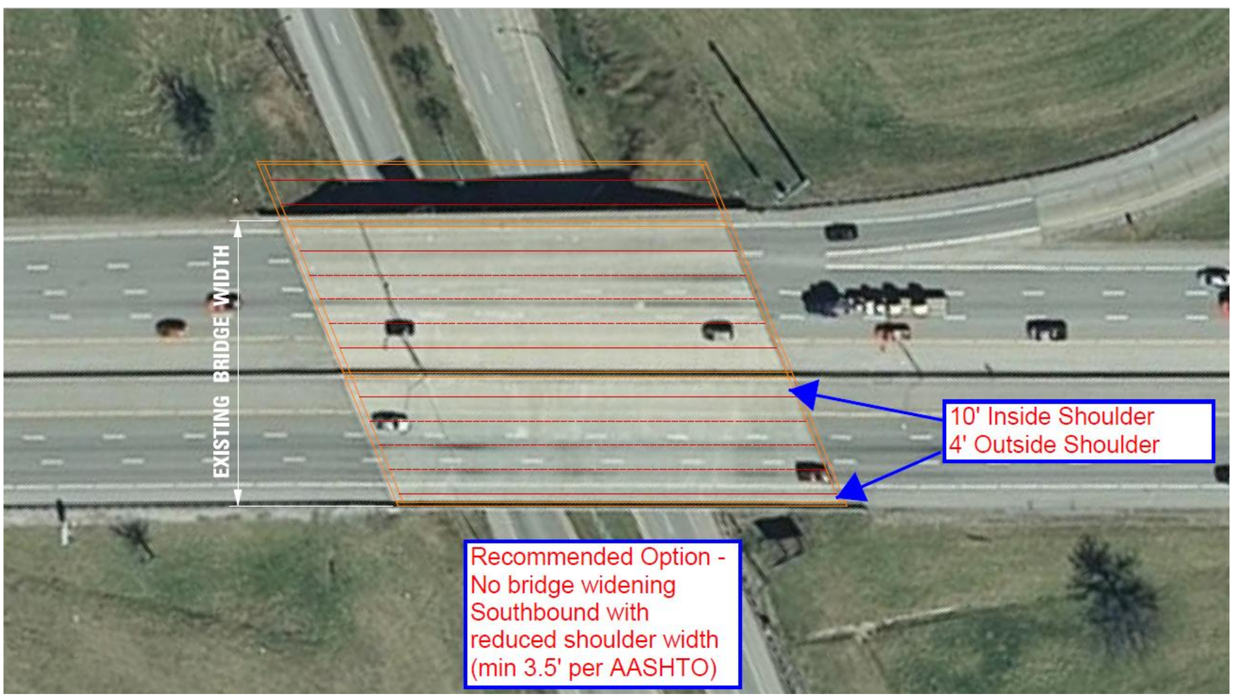
One disadvantage to consider from a design and user perspective is the tapering in and out of the inside and outside edge lines to accommodate the bridge decking and narrow shoulder allowances. To mitigate this, as both the inside and outside shoulder requirements are 3.5’ on the existing long bridge structures, it may be preferred during design that the inside shoulder be maintained on Alternative 2 at 8’, and a reduced 10’ shoulder on Alternative 3 leaving the outside shoulders to be 6’ and 4’ respectively. This would reduce the tapering in and out effect noticed by the drivers and make the cross-sectional elements more consistent.

Recommendation No. 2 Narrowing Shoulders at existing structures	**IDEA NO.** 8

Baseline Alternative 3 (Newtown Pike):



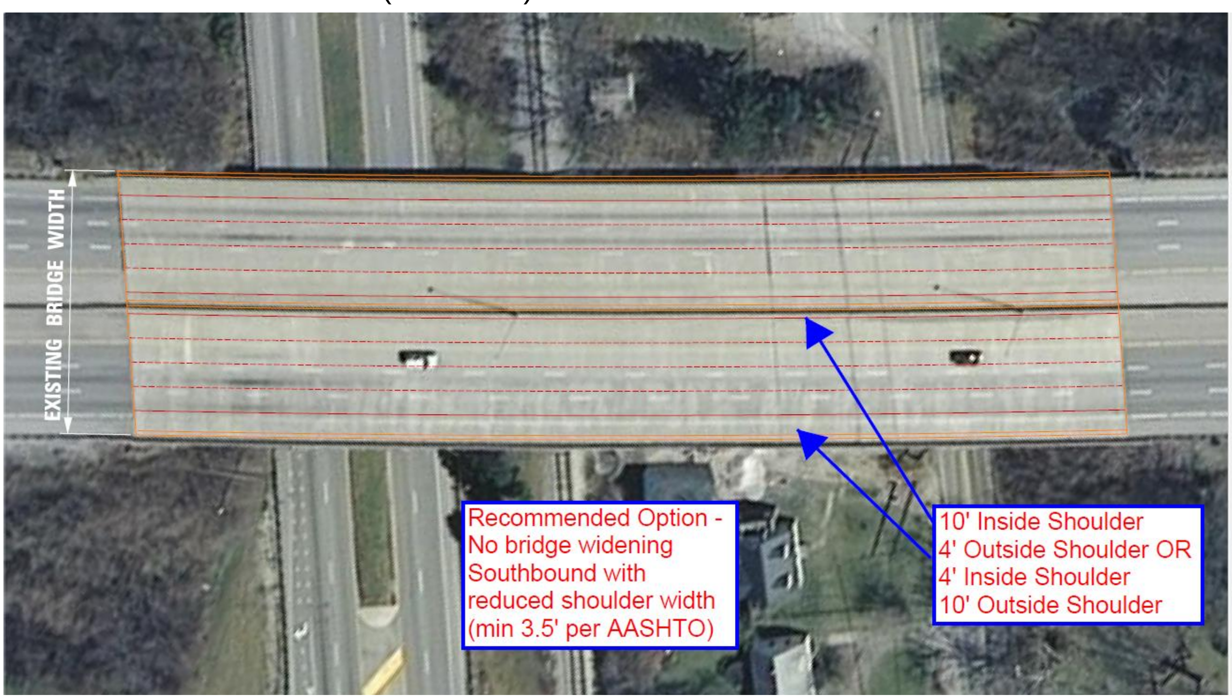
Recommended Alternative 3 (Newtown Pike):



Baseline Alternative 3 (Paris Pike):

Recommendation No. 2 Narrowing Shoulders at existing structures	IDEA NO. 8

Recommended Alternative 3 (Paris Pike):



Recommendation No. 2 Narrowing Shoulders at existing structures	**IDEA NO.** 8

Assumptions & Calculations

AASHTO Interstate Design Guidelines excerpt from page 8 of the "A Policy on Design Standards – Interstate System" May 2016 regarding the shoulders on existing structures:

Existing Bridges to Remain in Place

Mainline bridges on the Interstate system and bridges on routes to be incorporated into the system may remain in place if, as a minimum, they meet all of the following criteria:

- For bridges less than or equal to 200 ft (60 m) in length, the bridge cross section consists of at least 12 ft (3.6 m) lanes, 10 ft (3.0 m) shoulder on the right and 3.5 ft (1.1 m) shoulder on the left;
- For long bridges, shoulder width on both the left and right is at least 3.5 ft (1.1 m) measured from the edge of the nearest travel lane; and
- Bridge railing meets or will be upgraded to current standards.

KYTC Design Memorandum 02-14 excerpt regarding the required shoulder widths on the existing structures (https://transportation.ky.gov/Highway-Design/Memos/02-14.pdf):

The Minimum Usable Shoulder widths should be continued across all new structures. Per AASHTO Guidance, on long bridges (in excess of 200') it may be acceptable to have bridge shoulder widths less than the approach roadway shoulder widths.

Typically on Interstate Highways with a 4-lane section, the Minimum Usable Shoulder Width shall be paved and not less than 4' on the left side and not less than 10' on the right side. On sections with six or more lanes, a 10' paved usable left shoulder should be provided. Where truck traffic exceeds 250 DDHV, a paved (usable) width of 12' should be considered.

<u>Bridge and Alternative Cross-Sectional Calculations:</u>

	Baseline Cross-Section Elements				AASHTO Interstate Guidelines				Reduced Shoulders	
	Inside	Lane Width	Outside	Proposed Cross-Section width (per dir)	Inside (Long Bridges)	Inside (Short Bridges) *	Outside (Long Bridge)	Outside (Short Bridge)	(Long Bridge) - Cross Section (per dir)	(Short Bridge) - Cross Section (per dir)
Unit	*ft*	*ft*	*ft*	*ft*	*ft*	*ft*	*ft*	*ft*	*ft*	*ft*
Alt 1	8.667	11	10	62.667	3.5	10	3.5	10	51	64
Alt 2	8	12	10	66					55	68
Alt 3	12	12	10	70					55	68
Alt 4	4.667	12	10	62.667					55	68

* KYTC Design Memo does not specifically designate the width allowed on shorter bridges (default interstate guidance would be 10' inside)

Recommendation No. 2 Narrowing Shoulders at existing structures	IDEA NO. 8

Paris Pike Bridge Data:

Paris Pike Bridge			
Length	492'		
Type	**Long**		
	Direction	NB	SB
Alternate	Existing Useable Bridge Width	62.3	62.3
Alt 1	Baseline	62	62
	Narrow Shoulders	51	51
Alt 2	Baseline	66	66
	Narrow Shoulders	55	55
Alt 3	Baseline	70	70
	Narrow Shoulders	55	55
Alt 4	Baseline	62	62
	Narrow Shoulders	55	55

As shown, adhering to the long bridge dimensions, each alternative should fit within the existing bridge deck width.

Newtown Pike Bridge:

Newtown Pike Bridge			
Length	220'		
Type	**Long**		
	Direction	NB*	SB
Alternate	Existing Useable Bridge Width	62.3	62.3
Alt 1	Baseline	62.667	62
	Narrow Shoulders	N/A	51
Alt 2	Baseline	66	66
	Narrow Shoulders	N/A	55
Alt 3	Baseline	70	70
	Narrow Shoulders	N/A	55
Alt 4	Baseline	62.667	62
	Narrow Shoulders	N/A	55
*NB bridge will include the addition of the separated on-ramp which is not included in the ML cross sectional width			

Due to the expansion of the NB Newtown Pike bridge to separate the NB on-ramp, using narrow shoulders to fit within the existing roadway deck width is not feasible and therefore was not considered/included.

Recommendation No. 2 Narrowing Shoulders at existing structures	IDEA NO. 8

Cane Run Bridge:

Cane Run Bridge			
Length	117		
Type	**Short**		
	Direction	NB	SB*
Alternate	Existing Useable Bridge Width	62.3	78
Alt 1	Baseline	62.667	73.667
	Narrow Shoulders	64	75
Alt 2	Baseline	66	78
	Narrow Shoulders	68	80
Alt 3	Baseline	70	82
	Narrow Shoulders	68	80
Alt 4	Baseline	62.667	74.667
	Narrow Shoulders	68	80
* SB is 4 lanes in existing and will be 5 lanes in the baseline			

As shown, neither the NB or SB Cane Run bridges are able to maintain the bridge decks on any of the proposed alternatives which require expansion

To meet the minimum required shoulder criteria and utilize the full existing bridge deck it is proposed that the inside shoulder be set to 10' and outside shoulder set to 4' for both the SB Newtown Pike and Paris Pike bridges.

For Paris Pike bridges it may be advisable to shift lanes and put the 10' shoulder on the outside due to the merging "on ramp" and have a 4' inside shoulder. This configuration would also meet the AASHTO guidelines.

The cost savings associated with the changes to the bridge widening costs/quantities is outlined in the tables below for each alternative (should be noted that the bridges that can be remedied by the narrow shoulders will only be expanded in Alt 2 & 3. Additionally the cost of overlays and barrier upgrades are included on those bridges where the existing footprints can be utilized with narrow shoulders):

Alternative 2:

Recommendation No. 2 Narrowing Shoulders at existing structures	**IDEA NO.** 8

7-8909 I64/I75 Split
Value Planning Meeting
Alternative 2

ITEM DESCRIPTION	UNIT	ORIGINAL QNT	REVISED QNT	DELTA QNT	UNIT PRICE	TOTAL
STRUCTURES						
CANE RUN CREEK	LS	$ 709,600.00	$ 709,600.00	0		$ -
NEWTOWN PIKE	LS	$2,486,300.00	$ 2,189,550.00	-296,750		$ (296,750)
RUSSELL CAVE RD	LS	$2,675,780.00	$2,675,780.00	0		$ -
I-75 OVER PARIS PIKE	LS	$ 2,612,582.00	$ 1,579,050.00	-1,033,532		$ (1,033,532)
BRYAN STATION RD	SF	$ 2,381,136.00	$ 2,381,136.00	0		$ -
Subtotal						$ (1,330,282)
Contingency	*40%*					$ (532,113)
Total						**$ (1,862,395)**

Alternative 3:

7-8909 I64/I75 Split
Value Planning Meeting
Alternative 3

ITEM DESCRIPTION	UNIT	ORIGINAL QNT	REVISED QNT	DELTA QNT	UNIT PRICE	TOTAL
STRUCTURES						
CANE RUN CREEK	LS	944,600	944,600	0		$ -
NEWTOWN PIKE	LS	2,946,300	2,424,800	-521,500		$ (521,500)
RUSSELL CAVE RD	SF	2,769,997	$2,769,997.00	0		$ -
I-75 OVER PARIS PIKE	LS	3,385,490	$ 1,579,050.00	-1,806,440		$ (1,806,440)
BRYAN STATION RD	SF	2,466,788	$2,466,788.00	0		$ -
Subtotal						$ (2,327,940)
Contingency	*40%*					$ (931,176)
Total						**$ (3,259,116)**

Recommendation No. 3 10' Inside Shoulders	**IDEA NO.** 32

Baseline

The baseline alternative 3 accommodates the full AASHTO revised guidelines for lane widths and shoulders (inside and outside) being 12' lanes, 12' inside shoulders (based on the recommendation due to the heavy vehicle/truck volume), and 12' outside shoulders.

Recommendation

To save cost on pavement, earthwork, & ROW it is proposed that a modification of alternative 3 to change from a 12' inside shoulder to 10' is recommended. Based on the revised AASHTO Interstate Design Guidelines, the required inside shoulder width is 10' when there are 3 or more lanes.

Advantages	Disadvantages
• Adheres to the required FHWA standards • Reduces pavement, earthwork, and ROW costs • Locates existing lane joints closer to center of new lanes	▪ Does not accommodate the recommended/ consideration inside shoulder ▪ May require lane closures for all inside shoulder maintenance activities.

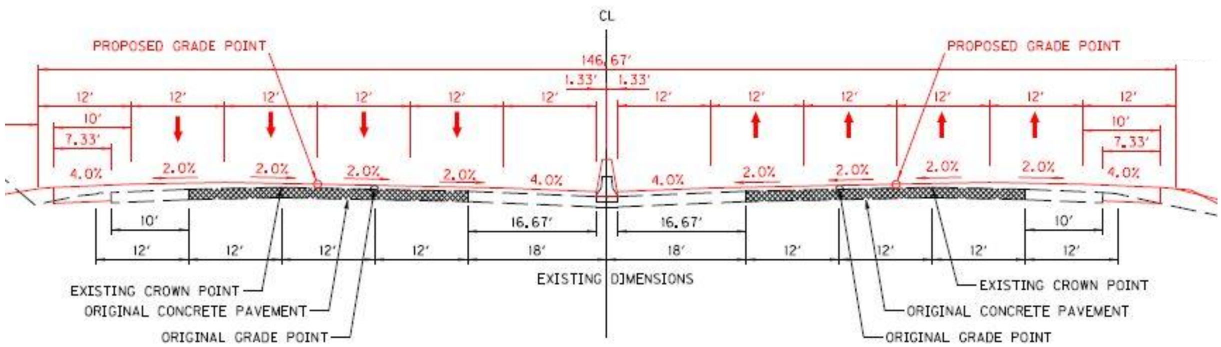
Summary of Cost Analysis

	Cost
Alternative 1	N/A
Alternative 2	N/A
Alternative 3	$2,500,000 Cost Avoidance
Alternative 4	N/A

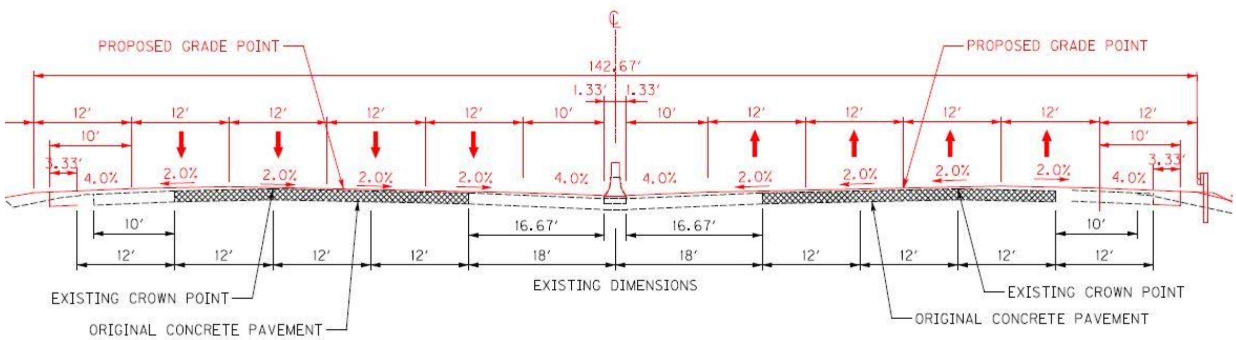
Recommendation No. 3 10' Inside Shoulders	**IDEA NO.** 32

Comments/Justification Sketches

Alternative 3 Baseline Typical:



Alternative 3 Recommended Typical:



Recommendation No. 3 10’ Inside Shoulders	IDEA NO. 32

Assumptions & Calculations

From the AASHTO Interstate Design Guidelines excerpt from page 8 of the “A Policy on Design Standards – Interstate System” May 2016 regarding the shoulders:

Shoulders

Minimum paved shoulder widths in each direction of travel as a function of terrain and the number of through lanes shall be in accordance with the following table:

Table 3. Minimum Paved Shoulder Widths

One-Directional No. Through lanes	Terrain	Left Shoulder (ft)	Right Shoulder (ft)	Left Shoulder (m)	Right Shoulder (m)
2-lane	Level or Rolling	4	10	1.2	3.0
3-lane or more	Level or Rolling	10	10	3.0	3.0
2 or 3-lane	Mountainous	4	8	1.2	2.4
4-lane or more	Mountainous	8	8	2.4	2.4

Where truck traffic exceeds 250 DDHV, additional shoulder width may be beneficial. Refer to AASHTO's *Green Book* for more information. Additional guidance on shoulder widths for tunnels and long bridges [overall length over 200 ft (60 m)] is provided later in this document.

The 12’ inside shoulder as an FHWA standard for Alternative 3 was developed based on the guidance documented on (https://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/chapter3/3_shoulderwidth.cfm). This is a document that pre-dates the 2016 guidelines, but has the same values for inside shoulders. However, it recommends the wider width to accommodate truck traffic, which exceeds the 250DDHV in both directions.

Clarification: Minimum Shoulder Widths for Interstate Highways

One clarification for shoulder width design exceptions relates to the requirements for Interstates with six or more lanes. The adopted criteria for Interstates specify that the paved width of the right shoulder shall not be less than 10 feet (3.0 meters). Where truck traffic exceeds 250 DDHV (the design hourly volume for one direction), a paved shoulder width of 12 feet (3.6 meters) should be considered. On a four-lane section, the paved width of the left shoulder shall be at least 4 feet (1.2 meters). On sections with six or more lanes, a 10-foot (3.0-meter) paved width for the left shoulder should be provided. Where truck traffic exceeds 250 DDHV, a paved width of 12 feet (3.6 meters) should be considered.

Regardless of the differences in language used in the adopted criteria ("shall," "should be considered," etc.) all of the shoulder widths described above have become standards for the Interstate System by virtue of their adoption by FHWA, and they are the minimum values for each condition described. Therefore, a project designed for the Interstate System that does not provide the applicable shoulder widths would require a formal design exception.

In addition, the incorporation of high occupancy vehicle (HOV) lanes is now common practice on many urban freeways. Lower-cost design solutions have in many cases resulted in the conversion of an existing full-width (12-foot) shoulder to a designated HOV lane. Where conversion of a shoulder to HOV use is being considered and replacement or construction of a new shoulder is not proposed, a design exception is required (potentially for both shoulder width and lateral offset to obstruction).

Both guidance documents recommend that the 12’ or wider shoulder be “considered” but are not a requirement. The recommended consideration language beyond the 10’ requirement for the inside shoulder is not consistent between documents and the most current version only recommends that a wider shoulder may be beneficial. In consideration for the 12’

Recommendation No. 3 10’ Inside Shoulders	IDEA NO. 32

recommendation due to the truck traffic, as well as for maintenance considerations, the 12’ inside shoulder was included in the baseline Alternative 3.

Maintenance

While a 12’ inside shoulder will allow for more maintenance space on the inside shoulder there is additional FHWA guidance (https://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/fhwa_sa_07011.pdf) which documents 8’ of inside shoulder being sufficient for enforcement and maintenance activities. Providing a 10’ shoulder provides more room than this recommendation to better accommodate these activities.

District 7 maintenance indicated that lane closures for maintenance of shoulder less than 12 feet would be required.

Shoulder Width

Shoulders provide a number of important functions. Safety and efficient traffic operations can be adversely affected if any of the following functions are compromised:

- Shoulders provide space for emergency storage of disabled vehicles (Figure 7). Particularly on high-speed, high-volume highways such as urban freeways, the ability to move a disabled vehicle off the travel lanes reduces the risk of rear-end crashes and can prevent a lane from being closed, which can cause severe congestion and safety problems on these facilities.
- Shoulders provide space for enforcement activities (Figure 7). This is particularly important for the outside (right) shoulder because law enforcement personnel prefer to conduct enforcement activities in this location. Shoulder widths of approximately 8 feet or greater are normally required for this function.
- Shoulders provide space for maintenance activities (Figure 7). If routine maintenance work can be conducted without closing a travel lane, both safety and operations will be improved. Shoulder widths of approximately 8 feet or greater are normally required for this function. In northern regions, shoulders also provide space for storing snow that has been cleared from the travel lanes.

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Recommendation Cost:

The simplified cost savings for this recommendation was determined based on splitting the cost difference between the baseline alternative 2 and 3 as the only difference between them was the inside shoulder widths of 8’ and 12’, respectively.

The difference between Alternative 2 and Alternative 3 baseline costs is approximately $5 million and based on the changes in pavement, earthwork, and ROW it is reasonable to assume that this 10’ inside shoulder recommendation would fall at the approximate midpoint of these options. Thus resulting in a cost savings from Alternative 3 of approximately $2.5 million.

Recommendation No. 4 Reduction of Right-of-Way Impacts	**IDEA NO.** 27,28,29,30

Baseline

The Baseline design as presented below is an evaluation of 4 Typical Sections all of which increase capacity within the limits of the study area. Alternative 1 has 4-11 foot lanes in each direction, 12 foot outside shoulder and 8.67 foot inside shoulder. Alternative 2 has 4-12 foot lanes in each direction, 12 foot outside shoulder and 8.0 foot inside shoulder. Alternative 3 has 4-12 foot lanes in each direction, 12 foot outside shoulder and 12 foot inside shoulder. **This is the Full Interstate Design Standards Typical.** Alternative 4 has 3-12 foot lanes in each direction, 12 foot outside shoulder and a “Hard Running” Inside Shoulder that is controlled by an ITS Network that opens and closes this 4^{th} inside lane.

Recommendation

This recommendation looks at eliminating right of way acquisition by constructing a combination noise/retaining wall in cut sections, a noise wall or short retaining wall near the top of a fill section, narrowed ditches in cut sections and steeper fill slopes with the installation of guardrail.

Advantages	Disadvantages
• Reduce Right of Way acquisition. • Reduces risk of delay due to right of way acquisition. • Reduces risk of potential 4(f) impacts. • Reduces risk of unknown utility impacts.	▪ Would require physical barrier due to reduction of clear zone. ▪ Addition of a fixed object where guardrail is installed. ▪ More complex construction with addition of pile and lag at the noise wall and construction of retaining walls in tight areas between steep slopes and right of way boundary. ▪ Qualitative considerations are guardrail through cut sections and loss of ditch flow capacity with shallower ditches (more storm sewer)

Summary of Cost Analysis

	Cost
Alternative 1	$21,157 Cost Increase
Alternative 2	$166,418 Cost Avoidance
Alternative 3	$656,365 Cost Increase
Alternative 4	$21,157 Cost Increase

Recommendation No. 4 Reduction of Right-of-Way Impacts	IDEA NO. 27,28,29,30

Comments/Justification Sketches

The tasks involved with this recommendation were to eliminate R/W acquisition as much as possible considering and evaluating the 4 ideas listed below:

IDEA #27: Consider using narrow ditches in cut sections with guardrail added.

IDEA #28: Consider using a Noise Wall on Pile & Lagging in cut situations near the top of cut.

IDEA #29: Consider using small/short retaining walls in fill areas.

IDEA #30: Consider using guardrail placed at the top of a fill slope to allow steepening of fill slope.

Cross Sections were evaluated considering the 4 ideas mentioned above. In addition to the above ideas, we also recommend refining cut and fill slopes where there is a very minor disturbance outside of the existing right of way line.

An assumption and thought for consideration not reflected within the calculations and estimates made, is that the project could move along faster with reduced environmental impacts and minimal right of way acquisition.

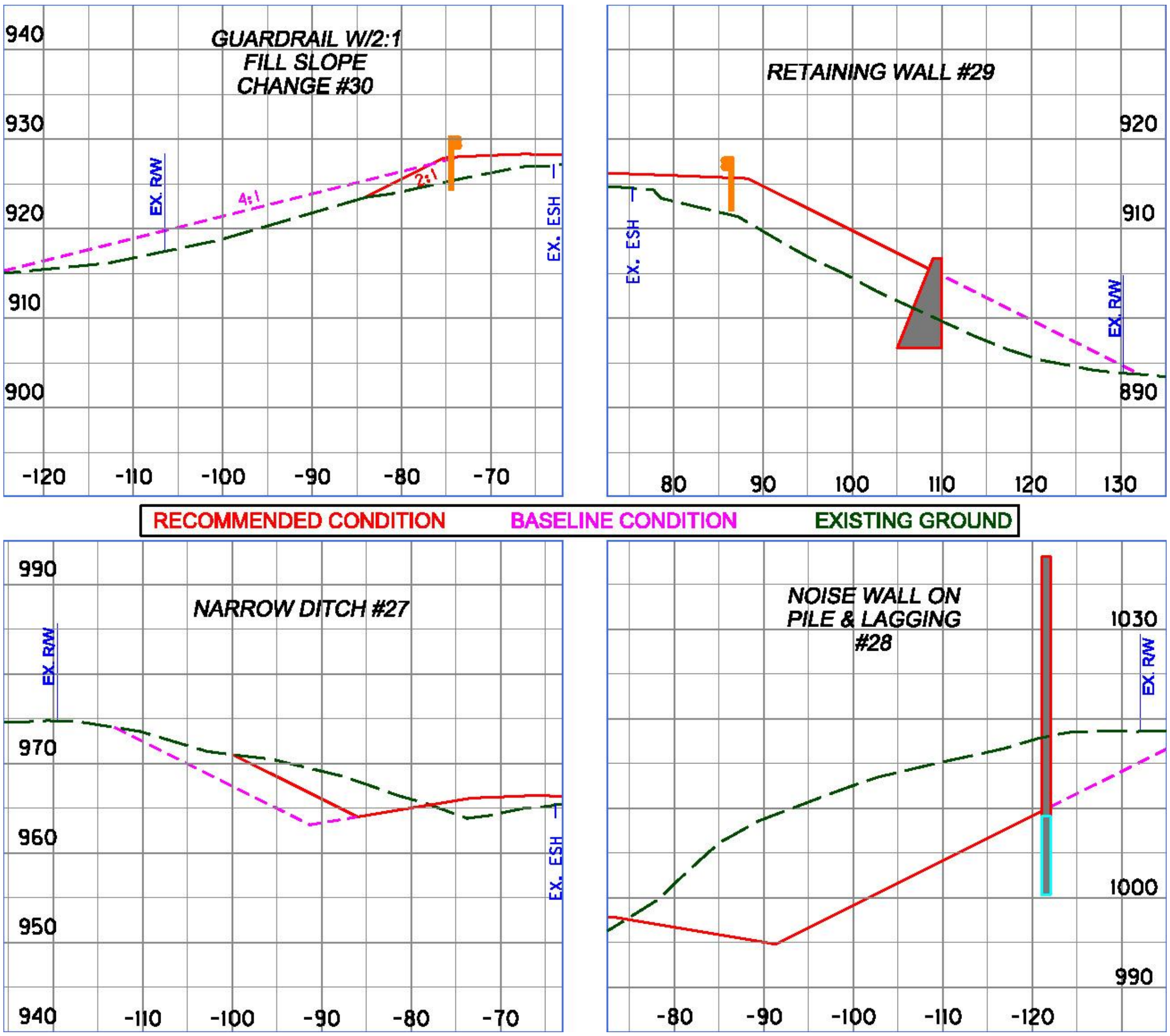
The table below reflects a decrease in the number of parcels affected for each Alternative after applying one or more of VE Ideas 27, 28, 29 and 30. If funding through an INFRA grant is awarded, the project could be positioned to move rapidly to construction.

	Alt 1	Alt 2	Alt 3	Alt 4
Baseline Parcels	4	32	46	4
Recommended Avoided	1	24	38	1
Recommended Remaining	3	8	8	3

ADDITIONAL COMMENTS

There may be some negative safety implications of adding guardrail where it is not present otherwise. Based on Highway Safety Manual equations implemented by ISATe an approximate 7% increase in crashes (12’ outside shoulder) on segments with guardrail versus segments without guardrail and 30’ clear zone could be anticipated. This 7% increase in crashes would be property damage only or minor injury. Any additional guardrail would increase overall maintenance.

Recommendation No. 4 Reduction of Right-of-Way Impacts	**IDEA NO.** 27,28,29,30



Recommendation No. 4

Reduction of Right-of-Way Impacts

IDEA NO.
27,28,29,30

Assumptions & Calculations

Station to Station	Length	Noise Wall Height (FT)	Noise Wall Area (SF)	Gravity Retaining Wall (SF)	Gravity Retaining Wall (CY)	Earthwork Adjust (CY)	Paved Shoulder (SY)	Guardrail (LF)	RW Reduction Area (AC)	Idea No.	Baseline Condition	Proposed Condition
ALTERNATIVES 1 & 4												
I-75 MAINLINE												
Rt 71+00 – 74+50	350								-0.06	27	Baseline Ditch	Modifiy Ditches.
Rt 181+50 – 184+50	300						67	400	-0.064	30	4:1 Fill Slope	2:1 fill slope & GR
Lt 293+25 – 295+60	235			12	105				-0.057	29	2:1 fill slope	Retaining wall near back of guardrail.
Total			**0**		**105**	**0**	**67**	**400**	**-0.181**			
ALTERNATIVE 2												
I-75 MAINLINE												
Lt 62+50 – 63+50	100			9	34				-0.073	29	2:1 Fill Slope	Retaining wall 100-110' Lt
Rt 71+00 – 74+50	350								-0.06	27	Baseline Ditch	Modifiy Ditches.
Rt 84+50 – 89+00	450			16	267				-0.147	29	2:1 Fill Slope	Retaining wall 100-110' Lt
Rt 94+50 – 98+50	400						89	500	-0.096	27	Baseline Ditch	Modifiy Ditches.
Rt 119+00 – 136+00	1700						378	1,200	-0.546	30	4:1 Fill Slope	2:1 fill slope & GR
Lt 134+00 – 137+00	300						67	300	-0.062	30	4:1 Fill Slope	2:1 fill slope & GR
Rt 181+00 – 194+00	1300						289	1,400	-0.285	30	4:1 Fill Slope	2:1 fill slope & GR
Lt 205+00 – 210+00	500						112	600	-0.87	27	Baseline Ditch	Modifiy Ditches.
Lt 212+00 – 214+00	200						45	400	-0.038	30	4:1 Fill Slope	2:1 fill slope & GR
Lt 240+15 – 240+70	55								-0.0155	27	Noise Wall	Refine design of backslopes.
Rt 241+55 – 242+85	130	5	650						-0.0282	28	Noise Wall	Pile & Lag noise wall.
Lt 291+80 – 296+00	420			21	327				-0.1315	29	2:1 fill slope	Retaining wall
Lt 308+70 – 313+00	430	6	2,580						-0.1261	28	Noise Wall	Pile & Lag noise wall.
Rt 314+05 – 316+85	280	5	1,400			-390			-0.0902	28	Noise Wall	Pile & Lag noise wall.
RUSSELL CAVE												
Lt 36+50 – 38+70	220						49	30	-0.1028	30	4:1 fill slope	Install guardrail & use 2:1 fill slopes.
Rt 42+35 – 48+25	590									-		Need R/W for Bridge & Approaches.
Rt 51+25 – 54+20	295									-		Need R/W for Bridge & Approaches.
Lt 58+80 – 60+00	120					-145			-0.0913	27	12 ft ditch	Narrow Ditches.
Rt 59+40 – 60+00	60					-67			-0.0139	27	12 ft ditch	Refine design of backslopes.
BRYAN STATION												
Lt 43+30 – 48+25	495									-		Need R/W for Bridge & Approaches
Lt 51+00 – 56+65	565									-		Need R/W for Bridge & Approaches
Total			**4,630**		**628**	**-602**	**1,029**	**4,430**	**-2.7765**			

Recommendation No. 4

Reduction of Right-of-Way Impacts

IDEA NO.
27,28,29,30

Station to Station	Length	Noise Wall Height (FT)	Noise Wall Area (SF)	Gravity Retaining Wall (SF)	Gravity Retaining Wall (CY)	Earthwork Adjust (CY)	Paved Shoulder (SY)	Guardrail (LF)	RW Reduction Area (AC)	Idea No.	Baseline Condition	Proposed Condition
ALTERNATIVE 3												
I-75 MAINLINE												
Lt 62+00 – 64+50	250			16	475				-0.073	29	2:1 Fill Slope	Retaining wall 100-110' Lt
Lt 67+00 – 70+00	300						67	200	-0.126	30	4:1 Fill Slope	2:1 fill slope
Lt 70+00 – 78+00	800					-445			-0.151	27	Baseline Ditch	Modifiy Ditches.
LT. 78+00 – 84+00	600						134	300	-0.207	30	4:1 Fill Slope	2:1 fill slope
Rt 71+00 – 74+00	300								-0.06	27	Baseline Ditch	Modifiy Ditches.
Rt 82+00 – 90+00	800			16	297				-0.213	29	2:1 Fill Slope	Retaining wall 105-125' Rt
Rt 93+50 – 99+50	600			9	50	-1,711	134	500	-0.135	29	Baseline Ditch	Retaining wall 89' Rt
Rt 119+00 – 122+50	350						78	350	-0.126	30	4:1 Fill Slope	2:1 fill slope
Rt 122+50 – 127+50	500			9	217		112	550	-0.255	29	2:1 Fill Slope	Retaining wall 105-125' Rt
Rt 127+50 – 136+00	850								-0.185	30	4:1 Fill Slope	2:1 fill slope
Rt 138+00 – 143+00	500			9	234				-0.11	29	2:1 Fill Slope	Retaining wall 105-108' Rt
Rt 143+00 – 144+50	150								-0.04	30	4:1 Fill Slope	2:1 fill slope & GR
Rt 144+50 – 146+50	200			9	79				-0.051	29	2:1 Fill Slope	Retaining wall 105 Rt
Rt 146+50 – 153+00	650								-0.075	30	4:1 Fill Slope	2:1 fill slope
Rt 180+50 – 195+50	1500						334	1,500	-0.398	30	4:1 Fill Slope	2:1 fill slope
Lt 203+00 – 210+00	700					-3,970	156	700	-0.2383	27	Baseline Ditch	Modifiy Ditches.
Lt 211+00 – 215+00	400						89	600	-0.085	30	4:1 Fill Slope	2:1 fill slope & GR
Lt 240+15 – 240+70	55								-0.0221	27	Noise Wall	Refine design of backslopes.
Rt 240+60 – 243+35	275	7	1,925						-0.0787	28	Noise Wall	Pile & Lag noise wall.
Lt 291+80 – 301+50	970			27	970				-0.3174	29	2:1 fill slope	Retaining wall
Rt 301+55 – 302+20	65					-12			-0.0104	27	Noise Wall	Refine design of backslopes.
Lt 302+85 – 303+80	95					-18			-0.008	27	Noise Wall	Refine design of backslopes.
Rt 304+50 – 306+75	225	5	1,125						-0.0507	28	Noise Wall	Pile & Lag noise wall.
Lt 307+80 – 314+60	680	10	6,800						-0.2836	28	Noise Wall	Pile & Lag noise wall.
Rt 309+40 – 311+05	165	5	825						-0.042	28	Noise Wall	Pile & Lag noise wall.
Rt 313+40 – 317+80	440	5	2,200						-0.1284	28	Noise Wall	Pile & Lag noise wall.
Lt 318+90 – 320+30	140	5	700						-0.02	28	Noise Wall	Pile & Lag noise wall.
RUSSELL CAVE												
Lt 36+50 – 38+70	220						49	30	-0.1028	30	4:1 fill slope	Install guardrail and use 2:1 fill slopes.
Rt 42+35 – 48+25	590									-		Need R/W for Bridge & Approaches.
Rt 51+25 – 54+20	295									-		Need R/W for Bridge & Approaches.
Lt 58+80 – 60+00	120					-145			-0.0913	27	12 ft ditch	Narrow Ditches to 8 ft to closely match existing condition.
Rt 59+40 – 60+00	60					-67			-0.0139	27	12 ft ditch	Refined design to match existing
BRYAN STATION												
Lt 43+30 – 48+25	495									-		Need R/W for Bridge & Approaches
Lt 51+00 – 56+65	565									-		Need R/W for Bridge & Approaches
Total			**13,575**		**2,322**	**-6,368**	**1,153**	**4,730**	**-3.6976**			

Recommendation No. 4

Reduction of Right-of-Way Impacts

IDEA NO.
27,28,29,30

ALTERNATIVES 1 & 4				
ITEM DESCRIPTION	***UNIT***	***DELTA QNT***	***UNIT PRICE***	***TOTAL***
ROADWAY				
EARTHWORK	CU YD	0	$ 12.00	$ -
GUARDRAIL	LF	400	$ 16.00	$ 6,400
PAVEMENT				
SURFACE	TONS	6	$ 100.00	$ 553
BASE	TONS	17	$ 85.00	$ 1,410
STRUCTURES				
NOISE WALL-PILE AND LAG	SF	0	$ 30.00	$ -
GRAVITY RETAINING WALL	CY	105	$ 375.00	$ 39,375
RIGHT OF WAY				
Perm. R/W	ACRES	-0.1810	$125,000.00	$ (22,625)
Added R/W Labor Savings	PARCEL	-1	$ 10,000.00	$ (10,000)
			SubTotal	$ 15,112
			40% Contingency	$ 6,045
			Total	**$ 21,157**

ALTERNATIVE 2				
ITEM DESCRIPTION	***UNIT***	***DELTA QNT***	***UNIT PRICE***	***TOTAL***
ROADWAY				
EARTHWORK	CU YD	-602	$ 12.00	$ (7,224)
GUARDRAIL	LF	4,430	$ 16.00	$ 70,880
PAVEMENT				
SURFACE	TONS	85	$ 100.00	$ 8,489
BASE	TONS	255	$ 85.00	$ 21,648
STRUCTURES				
NOISE WALL-PILE AND LAG	SF	4,630	$ 30.00	$ 138,900
GRAVITY RETAINING WALL	CY	628	$ 375.00	$ 235,500
RIGHT OF WAY				
Perm. R/W	ACRES	-2.7765	$125,000.00	$ (347,063)
Added R/W Labor Savings	PARCEL	-24	$ 10,000.00	$ (240,000)
			SubTotal	$ (118,870)
			40% Contingency	$ (47,548)
			Total	**$ (166,418)**

ALTERNATIVE 3				
ITEM DESCRIPTION	***UNIT***	***DELTA QNT***	***UNIT PRICE***	***TOTAL***
ROADWAY				
EARTHWORK	CU YD	-6,368	$ 12.00	$ (76,416)
GUARDRAIL	LF	4,730	$ 16.00	$ 75,680
PAVEMENT				
SURFACE	TONS	95	$ 100.00	$ 9,512
BASE	TONS	285	$ 85.00	$ 24,256
STRUCTURES				
NOISE WALL-PILE AND LAG	SF	13,575	$ 30.00	$ 407,250
GRAVITY RETAINING WALL	CY	2,322	$ 375.00	$ 870,750
RIGHT OF WAY				
Perm. R/W	ACRES	-3.6976	$125,000.00	$ (462,200)
Added R/W Labor Savings	PARCEL	-38	$ 10,000.00	$ (380,000)
			SubTotal	$ 468,832
			40% Contingency	$ 187,533
			Total	**$ 656,365**

Unit costs for Gravity Retaining Wall are based on historic project data of similar items.

Recommendation No. 5 Lengthen merge/diverge areas at ramps where needed (Paris Pike)	IDEA NO. 9

Baseline

The baseline design conditions for each of the build alternatives through the corridor maintains the existing ramp merge/ diverge design at each of the four ramps at the Paris Pike interchange. It is assumed that the existing cross section of the mainline will tie into the ramps at the same locations and therefore the ramps will maintain their existing designs with regard to approach and exit curvatures, accelerations/decelerations, and taper lengths. These existing lengths are based on the previous design requirements from the year the interchange was originally designed.

Recommendation

The recommendation is to extend the merge and diverge areas for all four of the existing ramps to accommodate the current design standards for interstates, where needed. These improvements would marginally improve both safety and operations for the ramps and influence areas.

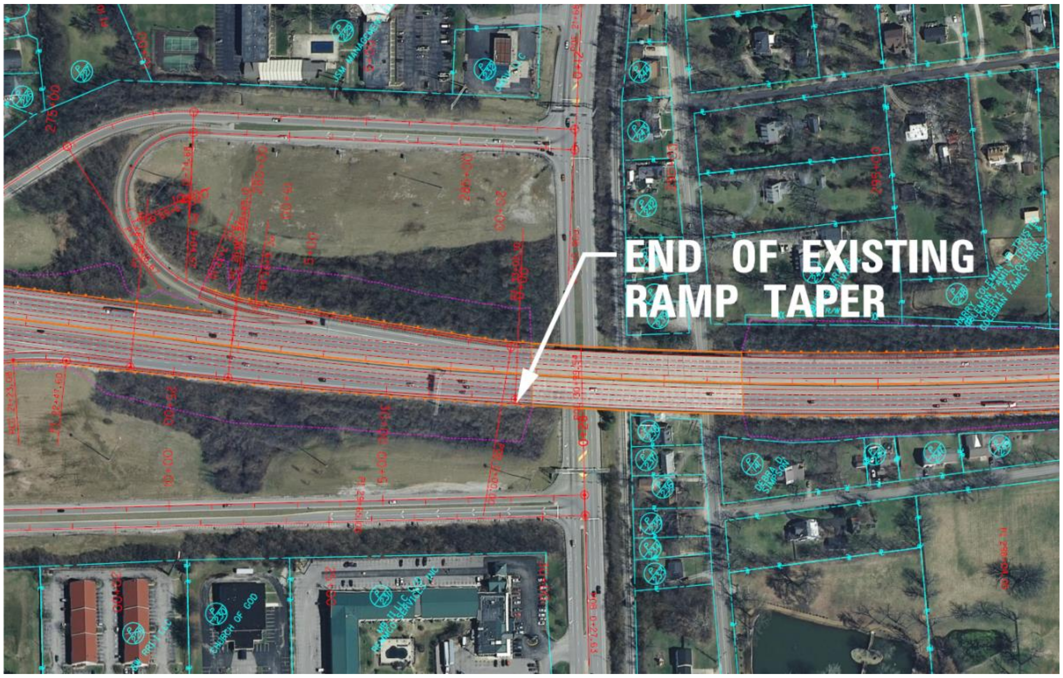
The anticipated safety improvements would result in a reduction of crashes in the ramp area of approximately 15%, resulting in approximately 3-6 crashes per year (of which most are property damage only). Operational benefits would improve the speed within the ramp areas (2 – 3 mph) as it allows vehicles to get to higher speeds before merging and offers more merging distance and a reduction in density (approximately 5-7%) through the ramp influence area.

Advantages	Disadvantages
• Improves merge/ diverge distances to improve mainline safety (reduces crashes) and operations	▪ Will require additional road and bridge widening costs

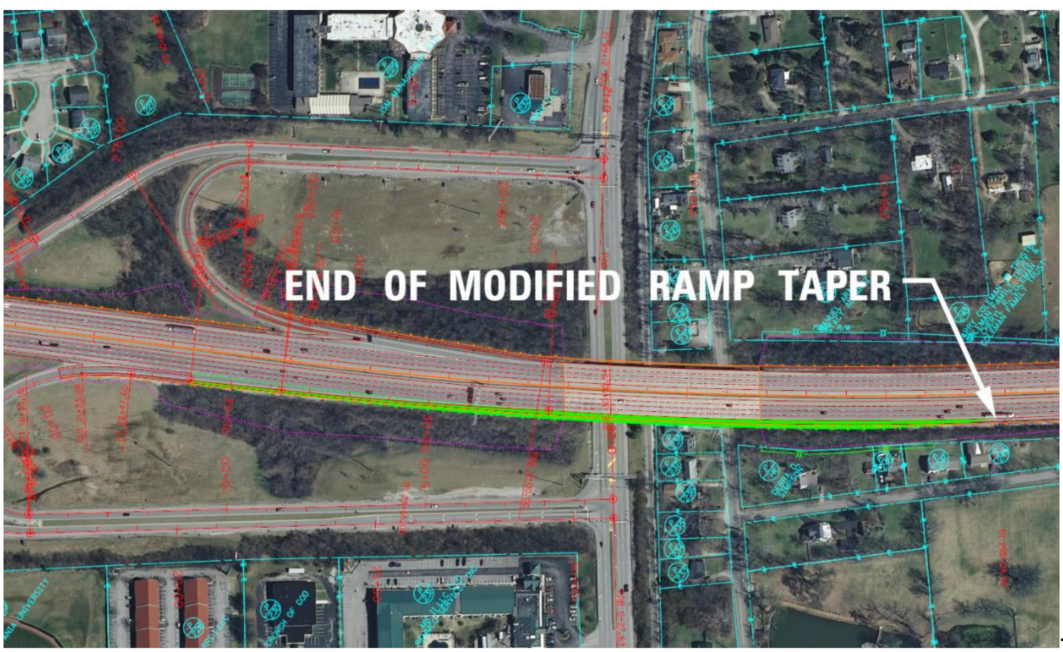
Summary of Cost Analysis

	Cost
Alternative 1	$2,303,099 Cost Increase
Alternative 2	$2,224,691 Cost Increase
Alternative 3	$2,246,964 Cost Increase
Alternative 4	$2,303,099 Cost Increase

Comments/Justification Sketches



Baseline Concept presented to the VE team



Recommended Concept

Recommendation No. 5 Lengthen merge/diverge areas at ramps where needed (Paris Pike)	IDEA NO. 9

The below table details the existing ramp dimensions and current standards (based on the AASHTO Green Book 2011 Table 10-3: Minimum Acceleration Lengths for Entrance Terminals with Flat Grades of 2% or Less & 10-4: Speed Change Lane Adjustment Factors as a Function of Grade)

Ramp	Existing Taper Length	Existing Type	Current Standard Taper Length	Proposed Ramp Type
SB Paris Pike Off-Ramp	608’	Taper	390’	N/A
SB Paris Pike On-Ramp	900’	Taper	2200’	Taper
NB Paris Pike Off-Ramp	608’	Taper	610’	N/A
NB Paris Pike On-Ramp	900’	Taper	492’	N/A

The only ramp at this interchange that is falling below the current standards is the **SB On-Ramp**. It is recommended that this ramp acceleration lane be extended to meet the current standards as shown to better accommodate traffic merging and roadway safety (reducing crashes from improved standards). This will involve additional roadway pavement, bridge decking across the Paris Pike bridge (SB only), and potentially additional ROW as compared with the baseline alternative.

Recommendation No. 5 Lengthen merge/diverge areas at ramps where needed (Paris Pike)	IDEA NO. 9

Alternative 1 – SB Paris Pike On Ramp Cost Calculations:

7-8909 I64/I75 Split

Value Planning Meeting

Alternative 1

ITEM DESCRIPTION	UNIT	DELTA QNT	UNIT PRICE	TOTAL
ROADWAY				
EARTHWORK	CU YD	2,928	$ 12.00	$ 35,136
PAVEMENT				
SURFACE	TONS	129	$ 100.00	$ 12,900
BASE	TONS	700	$ 85.00	$ 59,500
JPC PAVEMENT	SQYD	1,264	$ 95.00	$ 120,080
CRUSHED STONE BASE/DGA	TONS	1,165	$ 27.00	$ 31,455
STRUCTURES				
I-75 OVER PARIS PIKE	LS	1,386,000		$ 1,386,000
Subtotal				$ 1,645,071
Contingency	*40%*			$ 658,028
Total				**$ 2,303,099**

Alternative 2 – SB Paris Pike On Ramp Cost Calculations:

7-8909 I64/I75 Split

Value Planning Meeting

Alternative 2

ITEM DESCRIPTION	UNIT	DELTA QNT	UNIT PRICE	TOTAL
ROADWAY				
EARTHWORK	CU YD	3,224	$ 12.00	$ 38,688
PAVEMENT				
SURFACE	TONS	89	$ 100.00	$ 8,900
BASE	TONS	500	$ 85.00	$ 42,500
JPC PAVEMENT	SQYD	990	$ 95.00	$ 94,050
CRUSHED STONE BASE/DGA	TONS	701	$ 27.00	$ 18,927
STRUCTURES				
I-75 OVER PARIS PIKE	LS	1,386,000		$ 1,386,000
Subtotal				$ 1,589,065
Contingency	*40%*			$ 635,626
Total				**$ 2,224,691**

Recommendation No. 5 Lengthen merge/diverge areas at ramps where needed (Paris Pike)	**IDEA NO.** 9

Alternative 3 – SB Paris Pike On Ramp Cost Calculations:

7-8909 I64/I75 Split				
Value Planning Meeting				
Alternative 3				
ITEM DESCRIPTION	***UNIT***	***DELTA QNT***	***UNIT PRICE***	***TOTAL***
ROADWAY				
EARTHWORK	CU YD	3,673	$ 12.00	$ 44,076
PAVEMENT				
SURFACE	TONS	86	$ 100.00	$ 8,600
BASE	TONS	492	$ 85.00	$ 41,820
JPC PAVEMENT	SQYD	990	$ 95.00	$ 94,050
CRUSHED STONE BASE/DGA	TONS	664	$ 27.00	$ 17,928
STRUCTURES				
I-75 OVER PARIS PIKE	LS	1,386,000		$ 1,386,000
RIGHT OF WAY				
PURCHASE	ACRES	0.1	$ 125,000.00	$ 12,500
Subtotal				$ 1,604,974
Contingency	*40%*			$ 641,990
Total				**$ 2,246,964**

Alternative 4 – SB Paris Pike On Ramp Cost Calculations:

7-8909 I64/I75 Split				
Value Planning Meeting				
Alternative 4				
ITEM DESCRIPTION	***UNIT***	***DELTA QNT***	***UNIT PRICE***	***TOTAL***
ROADWAY				
EARTHWORK	CU YD	2,928	$ 12.00	$ 35,136
PAVEMENT				
SURFACE	TONS	129	$ 100.00	$ 12,900
BASE	TONS	700	$ 85.00	$ 59,500
JPC PAVEMENT	SQYD	1,264	$ 95.00	$ 120,080
CRUSHED STONE BASE/DGA	TONS	1,165	$ 27.00	$ 31,455
STRUCTURES				
I-75 OVER PARIS PIKE	LS	1,386,000		$ 1,386,000
Subtotal				$ 1,645,071
Contingency	*40%*			$ 658,028
Total				**$ 2,303,099**

Recommendation No. 5 Lengthen merge/diverge areas at ramps where needed (Paris Pike)	**IDEA NO.** 9

Assumptions

SB On-Ramp:

Assumed initial speed entering ramp taper – 25mph based on curve advisory speed

Assumed Roadway Design Speed – 70mph

Based upon 2011 Green Book Table 10-3 – required Acceleration Length (L_A): 1420'

Based on the mainline upgrade the adjustment factor from Table 10-4: 1.55

The resulting adjusted L_A value: 2200'

According to the Green Book the L_A should begin at a point after the ramp curvature or when the ramp curvature exceeds a radius of 300'.

This would result in starting the L_A 550' prior to the current gore point, thus requiring 1650' of taper length adjacent to the mainline prior to tapering in.

Safety Calculation:

This increase in costs will also come with an improvement in performance from both an operational and roadway safety perspective. From a safety standpoint, the extension of the ramp acceleration distance (speed change lane) will result in a reduction of crashes from the baseline (existing) configuration by approximately 15% through the ramp influence area. Based upon the uncalibrated results of the ISATe analysis, it can be assumed that this may translate to 3-6 fewer crashes per year through this area – of which they are primarily PDO crashes.

To quantify the safety benefit a simple example ISATe predictive analysis was done. The baseline and extended merge configuration were developed with other values being held constant to analyze the resulting amount of predicted crashes in each scenario. The resulting number of crashes from this analysis was compared to determine the difference (percentile) in crashes between the baseline and proposed scenario. The following screenshots represent the results for each of the analyses.

Baseline:

Estimated Crash Statistics								
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		327.1	1.4	3.7	23.5	74.0	224.5
Estimated average crash freq. during Study Period, crashes/yr:		15.6	0.1	0.2	1.1	3.5	10.7
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	2	327.1	1.4	3.7	23.5	74.0	224.5
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Recommendation No. 5 Lengthen merge/diverge areas at ramps where needed (Paris Pike)	**IDEA NO.** 9

Extended Ramp:

Estimated Crash Statistics								
Crashes for Entire Facility		**Total**	**K**	**A**	**B**	**C**	**PDO**
Estimated number of crashes during Study Period, crashes:		278.3	1.2	3.2	20.5	64.4	189.1
Estimated average crash freq. during Study Period, crashes/yr:		13.3	0.1	0.2	1.0	3.1	9.0
Crashes by Facility Component	**Nbr. Sites**	**Total**	**K**	**A**	**B**	**C**	**PDO**
Freeway segments, crashes:	1	278.3	1.2	3.2	20.5	64.4	189.1
Ramp segments, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:	0	0.0	0.0	0.0	0.0	0.0	0.0

Traffic Operations Calculation:

From an operational standpoint, the longer merge area will provide marginal operational benefit. Basic VISSIM analysis and HCM calculations for density indicate that there is a slight improvement to density and speed through the influence area, but it is not enough to numerically justify.

Some HCM calculations based on HCM6 – Chapter 14 (Exhibits 14-13-14-15) determining the speed and density increases through the influence area:

Step 5: Estimate Speeds in the Vicinity of Ramp–Freeway Junctions

While an estimation of average vehicle speeds within and adjacent to ramp influence areas is not necessary, it is often a useful additional performance measure. Two types of speeds may be estimated:

- Average speed of vehicles within the ramp influence area (mi/h), and
- Average speed of vehicles across all lanes (including outer lanes) within the 1,500-ft length of the ramp influence area (mi/h).

Both types of speeds are needed when a freeway facility analysis is conducted (Chapters 10 and 11). The first type of speed provides a useful companion measure to density within the ramp influence area in all cases.

Exhibit 14-13 and Exhibit 14-14 provide equations for estimating the average speed of vehicles (*a*) within the ramp influence area and (*b*) in outer lanes of the freeway adjacent to the 1,500-ft ramp influence area. For four-lane freeways (two lanes in each direction), there are no "outer lanes." For six-lane freeways (three lanes in each direction), there is one outer lane (Lane 3). For eight-lane freeways (four lanes in each direction), there are two outer lanes (Lanes 3 and 4).

Exhibit 14-13
Estimating Speed at On-Ramp (Merge) Junctions

Average Speed in	Equation	
Ramp influence area	$S_R = FFS \times SAF - (FFS \times SAF - 42)M_S$ $M_S = 0.321 + 0.0039e^{(v_{R12}/1{,}000)} - 0.002(L_A \times S_{FR} \times SAF/1{,}000)$	
Outer lanes of freeway	$S_O = FFS \times SAF$	$v_{OA} < 500$ pc/h
	$S_O = FFS \times SAF - 0.0036(v_{OA} - 500)$	$500 \leq v_{OA} \leq 2{,}300$ pc/h
	$S_O = FFS \times SAF - 6.53 - 0.006(v_{OA} - 2{,}300)$	$v_{OA} > 2{,}300$ pc/h

Core Methodology
Page 14-26

Chapter 14/Freeway Merge and Diverge Segments
Version 6.0

Recommendation No. 5

Lengthen merge/diverge areas at ramps where needed (Paris Pike)

IDEA NO. 9

Value	Equation
Average flow in outer lanes v_{OA} (pc/h)	$v_{OA} = \frac{v_F - v_{12}}{N_O}$
Average speed for on-ramp (merge) junctions (mi/h)	$S = \frac{v_{R12} + v_{OA}N_O}{\left(\frac{v_{R12}}{S_R}\right) + \left(\frac{V_{OA}N_O}{S_O}\right)}$
Average speed for off-ramp (diverge) junctions (mi/h)	$S = \frac{v_{12} + v_{OA}N_O}{\left(\frac{v_{12}}{S_R}\right) + \left(\frac{V_{OA}N_O}{S_O}\right)}$

Exhibit 14-15
Estimating Average Speed of All Vehicles at Ramp–Freeway Junctions

	Base	Extended
FFS	76	76
SAF	0.95	0.95
Ms	0.442023	0.306388
Vr12	4010	4011
V12	2830	2830
Vr	1180	1181
La	900	2200
Sfr	55	55
Sr	58.85091	62.94708
Voa	2555	2554.5
Vf	6290	6290
N0	2	2
Speed	65.65217	67.81579
V	1867.5	1867.75
Density	28.44536	27.54152

Design Recommendation No. 6 Narrow Shoulders at Existing Bridge Piers	IDEA NO. 32

Baseline

For Alternatives 2 and 3, the proposed typical section includes 12’ outside shoulders and an 8’ and 12’ inside shoulder, respectively. As a result, two new offline bridge replacements at Russell Cave Road and Bryan Station Road are included in the baseline due to insufficient horizontal clearance at the existing bridge piers to fit these typical sections in.

Recommendation

For alternatives 2 & 3, narrow the proposed shoulders in the immediate vicinity of the existing bridge piers at Russell Cave Road and Bryan Station Rd., so that the existing substructure can be re-used and total bridge replacement is not needed. However, the superstructure would have to be raised or replaced to address vertical clearance. (This is what is proposed for Alt. 1 and 4).

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Advantages	Disadvantages
• Minimizes construction costs • Minimizes construction schedule • Minimizes utility relocations	• Does not allow for standard shoulder widths on I-75 (requires interstate shoulder tapers near bridge) • Substructure (55 years old) may need to be replaced in approx. 30 years. • Both side roads need to be closed during construction and traffic detoured

Summary of Cost Analysis

	Cost
Alternative 1	N/A (re-using the existing substructure is already part of this alternative)
Alternative 2	$5.3M Cost Avoidance
Alternative 3	$5.3M Cost Avoidance
Alternative 4	N/A (re-using the existing substructure is already part of this alternative)

Comments/Justification Sketches

Below is a photo of the existing Bryan Station Road Bridge. As you can see, adding a fourth lane in between the existing piers is tight. By reducing the proposed shoulder widths, the fourth lane can be added without total bridge replacement. However, the superstructure would still need to be raised or replaced in order to address the vertical clearance issues.

Reducing the proposed shoulders allows the re-use of the substructure. Similar ideas have been implemented on I-64 in the Louisville, KY area. See photo below.

To address the verical clearance issue, the supersturcture will either have to be raised or replaced. See photo below of similar project where superstructure was replaced and existing piers re-used (higher beam seats). This idea was validated in Design Validation No.1 of this VE Planning Study, “Bridge Raising”.

Design Recommendation No. 6 Narrow Shoulders at Existing Bridge Piers	IDEA NO. 32

Assumptions & Calculations

Baseline for Alternative 2 and 3:

Route Carried By Bridge	Route Under Bridge	Superstr. Type	Total Length (ft)	Total Width (ft)	Total Deck Area (SF)	Number of Spans	Max. Span Length (ft)	Unit Cost ($ / SF)	Replacement Cost
Russel Cave Rd. (KY 353)--Alt. #3	I-75	PC Box Beams	294	44	12936	4	90	$214	$2,769,997
Bryan Station Rd. (KY 57)--Alt. #3	I-75	PC Box Beams	288	40	11520	4	86	$214	$2,466,788

Total costs (Russel Cave Bridge + Bryan Station Bridge + roadway, utilities, and ROW):
2,769,997 + 2,466,788 + 2,462,000 = **$7,698,786**

Cost of superstructure replacement:

Modification	Unit Cost	Count	Units	Total Cost	
Remove Superstructure	$60,000	1	LS	$60,000	
HN 36 PCI Beams	$491.00	1080	LF	$530,280	
Concrete deck	$1,000	241	CY	$241,200	
Deck reinforcement	$1.20	35102	LB	$42,122	
2 barriers	$95	540	LF	$51,300	
Concrete Diaphragms	$950	38	CY	$36,021	
Built Up Beam Seats at Piers	$950	35	CY	$33,250	
Reinforcement in Substructure	$1.15	8682	LB	$9,985	
Patching of Existing Substructure	$50,000	1	LS	$50,000	
				$1,054,158	total, per bridge
Area of new deck	*9720*	*SF*		*$108*	*per SF*

Cost of bid prices is based on KYTC average unit bid prices for 2017 (most recent available) and then adjusted for estimated inflation. The estimated costs for approach roadway work, ROW, and utilties at two bridges totals $300,000 (assuming worst case of raising existing superstructure).

Total costs (Bryan Station Bridge + Russel Cave Bridge + Roadway, Utilities, and ROW):
2(1,054,158) + 300,000 = **$2,408,315**

A superstructure replacement would avoid save $5.3M compared to the cost of replacing both bridges completely.

Design Recommendation No. 6 Narrow Shoulders at Existing Bridge Piers	IDEA NO. 32

Example of new superstructure on raised substructure

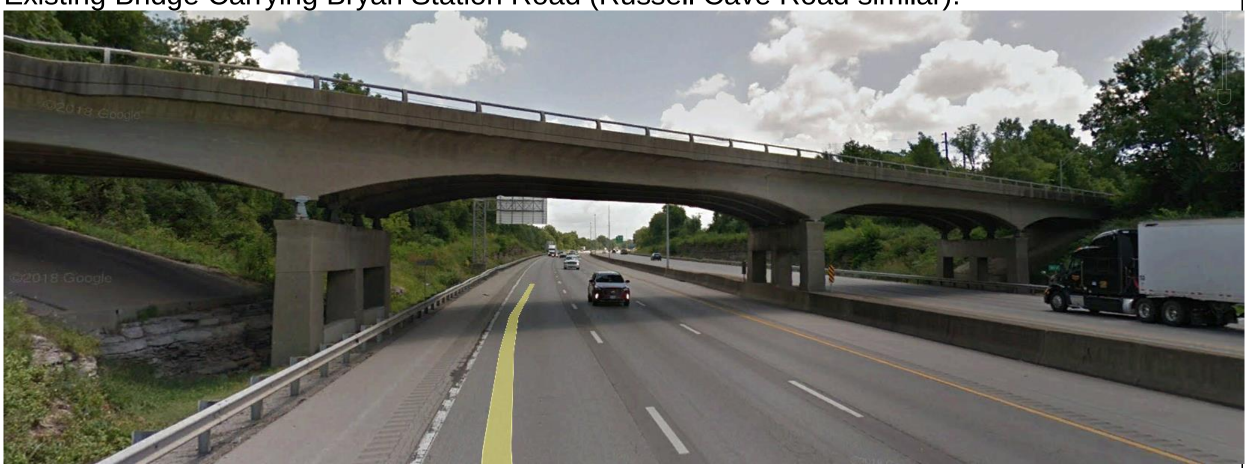
Design Validation No. 1	IDEA NO. 23

Baseline

Alternatives 1 and 4:
Permanently raise two bridges (Russell Cave Road and Bryan Station Road) approximately 2.5 feet in elevation in order to provide vertical clearance over the proposed I-75 roadway. This would also require re-construction of the approach roadway at the end of each bridge.

Approx. Structure Costs: $2,088,535
Approx. Roadway, ROW, and Utility Costs: $478,000

Existing Bridge Carrying Bryan Station Road (Russell Cave Road similar):



As part of our due diligence on this matter, we conversed with a local contractor that specializes in this special type of construction activity. They were confident in the ability to raise these structures to the required height. A basic cost estimate was given to us by the contractor. A risk factor was added to the documented estimates in this report.

Design Validation No. 1	IDEA NO. 23

Recommendation

The recommendation is to keep the raising/jacking option as part of Alternatives 1 and 4. We estimate that the remaining service life of these two bridges would be approximately 20 years after this modification.

Advantages	Disadvantages
• Minimizes construction costs • Minimizes construction schedule	• Risky construction methods • Uncertain if 3 lanes can be maintained on the interstate in each direction during raising/jacking operations • Does not allow for standard lane and shoulder widths on I-75 • Maintenance/rehab needs in future have some uncertainty for these 60 year old bridges • Both side roads may need to be closed during construction and traffic detoured • No bike lanes or sidewalks can be added to side roads

Summary of Cost Analysis

	Cost
Alternative 1	$0
Alternative 2	N/A (replacing these two bridges is part of this alternative)
Alternative 3	N/A (replacing these two bridges is part of this alternative)
Alternative 4	$0

Design Validation No. 1	IDEA NO. 23

Comments/Justification Sketches

Photo of similar project where superstucture was temporarily supported by falsework:

Photo of similar project where superstructure was raised and placed on higher beam seats.

Design Validation No. 1	IDEA NO. 23

Assumptions & Calculations

Baseline for Alternatives 1 and 4:

Russel Cave Road Bridge

Modification	Unit Cost	Count	Units	Total Cost	
Jack and Temporarily Support Bridge	$200,000	5	each	$1,000,000	
Build up the concrete beam seats	$950	14	CY	$13,634	
New wing walls at Abut's.	$950	12	CY	$11,611	
Raise Abutment Backwalls	$950	8	CY	$8,022	
Replace joints at each abutment	$500	2	each	$1,000	
Replace bearings	$500	20	each	$10,000	
				$1,044,268	total

Bryan Station Road Bridge

Modification	Unit Cost	Count	Units	Total Cost	
Jack and Temporarily Support Bridge	$200,000	5	each	$1,000,000	
Build up the concrete beam seats	$950	14	CY	$13,634	
New wing walls at Abut's.	$950	12	CY	$11,611	
Raise Abutment Backwalls	$950	8	CY	$8,022	
Replace joints at each abutment	$500	2	each	$1,000	
Replace bearings	$500	20	each	$10,000	
				$1,044,268	total

Total costs (bridge + roadway, utilities, and ROW):
Alt. 1: 2x(1,044,268) + 241,000 + 237,000 = **$2,566,535**

Cost of full replacement (assuming phased construction):

Route Carried By Bridge	Route Under Bridge	Superstr. Type	Total Length (ft)	Total Width (ft)	Total Deck Area (SF)	Number of Spans	Max. Span Length (ft)	Depth of Superstr. (ft)	Unit Cost ($ / SF)	Replacement Cost
Bryan Station Rd. (KY 57)--Alt. #2	I-75	PC Box Beams	278	40	11120	4	81	5.8	$214	$2,381,136
Bryan Station Rd. (KY 57)--Alt. #3	I-75	PC Box Beams	288	40	11520	4	86	5.8	$214	$2,466,788
Russel Cave Rd. (KY 353)--Alt. #2	I-75	PC Box Beams	284	44	12496	4	85	5.8	$214	$2,675,780
Russel Cave Rd. (KY 353)--Alt. #3	I-75	PC Box Beams	294	44	12936	4	90	6.3	$214	$2,769,997

Cost ($ per SF) are based on KYTC publication by Div. of Structural Design (adjusted for inflation).
Alternative 2 allows for 4~12' lanes with reduced shoulder widths.
Alternative 3 allows for 4~12' lanes with full shoulder widths.

Roadway costs for approach work at two bridges totals $2.462M (both Alternatives 2 and 3).

Total costs (Bryan Station Bridge + Russel Cave Bridge + Roadway, Utilities, and ROW):
Alt. 2: 2,381,136 + 2,675,780 + 2,462,000 = **$7,518,916**
Alt. 3: 2,466,788 + 2,769,997 + 2,462,000 = **$7,698,785**

Alternative #3 would cost approx. $5.1M more than Alternative #1.

Design Considerations

In addition to the VE recommendations and the design validation the team identified a number of design considerations to be evaluated throughout the design process. Additional information about these design considerations can be found in the evaluations section of this report.

- Only pave widened areas that have not recently been rehabbed
- Advanced signing / road markings for lane choice
- Legacy trail structure revisions to prevent 4-F impacts
- Ramp metering at interchanges
- Break and seat existing concrete with overlay
- Widening without concrete base

The following is a detailed design consideration to further define how the potential 4-F impacts at legacy Trail can be avoided.

Detailed Design Consideration No. 1 Legacy Trail Wagon-Box Head & Wing Wall Extensions	**IDEA NO.** 24
Baseline	
A wagon-box structure passes below mainline I-75/I-64, accommodating pedestrian traffic for the city's Legacy Trail. Alternatives 2 and 3 widen both the northbound and southbound sections. This will result in an offset of the 2:1 fill slopes and require modifications at the end of the wagon-box. Any disruption to the trail might be considered a 4(f) environmental impact.	
Recommendation	
Widening of the interstate above the wagon-box can certainly be performed. However, a more detailed engineering design will be required to determine which solutions are feasible and which is the overall best solution. The following options could be evaluated in order of least impact to the trail: 1. Utilize a Moment Slab Toe Wall similar to the PennDOT Standard Drawing, as shown in Figure 1. This system acts as a retaining wall at the edge of the widened roadway for limited heights below the pavement. If engineering design proves this will work, it will result in no impact to the wagon-box/trail. 2. Extend the vertical heights of the parapet and wingwalls to receive the widened 2:1 slopes, as shown in Figure 2. The widening will result in an additional 4ft of height. Using rough numbers, this essentially doubles the moment demand at the base of the wingwalls. It will also significantly increase the maximum bearing pressure and increase the likelihood of overturning. The original plans for these wing walls have not yet been located. The situation might be improved by obtaining refined geotechnical information, the use of lightweight fill, and exploiting potential conservatism in the original design. The wingwalls could be thickened to handle the increased forces. However, upgrades to foundations are typically not economical or easy to construct. 3. Extend the wagon-box the length of the widened slopes. Of the three options, this will result in the most impact to the trail. The existing grade of the trail can be built into the barrel, avoiding impacts outside of ROW. If sight distance for trail users or farm vehicles is a concern, due to the 90° turn at one end, the barrel could be flared to accommodate better line of sight.	

Detailed Design Consideration No. 1 Legacy Trail Wagon-Box Head & Wing Wall Extensions	**IDEA NO.** 24

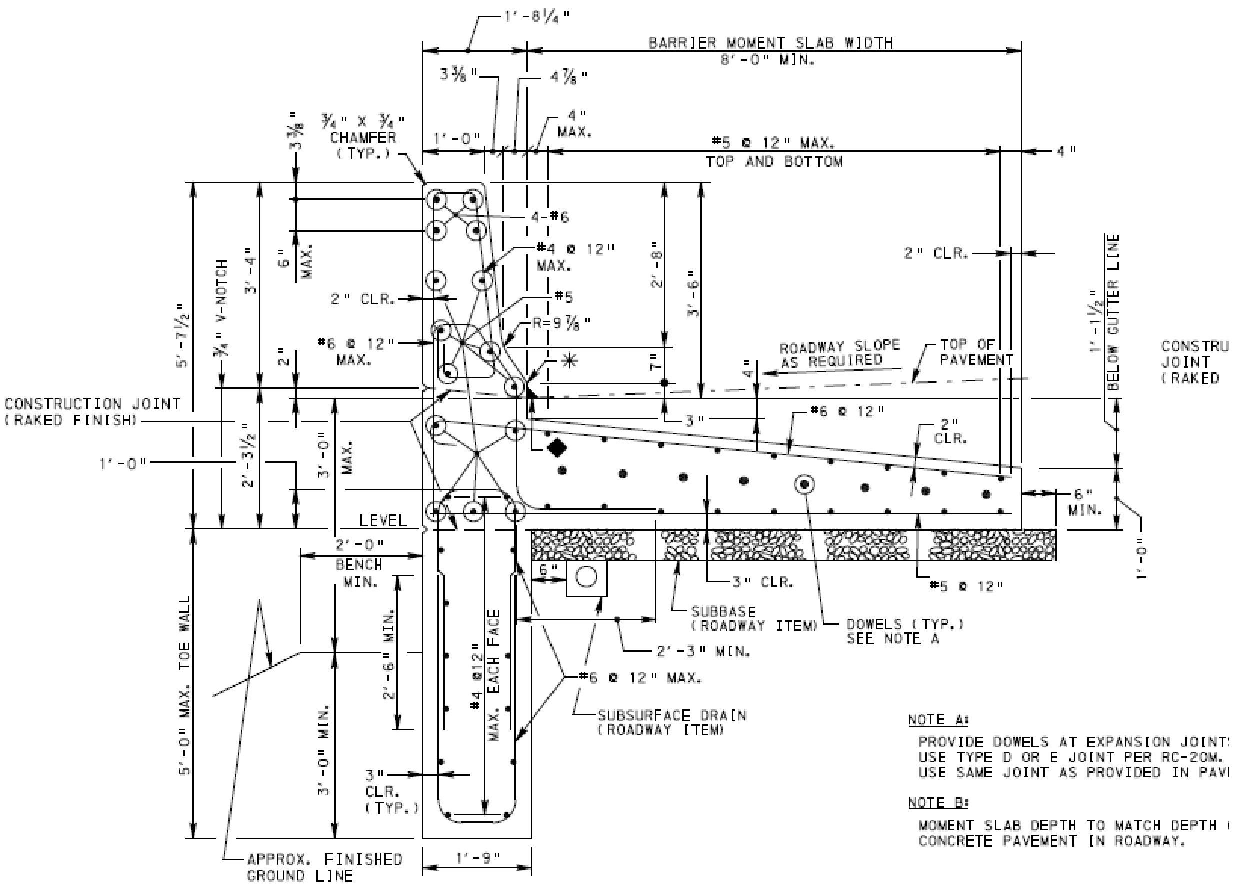
Advantages	**Disadvantages**
Moment Slab: • No impact to wagon-box or trail. • All work will involve relatively easy access along the interstate Vertical Extension of Wings and Headwalls: • Limited impact to trail during construction (compared to full extension) • Less construction cost (compared to full extension) • Shorter construction duration (compared to full extension) Full Extension: • Most conventional option • Will certainly work from a structural design standpoint (there is some question with other options)	Moment Slab: • Solution may not work if fill height on culvert is less than 5ft Vertical Extension of Wings and Headwalls: • Design may show it to be unfeasible • Partial closure of trail required, with intermittent full closures during construction. • Farm-to-farm access for large vehicles will be difficult if not impossible to maintain during a significant portion of construction. • Could result in costly foundation upgrades. • Less construction cost than full extension Full Extension: • Partial closure of trail required, with intermittent full closures during construction. • Farm-to-farm access for large vehicles will be difficult if not impossible to maintain during construction. • Most expensive option • Longest construction duration

Summary of Cost Analysis

	Cost
Alternative 1	N/A
Alternative 2	To be determined during design phase
Alternative 3	To be determined during design phase
Alternative 4	N/A

Comments/Justification Sketches

Figure 1 – Moment Slab Toe Wall



MOMENT SLAB (BURIED) WITH TOE WALL
AND TYPICAL C.I.P. BARRIER

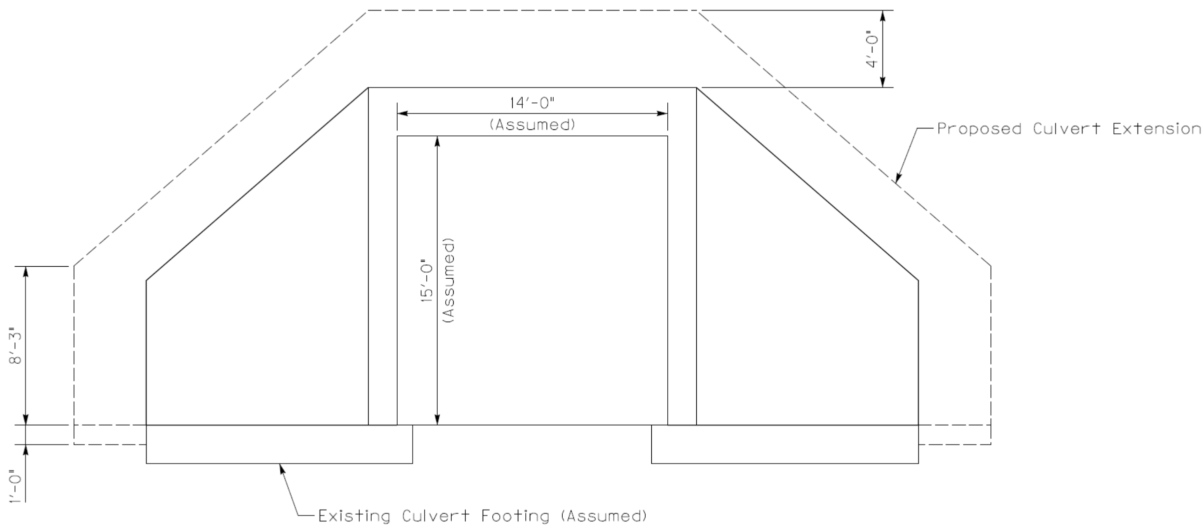
SEE SHEET 6 FOR PLAN OF C.I.P. MOMENT SLAB

✳ R=1"

◆ ASPHALT RUBBER SEALING COMPOUND [PUB. 408, SECTION 705.4(g)]

Detailed Design Consideration No. 1 Legacy Trail Wagon-Box Head & Wing Wall Extensions	IDEA NO. 24

Figure 2 – Vertical Headwall and Wingwall Extension Schematic



The most conventional method of handling the extension of fill slopes would be to extend the structure so the slopes toe out normally. This will certainly require special construction methods to minimize the impacts to the trail.

Another potential issue with lengthening the wagon-box is the coordination with the existing grade of the trail. After exiting one end of the structure, the grade of the trail increases significantly. Maintaining the existing wagon-box grade on the extension would require modification of the trail.

Scoring Performance for Alternatives with VE Recommendations.

To develop the total performance score for each of the four alternatives presented, the VE team used the weighting and scoring criteria to score each of the attributes.

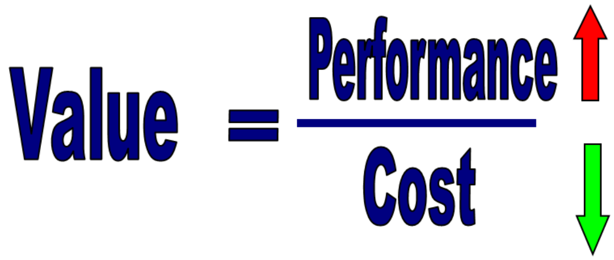
Alternative 1 VE		
PERFORMANCE MEASURES **Attributes and Rating Rationale**	**Performance**	**Score**
Mainline Operations ▪ Design exceptions – lane 11 ft ▪ Design exception – inside shoulder 8.7 ft ▪ Full outside shoulder ▪ Exceeds LOS C in design year ▪ Increased ramp merge at Paris Pike	Rating	6.5
	Weight	28.6
	Contribution	185.9
Local Operations ▪ Russell Cave and Bryan Station – raising structures therefore no adjustments to lane or shoulder widths ▪ Does not Commitment satisfy commitment to provide bike and pedestrian access Russell Cave road	Rating	6
	Weight	19.0
	Contribution	114.0
Maintainability ▪ Similar maintenance to existing facility ▪ Maintenance has expressed concerns for inside shoulder maintenance activities – would require lane closures ▪ Raising structures built in late 60s may have additional maintenance ▪ Additional walls/guardrail	Rating	4
	Weight	23.8
	Contribution	95.2
Construction Impacts ▪ Maintain 2-3 lanes in each direction throughout construction with interim night closures ▪ Addition of ramp merge could add additional structure construction time. Construction time/interim ramp closure	Rating	6
	Weight	14.2
	Contribution	85.2
Environmental Impacts ▪ Assumes noise walls where required ▪ Stays mostly within existing right of way ▪ Used mitigation measures to minimize right of way impacts	Rating	6
	Weight	9.5
	Contribution	57.0
Reduce Risk ▪ Risk of additional cost to repair existing structures ▪ Stays within existing roadway prism, minimizing risk to environmental, right of way and utilities ▪ Will require design exceptions for lane and shoulder widths ▪ Raising structures ▪ Does not address lane balance at northern split	Rating	5
	Weight	4.7
	Contribution	23.5
	Total Performance:	**561**

Alternative 2 VE		
PERFORMANCE MEASURES **Attributes and Rating Rationale**	**Performance**	**Score**
Mainline Operations ▪ Design exception – inside shoulder 8 ft with 4ft across existing structures ▪ Full outside shoulder ▪ Exceeds LOS C in design year ▪ Increased ramp merge at Paris Pike	Rating	8
	Weight	28.6
	Contribution	228.8
Local Operations ▪ Russell Cave and Bryan Station – replaces super structures with adjustments to lane or shoulder widths	Rating	8
	Weight	19.0
	Contribution	152
Maintainability ▪ Similar maintenance to existing facility ▪ Maintenance has expressed concerns for inside shoulder maintenance activities – would require lane closures ▪ Replacing structures built in late 60s will have less maintenance ▪ Additional walls/guardrail ▪ Narrower shoulders across existing structures, may potentially require a lane closure for maintenance on structures	Rating	4
	Weight	23.8
	Contribution	95.2
Construction Impacts ▪ Maintain 2-3 lanes in each direction throughout construction with interim night closures ▪ Addition of ramp merge could add additional structure construction time. Construction time/interim ramp closure ▪ Additional wall/guardrail construction time ▪ Reduction in construction time duration for bridge work	Rating	6
	Weight	14.2
	Contribution	85.2
Environmental Impacts ▪ Assumes noise walls where required ▪ Some right of way required ▪ Outside widening throughout ▪ Added shoulder or sidewalk on Russell Cave and Bryan Station ▪ Used mitigation measures to minimize right of way impacts	Rating	5.8
	Weight	9.5
	Contribution	55.1
Reduce Risk ▪ Risk of additional cost to repair existing structures ▪ Will require design exceptions for shoulder widths ▪ Widening outside of current right of way has been mitigated with VE Rec 4 ▪ Does not address lane balance at northern split	Rating	5.5
	Weight	4.7
	Contribution	25.9
	Total Performance:	**642**

Alternative 3 VE		
PERFORMANCE MEASURES **Attributes and Rating Rationale**	**Performance**	**Score**
Mainline Operations ▪ No design exceptions ▪ Reduces shoulders on existing bridges to 4'/10' ▪ Reduce inside shoulder to ASHTO 10' requirement ▪ Exceeds LOS C in design year ▪ Increased ramp merge at Paris Pike	Rating	9.5
	Weight	28.6
	Contribution	271.7
Local Operations ▪ Russell Cave and Bryan Station – replaces super structures with adjustments to lane or shoulder widths	Rating	8
	Weight	19.0
	Contribution	152.0
Maintainability ▪ Similar maintenance to existing facility ▪ Replacing structures built in late 60s will have less maintenance ▪ Additional walls/guardrail ▪ Narrower shoulders across existing structures, may potentially require a lane closure for maintenance on structures ▪ 10' inside shoulder reduced from 12' due to VE	Rating	4.5
	Weight	23.8
	Contribution	107.1
Construction Impacts ▪ Maintain 2-3 lanes in each direction throughout construction with interim night closures ▪ May not require outside shoulder widening for stage 1 construction ▪ Added drainage/slope construction work on outside could add to construction duration ▪ Addition of ramp merge could add additional structure construction time. Construction time/interim ramp closure ▪ Additional wall/guardrail construction time ▪ Reduction in construction time duration for bridge work	Rating	6
	Weight	14.2
	Contribution	85.2
Environmental Impacts ▪ Assumes noise walls where required ▪ Additional right of way required ▪ Outside widening throughout ▪ Added shoulder or sidewalk on Russell Cave and Bryan Station ▪ Potential 4f impacts has been mitigated ▪ Used mitigation measures to minimize right of way impacts ▪ Reduced roadway width with VE (inside shoulder)	Rating	5.8
	Weight	9.5
	Contribution	55.1
Reduce Risk ▪ Risk of additional cost to repair existing structures ▪ Outside of current right of way has been mitigated with VE Rec 4 ▪ Does not address lane balance at northern split	Rating	6.5
	Weight	4.7
	Contribution	30.6
Total Performance:		**702**

Alternative 4 VE		
PERFORMANCE MEASURES **Attributes and Rating Rationale**	**Performance**	**Score**
Mainline Operations ▪ Design exception – inside shoulder 4.7 ft during peak hours, 16.7 ft off peak ▪ Full outside shoulder ▪ Opening and closing of lanes could cause operational issues ▪ Reliability of ITS may affect lane operations ▪ Complicates merge on southern split ▪ May have inside shoulder reduction in areas of overhead signing (ITS) ▪ Increased ramp merge at Paris Pike	Rating	4.5
	Weight	28.6
	Contribution	127.8
Local Operations ▪ Russell Cave and Bryan Station – raising structures therefore no adjustments to lane or shoulder widths ▪ Does not Commitment satisfy commitment to provide bike and pedestrian access Russell Cave road	Rating	6
	Weight	19.0
	Contribution	114.0
Maintainability ▪ Maintenance has expressed concerns for inside shoulder maintenance activities – would require lane closures ▪ Raising structures built in late 60s may have additional maintenance ▪ Maintaining ITS components significant ▪ Maintenance of hard shoulder running lane between peak hours ▪ Additional walls/guardrail	Rating	2
	Weight	23.8
	Contribution	47.6
Construction Impacts ▪ Maintain 2-3 lanes in each direction throughout construction with interim night closures ▪ Addition of ramp merge could add additional structure construction time. Construction time/interim ramp closure	Rating	6
	Weight	14.2
	Contribution	85.2
Environmental Impacts ▪ Assumes noise walls where required ▪ Stays mostly within existing right of way ▪ Used mitigation measures to minimize right of way impacts	Rating	6
	Weight	9.5
	Contribution	57.0

Reduce Risk ▪ Risk of additional cost to repair existing structures ▪ Stays within existing roadway prism, minimizing risk to environmental, right of way and utilities ▪ Will require design exceptions for shoulder widths ▪ Raising structures ▪ Does not address lane balance at northern split ▪ Coordination and operation of ITS ▪ Opening and transitioning of inside lane on southern split	Rating	5
	Weight	4.7
	Contribution	22.1
Total Performance:		**456**



Alternative Summary								
Alternatives		**Performance (P)**	**% Change Performance**	**Cost (C) $ millions**	**Cost Change $ millions**	**% Change Cost**	**Value Index**	**% Value Improvement**
1	Alternative 1	547		$64.5	$64.46		8.48	
2	Alternative 2	646		$85.8	$85.84		7.53	
3	Alternative 3	699		$90.2	$90.21		7.75	
4	Alternative 4	442		$78.1	$78.13		5.65	
5	VE Alternative 1	561	+2.6%	$58.0	($6.48)	-10.1%	9.67	+14.1%
6	VE Alternative 2	642	-0.7%	$72.1	($13.75)	-16.0%	8.91	+18.3%
7	VE Alternative 3	702	+0.4%	$73.1	($17.09)	-18.9%	9.60	+23.9%
8	VE Alternative 4	456	+3.2%	$71.7	($6.48)	-8.3%	6.36	+12.6%

Table 9 Value Index

The value engineering recommendations was able to reduce cost by 8.3% to 18.9% without significant sacrifices in performance. Alternative 1 with the VE recommendations is the lowest cost at $58.0 Million but Alternative 3 with the VE recommendations had a much higher performance making it a very viable alternative as well.

Appendix

- VE Recommendation Approval Form
- VE Study Agenda
- VE Study Attendee List
- VE Study Report Out Presentation
- Project Presentation to VE Team
- Value Engineering Process

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VE Study Recommendation Approval Form

Project: I 64 / I 75 Widening **VE Study Date:** January 28-February 1, 2019

Recommendation		Approved Y/N	FHWA Functional Benefit: Safety	Operations	Environment	Construction	Right-of-Way	VE Team Estimated Cost Avoidance or Cost Added	Actual Estimated Cost Avoidance or Cost Added
1	Pavement							$8.6M – $8.9M	
2	Narrowing Shoulders at existing structures							$1.9M-$3.5M	
3	10' Inside Shoulders							$2.5M	
4	Reduction of Right-of-Way Impacts							$0.17M - $0.66M	
5	Lengthen merge/diverge areas at ramps where needed (Paris Pike)							$2.2M -$2.3M	
6	Narrow Shoulders at Existing Bridge Piers							$5.3M	

Please provide justification if the value engineering workshop recommendations are **not** approved or are implemented in a modified form.

The Project Manager will review and evaluate the VE team's recommendation(s) that are included in the Final Report. The Project Manager shall complete the VE Recommendation Approval form that is included in this report.

For each recommendation that is not approved or is modified by the Project Manager, justification needs to be provided. This justification shall include a summary statement containing the Project Manager's decision not to use the recommendation in the project.

The completed VE Recommendation Approval form including justification for any recommendations not approved or modified shall be sent to the KTC VE Office so the results can be included in the annual Value Engineering Report to FHWA.

________________________________ ________________

Signature Project Manager Date

____

Name (please print)

<u>FHWA Functional Benefit Criteria</u>

Each year, State DOT's are required to report on VE recommendations to FHWA. In addition to cost implications, FHWA requires the DOT's to evaluate each approved recommendation in terms of the project feature or features that recommendation benefits. If a specific recommendation can be shown to provide benefit to more than one feature described below, count the recommendation in ***each category that is applicable.***

Safety: Recommendations that mitigate or reduce hazards on the facility.
Operations: Recommendations that improve real-time service and/or local, corridor, or regional levels of service of the facility.
Environment: Recommendations that successfully avoid or mitigate impacts to natural and or cultural resources.
Construction: Recommendations that improve work zone conditions, or expedite the project delivery.
Right-of-Way: Recommendations that lower the impacts or costs of right-of-way.

VE Study Agenda

Agenda Memo

Date:	Friday, January 25, 2019
Project:	I-64 / I-75 Split
To:	VE Team Members
From:	Ken L. Smith, PE, CVS®
Subject:	Value Planning alternative evaluation study

This memo is to introduce some of the expectations for the upcoming Value Planning alternative evaluation study. I'm looking forward to working with you on this endeavor. My hope is that this memo will provide information to you about the project and our work together.

If you have any questions, please direct them to me, Ken Smith, at 360-451-2527, or e-mail: ken.l.smith@hdrinc.com.

PROJECT BACKGROUND

THE PURPOSE OF THE PROPOSED PROJECT IS TO DECREASE CONGESTION AND IMPROVE SAFETY, OPERATIONS, AND ROADWAY TRAFFIC CAPACITY ON THE COMBINED I-75/I-64 INTERSTATE ROUTE AROUND LEXINGTON. THE PROJECT IS NEEDED TO ADDRESS THE INCREASED TRAFFIC ALONG THE PROJECT CORRIDOR IN RECENT YEARS AS WELL AS ANTICIPATED CONTINUED POPULATION GROWTH IN FAYETTE AND SURROUNDING COUNTIES.

STUDY DATES AND LOCATION

The Opening session will be held January 28, 2019 at

HDR
2517 Sir Barton Way
Lexington, KY 40509

The closing session will be held February 1, 2019 at

KYTC District 7
800 Newtown Circle
Lexington, KY 40511

The workshop will be held Monday Jan-28 through Feb-1 2019 at

HDR
2517 Sir Barton Way
Lexington, KY 40509

WHAT TO BRING

Be sure to bring your normal tools of the trade (e.g., calculator, laptop computer [if possible], scale, etc.). Bring a creative and open mind. These types of studies are a lot of work, but you will have a good time and a rewarding experience.

GROUND RULES

The study follows a process that has been proven over many years to produce the best results. This process needs the team members to be fully engaged and have an open mind to "step" outside of the box throughout the week.

To maintain our schedule and provide the best results to the project team, I ask that we follow some basic ground rules:

1. **Please be prepared to attend all five days.** You were selected to assist on this team based on your expertise. If you cannot be in attendance for the entire time, then please contact me prior to the study so we can make the appropriate arrangements.
   When team members leave part way through, or come and go frequently, the team can lose its momentum and cohesiveness.
2. **Please turn your cell phones to vibrate mode during the study.** Unless it is information to assist the team, please try to wait until breaks to return phone calls, check on messages, or sort through e-mails.
3. **No dress code.** I want everyone to be comfortable. The dress is what some would call business casual (no ties required).
4. **If you have a laptop please bring it.** I have found most team members are more comfortable developing their write-ups and ideas on a computer. The facilities we use don't always have network connections, so the memory stick is usually the network of choice for sharing files.
5. **Our success will be evaluated based on the level of contribution that we bring to the project.** Remember that the goal is to "add value" to the project and saving money is just a byproduct. We want to make recommendations based on solid engineering judgment that will result in an improved overall project.

I'm looking forward to working with you on this study and I really appreciate each of you blocking time out of your busy schedule to participate. Please don't hesitate to call or e-mail me if you have any questions.

Sincerely,

Ken L. Smith, PE, CVS
Vice President
Senior Value Engineering
& Project Risk Manager

HDR
905 Plum Street
Suite 200, Olympia, WA 98501-1516
M 360-451-2527
ken.l.smith@hdrinc.com

Agenda

Day 1	Monday, January 28 Objective for the day: Learn about the project and alternatives	
08:30 AM	**Team Introductions** • Team "meet and greet" • Study kickoff • Team introductions	**Project Team/designer**
08:45 AM	**Process Overview** • An instructional presentation on the process for the study	**Facilitator:** Ken Smith, PE, CVS
09:15 AM	**Project documentation review for each alternative** • Rough order of magnitude costs • Traffic information • Concerns and issues	**Project Team/designer**
10:00 AM	**Break**	
11:00 AM	**Begin Risk Elicitation for each alternative** • Define risks for each alternative • Develop responses strategies	**Facilitator** **Team**
12:00 PM	**Lunch**	**All Audiences**
01:00 PM	**Team Introductions and Project Overview** • Purpose and Need of the project • Goals and objectives of the project • Constraints • Present each of the three current Alternatives • Google Earth walk through ○ Roadway Design ○ Traffic Analysis ○ Structures ○ Drainage/Hydraulics ○ Utilities ○ Railroad (Third Party) ○ Environmental Conditions ○ Contamination • Questions and answers	**All Audiences: Project Owner, management, stakeholders, designers, etc.**
02:00 PM	**Discuss Project documentation review for each alternative** • Rough order of magnitude costs • Traffic information • Concerns and issues	**All Audiences**
02:30 PM	**Complete Risk Elicitation for each alternative** • Define risks for each alternative • Develop responses strategies	**Facilitator** **All Audiences**
05:00 PM	**Adjourn**	

Day 2	Tuesday January 29	
08:30 AM	**Review and refine Evaluation criteria** • Review how each alternative will be evaluated and score • Revise criteria and build consensus	**Team**
09:00 AM	**Creative Phase** • Brainstorm alternative ways to perform key functions • Brainstorm ways to improve value of key functions	**Team**
12:00 AM	**Lunch**	
01:00 PM	**Sub team break-out** • Incorporate key brainstorm alternatives into each alternative • Develop conceptual layout and cross sections for alternative • Define how total project can be phased or staged • Develop delivery schedules • Refine base costs	**Sub Teams**
05:00 PM	**Adjourn**	

Day 3	Wednesday January 30 Continue Developing	
08:30 AM *Development Phase*	**Develop Ideas into Recommendations** • Individual/team assignments • Development of recommendations: ○ Test design feasibility ○ Design analysis ○ Technical narratives ○ Further discussion on advantages and disadvantages ○ Cost analysis (life cycle cost comparison)	**Sub teams**
12:00 AM	**Lunch**	
01:00 PM	**Continue Development** • Wrap up Recommendations write-ups	**Sub Teams**
05:00 PM	**Adjourn**	

Day 4	Error! Reference source not found.	
08:30 AM	**Revisit Risk** • Revise risk profile for revised alternatives	**Team**
12:00 AM	**Lunch**	
01:00 PM	**Evaluation of Alternatives** • Review and score each alternative	**Team**
03:30 PM	**Prepare report out presentation**	**Team**
05:00 PM	**Adjourn**	

Day 5	Error! Reference source not found. **1** **Objective for the day: Deliver Close-out Presentation**	
10:30 AM *Presentation Phase*	**Finalize Close-out Presentation** **Team Rehearsal**	**Alignment Review/VE team**
1:00 PM *Presentation Phase*	**Presentation of VE Findings** • Team presents recommendations to management • Questions and answers	**All Audiences:** Project owner, management, stakeholders, designers, etc.
	Adjourn	

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VE Study Attendees

I-64 / I-75 Split, Fayette County, KY

January/ February 2019					NAME	ORGANIZATION	POSITION/DISCIPLINE	TELEPHONE		E-MAIL
28	29	30	31	1				Office	Cell	
✓	✓	✓	✓	✓	Ken Smith	HDR	Facilitator		360-451-2527	Ken.l.smith@hdrinc.com
✓	✓	✓	✓	✓	Ben Edelen	HDR	Project manager	859-629-4833	859-221-3266	Ben.edelen@hdrinc.com
	✓				David Lindeman	Palmer Engineering	Highway Design	859-744-1218		dlindeman@palmernet.com
✓	✓		✓		Joshua Samples	KYTC District 7	Project Manager	859-246-2355		Joshua.samples@ky.gov
✓					Tony McGaha	KYTC District 7		859-246-2355		Tony.mcgaha@ky.gov
✓					Keith Caudill	KYTC District 7		859-246-2355		Keith.caudill@ky.gov
✓					Daniel Kucela	KYTC District 7		859-246-2355		
✓					Natalia McMillan	KYTC District 7	Traffic	859-246-2355		Natalia.mcmillan@ky.gov
✓					Patrick Perry	KYTC Central Office	Location Engineer	502-564-3280		Patrick.perry@ky.gov

VE Study Attendees

I-64 / I-75 Split, Fayette County, KY

January/ February 2019					NAME	ORGANIZATION	POSITION/DISCIPLINE	TELEPHONE	
								Office	Cell
28	29	30	31	1				E-MAIL	
✓					Aaron Buckner	FHWA		502-223-6749	
								Aaron.buckner@dot.gov	
✓					Doug Burton	LFUCG		859-258-3410	
								dburton@lexingtonky.gov	
✓	✓	✓	✓	✓	Jim Guinn	HDR	Project Manager	859-629-4842	
								Jim.guinn@hdrinc.com	
✓	✓	✓	✓	✓	Joe Cochran	HDR	Roadway Engineer	859-629-4836	
								Joe.cochran@hdrinc.com	
✓	✓	✓	✓	✓	Matt Newman	HDR	Design Engineer	502-909-6258	502-420-8500
								Matt.newman@hdrinc.com	
✓	✓	✓	✓	✓	Allison Westcote	HDR	Roadway Engineer	859-629-4875	
								Allison.westcote@hdrinc.com	
✓	✓	✓	✓	✓	Philip Pfaffenberger	HDR	Roadway Design	502-909-3259	
								Philip.pfaffenberger@hdrinc.com	
✓	✓	✓	✓	✓	Adam Hedges	HDR	Traffic Engineer	859-629-4872	
								Adam.hedges@hdrinc.com	
✓					Rob Frazier	HDR	Traffic Lead	816-309-2907	
								Robert.frazier@hdrinc.com	

VE Study Attendees

I-64 / I-75 Split, Fayette County, KY

January/ February 2019					NAME	ORGANIZATION	POSITION/DISCIPLINE	TELEPHONE	
								Office	Cell
28	29	30	31	1				E-MAIL	
✓	✓	✓	✓	✓	Wes Hagerman	HDR	Bridge Engineer	859-629-4860	
								Wesley.hagerman@hdrinc.com	
✓	✓	✓	✓	✓	Jeff Cowan	Palmer Engineering	Project Manager	859-744-1218	
								jcowan@palmernet.com	
✓	✓	✓	✓	✓	Bob Nunley	Civil Design Inc.	Project Manager	502-242-9057	859-494-4869
								bnunley@civildesigninc.com	
✓					Kevin Damron	Palmer Engineering	Safety / HSM	859-744-1218	859-537-6657
								kdamron@palmernet.com	
✓	✓	✓	✓	✓	Jody Barker	Palmer Engineering	Design/Drafting	889-744-1218	
								jbarker@palmernet.com	
✓					Rebecca Colin	HDR	Environmental	859-629-4848	859-619-8004
								Rebecca.colin@hdrinc.com	
✓		✓			David Deitz	Palmer Engineering	Structures	859-744-1218	859-227-5908
								ddeitz@palmernet.com	
✓					Michael Loysell	FHWA	Major Projects Engineer	502-223-6748	
								Michael.loysell@dot.gov	
✓					Tracy Louel	KYTC			
								Tracy.louel@ky.gov	

VE Study Attendees

I-64 / I-75 Split, Fayette County, KY

January/ February 2019					NAME	ORGANIZATION	POSITION/DISCIPLINE	TELEPHONE	
								Office	Cell
28	29	30	31	1				E-MAIL	
	✓				Stephen Sewell	Palmer Engineering	Design / Traffic	859-744-1218	859-492-0199
								ssewell@palmernet.com	

I-64 / I-75 Widening,
Item No. 7-8909.00,
Fayette County, KY

KENTUCKY TRANSPORTATION CABINET

Value Engineering Report Out

February 1st, 2019

HDR

Introductions & Value Engineering Team

- Jody Barker
- Joe Cochran
- Jeff Cowan
- Ben Edelen
- Jim Guinn
- Wes Hagerman
- Adam Hedges
- Matt Newman
- Bob Nunley
- Philip Pfaffenberger
- Ken L. Smith – VE team leader
- Allison Westcote

HDR

Project Purpose

The purpose of the proposed project is to decrease congestion and improve safety, operations, and roadway traffic capacity on the combined I-75/I-64 interstate route around Lexington. The project is needed to address the increased traffic along the project corridor in recent years as well as anticipated continued population growth in Fayette and surrounding counties.

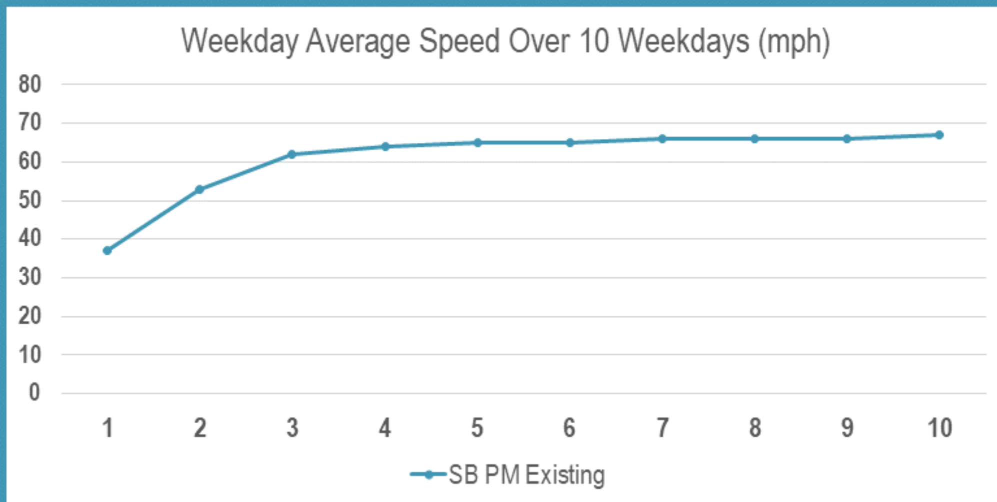
From the North I-64/I-75 split to Newtown Pike I/C

I-64/I-75 from Newtown Pike I/C to South I-64/ I-75

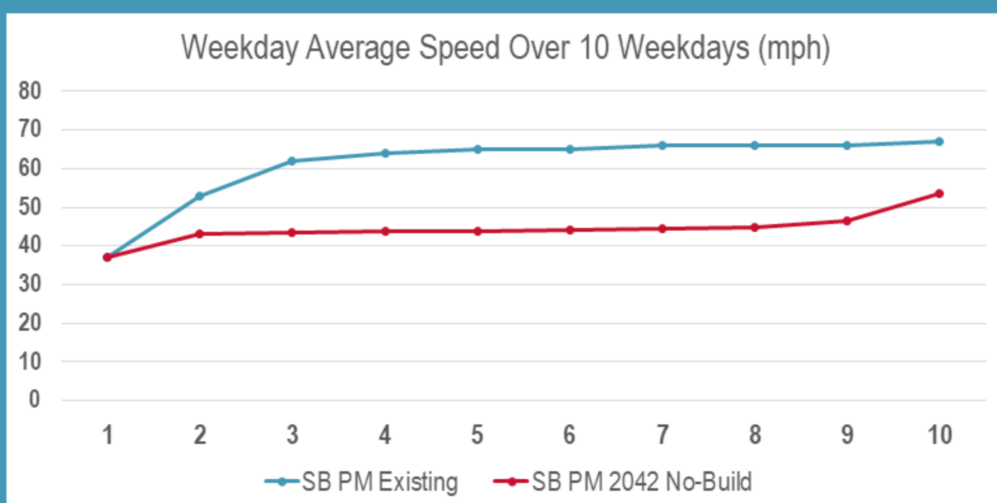
Traffic Operations & Safety
Data / Tools

Data	Traffic Operations Tools	Safety Tools
Counts / Forecasts	FREEVAL	ISATe
Origin-Destination	Vissim	(Highway Safety Manual)
Speeds (two sets)	Synchro	CRF
Crash		(Critical Rate Factor)

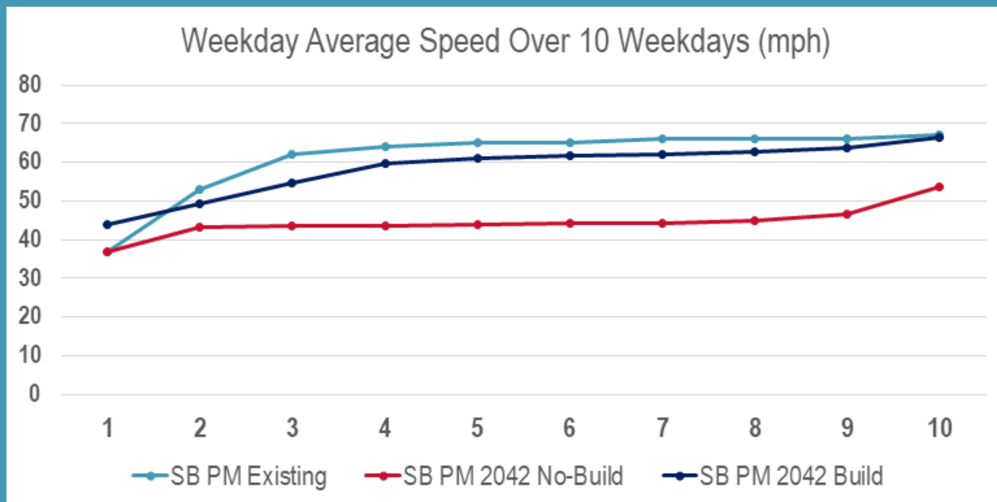
Traffic Operations & Safety
SB PM Speeds



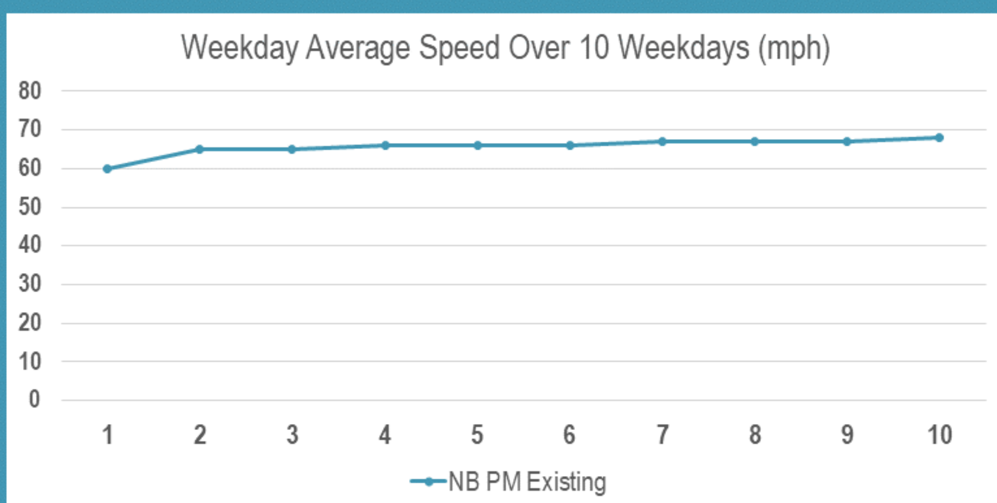
Traffic Operations & Safety
SB PM Speeds



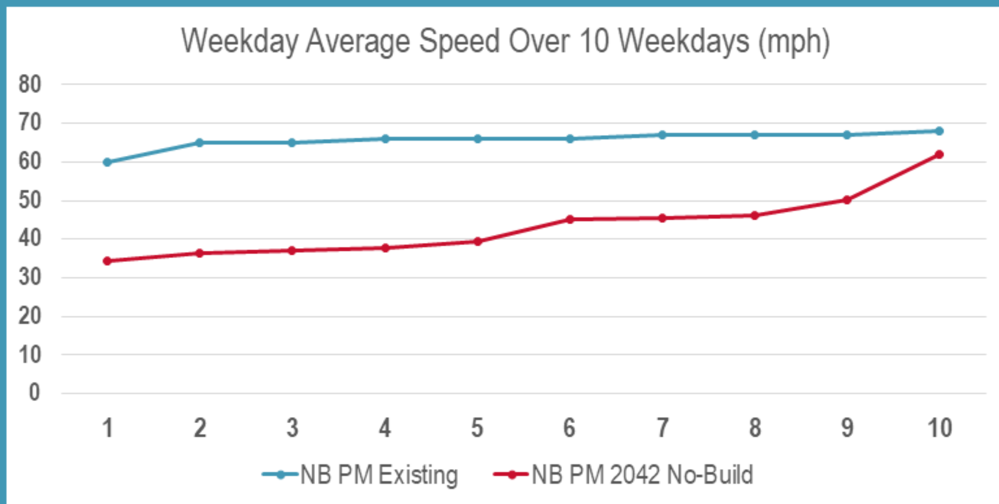
Traffic Operations & Safety
SB PM Speeds



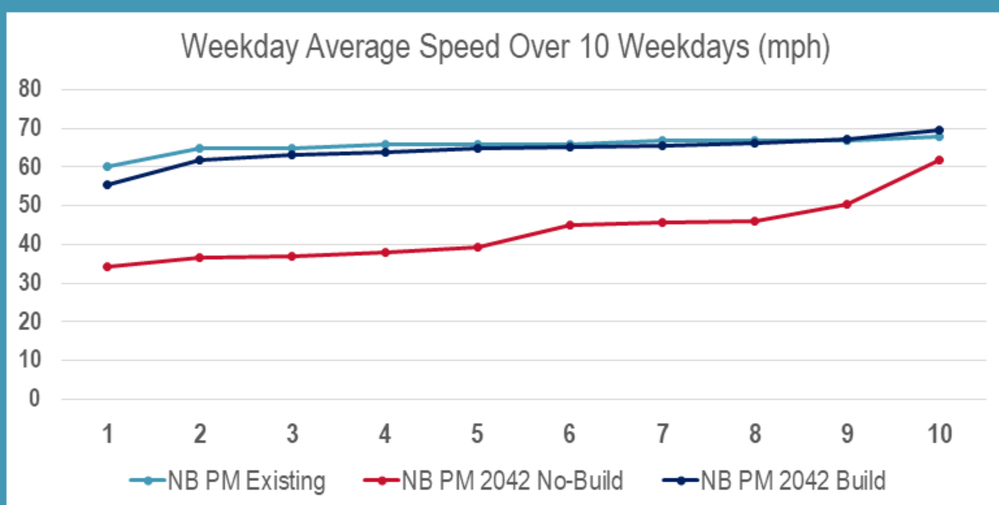
Traffic Operations & Safety
NB PM Speeds



Traffic Operations & Safety
NB PM Speeds



Traffic Operations & Safety
NB PM Speeds



Traffic Operations
SB PM Speed Profiles

Existing (2018)

Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17
#1 15:00 - 15:15	70.8	65.4	73.3	67.7	68.2	67.7	67.3	59.6	64.4	64.4	65.1	61.0	62.0	67.4	67.0	66.9	66.9
#2 15:15 - 15:30	72.3	65.5	74.4	69.6	70.1	69.6	69.2	60.7	66.1	66.1	66.6	62.0	64.1	68.8	68.3	68.3	68.3
#3 15:30 - 15:45	70.3	65.4	73.0	67.2	67.6	67.2	66.7	59.2	63.9	63.9	64.6	60.7	61.4	66.9	66.5	66.4	66.4
#4 15:45 - 16:00	69.9	65.4	72.7	66.8	67.2	66.8	66.3	59.0	63.6	63.6	64.3	60.5	61.0	66.6	66.2	66.2	66.2
#5 16:00 - 16:15	70.8	65.4	73.3	67.8	68.2	67.8	67.4	59.7	64.5	64.5	65.1	61.1	62.1	67.4	67.0	66.9	66.9
#6 16:15 - 16:30	69.9	65.4	72.7	66.7	67.1	66.7	66.2	58.9	63.5	63.5	64.2	60.5	60.9	66.6	66.2	66.1	66.1
#7 16:30 - 16:45	68.3	65.4	71.6	64.8	65.2	64.8	64.3	57.8	62.0	62.0	62.8	58.8	58.8	65.2	64.9	64.8	64.8
#8 16:45 - 17:00	68.9	65.4	72.0	65.6	65.9	65.6	65.0	58.2	62.6	62.6	63.3	59.7	59.7	65.7	65.4	65.3	65.3
#9 17:00 - 17:15	67.1	65.3	70.8	63.5	63.8	63.5	62.9	56.9	60.9	60.9	61.8	57.4	57.4	64.2	63.9	63.8	63.8
#10 17:15 - 17:30	69.3	65.4	72.3	66.0	66.4	66.0	65.4	58.5	62.9	62.9	63.6	60.1	60.1	66.0	65.7	65.6	65.6
#11 17:30 - 17:45	69.8	65.4	72.6	66.6	67.0	66.6	66.1	58.9	63.4	63.4	64.1	60.4	60.7	66.5	66.1	66.0	66.0
#12 17:45 - 18:00	72.6	65.5	74.5	69.8	70.3	69.8	69.4	60.9	66.3	66.1	66.8	62.1	64.4	69.0	68.5	68.4	68.4

2042 No-Build

Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17
#1 15:00 - 15:15	57.5	65.0	64.0	52.2	52.3	52.2	49.6	48.5	46.3	36.0	22.8	58.0	58.0	64.6	64.3	62.9	62.9
#2 15:15 - 15:30	61.4	65.2	66.7	56.7	56.9	56.7	47.1	36.5	36.9	27.9	21.4	58.1	58.1	64.7	64.4	63.4	63.4
#3 15:30 - 15:45	56.4	65.0	63.2	50.8	50.9	56.1	31.5	36.2	37.1	28.0	21.4	58.1	58.1	64.7	64.4	62.8	62.8
#4 15:45 - 16:00	55.5	65.0	62.5	45.9	36.7	29.4	30.8	36.5	37.0	27.9	21.4	58.1	58.1	64.7	64.4	62.8	62.8
#5 16:00 - 16:15	57.6	65.0	64.1	39.1	32.6	27.7	32.1	36.1	37.1	27.9	21.4	58.1	58.1	64.7	64.4	63.0	63.0
#6 16:15 - 16:30	55.3	65.0	57.2	32.3	38.2	39.6	33.8	37.7	37.1	27.9	21.4	58.1	58.1	64.7	64.4	62.7	62.7
#7 16:30 - 16:45	51.6	64.9	55.9	39.4	36.6	29.5	30.1	34.4	37.1	28.0	21.4	58.1	58.1	64.7	64.4	62.4	62.4
#8 16:45 - 17:00	53.0	64.9	56.4	39.2	37.1	37.3	32.2	39.1	37.3	27.8	21.4	58.1	58.1	64.7	64.4	62.5	62.5
#9 17:00 - 17:15	48.8	64.9	53.3	29.7	35.6	33.3	30.9	37.2	37.4	28.0	21.4	58.1	58.1	64.7	64.4	62.1	62.1
#10 17:15 - 17:30	53.9	65.0	61.6	41.3	38.8	32.3	31.8	36.6	37.2	27.9	21.4	58.1	58.1	64.7	64.4	62.6	62.6
#11 17:30 - 17:45	55.2	65.0	60.3	42.8	37.1	28.4	31.9	37.1	37.1	27.9	21.4	58.1	58.1	64.7	64.4	62.7	62.7
#12 17:45 - 18:00	61.9	65.2	67.1	55.8	45.6	30.1	32.5	40.0	37.4	27.6	21.4	58.1	58.1	64.7	64.4	63.5	63.5

2042 Build

Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17
#1 15:00 - 15:15	57.5	65.0	64.0	64.4	64.8	64.4	66.3	72.6	67.0	67.0	67.5	63.3	64.4	56.4	56.3	56.0	56.0
#2 15:15 - 15:30	61.4	65.2	66.7	66.8	67.3	66.8	68.3	73.3	68.4	68.4	68.8	64.2	66.4	59.5	59.3	59.0	59.0
#3 15:30 - 15:45	56.4	65.0	63.2	63.7	64.0	63.7	65.6	72.4	66.6	66.6	67.1	63.0	63.9	55.5	55.4	55.0	55.0
#4 15:45 - 16:00	55.5	65.0	62.5	63.1	63.5	63.1	65.1	72.3	66.3	66.3	66.8	62.8	63.4	54.8	54.8	54.4	54.4
#5 16:00 - 16:15	57.6	65.0	64.1	64.5	64.8	64.5	66.3	72.6	67.0	67.0	67.5	63.3	64.5	56.4	56.4	56.0	56.0
#6 16:15 - 16:30	55.3	65.0	62.4	63.0	63.3	63.0	65.0	72.2	66.2	66.2	66.7	62.7	63.4	54.7	54.7	54.2	54.2
#7 16:30 - 16:45	51.6	64.9	59.7	61.9	62.2	61.9	64.1	71.9	65.6	65.6	66.1	62.0	62.3	53.0	53.0	52.3	52.3
#8 16:45 - 17:00	53.0	64.9	60.7	62.3	62.6	62.3	64.4	72.0	65.8	65.8	66.4	62.3	62.7	53.6	53.6	53.0	53.0
#9 17:00 - 17:15	48.8	64.9	57.6	61.2	61.5	61.2	63.5	71.7	65.2	65.2	65.8	61.6	61.6	51.9	51.9	51.0	51.0
#10 17:15 - 17:30	53.9	65.0	61.4	62.5	62.8	62.5	64.6	72.1	65.9	65.9	66.5	62.5	62.9	54.0	54.0	53.4	53.4
#11 17:30 - 17:45	55.2	65.0	62.2	62.8	63.1	62.8	64.9	72.2	66.1	66.1	66.6	62.7	63.2	54.5	54.4	54.0	54.0
#12 17:45 - 18:00	61.9	65.2	67.1	64.7	65.1	64.7	66.6	72.7	67.2	67.2	67.7	63.8	65.2	57.5	57.4	57.5	57.5

Traffic Operations
SB PM Speed Profiles

I-75 On-Ramp (between Seg. 3 and Seg. 4)

Newtown Pike On-Ramp (between Seg. 7 and Seg. 8)

Paris Pike On-Ramp (between Seg. 11 and Seg. 12)

Existing (2018)

Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17
#1 15:00 - 15:15	70.8	65.4	73.3	67.7	68.2	67.7	67.3	59.6	64.4	64.4	65.1	61.0	62.0	67.4	67.0	66.9	66.9
#2 15:15 - 15:30	72.3	65.5	74.4	69.6	70.1	69.6	69.2	60.7	66.1	66.1	66.6	62.0	64.1	68.8	68.3	68.3	68.3
#3 15:30 - 15:45	70.3	65.4	73.0	67.2	67.6	67.2	66.7	59.2	63.9	63.9	64.6	60.7	61.4	66.9	66.5	66.4	66.4
#4 15:45 - 16:00	69.9	65.4	72.7	66.8	67.2	66.8	66.3	59.0	63.6	63.6	64.3	60.5	61.0	66.6	66.2	66.2	66.2
#5 16:00 - 16:15	70.8	65.4	73.3	67.8	68.2	67.8	67.4	59.7	64.5	64.5	65.1	61.1	62.1	67.4	67.0	66.9	66.9
#6 16:15 - 16:30	69.9	65.4	72.7	66.7	67.1	66.7	66.2	58.9	63.5	63.5	64.2	60.5	60.9	66.6	66.2	66.1	66.1
#7 16:30 - 16:45	68.3	65.4	71.6	64.8	65.2	64.8	64.3	57.8	62.0	62.0	62.8	58.8	58.8	65.2	64.9	64.8	64.8
#8 16:45 - 17:00	68.9	65.4	72.0	65.6	65.9	65.6	65.0	58.2	62.6	62.6	63.3	59.7	59.7	65.7	65.4	65.3	65.3
#9 17:00 - 17:15	67.1	65.3	70.8	63.5	63.8	63.5	62.9	56.9	60.9	60.9	61.8	57.4	57.4	64.2	63.9	63.8	63.8
#10 17:15 - 17:30	69.3	65.4	72.3	66.0	66.4	66.0	65.4	58.5	62.9	62.9	63.6	60.1	60.1	66.0	65.7	65.6	65.6
#11 17:30 - 17:45	69.8	65.4	72.6	66.6	67.0	66.6	66.1	58.9	63.4	63.4	64.1	60.4	60.7	66.5	66.1	66.0	66.0
#12 17:45 - 18:00	72.6	65.5	74.5	69.8	70.3	69.8	69.4	60.9	66.3	66.1	66.8	62.1	64.4	69.0	68.5	68.4	68.4

2042 No-Build

Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17
#1 15:00 - 15:15	57.5	65.0	64.0	52.2	52.3	52.2	49.6	48.5	46.3	36.0	22.8	58.0	58.0	64.6	64.3	62.9	62.9
#2 15:15 - 15:30	61.4	65.2	66.7	56.7	56.9	56.7	47.1	36.5	36.9	27.9	21.4	58.1	58.1	64.7	64.4	63.4	63.4
#3 15:30 - 15:45	56.4	65.0	63.2	50.8	50.9	56.1	31.5	36.2	37.1	28.0	21.4	58.1	58.1	64.7	64.4	62.8	62.8
#4 15:45 - 16:00	55.5	65.0	62.5	45.9	36.7	29.4	30.8	36.5	37.0	27.9	21.4	58.1	58.1	64.7	64.4	62.8	62.8
#5 16:00 - 16:15	57.6	65.0	64.1	39.1	32.6	27.7	32.1	36.1	37.1	27.9	21.4	58.1	58.1	64.7	64.4	63.0	63.0
#6 16:15 - 16:30	55.3	65.0	57.2	32.3	38.2	39.6	33.8	37.7	37.1	27.9	21.4	58.1	58.1	64.7	64.4	62.7	62.7
#7 16:30 - 16:45	51.6	64.9	55.9	39.4	36.6	29.5	30.1	34.4	37.1	28.0	21.4	58.1	58.1	64.7	64.4	62.4	62.4
#8 16:45 - 17:00	53.0	64.9	56.4	39.2	37.1	37.3	32.2	39.1	37.3	27.8	21.4	58.1	58.1	64.7	64.4	62.5	62.5
#9 17:00 - 17:15	48.8	64.9	53.3	29.7	35.6	33.3	30.9	37.2	37.4	28.0	21.4	58.1	58.1	64.7	64.4	62.1	62.1
#10 17:15 - 17:30	53.9	65.0	61.6	41.3	38.8	32.3	31.8	36.6	37.2	27.9	21.4	58.1	58.1	64.7	64.4	62.6	62.6
#11 17:30 - 17:45	55.2	65.0	60.3	42.8	37.1	28.4	31.9	37.1	37.1	27.9	21.4	58.1	58.1	64.7	64.4	62.7	62.7
#12 17:45 - 18:00	61.9	65.2	67.1	55.8	45.6	30.1	32.5	40.0	37.4	27.6	21.4	58.1	58.1	64.7	64.4	63.5	63.5

2042 Build

Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17
#1 15:00 - 15:15	57.5	65.0	64.0	64.4	64.8	64.4	66.3	72.6	67.0	67.0	67.5	63.3	64.4	56.4	56.3	56.0	56.0
#2 15:15 - 15:30	61.4	65.2	66.7	66.8	67.3	66.8	68.3	73.3	68.4	68.4	68.8	64.2	66.4	59.5	59.3	59.0	59.0
#3 15:30 - 15:45	56.4	65.0	63.2	63.7	64.0	63.7	65.6	72.4	66.6	66.6	67.1	63.0	63.9	55.5	55.4	55.0	55.0
#4 15:45 - 16:00	55.5	65.0	62.5	63.1	63.5	63.1	65.1	72.3	66.3	66.3	66.8	62.8	63.4	54.8	54.8	54.4	54.4
#5 16:00 - 16:15	57.6	65.0	64.1	64.5	64.8	64.5	66.3	72.6	67.0	67.0	67.5	63.3	64.5	56.4	56.4	56.0	56.0
#6 16:15 - 16:30	55.3	65.0	62.4	63.0	63.3	63.0	65.0	72.2	66.2	66.2	66.7	62.7	63.4	54.7	54.7	54.2	54.2
#7 16:30 - 16:45	51.6	64.9	59.7	61.9	62.2	61.9	64.1	71.9	65.6	65.6	66.1	62.0	62.3	53.0	53.0	52.3	52.3
#8 16:45 - 17:00	53.0	64.9	60.7	62.3	62.6	62.3	64.4	72.0	65.8	65.8	66.4	62.3	62.7	53.6	53.6	53.0	53.0
#9 17:00 - 17:15	48.8	64.9	57.6	61.2	61.5	61.2	63.5	71.7	65.2	65.2	65.8	61.6	61.6	51.9	51.9	51.0	51.0
#10 17:15 - 17:30	53.9	65.0	61.4	62.5	62.8	62.5	64.6	72.1	65.9	65.9	66.5	62.5	62.9	54.0	54.0	53.4	53.4
#11 17:30 - 17:45	55.2	65.0	62.2	62.8	63.1	62.8	64.9	72.2	66.1	66.1	66.6	62.7	63.2	54.5	54.4	54.0	54.0
#12 17:45 - 18:00	61.9	65.2	67.1	64.7	65.1	64.7	66.6	72.7	67.2	67.2	67.7	63.8	65.2	57.5	57.4	57.5	57.5

Traffic Operations
NB PM Speed Profiles

I-64 On-Ramp

Existing (2018)

Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17	Seg. 18
#1 15:00 - 15:15	67.4	67.4	71.7	72.0	67.3	61.4	68.5	67.7	68.6	66.7	70.8	66.1	66.2	68.3	65.3	74.0	66.9	71.0
#2 15:15 - 15:30	67.9	67.7	72.0	70.6	67.7	61.4	68.8	67.8	69.0	66.7	71.1	67.0	66.3	68.6	65.7	74.1	66.9	71.2
#3 15:30 - 15:45	68.0	67.7	72.0	70.6	67.9	61.4	69.0	67.9	69.2	66.8	71.2	67.0	66.3	68.8	65.8	74.2	66.9	71.3
#4 15:45 - 16:00	67.6	67.6	71.8	70.6	67.5	61.4	68.7	67.8	68.8	66.7	71.0	66.9	66.3	68.4	65.5	74.1	66.9	71.1
#5 16:00 - 16:15	65.0	65.0	70.3	70.1	64.8	61.4	66.2	67.1	66.4	66.5	69.2	66.2	65.8	66.1	63.0	73.2	66.7	69.4
#6 16:15 - 16:30	64.8	64.8	70.2	70.1	64.6	61.4	66.1	67.1	66.3	66.5	69.1	66.1	65.8	66.0	62.9	73.1	66.7	69.2
#7 16:30 - 16:45	65.6	65.6	70.6	70.2	65.4	61.4	66.8	67.3	66.9	66.6	69.6	66.3	65.9	66.6	63.5	73.4	66.7	69.8
#8 16:45 - 17:00	66.1	66.1	70.9	70.3	65.9	61.4	67.3	67.4	67.5	66.6	70.0	66.5	66.0	67.1	64.1	73.6	66.8	70.1
#9 17:00 - 17:15	68.6	67.8	72.4	70.7	68.5	61.4	69.5	68.0	69.7	66.8	71.6	67.1	66.4	69.3	66.3	74.4	67.0	71.7
#10 17:15 - 17:30	68.9	67.8	72.6	70.8	68.8	61.5	69.8	68.1	70.0	66.8	71.8	67.2	66.5	69.6	66.7	74.5	67.0	71.9
#11 17:30 - 17:45	68.3	67.7	72.3	70.7	68.3	61.4	69.3	67.9	69.5	66.8	71.5	67.1	66.4	69.1	66.2	74.4	67.0	71.6
#12 17:45 - 18:00	67.6	67.6	71.8	70.6	67.5	61.4	68.6	67.8	68.8	66.7	70.9	66.9	66.3	68.4	65.4	74.1	66.9	71.1

2042 No-Build

Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17	Seg. 18
#1 15:00 - 15:15	49.8	49.8	60.9	34.2	54.6	61.1	57.4	63.7	56.7	63.5	62.2	61.2	63.4	55.6	51.7	68.8	65.6	61.2
#2 15:15 - 15:30	50.9	50.9	61.6	[illegible]	54.7	61.1	57.5	63.9	57.0	63.7	62.4	62.3	63.6	56.0	52.1	69.1	65.6	61.7
#3 15:30 - 15:45	51.4	51.4	59.6	[illegible]	54.7	61.1	57.6	63.9	57.0	63.7	62.4	62.4	63.7	56.1	52.3	69.1	65.6	61.7
#4 15:45 - 16:00	50.3	50.3	49.9	12.3	54.7	61.1	57.5	63.8	56.9	63.6	62.3	62.2	63.6	55.8	51.9	68.9	65.6	61.4
#5 16:00 - 16:15	45.3	45.3	48.5	12.3	54.7	61.1	57.5	63.3	56.2	63.1	61.8	61.1	62.2	53.9	49.8	68.1	65.3	59.5
#6 16:15 - 16:30	45.3	45.3	48.7	12.3	54.7	61.1	57.5	63.3	56.2	63.1	61.8	61.1	62.2	53.9	49.8	68.1	65.3	59.6
#7 16:30 - 16:45	45.3	45.3	48.4	12.3	54.7	61.1	57.5	63.5	56.3	63.3	61.9	61.4	62.5	54.3	50.3	68.3	65.4	60.0
#8 16:45 - 17:00	45.3	45.3	49.5	12.3	54.7	61.1	57.5	63.6	56.5	63.4	62.0	61.6	62.8	54.7	50.7	68.5	65.4	60.3
#9 17:00 - 17:15	51.5	51.5	51.2	12.3	54.7	61.1	57.5	64.0	57.1	63.8	62.4	62.6	63.8	56.6	52.7	69.2	65.7	62.1
#10 17:15 - 17:30	53.5	53.5	50.8	12.3	54.7	61.1	57.5	64.1	57.2	63.9	62.5	62.7	63.8	56.9	53.0	69.4	65.8	62.4
#11 17:30 - 17:45	52.1	52.1	50.5	12.3	54.7	61.1	57.6	64.0	57.1	63.8	62.4	62.5	63.7	56.4	52.6	69.2	65.7	62.0
#12 17:45 - 18:00	50.2	50.2	50.0	12.3	54.7	61.1	57.5	63.8	56.9	63.6	62.3	62.2	63.6	55.8	51.9	69.0	65.6	61.5

2042 Build

Traffic Operations
NB PM Speed Profiles

I-64 On-Ramp

Paris Pike On-Ramp

Newtown Pike On-Ramp

I-75 Off-Ramp

Existing (2018)

Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17	Seg. 18
#1 15:00 - 15:15	67.4	67.4	71.7	72.0	67.3	61.4	68.5	67.7	68.6	66.7	70.8	66.1	66.2	68.3	65.3	74.0	66.9	71.0
#2 15:15 - 15:30	67.9	67.7	72.0	70.6	67.7	61.4	68.8	67.8	69.0	66.7	71.1	67.0	66.3	68.6	65.7	74.1	66.9	71.2
#3 15:30 - 15:45	68.0	67.7	72.0	70.6	67.9	61.4	69.0	67.9	69.2	66.8	71.2	67.0	66.3	68.8	65.8	74.2	66.9	71.3
#4 15:45 - 16:00	67.6	67.6	71.8	70.6	67.5	61.4	68.7	67.8	68.8	66.7	71.0	66.9	66.3	68.4	65.5	74.1	66.9	71.1
#5 16:00 - 16:15	65.0	65.0	70.3	70.1	64.8	61.4	66.2	67.1	66.4	66.5	69.2	66.2	65.8	66.1	63.0	73.2	66.7	69.4
#6 16:15 - 16:30	64.8	64.8	70.2	70.1	64.6	61.4	66.1	67.1	66.3	66.5	69.1	66.1	65.8	66.0	62.9	73.1	66.7	69.2
#7 16:30 - 16:45	65.6	65.6	70.6	70.2	65.4	61.4	66.8	67.3	66.9	66.6	69.6	66.3	65.9	66.6	63.5	73.4	66.7	69.8
#8 16:45 - 17:00	66.1	66.1	70.9	70.3	65.9	61.4	67.3	67.4	67.5	66.6	70.0	66.5	66.0	67.1	64.1	73.6	66.8	70.1
#9 17:00 - 17:15	68.6	67.8	72.4	70.7	68.5	61.4	69.5	68.0	69.7	66.8	71.6	67.1	66.4	69.3	66.3	74.4	67.0	71.7
#10 17:15 - 17:30	68.9	67.8	72.6	70.8	68.8	61.5	69.8	68.1	70.0	66.8	71.8	67.2	66.5	69.6	66.7	74.5	67.0	71.9
#11 17:30 - 17:45	68.3	67.7	72.3	70.7	68.3	61.4	69.3	67.9	69.5	66.8	71.5	67.1	66.4	69.1	66.2	74.4	67.0	71.6
#12 17:45 - 18:00	67.6	67.6	71.8	70.6	67.5	61.4	68.6	67.8	68.8	66.7	70.9	66.9	66.3	68.4	65.4	74.1	66.9	71.1

2042 No-Build

Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17	Seg. 18
#1 15:00 - 15:15	49.8	49.8	60.9	68.5	66.1	70.6	52.4	60.4	52.2	60.2	58.8	59.6	61.1	52.3	48.1	67.4	65.3	59.2
#2 15:15 - 15:30	50.9	50.9	61.6	67.2	66.6	71.0	53.5	61.2	53.4	61.1	59.7	60.6	61.9	53.4	49.3	67.9	65.4	60.1
#3 15:30 - 15:45	51.4	51.4	61.9	67.3	66.8	71.1	53.9	61.5	53.7	61.3	60.0	60.7	62.1	53.8	49.7	68.1	65.4	60.3
#4 15:45 - 16:00	50.3	50.3	61.2	67.1	66.3	70.8	52.9	60.7	52.7	60.6	59.2	60.3	61.5	52.8	48.6	67.6	65.3	59.6
#5 16:00 - 16:15	45.3	45.3	58.1	65.6	63.8	46.4	28.4	27.3	55.1	62.3	60.9	59.9	59.7	39.2	52.9	69.3	65.6	61.3
#6 16:15 - 16:30	45.3	45.3	58.1	65.5	49.3	14.2	21.3	24.8	55.2	62.4	61.0	59.9	61.7	34.8	53.0	69.4	65.6	61.4
#7 16:30 - 16:45	45.3	45.3	58.1	44.0	26.9	13.2	21.5	24.8	55.2	62.4	61.0	60.2	61.9	28.3	53.0	69.4	65.6	61.5
#8 16:45 - 17:00	45.3	45.3	52.6	23.4	24.5	13.5	21.7	24.8	55.2	62.4	61.0	56.9	30.3	25.8	53.0	69.4	65.6	61.7
#9 17:00 - 17:15	51.5	51.5	58.6	40.4	19.4	13.6	23.5	24.8	55.2	62.4	55.2	23.4	21.9	25.7	53.0	69.3	65.7	62.3
#10 17:15 - 17:30	53.5	53.5	52.5	21.7	20.2	13.7	22.6	24.8	55.2	62.4	44.5	23.4	22.4	25.8	53.0	69.4	65.7	62.4
#11 17:30 - 17:45	52.1	52.1	51.9	21.7	26.1	13.6	22.4	24.8	55.2	65.2	41.2	23.8	22.4	25.8	53.0	69.4	65.7	62.2
#12 17:45 - 18:00	50.2	50.2	48.5	24.7	20.7	13.6	22.2	24.8	55.2	62.4	48.0	21.6	21.9	25.7	53.0	69.4	65.7	62.1

2042 Build

Traffic Operations
NB PM Speed Profiles

I-64 On-Ramp (between Seg. 4 and Seg. 5) · Paris Pike On-Ramp (between Seg. 8 and Seg. 9) · Newtown Pike On-Ramp (between Seg. 13 and Seg. 14) · I-75 Off-Ramp (between Seg. 15 and Seg. 16)

Existing (2018)

Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17	Seg. 18
#1 15:00 - 15:15	67.4	67.4	71.7	72.0	67.3	61.4	68.5	67.7	68.6	66.7	70.8	66.1	66.2	68.3	65.3	74.0	66.9	71.0
#2 15:15 - 15:30	67.9	67.7	72.0	70.6	67.7	61.4	68.8	67.8	69.0	66.7	71.1	67.0	66.3	68.6	65.7	74.1	66.9	71.2
#3 15:30 - 15:45	68.0	67.7	72.0	70.6	67.9	61.4	69.0	67.9	69.2	66.8	71.2	67.0	66.3	68.8	65.8	74.2	66.9	71.3
#4 15:45 - 16:00	67.6	67.6	71.8	70.6	67.5	61.4	68.7	67.8	68.8	66.7	71.0	66.9	66.3	68.4	65.5	74.1	66.9	71.1
#5 16:00 - 16:15	65.0	65.0	70.3	70.1	64.8	61.4	66.2	67.1	66.4	66.5	69.2	66.2	65.8	66.1	63.0	73.2	66.7	69.4
#6 16:15 - 16:30	64.8	64.8	70.2	70.1	64.6	61.4	66.1	67.1	66.3	66.5	69.1	66.1	65.8	66.0	62.9	73.1	66.7	69.2
#7 16:30 - 16:45	65.6	65.6	70.6	70.2	65.4	61.4	66.8	67.3	66.9	66.6	69.6	66.3	65.9	66.6	63.5	73.4	66.7	69.8
#8 16:45 - 17:00	66.1	66.1	70.9	70.3	65.9	61.4	67.3	67.4	67.5	66.6	70.0	66.5	66.0	67.1	64.1	73.6	66.8	70.1
#9 17:00 - 17:15	68.6	67.8	72.4	70.7	68.5	61.4	69.5	68.0	69.7	66.8	71.6	67.1	66.4	69.3	66.3	74.4	67.0	71.7
#10 17:15 - 17:30	68.9	67.8	72.6	70.8	68.8	61.5	69.8	68.1	70.0	66.8	71.8	67.2	66.5	69.6	66.7	74.5	67.0	71.9
#11 17:30 - 17:45	68.3	67.7	72.3	70.7	68.3	61.4	69.3	67.9	69.5	66.8	71.5	67.1	66.4	69.1	66.2	74.4	67.0	71.6
#12 17:45 - 18:00	67.6	67.6	71.8	70.6	67.5	61.4	68.6	67.8	68.8	66.7	70.9	66.9	66.3	68.4	65.4	74.1	66.9	71.1

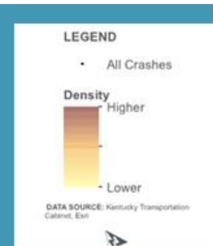
2042 No-Build

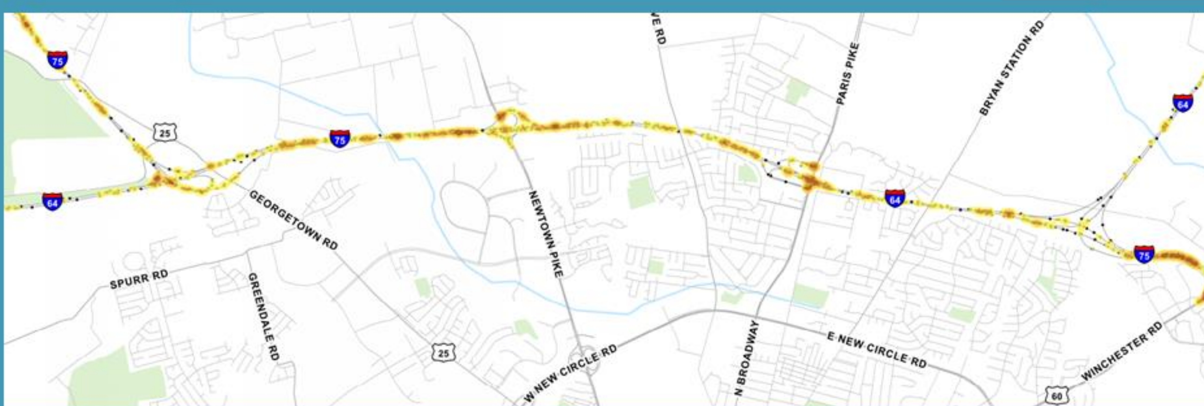
Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17	Seg. 18
#1 15:00 - 15:15	0.95	0.95	0.78	0.69	1.00	0.92	0.92	0.90	0.97	0.90	0.81	0.87	0.88	0.96	0.99	0.67	0.64	0.80
#2 15:15 - 15:30	0.94	0.94	0.77	0.68	0.99	0.91	0.91	0.89	0.95	0.89	0.80	0.86	0.87	0.95	0.98	0.65	0.63	0.79
#3 15:30 - 15:45	0.93	0.93	0.76	0.68	0.98	0.90	0.90	0.88	0.95	0.88	0.79	0.85	0.87	0.94	0.97	0.65	0.63	0.79
#4 15:45 - 16:00	0.94	0.94	0.77	0.69	1.00	0.92	0.91	0.89	0.96	0.89	0.80	0.86	0.88	0.95	0.99	0.66	0.64	0.80
#5 16:00 - 16:15	1.01	1.01	0.83	0.74	1.07	0.98	0.98	0.96	1.03	0.96	0.86	0.93	0.94	1.02	1.00	0.71	0.69	0.86
#6 16:15 - 16:30	1.02	1.02	0.83	0.74	1.07	0.99	0.98	0.96	1.04	0.96	0.86	0.93	0.94	1.03	1.06	0.71	0.69	0.86
#7 16:30 - 16:45	1.00	1.00	0.82	0.73	1.05	0.97	0.97	0.95	1.02	0.95	0.85	0.91	0.93	1.01	1.04	0.70	0.67	0.84
#8 16:45 - 17:00	0.98	0.98	0.81	0.72	1.04	0.96	0.95	0.93	1.00	0.93	0.84	0.90	0.91	0.99	1.03	0.69	0.67	0.83
#9 17:00 - 17:15	0.92	0.92	0.75	0.67	0.97	0.89	0.89	0.87	0.93	0.87	0.78	0.84	0.85	0.93	0.96	0.64	0.62	0.77
#10 17:15 - 17:30	0.91	0.91	0.74	0.66	0.95	0.88	0.87	0.86	0.92	0.86	0.77	0.83	0.84	0.91	0.94	0.63	0.61	0.76
#11 17:30 - 17:45	0.92	0.92	0.75	0.67	0.97	0.89	0.89	0.87	0.94	0.87	0.78	0.84	0.86	0.93	0.96	0.65	0.62	0.78
#12 17:45 - 18:00	0.95	0.95	0.77	0.69	1.00	0.92	0.91	0.89	0.96	0.89	0.80	0.86	0.88	0.95	0.99	0.66	0.64	0.80

2042 Build

Analysis Period	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Seg. 12	Seg. 13	Seg. 14	Seg. 15	Seg. 16	Seg. 17	Seg. 18
#1 15:00 - 15:15	49.8	49.8	60.9	75.2	66.1	64.2	67.4	68.9	67.6	67.6	70.1	66.8	67.5	67.3	64.2	67.4	65.3	59.2
#2 15:15 - 15:30	50.9	50.9	61.6	75.4	66.6	64.2	67.9	69.0	68.1	67.6	70.5	67.5	67.6	67.7	64.7	67.9	65.4	60.1
#3 15:30 - 15:45	51.4	51.4	61.9	75.4	66.8	64.3	68.1	69.0	68.3	67.7	70.6	67.6	67.6	67.9	64.9	68.1	65.4	60.3
#4 15:45 - 16:00	50.3	50.3	61.2	75.3	66.3	64.2	67.6	68.9	67.8	67.6	70.3	67.5	67.5	67.5	64.5	67.6	65.3	59.6
#5 16:00 - 16:15	45.3	45.3	58.1	74.5	63.8	64.0	65.4	68.4	65.5	67.2	68.6	66.6	67.1	65.2	62.0	65.3	64.6	55.5
#6 16:15 - 16:30	45.3	45.3	58.1	74.5	63.7	63.9	65.3	68.4	65.4	67.2	68.6	66.6	67.1	65.1	61.9	65.3	64.7	55.6
#7 16:30 - 16:45	45.5	45.5	58.2	74.6	64.0	64.0	65.6	68.5	65.8	67.3	68.8	66.8	67.2	65.5	62.4	65.6	64.8	56.2
#8 16:45 - 17:00	46.7	46.7	59.0	74.8	64.6	64.0	66.2	68.6	66.3	67.3	69.2	67.0	67.3	66.0	62.9	66.2	64.9	57.1
#9 17:00 - 17:15	52.6	52.6	62.7	75.6	67.4	64.3	68.6	69.2	68.8	67.8	71.0	67.8	67.7	68.4	65.4	68.5	65.5	61.1
#10 17:15 - 17:30	53.5	53.5	63.3	75.7	67.8	64.4	69.0	69.2	69.2	67.8	71.2	67.9	67.8	68.8	65.8	68.9	65.7	61.8
#11 17:30 - 17:45	52.1	52.1	62.4	75.5	67.2	64.3	68.4	69.1	68.6	67.7	70.8	67.7	67.7	68.2	65.3	68.4	65.5	60.8
#12 17:45 - 18:00	50.2	50.2	61.2	75.3	66.3	64.2	67.6	68.9	67.8	67.6	70.3	67.5	67.5	67.5	64.5	67.7	65.3	59.6

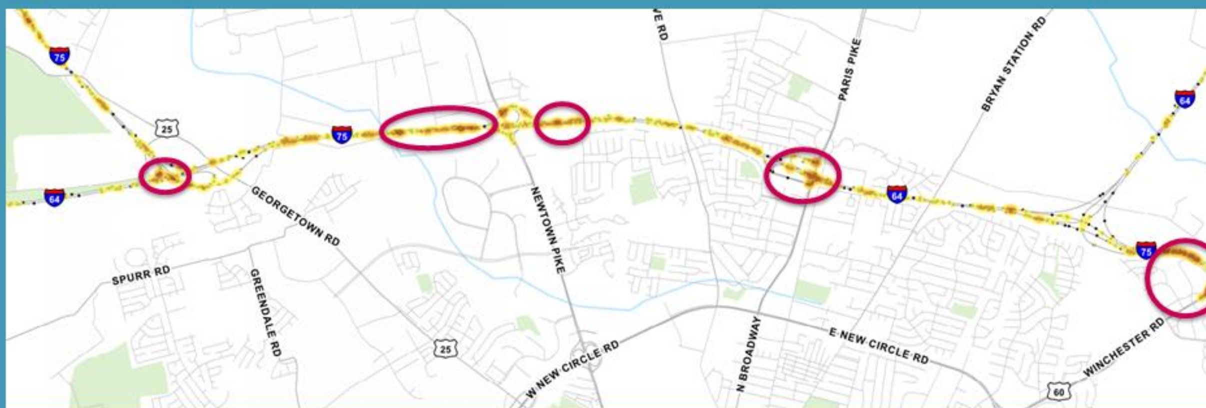
Traffic Operations & Safety
NB PM Speeds





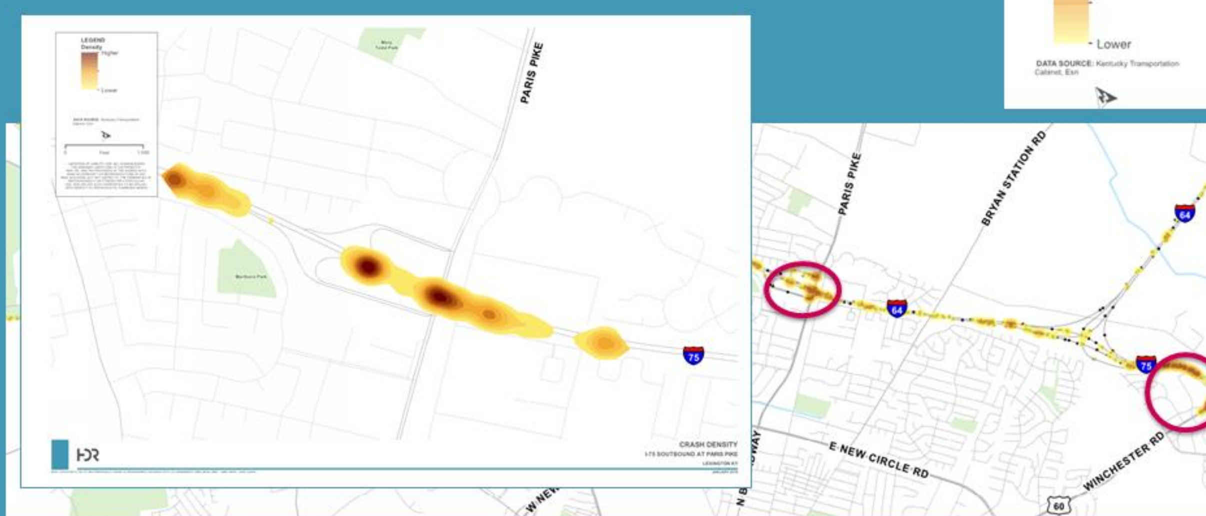
Traffic Operations & Safety
NB PM Speeds

LEGEND
All Crashes
Density
Higher
Lower
DATA SOURCE: Kentucky Transportation Cabinet, Esri

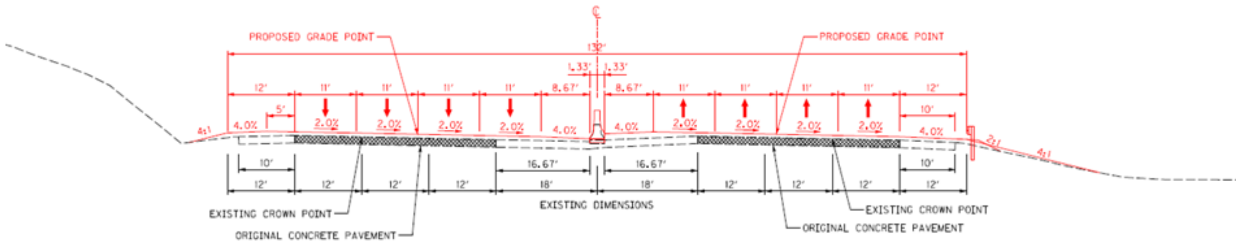


Traffic Operations & Safety
NB PM Speeds

LEGEND
All Crashes
Density
Higher
Lower
DATA SOURCE: Kentucky Transportation Cabinet, Esri



Alternative 1

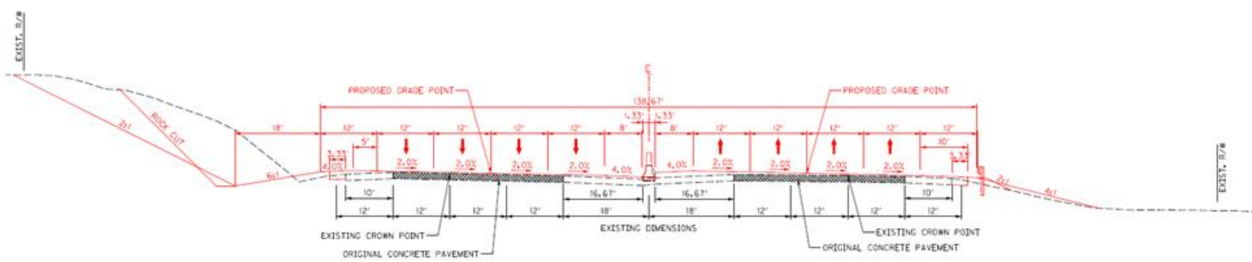


4-11' lanes
8.7' inside shoulder
12' outside shoulder

HDR

KENTUCKY TRANSPORTATION CABINET

Alternative 2

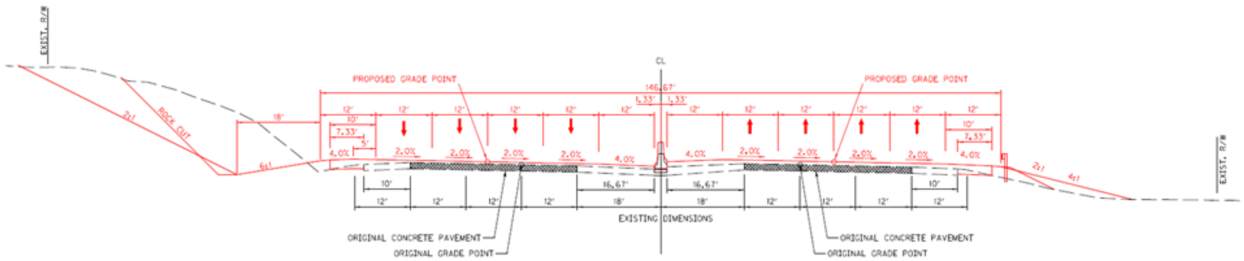


4-12' lanes
8' inside shoulder
12' outside shoulder

HDR

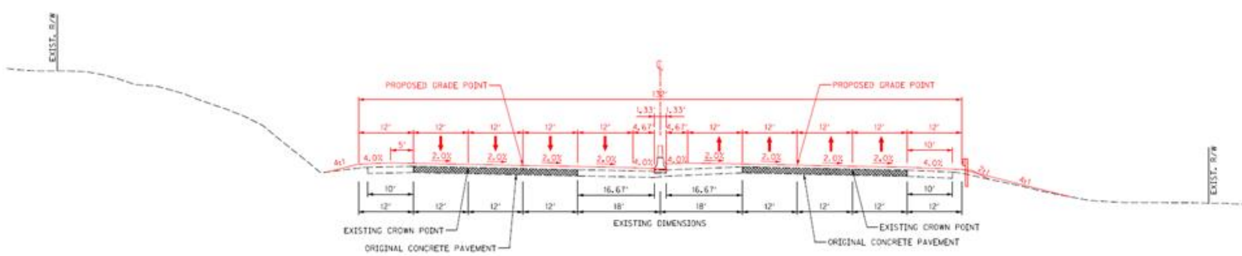
KENTUCKY TRANSPORTATION CABINET

Alternative 3



4-12' lanes
12' inside shoulder
12' outside shoulder

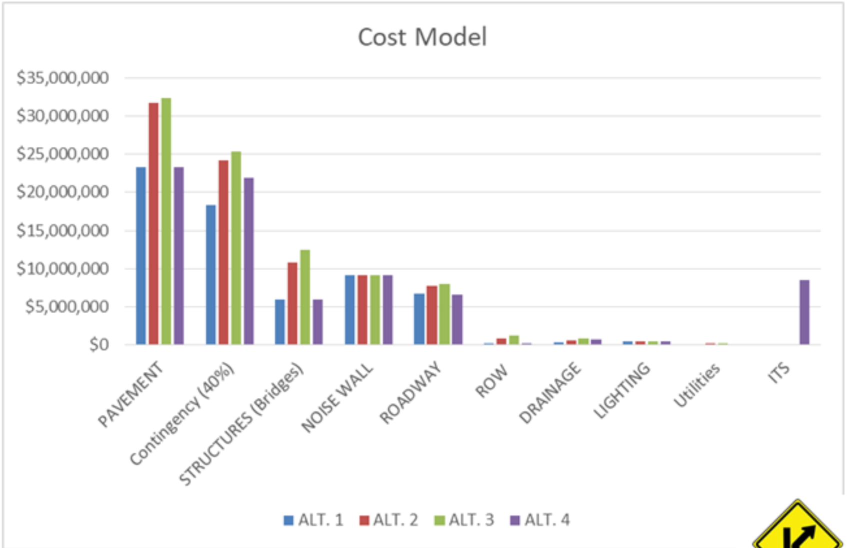
Alternative 4



Non peak hour
3-12' lanes
16.7' inside shoulder
12' outside shoulder

Hard Shoulder Running (peak hour)
4-12' lanes
4.7' inside shoulder
12' outside shoulder

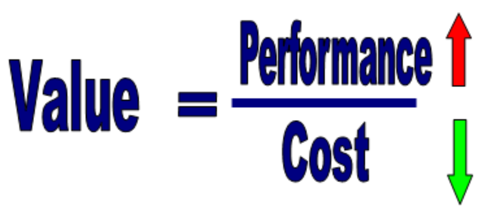
Costs



Performance Based VE

Value Engineering is not just about reducing project costs, but can also improve project performance

- Mainline Operations
- Local Operations
- Maintainability
- Construction Impacts
- Environmental Impacts
- Reduce Risk



Performance Attributes

Performance Attribute	Description
Main Line Operations	An assessment of traffic operations and safety on the main line within the project limits. Operational considerations include level of service relative to the 20-year traffic projections, as well as geometric considerations such as design speed, sight distance, and lane and shoulder widths.
Local Operations	An assessment of traffic operations and safety on the local roadway infrastructure. Local Operations include frontage roads as well as cross roads. Operational considerations include level of service relative to the 20-year traffic projections; geometric considerations such as design speed, sight distance, lane and shoulder widths; bicycle and pedestrian operations and access.
Maintainability	An assessment of the long-term maintainability of the facilities and equipment. Maintenance considerations include the overall durability, longevity, and maintainability of structures and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.
Construction Impacts	An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours and delays; impacts to existing utilities; impacts to businesses and residents relative to access, visual effects, noise, vibration, dust, and construction traffic; environmental impacts.
Environmental Impacts	An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts; impacts to shore edge; impacts to cultural, recreational and historic resources.
Reduce Risk	An assessment of reducing project risks concept through construction

Performance Attributes Criteria Matrix

Paired Comparison

							Total points	% of Total
Main Line Operations	A	A	A	A	A	A	6.0	29%
Local Operations		B	C	B	B	B	4	19%
Maintainability			C	C	C	C	5.0	24%
Construction Impacts				D	D	D	3.0	14%
Environmental Impacts					E	E	2.0	10%
Reduce Risk						F	1.0	5%
						Total	21.0	100%

PERFORMANCE CRITERIA RATING

Following are definitions and rating scales for the standardized performance criteria. Use the following scoring when there isn't a "baseline" to compare ideas too.

Criteria	Definition	Rating Scale	Unit of Measure/Quantification
Mainline Operations	An assessment of traffic operations and safety on the mainline facility(s), including off-ramps, and collector-distributor roads. Operational considerations include level of service relative to the 20 year traffic projections as well as geometric considerations such as design speed, sight distance, lane widths and shoulder widths.	10	Free flow – excellent operation
		9	Full Design standards
		8	Stable flow – very good operation
		7	Minor design exceptions
		6	Stable flow – good operation
		5	Approaching unstable flow – fair operation
		4	Design exceptions (geometry, sight distance)
		3	Unstable flow – poor operation
		2	Major Design exceptions (weaving and merging)
		1	Traffic congestion
Local Operations	An assessment of traffic operations and safety on the local roadway infrastructure, including on-ramps and frontage roads. Operational considerations include level of service relative to the 20 year traffic projections; geometric considerations such as design speed, sight distance, lane widths; bicycle and pedestrian operations and access.	10	Free flow – excellent operation
		9	Full Design standards
		8	Stable flow – very good operation
		7	Minor design exceptions
		6	Stable flow – good operation
		5	Approaching unstable flow – fair operation
		4	Design exceptions (geometry, sight distance)
		3	Unstable flow – poor operation
		2	Major Design exceptions (weaving and merging)
		1	Traffic congestion

Performance Rating scales defined for each Attribute

Evaluate and Scoring Baseline Alternatives

Alternative 1		
PERFORMANCE MEASURES **Attributes and Rating Rationale**	**Performance**	**Score**
Mainline Operations ▪ Design exceptions – lane 11 ft ▪ Design exception – inside shoulder 8.7 ft ▪ Full outside shoulder ▪ Exceeds LOS C in design year	Rating	6
	Weight	28.6
	Contribution	171.6
Local Operations ▪ Russell Cave and Bryan Station – raising structures therefore no adjustments to lane or shoulder widths	Rating	7
	Weight	19.0
	Contribution	133.0
Maintainability ▪ Similar maintenance to existing facility ▪ Maintenance has expressed concerns for inside shoulder maintenance activities – would require lane closures ▪ Raising structures built in late 60s may have additional maintenance	Rating	4
	Weight	23.8
	Contribution	95.2
Construction Impacts ▪ Maintain 2-3 lanes in each direction throughout construction with interim night closures	Rating	6
	Weight	14.2
	Contribution	85.2
Environmental Impacts ▪ Assumes noise walls where required ▪ Stays mostly within existing right of way	Rating	6
	Weight	9.5
	Contribution	57.0
Reduce Risk ▪ Risk of additional cost to repair existing structures ▪ Stays within existing roadway prism, minimizing risk to environmental, right of way and utilities ▪ Will require design exceptions for lane and shoulder widths ▪ Raising structures ▪ Does not address lane balance at northern split	Rating	5
	Weight	4.7
	Contribution	23.5
	Total Performance:	**566**

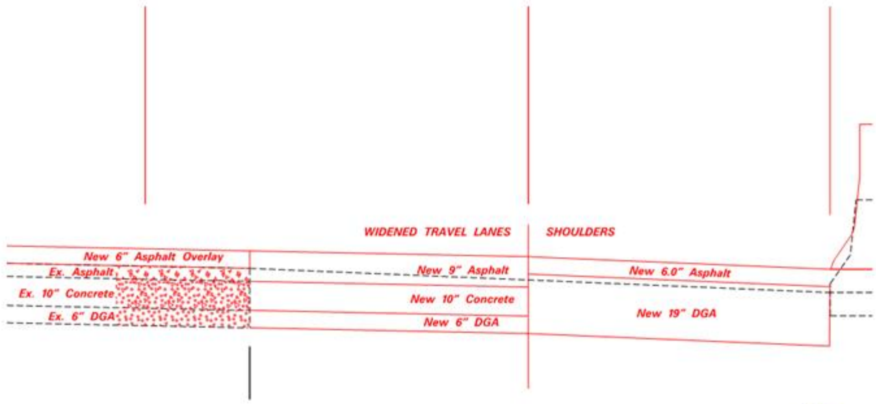
Summary of Performance

Performance Attribute Ratings				
Attribute	Attribute Weight	Concept	Performance Rating	Total Performance
Main Line Operations	28.6	1	6	171.6
		2	7.5	214.5
		3	9	257.4
		4	4	114.4
Local Operations	19.0	1	7	133.0
		2	8	152.0
		3	8	152.0
		4	7	133.0
Maintainability	23.8	1	4	95.2
		2	5	119.0
		3	6	142.8
		4	2	47.6
Construction Impacts	14.2	1	6	85.2
		2	6	85.2
		3	6	85.2
		4	6	85.2
Environmental Impacts	9.5	1	6	57.0
		2	5	47.5
		3	4	38.0
		4	6	57.0
Reduce Risk	4.7	1	5	23.5
		2	6	28.2
		3	5	23.5
		4	5	23.5

Recommendation Summary

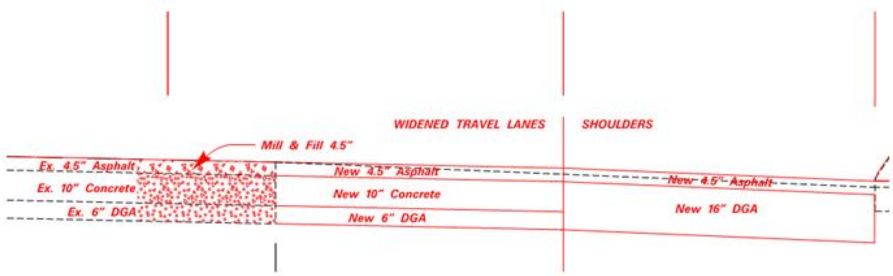
	Alt 1	Alt 2	Alt 3	Alt 4
Pavement	✓	✓	✓	✓
Bridge Shoulders		✓	✓	
Inside Shoulders			✓	
Reduce ROW Impacts	✓	✓	✓	✓
Ramp Merge	✓	✓	✓	✓
Narrow Shoulders at Existing Bridge Piers		✓	✓	

Recommendation # 1 Pavement



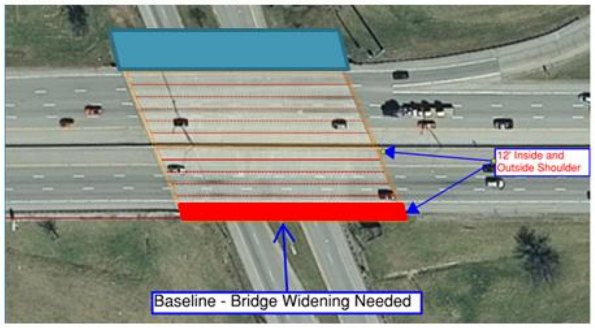
Baseline

Recommendation # 1 Pavement

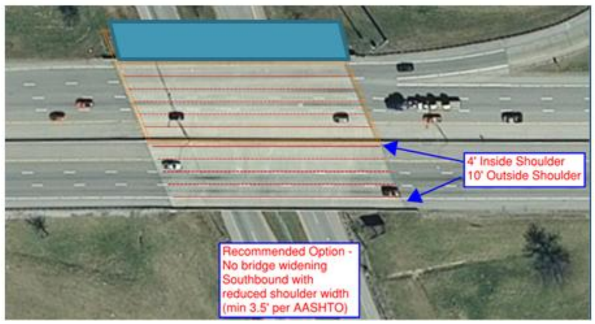


Cost avoidance
Alt 1 $8.8M
Alt 2 $8.6M
Alt 3 $8.9M
Alt 4 $8.8M

Recommendation # 2 Shoulders on Structures



Newtown Pike

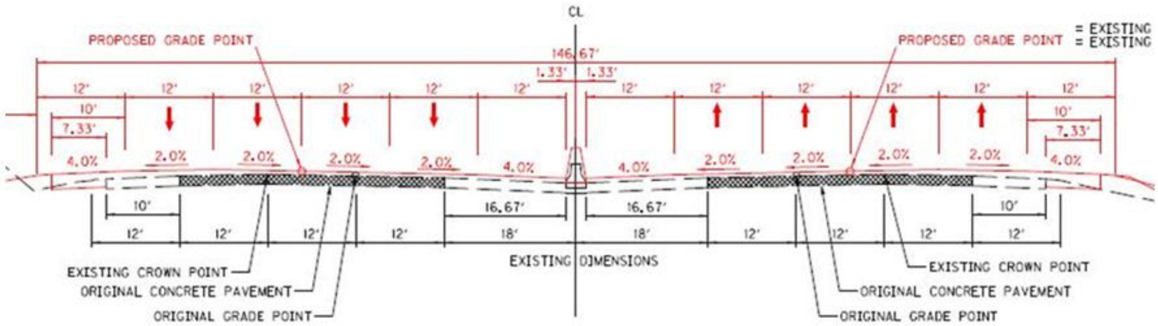


Recommendation # 2 Shoulders on Structures

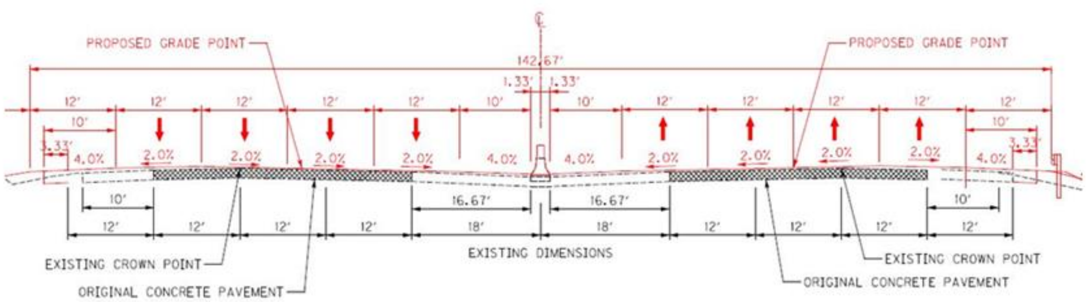
Paris Pike

Cost avoidance
Alt 1 N/A
Alt 2 $1.9M
Alt 3 $3.3M
Alt 4 N/A

Recommendation # 3 Inside Shoulders

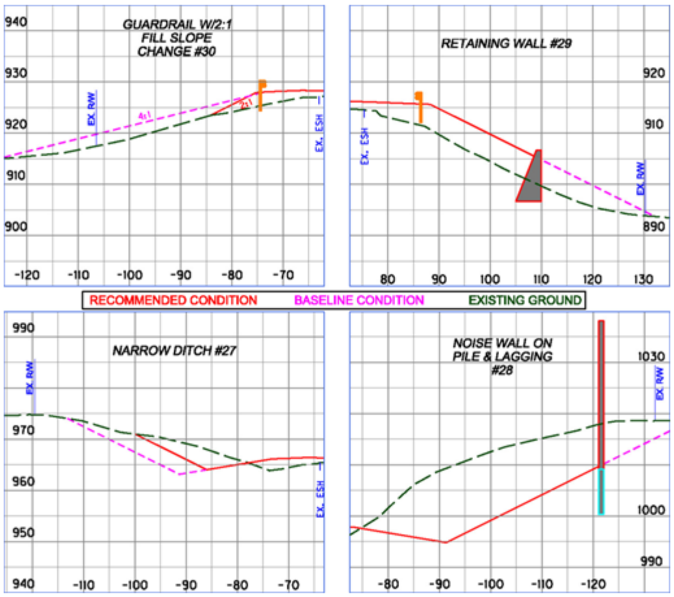


Recommendation # 3 Inside Shoulders



Cost avoidance
Alt 1 N/A
Alt 2 N/A
Alt 3 $2.5M
Alt 4 N/A

Recommendation # 4 Reduce ROW Impacts



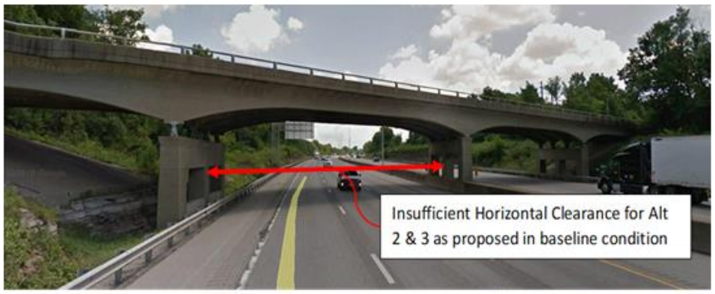
	Alt 1	Alt 2	Alt 3	Alt 4
Baseline Parcels	4	32	46	4
Recommended Avoided	1	24	38	1
Recommended Remaining	3	8	8	3

Cost Delta
Alt 1+ $0.02M
Alt 2 -$0.17M
Alt 3 +$0.66M
Alt 4 +0.02M

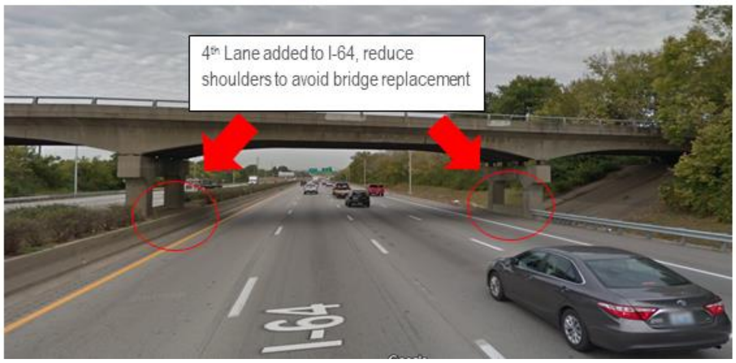
Recommendation # 5 Ramp Merge Paris Pike

Added Costs
Alt 1 $2.30M
Alt 2 $2.22M
Alt 3 $2.25M
Alt 4 $2.30M

Recommendation # 6 Narrow Shoulders at Existing Bridge Piers



Cost avoidance
Alt 1 N/A
Alt 2 $5.3M
Alt 3 $5.3M
Alt 4 N/A



Design Validation – Bridge Raising

HDR

Design Validation – Bridge Raising

Performance / Value
Pre- VE

$$\text{Value} = \frac{\text{Performance} \uparrow}{\text{Cost} \downarrow}$$

Alternative Summary					
Alternatives		Performance (P)	Cost (C) $ millions	Cost Change $ millions	Value Index
1	Alternative 1	547	$64.5	$64.46	8.48
2	Alternative 2	646	$85.8	$85.84	7.53
3	Alternative 3	699	$90.2	$90.21	7.75
4	Alternative 4	442	$78.1	$78.13	5.65

Performance / Value Post VE

$$\text{Value} = \frac{\text{Performance} \uparrow}{\text{Cost} \downarrow}$$

Alternative Summary								
Alternatives		Performance (P)	% Change Performance	Cost (C) $ millions	Cost Change $ millions	% Change Cost	Value Index	% Value Improvement
1	Alternative 1	547		$64.5	$64.46		8.48	
2	Alternative 2	646		$85.8	$85.84		7.53	
3	Alternative 3	699		$90.2	$90.21		7.75	
4	Alternative 4	442		$78.1	$78.13		5.65	
5	VE Alternative 1	561	+2.6%	$58.0	($6.48)	-10.1%	9.67	+14.1%
6	VE Alternative 2	642	-0.7%	$72.1	($13.75)	-16.0%	8.91	+18.3%
7	VE Alternative 3	702	+0.4%	$73.1	($17.09)	-18.9%	9.60	+23.9%
8	VE Alternative 4	456	+3.2%	$71.7	($6.48)	-8.3%	6.36	+12.6%

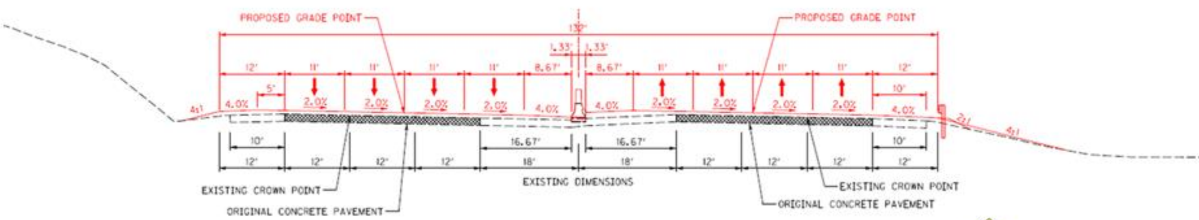
Northern split 3 lane widening (I-75N/I-75S)

Flyover southern split

Future Design Considerations

- Only pave widened areas that have not recently been rehabbed
- Advanced signing / road markings for lane choice
- Legacy trail structure revisions to prevent 4-F impacts
- Ramp metering at interchanges
- Break and seat existing concrete with overlay
- Widening without concrete base

What you can get for $30M +/-



Questions ?

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Value Engineering Process

Value Engineering (VE) is a systematic process using a multidisciplinary team to improve the value of a project through the analysis of its functions. The VE process incorporates, to the extent possible, the values of design; construction; maintenance; contractor; state, local and federal approval agencies; other stakeholders; and the public.

The primary objective of a VE workshop is value improvement. The value improvements might relate to scope definition, functional design, constructability, coordination (both internal and external), or the schedule for project development. Other possible value improvements are reduced environmental impacts, reduced public inconvenience, or reduced project cost.

Value Methodology Job Plan

The Value Methodology Job Plan was employed in analyzing the project. This process is recommended by SAVE International® and is composed of the following phases:

Information - The objective of this phase was to obtain a thorough understanding of the project's design criteria and objectives by reviewing the project's documents and drawings, cost estimates, and schedules.

Function Analysis - The purpose of this phase was to identify and define the primary and secondary functions of the project. A Function Analysis System Technique (FAST) was used to quickly define the functions of the project.

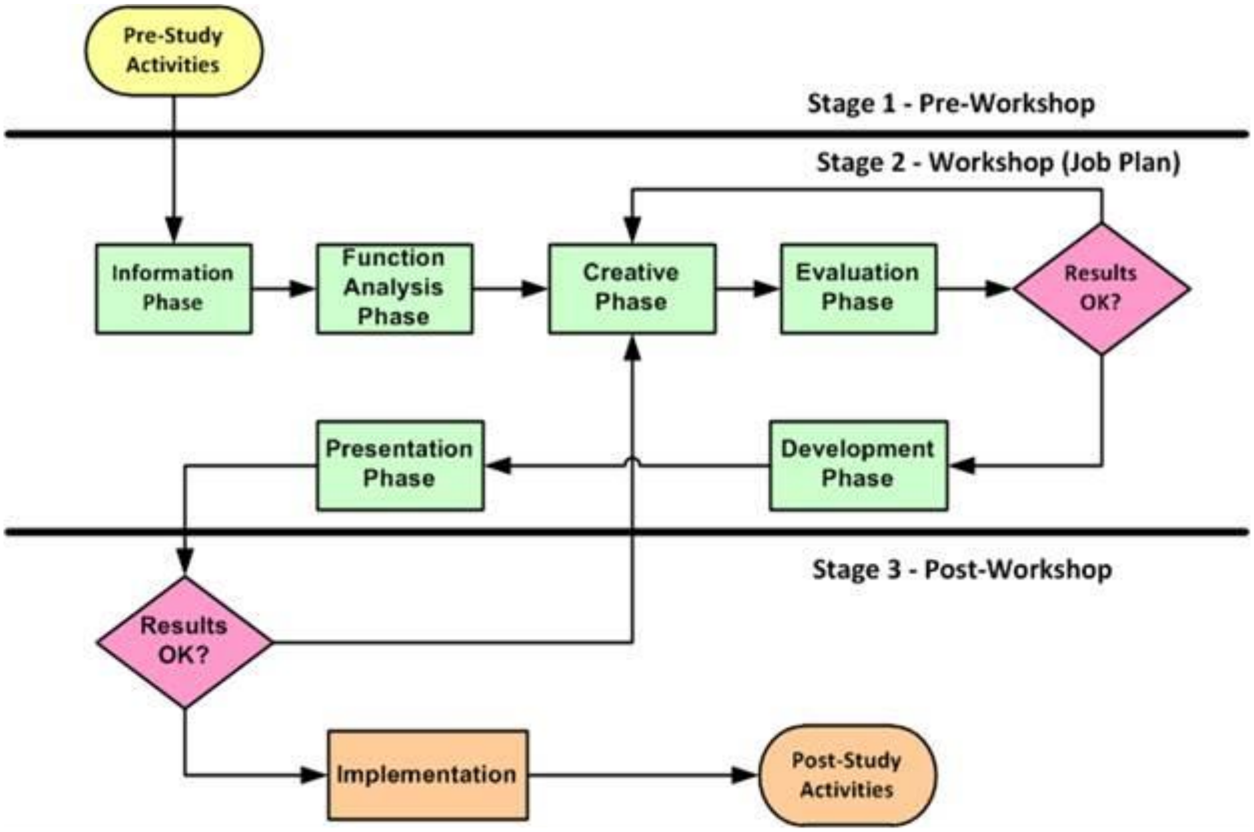
Creative - During this phase the team employed creative techniques such as team brainstorming to develop a number of alternative concepts that satisfy the project's primary functions.

Evaluation - The purpose of this phase was to evaluate the alternative concepts developed by the VE team during the brainstorming sessions. The team used a number of tools to determine the qualitative and quantitative merits of each concept.

Development - Those concepts that ranked highest in the evaluation were further developed into VE recommendations. Narratives, drawings, calculations, and cost estimates were prepared for each recommendation.

Presentation - The VE team presented their finding in the form of a written report. In addition, an oral presentation was made to the owner and the design team to discuss the VE recommendations.

Implementation/Resolution - Evaluate, resolve, document and implement all approved recommendations.



Methodology Job Plan

Reporting

Following the VE workshop, the Team Leader assembles all workshop documentation into the draft/final reports:

- Publish Results – Prepare a draft and a final VE workshop Report; distribute printed and electronic copies as needed.

The VE workshop is complete when the report is issued as a record of the VE team's analysis and development work, as well as the Project Team's implementation dispositions for the recommendations.

Baseline Construction Cost Estimates

7-8909 I64/I75 Split				
Value Planning Meeting				
Alternative 1				
ITEM DESCRIPTION	***UNIT***	***QNT***	***UNIT PRICE***	***TOTAL***
ROADWAY				
EARTHWORK	CU YD	109,955	$ 12.00	$ 1,319,460
CONCRETE MEDIAN BARRIER 50" WALL	LF	32,575	$ 145.00	$ 4,723,375
GUARDRAIL	LF	25,268	$ 16.00	$ 404,288
SIGNING	SF	9,319	$ 25.00	$ 232,975
NOISE WALL	SF	305,500	$ 30.00	$ 9,165,000
PAVEMENT				
SURFACE	TONS	31,832	$ 100.00	$ 3,183,200
BASE	TONS	130,740	$ 85.00	$ 11,112,900
JPC PAVEMENT	SQYD	63,509	$ 95.00	$ 6,033,355
CRUSHED STONE BASE/DGA	TONS	108,776	$ 27.00	$ 2,936,952
DRAINAGE				
MEDIAN BARRIER BOX INLETS	EACH	4	$ 5,000.00	$ 20,000
MODIFY MEDIAN BARRIER BOX INLETS	EACH	50	$ 3,800.00	$ 190,000
PIPE CULVERTS				
15"	LF	0	$ 90.00	$ -
18"	LF	50	$ 105.00	$ 5,250
24"	LF	0	$ 108.00	$ -
30"	LF	0	$ 115.00	$ -
36"	LF	0	$ 120.00	$ -
42"	LF	0	$ 125.00	$ -
48"	LF	20	$ 150.00	$ 3,000
54"	LF	0	$ 200.00	$ -
60"	LF	0	$ 250.00	$ -
72"	LF	0	$ 300.00	$ -
BOX CULVERTS				
Sta. 62+00 8'x4' RCBC	LF	0	$ 1,625.00	$ -
Sta. 87+90 14'x14' RCBC (LEGACY TRAIL)	LF	0	$ 6,000.00	$ -
Sta. 89+64 14'x3' RCBC	LF	0	$ 3,100.00	$ -
Sta. 109+99 16'x5' RCBC	LF	0	$ 3,700.00	$ -
Sta. 135+65 4'x4' RCBC	LF	16	$ 1,000.00	$ 16,000
Sta. 153+65 8'x4' RCBC	LF	45	$ 1,625.00	$ 73,125
Sta. 228+04 8'x4' RCBC	LF	0	$ 1,625.00	$ -
Sta. 246+43 4'x4' RCBC	LF	0	$ 1,000.00	$ -
Sta. 261+08 5'x5' RCBC	LF	0	$ 1,250.00	$ -
Sta. 278+50 8'x5' RCBC	LF	0	$ 1,875.00	$ -
Sta. 354+20 6'x3' RCBC	LF	0	$ 1,125.00	$ -
STRUCTURES				
CANE RUN CREEK	LS	1	$ 396,100.00	$ 396,100
NEWTOWN PIKE	LS	1	$ 1,949,550.00	$ 1,949,550
RUSSELL CAVE RD	LS	1	$ 1,036,536.00	$ 1,036,536
I-75 OVER PARIS PIKE	LS	1	$ 1,579,050.00	$ 1,579,050
BRYAN STATION RD	LS	1	$ 1,036,536.00	$ 1,036,536
LIGHTING				
LUMINAIRE POLE	EACH	125	$ 3,500.00	$ 437,500
HIGH MAST POLE	EACH	0	$ 30,000.00	$ -
Subtotal				$ 45,854,152
Contingency	*40%*			$ 18,341,661
Total				**$ 64,195,813**

7-8909 I64/I75 Split				
Value Planning Meeting				
Alternative 2				
ITEM DESCRIPTION	***UNIT***	***QNT***	***UNIT PRICE***	***TOTAL***
ROADWAY				
EARTHWORK	CU YD	198,240	$ 12.00	$ 2,378,880
CONCRETE MEDIAN BARRIER 50" WALL	LF	32,661	$ 145.00	$ 4,735,845
GUARDRAIL	LF	25,435	$ 16.00	$ 406,960
SIGNING	SF	10,587	$ 25.00	$ 264,675
NOISE WALL	SF	305,500	$ 30.00	$ 9,165,000
PAVEMENT				
SURFACE	TONS	35,467	$ 100.00	$ 3,546,700
BASE	TONS	147,535	$ 85.00	$ 12,540,475
JPC PAVEMENT	SQYD	95,717	$ 95.00	$ 9,093,115
CRUSHED STONE BASE/DGA	TONS	240,003	$ 27.00	$ 6,480,081
DRAINAGE				
MEDIAN BARRIER BOX INLETS	EACH	7	$ 5,000.00	$ 35,000
MODIFY MEDIAN BARRIER BOX INLETS	EACH	50	$ 3,800.00	$ 190,000
PIPE CULVERTS				
15"	LF	95	$ 90.00	$ 8,550
18"	LF	279	$ 105.00	$ 29,295
24"	LF	0	$ 108.00	$ -
30"	LF	40	$ 115.00	$ 4,600
36"	LF	0	$ 120.00	$ -
42"	LF	0	$ 125.00	$ -
48"	LF	40	$ 150.00	$ 6,000
54"	LF	0	$ 200.00	$ -
60"	LF	0	$ 250.00	$ -
72"	LF	0	$ 300.00	$ -
BOX CULVERTS				
Sta. 62+00 8'x4' RCBC	LF	8	$ 1,625.00	$ 13,000
Sta. 87+90 14'x14' RCBC (LEGACY TRAIL)	LF	15	$ 6,000.00	$ 90,000
Sta. 89+64 14'x3' RCBC	LF	19	$ 3,100.00	$ 58,900
Sta. 109+99 16'x5' RCBC	LF	17	$ 3,700.00	$ 62,900
Sta. 135+65 4'x4' RCBC	LF	33	$ 1,000.00	$ 33,000
Sta. 153+65 8'x4' RCBC	LF	49	$ 1,625.00	$ 79,625
Sta. 228+04 8'x4' RCBC	LF	0	$ 1,625.00	$ -
4'x4' RCBC Sta. 246+43 Ext.	LF	0	$ 1,000.00	$ -
5'x5' RCBC Sta. 261+08 Ext.	LF	0	$ 1,250.00	$ -
8'x5' RCBC Sta. 278+50 Ext.	LF	0	$ 1,875.00	$ -
6'x3' RCBC Sta. 354+20 Ext.	LF	0	$ 1,125.00	$ -
STRUCTURES				
CANE RUN CREEK	LS	1	$ 709,600.00	$ 709,600
NEWTOWN PIKE	LS	1	$ 2,486,300.00	$ 2,486,300
RUSSELL CAVE RD	LS	1	$ 2,675,780.00	$ 2,675,780
I-75 OVER PARIS PIKE	LS	1	$ 2,612,582.00	$ 2,612,582
BRYAN STATION RD	SF	1	$ 2,381,136.00	$ 2,381,136
				$ -
LIGHTING				
LUMINAIRE POLE	EACH	134	$ 3,500.00	$ 469,000
HIGH MAST POLE	EACH	0	$ 30,000.00	$ -
Subtotal				$ 60,556,999
Contingency	*40%*			$ 24,222,800
Total				**$ 84,779,799**

7-8909 I64/I75 Split
Value Planning Meeting
Alternative 3

ITEM DESCRIPTION	UNIT	QNT	UNIT PRICE	TOTAL
ROADWAY				
EARTHWORK	CU YD	217,703	$ 12.00	$ 2,612,436
CONCRETE MEDIAN BARRIER 50" WALL	LF	32,608	$ 145.00	$ 4,728,160
GUARDRAIL	LF	25,965	$ 16.00	$ 415,440
SIGNING	SF	10,587	$ 25.00	$ 264,675
NOISE WALL	SF	305,500	$ 30.00	$ 9,165,000
PAVEMENT				
SURFACE	TONS	36,810	$ 100.00	$ 3,681,000
BASE	TONS	151,861	$ 85.00	$ 12,908,185
JPC PAVEMENT	SQYD	90,896	$ 95.00	$ 8,635,120
CRUSHED STONE BASE/DGA	TONS	266,043	$ 27.00	$ 7,183,161
DRAINAGE				
MEDIAN BARRIER BOX INLETS	EACH	0	$ 5,000.00	$ -
MODIFY MEDIAN BARRIER BOX INLETS	EACH	50	$ 3,800.00	$ 190,000
PIPE CULVERTS				
15"	LF	126	$ 90.00	$ 11,340
18"	LF	354	$ 105.00	$ 37,170
24"	LF	34	$ 108.00	$ 3,672
30"	LF	40	$ 115.00	$ 4,600
36"	LF	0	$ 120.00	$ -
42"	LF	0	$ 125.00	$ -
48"	LF	50	$ 150.00	$ 7,500
54"	LF	0	$ 200.00	$ -
60"	LF	0	$ 250.00	$ -
72"	LF	0	$ 300.00	$ -
BOX CULVERTS				
Sta. 62+00 8'x4' RCBC	LF	8	$ 1,625.00	$ 13,000
Sta. 87+90 14'x14' RCBC (LEGACY TRAIL)	LF	23	$ 6,000.00	$ 138,000
Sta. 89+64 14'x3' RCBC	LF	27	$ 3,100.00	$ 83,700
Sta. 109+99 16'x5' RCBC	LF	22	$ 3,700.00	$ 81,400
Sta. 135+65 4'x4' RCBC	LF	41	$ 1,000.00	$ 41,000
Sta. 153+65 8'x4' RCBC	LF	51	$ 1,625.00	$ 82,875
Sta. 228+04 8'x4' RCBC	LF	11	$ 1,625.00	$ 17,875
4'x4' RCBC Sta. 246+43 Ext.	LF	14	$ 1,000.00	$ 14,000
5'x5' RCBC Sta. 261+08 Ext.	LF	0	$ 1,250.00	$ -
8'x5' RCBC Sta. 278+50 Ext.	LF	40	$ 1,875.00	$ 75,000
6'x3' RCBC Sta. 354+20 Ext.	LF	0	$ 1,125.00	$ -
STRUCTURES				
CANE RUN CREEK	LS	1	$ 944,600.00	$ 944,600
NEWTOWN PIKE	LS	1	$ 2,946,300.00	$ 2,946,300
RUSSELL CAVE RD	SF	1	$ 2,769,997.00	$ 2,769,997
I-75 OVER PARIS PIKE	LS	1	$ 3,385,490.00	$ 3,385,490
BRYAN STATION RD	SF	1	$ 2,466,788.00	$ 2,466,788
				$ -
LIGHTING				
LUMINAIRE POLE	EACH	134	$ 3,500.00	$ 469,000
HIGH MAST POLE	EACH	0	$ 30,000.00	$ -
Subtotal				$ 63,376,484
Contingency	*40%*			$ 25,350,594
Total				**$ 88,727,078**

7-8909 I64/I75 Split
Value Planning Meeting
Alternative 4

ITEM DESCRIPTION	UNIT	QNT	UNIT PRICE	TOTAL
ROADWAY				
EARTHWORK	CU YD	102,880	$ 12.00	$ 1,234,560.00
CONCRETE MEDIAN BARRIER 50" WALL	LF	32,575	$ 145.00	$ 4,723,375.00
GUARDRAIL	LF	25,268	$ 16.00	$ 404,288.00
SIGNING	SF	7,777	$ 25.00	$ 194,425.00
NOISE WALL	SF	305,500	$ 30.00	$ 9,165,000.00
PAVEMENT				
SURFACE	TONS	31,832	$ 100.00	$ 3,183,200.00
BASE	TONS	132,587	$ 85.00	$ 11,269,895.00
JPC PAVEMENT	SQYD	74,705	$ 95.00	$ 7,096,975.00
CRUSHED STONE BASE/DGA	TONS	99,989	$ 27.00	$ 2,699,703.00
DRAINAGE				
MEDIAN BARRIER BOX INLETS	EACH	93	$ 5,000.00	$ 465,000.00
MODIFY MEDIAN BARRIER BOX INLETS	EACH	50	$ 3,800.00	$ 190,000.00
PIPE CULVERTS				
15"	LF		$ 90.00	$ -
18"	LF	50	$ 105.00	$ 5,250.00
24"	LF		$ 108.00	$ -
30"	LF		$ 115.00	$ -
36"	LF		$ 120.00	$ -
42"	LF		$ 125.00	$ -
48"	LF	20	$ 150.00	$ 3,000.00
54"	LF		$ 200.00	$ -
60"	LF		$ 250.00	$ -
72"	LF		$ 300.00	$ -
BOX CULVERTS				
Sta. 62+00 8'x4' RCBC	LF		$ 1,625.00	$ -
Sta. 87+90 14'x14' RCBC (LEGACY TRAIL)	LF		$ 6,000.00	$ -
Sta. 89+64 14'x3' RCBC	LF		$ 3,100.00	$ -
Sta. 109+99 16'x5' RCBC	LF		$ 3,700.00	$ -
Sta. 135+65 4'x4' RCBC	LF	16	$ 1,000.00	$ 16,000.00
Sta. 153+65 8'x4' RCBC	LF	45	$ 1,625.00	$ 73,125.00
Sta. 228+04 8'x4' RCBC	LF		$ 1,625.00	$ -
4'x4' RCBC Approx. Sta. 246+43	LF		$ 1,000.00	$ -
5'x5' RCBC Approx. Sta. 261+08	LF		$ 1,250.00	$ -
8'x5' RCBC Approx. Sta. 278+50	LF		$ 1,875.00	$ -
6'x3' RCBC Approx. Sta. 354+20	LF		$ 1,125.00	$ -
STRUCTURES				
CANE RUN CREEK	LS	1	$ 396,100.00	$ 396,100.00
NEWTOWN PIKE	LS	1	$ 1,949,550.00	$ 1,949,550.00
RUSSELL CAVE RD	LS	1	$ 1,036,536.00	$ 1,036,536.00
I-75 OVER PARIS PIKE	LS	1	$ 1,579,050.00	$ 1,579,050
BRYAN STATION RD	SF	1	$ 1,036,536.00	$ 1,036,536.00
LIGHTING				
LUMINAIRE POLE	EACH	125	$ 3,500.00	$ 437,500.00
IT	LS	1	$ 8,460,000.00	$ 8,460,000.00
HIGH MAST POLE	EACH	0	$ 30,000.00	$ -
Subtotal				$ 55,619,068.00
Contingency	*40%*			$ 22,247,627.20
Total				**$ 77,866,695**