Value Engineering Study

Final Report

Kentucky Transportation Cabinet

I-65 & KY 222 Interchange

Hardin County

August 2009

Strategic Value Solutions, Inc.
Value Improvement Specialists

Value Engineering Study

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Prepared for:

Kentucky Transportation Cabinet
200 Mero Street
Frankfort, KY

Prepared by:

Strategic Value Solutions, Inc.

19201 E. Valley View Pkwy, Suite H
Independence, MO 64055
816-795-0700

www.SVS-inc.net

Value Team Roster

Value Team Leader

John L. Robinson, PE, CVS-Life	Strategic Value Solutions, Inc.

Value Team Members

Name	Organization	Role
Chuck Allen PE	Kentucky Transportation Cabinet	Interchange Design
Jennifer Goins PE	HNTB Corporation	Interchange Design
Wes Hagerman PE	Kentucky Transportation Cabinet	Bridge Design
Adam Kirk PE, PTOE, AICP	Kentucky Transportation Cabinet University of Kentucky	Traffic Engineer
Siamak Shafaghi	Kentucky Transportation Cabinet	Quality Assurance
Brent Sweger PE	Kentucky Transportation Cabinet	Planning

Value Team Support Staff

Korene V. Robinson, PE	Strategic Value Solutions, Inc.	Technical Assistant
Dawn Marie Bennett	Strategic Value Solutions, Inc.	Administrative Assistant

ACKNOWLEDGEMENTS

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In addition, we would like to thank Steve Slade and Ben Edelen of the Parsons Brinckerhoff, Inc. design team for sharing their knowledge about the project and for their responsiveness to our questions and requests throughout this Value Engineering study.

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SECTION 1

EXECUTIVE SUMMARY

SECTION 1
EXECUTIVE SUMMARY

This report presents the results of a Value Study conducted by Strategic Value Solutions, Inc. (SVS) on the plan of the I-65 & KY 222 Interchange project for the Kentucky Transportation Cabinet (KYTC). The project was reviewed at the end of the Phase 1 planning.

The project plan being reviewed was developed by Parsons Brinckerhoff, Inc. (PB).

The Value Study included a 5-day (40-hour) value methodology workshop that was conducted with a multidisciplinary team in Frankfort, KY on July 13 – 17, 2009.

PROJECT DESCRIPTION SUMMARY

This project is for the reconstruction of the I-65 and KY 222 Interchange near Glendale, KY. The existing diamond interchange is under capacity to serve the high volume of traffic (40% truck) predominately accessing two large truck stops. The interchange capacity is reduced due to the lack of access control along KY 222 adjacent to this interchange. The Preferred Alternative is to construct a new single point urban interchange (SPUI) approximately 600 feet south of the existing interchange. A new alignment is created for KY 222 to the west with a four-lane median separated section instead of the existing two-lane. A roundabout is being considered for the intersection of KY 222 to a new connector road back to the existing KY 222 alignment in order to serve the Petro Truck Stop on the west side of the interchange. On the east side, another roundabout is proposed to create a free flow intersection for traffic accessing the Pilot Truck Stop as well as traffic on US 31W.

In addition to the existing operational concerns, a significant driver for a new interchange is the State's desire to provide access to 1,500 acres of State-owned land that has been designated for an economic development project. The traffic projections include a 2.5% per year growth rate as well as an additional 2,000 to 2,500 persons working at this new site.

VALUE STUDY TEAM

The team members that comprised this multidisciplinary Value Team are listed on the introductory pages of this report. All other participants of the study are provided in Appendix A.

In general, the Value Team members were independent of the project development team. This ensured maximum objectivity towards identifying alternative solutions.

VALUE METHODOLOGY

This Value Study used the international standard Value Methodology established by SAVE International, the Value Society. The Value Methodology (VM) uses a six-phase process executed in a workshop format with a multidisciplinary team. Value is expressed as the relationship between functions and resources where function is measured by the performance requirements of the customer and resources are measured in materials, labor, price, time, etc. required to accomplish that function. VM focuses on improving Value by identifying the most

resource efficient way to reliably accomplish a function that meets the performance expectations of the customer.

With this process, the Value Team identifies the essential project functions and alternative ways to achieve those functions, and then selects the best alternatives to develop into workable solutions for value improvements.

Additional information about the Value Study processes used in the generation of the results presented is provided in Section 3 of this report.

Value Study Constraints

Constraints or limits on the Value Study are used to define the boundaries between project aspects that the project stakeholders will consider changing and those that cannot be changed. These constraints may result from a variety of political, technical, schedule, or environmental causes. Excessive constraints tend to inhibit the team's ability to identify creative opportunities for value improvement. Inadequately defined constraints can result in the team's effort being wasted in areas where there is no possibility of change.

Constraints identified for this study were:

- Keep the solutions within the general study area of the project
- Stay north of the Camp Nevin historic area

WORKSHOP RESULTS

The purpose of the workshop is to identify and develop alternative concepts that will improve the overall value of the project. In order to be successful at identifying alternatives, it is essential that the Value Team first understand the project objectives and the problems that must be solved. For this reason, the workshop began with presentations by KYTC's project management to define the project objectives and to provide background information on the project. This was followed by a more detailed presentation of the project plan by the project development team on how the plan will accomplish the project's objectives.

This Information Phase of the workshop was followed by an in-depth analysis of the functional requirements of the project. A complete understanding of the basic functions that must be accomplished in order to successfully achieve the mission of the project is essential for the team to identify feasible alternatives to the current concept.

Using function analysis and Function Analysis System Technique (FAST) diagramming, the team defined the basic functions of this project as Improve Operations. Key secondary functions that supported this basic function(s) included Reduce Accidents and Increase Throughput (Capacity). Analysis of the functions intended to be performed by the project, helped the team focus on the mission of the project and, consequently, how to identify alternative concepts that would still meet the mission while exploring opportunities for value enhancement.

Analyzing the functions of this project gave the team the following key insights:

- The growth and planning factors built into the traffic projections are on the conservative side. The traffic considers a 20% increase in peak hour volumes due to an unspecified future development on the State-owned economic development site in addition to a 2.5% annual increase.

- The capacity issues in the existing interchange are driven by a lack of access control. The Preferred Alternative realigns KY 222 rather than modify the access points.

- The design concepts seem to cater to the truck stops' access and operational preferences which may not result in the best long term solution for the development of this area.

- The design concepts seem to have been selected based on the path of least resistance which again may not result in the best long term solution.

- To increase the capacity of the interchange, the project needs to minimize high volume left turn movements at access points. The roundabout in front of the Pilot Travel Center has a significant operational concern. There is a high volume left-turn movement for the ingress traffic that has to travel ¾ of the way around the roundabout and crosses in front of the egress traffic from the truck stop thus causing a conflict point.

With an understanding of the functional requirements, the Value Team transitioned to the Creative Phase of the workshop and brainstormed on all of the possible ways to accomplish each of those functions. The team generated 66 ideas for potential changes to the current plan.

Based on the team members' professional judgment and input from KYTC and PB representatives, 11 of these ideas were selected for developing into Value Alternatives.

Value Alternatives

Table 1-1, at the end of this section, includes a complete list of all the Value Alternatives developed. This table shows the number and title of each alternative as well as a summary of the cost savings. These savings include the capital or first cost savings as well as the present worth value of the savings associated with the long term owning and operating costs over the economic life of the project. The first cost savings and the present worth savings on operations and maintenance (O&M) sum to give the overall life cycle cost savings for each Value Alternative.

It should be noted that Value Studies are working sessions for the purpose of developing and recommending alternative approaches to the current plan. As such, the results presented are of a conceptual nature and are not intended as a final design. Detailed feasibility assessment and final design development of any of the alternatives or suggestions presented herein, should they be accepted, remain the responsibility of KYTC and PB.

Some alternatives presented in this report are variations of a common concept and others are alternatives to a specific aspect of the plan. Thus, not necessarily all alternatives in this report can be implemented as selection of some may preclude or limit the use of others.

These potential savings do not reflect any costs for redesign, which must be considered. Moreover, the full benefit and impact of many of the alternatives goes beyond the cost savings to include improved project performance of required functions.

Optimum Combination of Alternatives

After completing the development of the Value Alternatives, the team reviewed the composite list of alternatives to identify what they believed to be the optimum combination of alternatives. This combination represents the best value solution for the project in the opinion of the Value Team. Three solutions are presented as a result of this review and are listed in Table 1-2.

The three preferred solutions by the Value Team result in the following potential cost savings:

VE Team Recommended Solution	
Life Cycle Cost Savings	$ 24,164,000
Minimum Solution to Address Current Needs	
Life Cycle Cost Savings	$ 8,414,000
VE Team Optimization of the Preferred Alternate	
First Cost Savings	$1,903,000
Present Worth O&M Savings	$1,991,000
Life Cycle Cost Savings	$3,894,000

The savings from some of the individual Value Alternatives have been adjusted to account for overlapping savings when combined with other Value Alternatives.

Design Suggestions

In addition to the Value Alternatives, the team also identified six design suggestions. These are suggestions for changes or clarifications to the project documents that did not have an identifiable or quantifiable cost impact that could be determined within the scope of the workshop. The design suggestions from this study are included in Section 5 of this report.

Additional Benefits

A Value Study typically results in benefits beyond cost savings. These benefits are generated as a part of an alternative, design suggestion, or from an observation made by the team or one of the other participants during the workshop. Below are some of the benefits realized from this study, in addition to the cost savings discussed above.

- The study highlighted a concern for potential operational issues with the roundabout in front of the Pilot Travel Center and offered multiple alternatives to alleviate this conflict and thus improve operations

RESOLUTION OF VALUE ALTERNATIVES

To finalize the Value Study it is essential that decisions are made on the resolution of each of the Value Alternatives and Design Suggestions presented in this report. This needs to be a collaborative effort between KYTC and PB. The ultimate disposition of the Value Alternatives will be documented separately from this report.

CONCLUSIONS

This Value Study looked at the project from two different perspectives. One was to step back and reassess whether the Preferred Alternative was really the best solution or whether there is a more cost effective solution that would accomplish the performance objectives related to the function of improving operations of the interchange. The second approach was to look for opportunities to optimize the cost and performance of the Preferred Alternative.

A common theme that runs through many of the Value Alternatives is to find another approach for addressing the operational issues that exist because of a lack of access control, primarily associated with the Petro and Pilot truck stops. The Preferred Alternative takes an approach that maintains the access points as is, but moves KY 222 to a new alignment in order to affect an increase in spacing between the ramp terminals and these access points. The VE Team believes there is significant opportunity for value improvement in the project by taking more of an access control approach and maintaining the existing alignment of KY 222.

In Value Alternative IO-31, the VE Team developed a concept that would provide a minimal solution to address today's problems as well as a reasonable amount of future growth (2.5%/year). This solution would not accommodate the anticipated growth (20%) associated with the economic development area. In today's economic environment, the VE Team feels it is appropriate to consider a solution that addresses existing needs while accommodating reasonable growth in population and development. However, the growth in traffic volumes associated with the economic development area is a significant unknown in both configuration and timing. To spend over $24 million to build a solution to accommodate this unknown condition may not be a wise expenditure.

If the decision is to accommodate the future economic development area, the team developed four additional Value Alternatives (IO-5, IO-11, IO-12, IO-63) that either revisit previously considered interchange configurations or present alternate configurations to solve the problems related to interchange operations. Some of these configurations were previously considered by PB but were dismissed because of the access control requirement it would place on the truck stops. The VE Team recommends a reconsideration of this constraint which based on the savings associated with Value Alternatives IO-5 and IO-12 is adding approximately $8 million to the cost of this project. Either of these two Value Alternatives will meet, and in some aspects exceed, the functional performance requirements for an acceptable level of service for this interchange considering the existing needs and the projected development.

If the decision is to stay with the Preferred Alternative, the VE Team recommends the implementation of several Value Alternatives listed in Table 1-2 that are aimed at improving

value through the optimization of this concept with the application of cost reductions and functional performance improvements. The existing interchange experiences some capacity issues today which are projected to become much worse as traffic increases. The capacity issue is related in large part to the left turn movements into the Pilot Travel Center. While the Preferred Alternative provides for more storage area between access points, it does not resolve the left turn conflicts. The VE Team believes this is an important issue that needs to be resolved in a more effective manner. Again, we recommend that KYTC revisit the constraint that appears to have been placed on the project to maintain the status quo for all truck stop access and operations.

In addition to the Value Alternatives developed, another concept was identified but not developed due to time constraints on the workshop. That concept combines IO-5 with the Preferred Alternative. This would result in an interchange configuration using a partial-cloverleaf on a new KY 222 alignment and would also modify the access or operations of the Pilot Travel Center to eliminate or minimize the left turn conflict in the roundabout. This too would result in significant savings by eliminating two lanes on the bridge and the related widening of KY 222.

Table 1-1
Summary of Alternatives

Alt. No.	Description	First Cost Savings	Present Worth O&M Savings	Life Cycle Cost Savings
Improve Operations (IO)				
IO-4	Reverse the truck flow through the Pilot Travel Center	($115,000)	$0	($115,000)
IO-5	Use a partial cloverleaf at the existing interchange location	$8,414,000	$0	$8,414,000
IO-11	Use Alternate 1	$2,900,000	$0	$2,900,000
IO-12	Reconstruct interchange as a diamond on the existing alignment	$7,250,000	$0	$7,250,000
IO-15	Tie KY 222 back into existing alignment east of Robey Drive	$1,680,000	$0	$1,680,000
IO-31	Keep existing interchange; reverse flow through Pilot Travel Center; signalize US 31W and ramps; move west access points to the west of Petro	$24,164,000	$0	$24,164,000
IO-35	Reduce median, shoulder and lane widths on Preferred Alternative (realigned KY 222). Eliminate rumble strips on non-interstate facilities.	$1,084,000	$0	$1,084,000
IO-39	Eliminate northwest leg of Pilot Travel Center roundabout and close existing truck entrance on KY 222	($34,000)	$0	($34,000)
IO-56	Use concrete to better accommodate truck turning movements	($1,581,000)	$1,991,000	$410,000
IO-59	Re-evaluate need for two-lane ramps for I-65 operations	$1,253,000	$0	$1,253,000
IO-63	Build new KY 1136 Interchange north of Camp Nevin and collector distributor between KY 1136 /KY 222 interchange. Implement minor modifications to existing KY 222 interchange. Two-step phased implementation.	($9,700,000)	$0	($9,700,000)

Table 1-2
Optimum Combination of Alternatives

Alt. No.	Description	First Cost Savings	Present Worth O&M Savings	Life Cycle Cost Savings
VE Team Recommended Solution				
IO-31	Keep existing interchange; reverse flow through Pilot Travel Center; signalize US 31W and ramps; move west access points to the west of Petro	$24,164,000	$0	$24,164,000
	Total	$24,164,000	$0	$24,164,000
Minimum Solution to Address Current Needs				
IO-5	Use a partial cloverleaf at the existing interchange location	$8,414,000	$0	$8,414,000
	Total	$8,414,000	$0	$8,414,000
VE Team Optimization of the Preferred Alternate				
IO-4	Reverse the truck flow through the Pilot Travel Center	($115,000)	$0	($115,000)
IO-15	Tie KY 222 back into existing alignment east of Robey Drive	$1,680,000	$0	$1,680,000
IO-35	Reduce median, shoulder and lane widths on Preferred Alternative (realigned KY 222). Eliminate rumble strips on non-interstate facilities.	$700,000	$0	$700,000*
IO-39	Eliminate northwest leg of Pilot Travel Center roundabout and close existing truck entrance on KY 222	($34,000)	$0	($34,000)
IO-56	Use concrete to better accommodate truck turning movements	($1,581,000)	$1,991,000	$410,000
IO-59	Re-evaluate need for two-lane ramps for I-65 operations	$1,253,000	$0	$1,253,000
	Total	$1,903,000	$1,991,000	$3,894,000

* Reduced based on combining with IO-15.

SECTION 2

PROJECT DESCRIPTION

SECTION 2
PROJECT DESCRIPTION

The I-65 & KY 222 Interchange project is to improve the safety and increase the capacity of the I-65 & KY 222 interchange. The project is located approximately ten miles south of Elizabethtown in a rural portion of Hardin County and 1.5 miles east of Glendale on KY 222. This interchange is experiencing congestion that is worsening as the area grows. Additionally, this interchange is in close proximity to two large truck stop facilities. Interchange conveyance times are over five minutes in length during peak hours. Additionally this interchange suffers from an undesirably high crash history due to the lack of access control. The design team has developed several alternatives to alleviate the interchange's high-capacity issues.

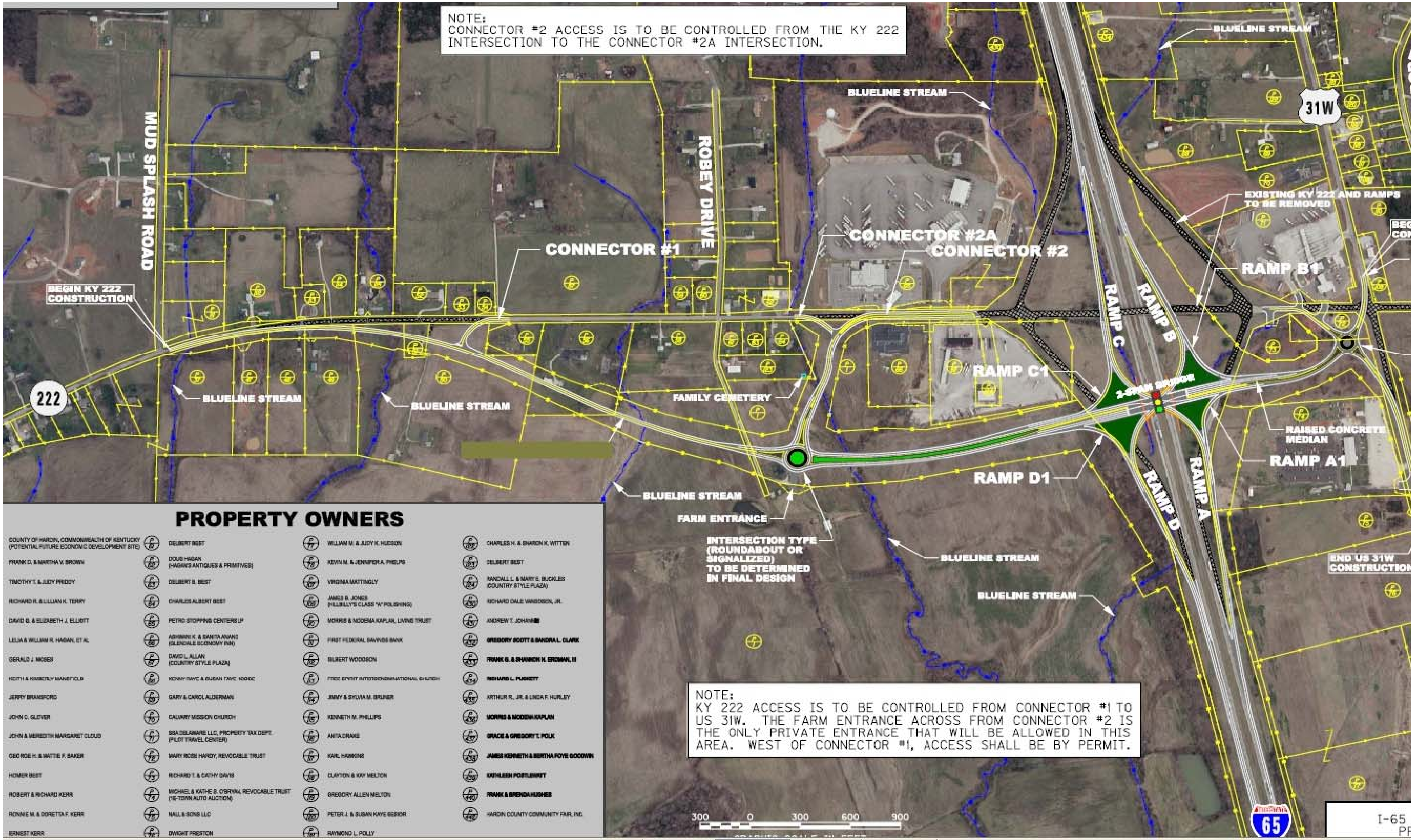
This project is expected to bring significant economic benefits to local businesses in the Glendale Historic District by bringing more visitors to the community. There are many shops and restaurants that are expected to benefit the greatest from the improved access. The increased revenue will aid in the preservation of the historic community, allowing for improved management and reinvestment into the historic structures. Ultimately, it is expected that this project will improve the vitality of the entire district.

A nearby industrial site has the potential for creating over 5,000 additional daily trips to this interchange, according to the Kentucky Cabinet for Economic Development. Although the site may develop without the construction of the new interchange, it is expected that the interchange will make the site a more attractive development site to potential developers.

PREFERRED ALTERNATIVE

The design team developed 18 alternative configurations for the project during design Phase 1; three of these alternatives were shortlisted for further review. From this secondary review at the end of Phase I, the team developed its Preferred Alternative shown in Figure 2-1 at the end of this section.

The Preferred Alternative recommends the construction of a single point urban interchange for the interchange between I-65 & KY 222. Additionally, KY 222 would be relocated 600 ft south of its existing location. The interchange between KY 222 and US 31W has been realigned, and has an option of a signalized intersection or a roundabout. This alternative addresses the congestion issues at the I- 65 & KY 222 Interchange, as well as reduces the safety concern with large trucks at US 31W & KY 222 Interchange.


NOTE:
CONNECTOR #2 ACCESS IS TO BE CONTROLLED FROM THE KY 222 INTERSECTION TO THE CONNECTOR #2A INTERSECTION.
BLUELINE STREAM
31W
MUD SPLASH ROAD
ROBEY DRIVE
EXISTING KY 222 AND RAMPS TO BE REMOVED
CONNECTOR #2A
CONNECTOR #2
CONNECTOR #1
RAMP B1
BEGIN KY 222 CONSTRUCTION
RAMP C
RAMP B
RAMP C1
2-SPAN BRIDGE
222
FAMILY CEMETERY
RAISED CONCRETE MEDIAN
RAMP A1
RAMP D1
RAMP D
RAMP A
FARM ENTRANCE
INTERSECTION TYPE (ROUNDABOUT OR SIGNALIZED) TO BE DETERMINED IN FINAL DESIGN
END US 31W CONSTRUCTION
PROPERTY OWNERS
COUNTY OF HARDIN, COMMONWEALTH OF KENTUCKY (POTENTIAL FUTURE ECONOMIC DEVELOPMENT SITE)
FRANK D. & MARTHA V. BROWN
TIMOTHY T. & JUDY PREDDY
RICHARD R. & LILLIAN K. TERRY
DAVID B. & ELIZABETH J. ELLIOTT
LELIA & WILLIAM R. HAGAN, ET AL
GERALD J. MOSER
JERRY BRANSFORD
JOHN C. GLOVER
JOHN & MEREDITH MARGARET CLOUD
HOMER BEST
ROBERT & RICHARD KERR
RONNIE M. & DORETTA F. KERR
ERNEST KERR
DELBERT BEST
DOUG HAGAN (HAGAN'S ANTIQUES & PRIMITIVES)
DELBERT B. BEST
CHARLES ALBERT BEST
PETRO STOPPING CENTERS LP
ASHWANI K. & SANITA ANAND (GLENDALE ECONOMY INN)
DAVID L. ALLAN (COUNTRY STYLE PLAZA)
GARY & CAROL ALDERMAN
CALVARY MISSION CHURCH
SSA DELAWARE LLC, PROPERTY TAX DEPT. (PILOT TRAVEL CENTER)
MARY ROSE HARDY, REVOCABLE TRUST
RICHARD T. & CATHY DAVIS
MICHAEL & KATHE B. O'BRYAN, REVOCABLE TRUST (E-TOWN AUTO AUCTION)
NALL & SONS LLC
DWIGHT PRESTON
WILLIAM M. & JUDY K. HUDSON
KEVIN M. & JENNIFER A. PHELPS
VIRGINIA MATTINGLY
JAMES B. JONES (HILLBILLY'S CLASS "A" POLISHING)
MORRIS & MODENA KAPLAN, LIVING TRUST
FIRST FEDERAL SAVINGS BANK
GILBERT WOODSON
JIMMY & SYLVIA M. BRUNER
KENNETH M. PHILLIPS
ANITA DRAKE
KARL HAWKINS
CLAYTON & KAY MELTON
GREGORY ALLEN MELTON
PETER J. & SUSAN KAYE GESIOR
RAYMOND L. POLLY
CHARLES H. & SHARON K. WITTEN
DELBERT BEST
RANDALL L. & MARY E. BUCKLES (COUNTRY STYLE PLAZA)
RICHARD DALE VANDIXSON, JR.
GREGORY SCOTT & SANDRA L. CLARK
RICHARD L. PUCKETT
ARTHUR R., JR. & LINDA F. HURLEY
MORRIS & MODENA KAPLAN
GRACE & GREGORY T. POLK
JAMES KENNETH & BERTHA FAYE GOODWIN
KATHLEEN POSTLEWAIT
FRANK & BRENDA HUGHES
HARDIN COUNTY COMMUNITY FAIR, INC.
NOTE:
KY 222 ACCESS IS TO BE CONTROLLED FROM CONNECTOR #1 TO US 31W. THE FARM ENTRANCE ACROSS FROM CONNECTOR #2 IS THE ONLY PRIVATE ENTRANCE THAT WILL BE ALLOWED IN THIS AREA. WEST OF CONNECTOR #1, ACCESS SHALL BE BY PERMIT.
300 0 300 600 900
65
I-65

SECTION 3

VALUE STUDY PROCESS

SECTION 3
VALUE STUDY PROCESS

This section describes the process used to conduct this Value Study and the significant findings of the Value Team. This Value Study used the international standard Value Methodology established by SAVE International, the Value Society. The standard establishes the specific 6-Phase, sequential process, and the objectives of each of those phases, but does not standardize the specific activities in each phase.

Value Methodology (VM) is the general term that describes the structure and process for executing the Value Workshop. This systematic process was used with a multidisciplinary team to improve the value of the project through the analysis of functions and the identification of targets of opportunity for value improvement.

The **VM Job Plan** provides the structure for the activities associated with the Value Study. These activities are further organized into three major stages:

1. Pre-Workshop preparation

2. VM Workshop

3. Post-Workshop documentation and implementation

Figure 3-2 at the end of this section shows a diagram of the VM Job Plan used for this Value Study.

DEFINING VALUE

Within the context of VM, Value is commonly represented by the following relationship:

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

In this expression, functions are measured by the performance requirements of the customer, such as mission objectives, risk reduction and quality improvements. Resources are measured in materials, labor, price, time, etc. required to accomplish the specific function. VM focuses on improving Value by identifying the most resource efficient way to reliably accomplish a function that meets the performance expectations of the customer.

It can be seen from this relationship that Value is improved or increased by:

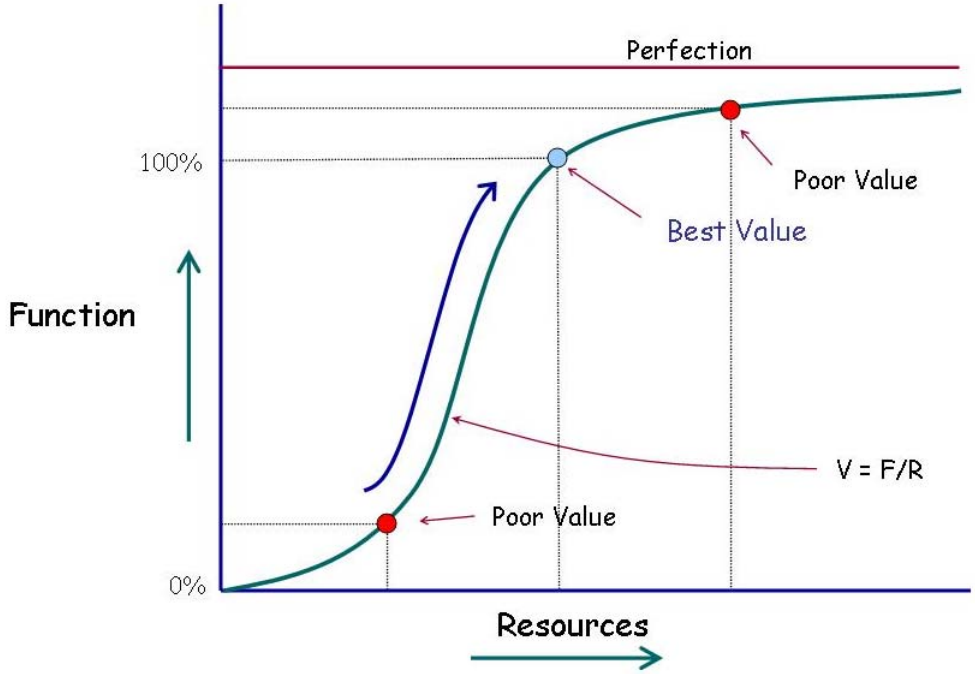
1. Increasing function without increasing resource consumption. Some increase in resources is acceptable as long as there is a greater increase in function performance.

2. Decreasing resources without decreasing function. Again, some decrease in function may be acceptable if the corresponding decrease in resources is significant enough.

Ideally, the Value Team looks for opportunities to increase function and concurrently decrease resource requirements. This will achieve the best value solution.

This Value concept is illustrated in the Figure 3-1, The Value Curve. This figure shows a hypothetical curve from plotting the value expression above. This curve will asymptotically approach perfection. The best value solution for a given project or project element will be found at the knee of the curve. At this point the required function or functions have been achieved to 100% of the required level with a corresponding minimum resource commitment. To attempt to increase the function performance beyond this level will result in a resource consumption that has a higher worth than the marginal increase in function. This results in a poor value solution. Conversely, a poor value solution can also be the result of not achieving the function to 100% of the requirement. In this case, an incremental increase in resources delivers significant increase in function performance. The Value Methodology is used to identify the poor value decisions in a project and then develop alternative solutions to better align the project along this curve to achieve a best value solution.

Figure 3-1
The Value Curve™



This understanding how Value is affected by changes in function or resources provides the foundation for all SVS Value Studies. The following paragraphs describe the process we used to understand the functional requirements and how we identified value improvement alternatives.

PRE-WORKSHOP

Prior to the start of the workshop, the team was tasked with reviewing the most current documentation on the project development. This was done to familiarize them with the project plan and to prepare them for asking questions of the project stakeholders during the project presentations at the beginning of the workshop. Much of the background information for this study was generated by PB. Other pre-workshop activities included:

- Coordinating workshop logistics and communicating those to the various participants
- Providing guidance to KYTC and PB on presentation content for the project introduction
- Scheduling workshop participants and assigning tasks to ensure the team is prepared for the workshop
- Gathering necessary background information on the project and making sure project documentation is distributed to the team members

Materials furnished to the team by KYTC and PB are listed in the Appendix.

Site Visit

Due to the remote location of the site relative to the location for the VM Workshop, a site visit was conducted prior to the workshop. This site visit was attended by representatives from the Value Team and KYTC. The purpose of the site visit was to give the team members a first-hand opportunity to see the physical features of the project site and existing conditions that influenced the plan development.

VM WORKSHOP

The VM workshop was an intensive session during which the project plan was analyzed to optimize the balance between functional requirements and resource commitments (primarily capital and O&M costs).

The VM Job Plan used by SVS includes the execution of the following phases during the workshop:

1. Information Phase
2. Function Analysis Phase
3. Creative Phase
4. Evaluation Phase
5. Development Phase
6. Presentation Phase

Information Phase

At the beginning of the workshop, it was important to understand the background of the project from which the plan was developed. This background was provided in an oral overview by KYTC and PB. The overview and subsequent project analysis provided information on the following topics:

- Rationale why this project is necessary
- Project objectives that have governed the proposed plan
- Rationale for the proposed plan configuration
- Explanation of plan features, criteria, and assumptions
- Value Study constraints
- Project cost

The KYTC project management presentation provided the team with an overview of the goals, issues, and expectations for the project. KYTC and the Value Team also finalized the Value Study constraints. This was followed by PB's more detailed presentation on the project plan and an explanation of the rationale behind key plan level decisions. Further, this gave PB an opportunity to share their issues and concerns about the project from their perspective.

From these presentations, the Value Team noted the following key information:

- Plan was initially to provide a new interchange for the economic development site when Hyundai was a potential buyer. Hyundai decided not to move to the site.
- Plan was originally to build new interchange using KY 1136 but there were concerns with the Camp Nevin historic site and pressure from FHWA to avoid having two interchanges so close together; less than a mile in a rural setting.
- The project evolved from a new interchange to serve the development site to a new or reconstructed interchange to serve the new development and to improve operational concerns with the existing KY 222 interchange.
- All of the concepts considered were heavily influenced by the local community stakeholders. This resulted in an alternative design concept that adjusted to accommodate essentially any resistance from the community or business owners.
- SPUI interchange configurations were preferred over diamond interchange configurations. The thought was one signalized intersection was better operationally than two.

Economic Data for Life Cycle Cost Analysis

To express life cycle costs, the Value Alternatives have been presented based on discounted present worth cost. The economic criteria used by the team were as follows:

Year of Analysis: 2009

Analysis Period: ..... 20 years

Gross Discount Rate: ..... 7% per year

Inflation Rate: ..... 3% per year

Net Discount Rate: ..... 4% per year

Present Worth Factors:

Annual: 15.622

Year 5: 0.8219

Year 10: 0.6756

Year 15 ..... 0.5553

Function Analysis Phase

Function Analysis is the heart of the VM process and is the key activity that differentiates the VM process from other problem solving or improvement practices. During the Function Analysis Phase of the VM Job Plan, functions are identified that describe the expected outcomes of the project under study. Function Analysis also defines how those outcomes are expected to be accomplished by the plan. These functions are described using a two-word, active verb and measurable noun pairing.

This identification and naming convention of project functions enables a more precise understanding by limiting the description of a function to an *active verb* that operates on a *measurable noun* to communicate what work an item or activity performs. This naming convention also helps multidisciplinary teams to build a shared understanding of the functional requirements of the project.

Function Determination

Defining functional requirements for the project allowed KYTC to be sure that the facility, with the current plan, would fulfill the needed purposes. The entire project was analyzed to determine what functions are being accomplished by the current plan. Required functions were retained. Some functions were not necessary to accomplish the mission of the project and thus became candidates for deletion.

During the Function Analysis Phase, the Value Team used various function analysis techniques to analyze the project. This analysis helped the team confirm its understanding of the overall project objectives and analyzed the functions of key project elements. The Value Team Leader led the team through an in-depth discussion of the possible functions of each key project element to clearly and precisely identify the purposes of each.

FAST Diagram

Function analysis was enhanced by using a graphical mapping tool known as the *Function Analysis System Technique* (FAST), which allows team members to understand how the functions of a project relate to each other. The resulting FAST Diagram allowed quick visualization of the logical relationship between project functions and the project as a whole. The FAST diagram is in the Function Analysis section of the Appendix.

The FAST Diagram is structured such that moving to the right of any function answers the question, "How are we accomplishing this function?" Moving to the left of any function answers the question, "Why are we accomplishing this function?" Elements that are vertically connected occur "When" or as a consequence of the function it is connected to on the horizontal path.

The diagram shows on the far left that the ultimate function or the mission that must be accomplished by this project is to Encourage Economic Development by Improving Access. This is accomplished by Improving Operations of the interchange between I-65 and KY 222. Operations are to be improved by reducing accidents and increasing throughput (capacity). To reduce accidents and increase throughput, the project is reducing conflicts by increasing access point spacing, limiting some access, and controlling movements.

The functions between the two dashed lines, called Scope Lines, represent the functional elements of the project which are within the scope of the Value Study. The first column of functions (basic functions) within the left Scope Line represents the functions that must occur in order for this project to successfully accomplish its mission. The remaining functions (secondary or support functions) represent how the current plan has chosen to accomplish those basic functions.

Function Findings

From the function analysis of this project, the team concluded that:

- The growth and planning factors built into the traffic projections are on the conservative side. The traffic considers a 20% increase in peak hour volumes due to an unspecified future development on the State-owned economic development site in addition to a 2.5% annual increase.

- The capacity issues in the existing interchange are driven by a lack of access control. The Preferred Alternative realigns KY 222 rather than modify the access points.

- The design concepts seem to cater to the truck stops' access and operational preferences which may not result in the best long term solution for the development of this area.

- The design concepts seem to have been selected based on the path of least resistance which again may not result in the best long term solution.

- To increase the capacity of the interchange, the project needs to minimize high volume left turn movements at access points. The roundabout in front of the Pilot Travel Center has a significant operational concern. There is a high volume left-turn movement for the ingress traffic that has to travel ¾ of the way around the roundabout and crosses in front of the egress traffic from the truck stop thus causing a conflict point.

In addition to identifying the essential project functions, this phase of the workshop also serves two other objectives:

1. The unification of the individual Value Team members into a synergistic, cohesive team, and

2. The stimulation of creative ideas prior to beginning the subsequent creative phase.

The function analysis worksheets are included in the Appendix.

Creative Phase

This step in the VM process involved generating ideas using creativity techniques. The team recorded all ideas regardless of their feasibility. In order to maximize the Value Team's creativity, evaluation of the ideas was not allowed during the creative phase. The team's effort was directed toward a large quantity of ideas. These ideas were later screened in the Evaluation Phase of the workshop.

The creative ideas generated by the team are included in the Appendix. The list also includes ratings for each idea based on the Evaluation Phase of the workshop. These lists should be carefully reviewed, as there may be other good ideas not developed by the team because of time constraints. These should be further evaluated or modified to gain the maximum benefit for the project.

Evaluation Phase

In this phase of the workshop, the team selected the ideas with the most merit for further development.

After an initial vote, the Value Team Leader assessed how many ideas could be developed into Value Alternatives within the remaining duration of the workshop. From this assessment, all ideas with a certain number of votes were selected for development. However, prior to the final selection, the results were revisited collectively by the Value Team to ensure that those selected by the voting process truly represented the best ideas for development. This gave the team the opportunity to down-rate some ideas and to up-rate other ideas based upon team discussion of the ideas.

The criteria used for selection were:

1. The inherent value, benefit and technical appropriateness of the idea

2. The expected magnitude of the potential cost savings, both capital and life cycle

3. The potential for KYTC and PB acceptance of the idea

Ideas were selected for development as Value Alternatives based on all three criteria.

Not all ideas were developed. This evaluation process is designed to identify those ideas with the greatest potential for value improvement that can be developed into Value Alternatives within the time constraints of the workshop and the production capacity of the team. The

remaining ideas were eliminated from further consideration by the team; however, the ideas not developed should also be reviewed, as there may still be other good ideas not developed by the team because of time constraints or other factors. These could be further evaluated or modified to gain the maximum benefit for the project.

To further ensure the Value Team is focused on developing the best ideas, a mid-point review meeting is conducted with the Value Team Leader, KYTC, and PB representatives. This mid-point review allowed KYTC and PB to identify any fatal flaws in the ideas that were not apparent to the Value Team but were apparent to KYTC and PB project team because of their greater institutional knowledge of the project. These fatal flaws may be technical, operational, political, etc.

Development Phase

During the Development Phase of the workshop, each idea was expanded into a workable alternative to the original project concept. Development consisted of preparing a description of the value alternative, evaluating advantages and disadvantages, and making cost comparisons.

Each alternative is presented with a brief narrative to compare the original concept and the alternative concept. Sketches and brief calculations were also developed, if needed, to clarify and support the alternative. The value alternatives developed during the workshop are presented in Section 4 – Value Improvement Alternatives.

The Value Team Leader and, to the extent possible, other team members reviewed each alternative to improve completeness and accuracy.

Redesign costs are not included in the cost comparison of alternatives. The responsibility for determining these costs is between KYTC and PB. Redesign costs, if any, should be addressed by PB in their response to KYTC on the alternatives.

Presentation Phase

The last phase of this workshop was the presentation of the Value Alternatives. The presentation was made by the Value Team on July 17, 2009 to representatives of KYTC's and PB's project team. The Value Team described each Value Alternative and the rationale that went into the development. This was followed by answering the audience's questions. The acceptability of the Value Alternatives was deferred.

From this presentation, the following key points of discussion were noted:

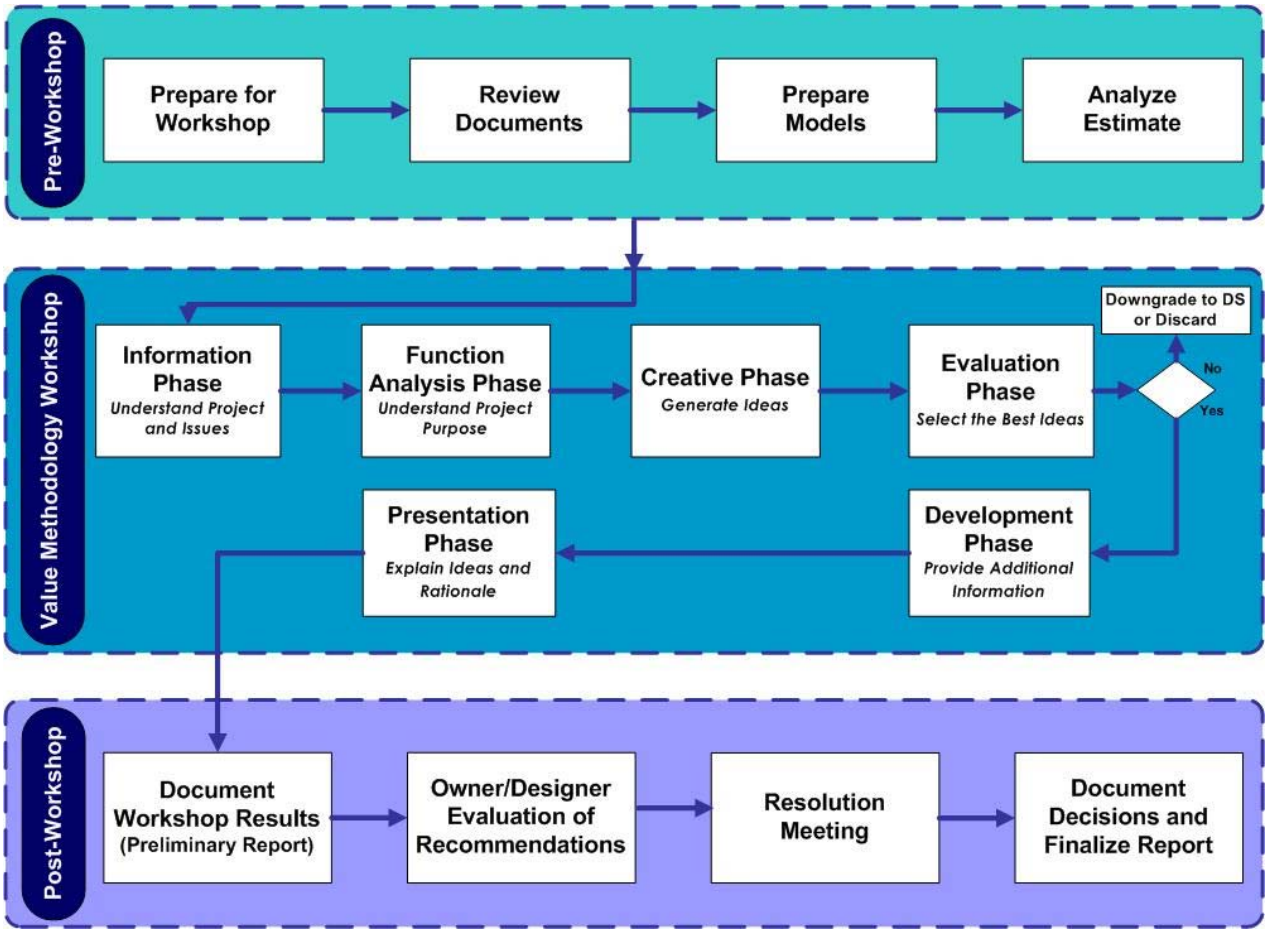
- While it is recognized that the truck stops' access and traffic flow patterns are affecting the design concept, there is concern that any changes will result in a legal battle.
- It was stated that the implemented solution needs to provide capacity for a major economic development in the future.

POST-WORKSHOP

The Post-Workshop activities of this Value Study consisted of preparing the Value Study Reports. Shortly after the conclusion of the workshop, our Preliminary Report was submitted to

KYTC for review. This report contained the raw workshop product. This Final Value Study Report includes documentation of the Value process, as well as, the Value Alternatives developed during the workshop. The decisions regarding implementation of the alternatives are documented outside this report.

Figure 3-2
Value Engineering Process Diagram



SECTION 4

VALUE ALTERNATIVES

SECTION 4
VALUE ALTERNATIVES

The results of this Value Study represent the value improvement opportunities that can be realized on this project. They are presented as individual alternatives for specific changes to the current plan.

Each alternative includes:

- A summary of the original concept
- A description of the alternative concept
- A brief narrative comparing the original plan and the recommended change
- Sketches, where appropriate, to further explain the alternative
- Calculations, where appropriate, to support the technical adequacy of the alternative
- A capital cost comparison
- And a life cycle cost analysis, if appropriate

Cost was the primary resource that was compared to the functions being accomplished in the project. To ensure that costs were compatible within the Value Alternatives proposed by the team, the project cost estimate and the KYTC published bid tabs were used as the basis of cost.

EVALUATING THE VALUE ALTERNATIVES

Each part of a Value Alternative should be evaluated on its own merit, rather than discarding an entire Value Alternative because of concern over a particular aspect of the proposed change. Furthermore, KYTC and PB are encouraged to review all of the ideas shown in the creative idea listing in the Appendix. Since the Value Team was constrained by a finite duration for the workshop and the production capacity of the team not all ideas were developed. Therefore there may be other ideas in that list that would provide additional value improvement opportunities for the project.

ORGANIZATION OF ALTERNATIVES

The alternatives presented on the following pages are organized by project or functional categories, and then numerically within each of those categories. The divisions used to organize the alternatives are as follows:

Improve Operations (IO)

This designation has been used throughout the VE process to organize the ideas.

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IMPROVE OPERATIONS (IO)

Value Alternative

Project: I-65 & KY 222 Interchange
Location: Hardin County

Alternative No:
IO-4

Title:
Reverse the truck flow pattern through the Pilot Travel Center

Description of Original Concept:

In the original concept the Pilot Travel Center located in the northeast quadrant of the existing diamond interchange has two entrances on the south side along KY 222 served by a roundabout and two entrances on its east side along US 31W. Almost all truck traffic enters the truck stop from the entrance on KY 222 while the second entrance is used by non-truck traffic to access McDonalds. Truck traffic entering the truck stop exits the truck stop from the east side by turning right onto US 31W toward KY 222 & US 31W intersection where it turns right heading west to I-65 past the two south side entrances on KY 222. This movement is controlled by the location of master and slave pumps at the Pilot Truck Center, which provides the master pump on the driver's side.

Description of Alternative Concept:

There are two alternative concept options.

Option 1

Reverse the location of the master and slave pumps and direct truck traffic into the Pilot Travel Center from the east side on US 31W and out from the south side entrance on KY 222 by turning right back toward I-65. Place an island on the KY 222 access point to allow a right-in right-out to the truck stop only.

Option 2

Close both access points on US 31W. Impose a turnaround within the Pilot Travel Center to redirect the truck traffic back out to I-65 through the same access point on KY 222

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☑ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☐ Decreased

Cost Savings Summary

First Cost Savings:	($ 115,000)
O&M Savings:	$ 0
Life Cycle Cost Savings:	($ 115,000)

Advantages/Disadvantages

Alternative No.: IO-4

Advantages of Alternative Concept

Option 1

- Enhanced traffic pattern in and out of the truck stop contributes to less traffic congestion on KY 222
- Elimination of conflict with traffic turning left into McDonalds on the south side of the truck stop thus improving safety

Option 2

- Controlled access to the truck stop only from KY 222

Disadvantages of Alternative Concept

- Cost associated with reversing the master and slave pumps
- Reconfiguration of the parking areas within the truck stop
- Truck stop has previously rejected any changes to their operation

Discussion

Alternative No.: IO-4

Option 1

The truck traffic entering the Pilot Travel Center is a major contributing factor to the congestion on KY 222 east of the existing diamond interchange. Truck traffic enters the Pilot Travel Center essentially for refueling both from the southbound and northbound ramps making up a high percentage of traffic in this area. The existing truck traffic enters the Pilot Travel Center from the KY 222 entrance because of the location of dual (master and slave) fuel pump lanes. The location of master and slave pumps is directly responsible for the truck traffic through the KY 222 entrance. Once refueled trucks proceed to exit from the US 31W access point through a right turn to loop around the truck stop back through KY 222 toward I-65 where they impose conflict to the traffic turning left onto either the fueling area or McDonalds hence worsening the traffic conditions in the area.

Large trucks have two fuel tanks that can be accessed from either the driver side or passenger side of the vehicle. Some trucks fuel tanks can only be filled from one side. The idea behind a dual pump is to accommodate access to the pump from either side of the truck. The master pump has a meter on it and in some cases means of payment with a credit card whereas the slave pump typically does not have a meter on its face. The slave pump can only be activated after the master (metered) pump is activated. Once finished with refueling, both nozzles should be put back on the pumps before the truck can proceed out of the fuel lane to pay the office for the fuel or drive away.

The existing set up of the dual pumps at the Pilot Travel Center is such that the driver can access the master pump from the driver side when the truck enters the fuel lane from the south side of the truck stop through the access point on KY 222. By reversing the location of master and slave pumps truck traffic will be directed to enter the truck stop from US 31W and leave the truck stop from the south access point thereby substantially improving the traffic conditions on KY 222. The “enter” and “exit” signs on US 31W should also be reversed. Construction of an island at the access point on KY 222 will impose a right-in right-out condition while placement of a “Do Not Enter” sign turned at an angle visible only to the KY 222 eastbound traffic will further enforce the overall movement and prevent left turns into the truck stop.

Option 2

In this scenario both access points on US 31W should be closed to allow only one access point from KY 222. The area within the truck stop should be slightly modified with proper signage to ensure trucks can turn around and be to redirected back to I-65 through the same access point on KY 222 thereby achieving controlled access and effective discouragement of truck traffic east of the access point which should considerably alleviate the existing congestion caused by slow moving truck traffic in this area.

Sketch

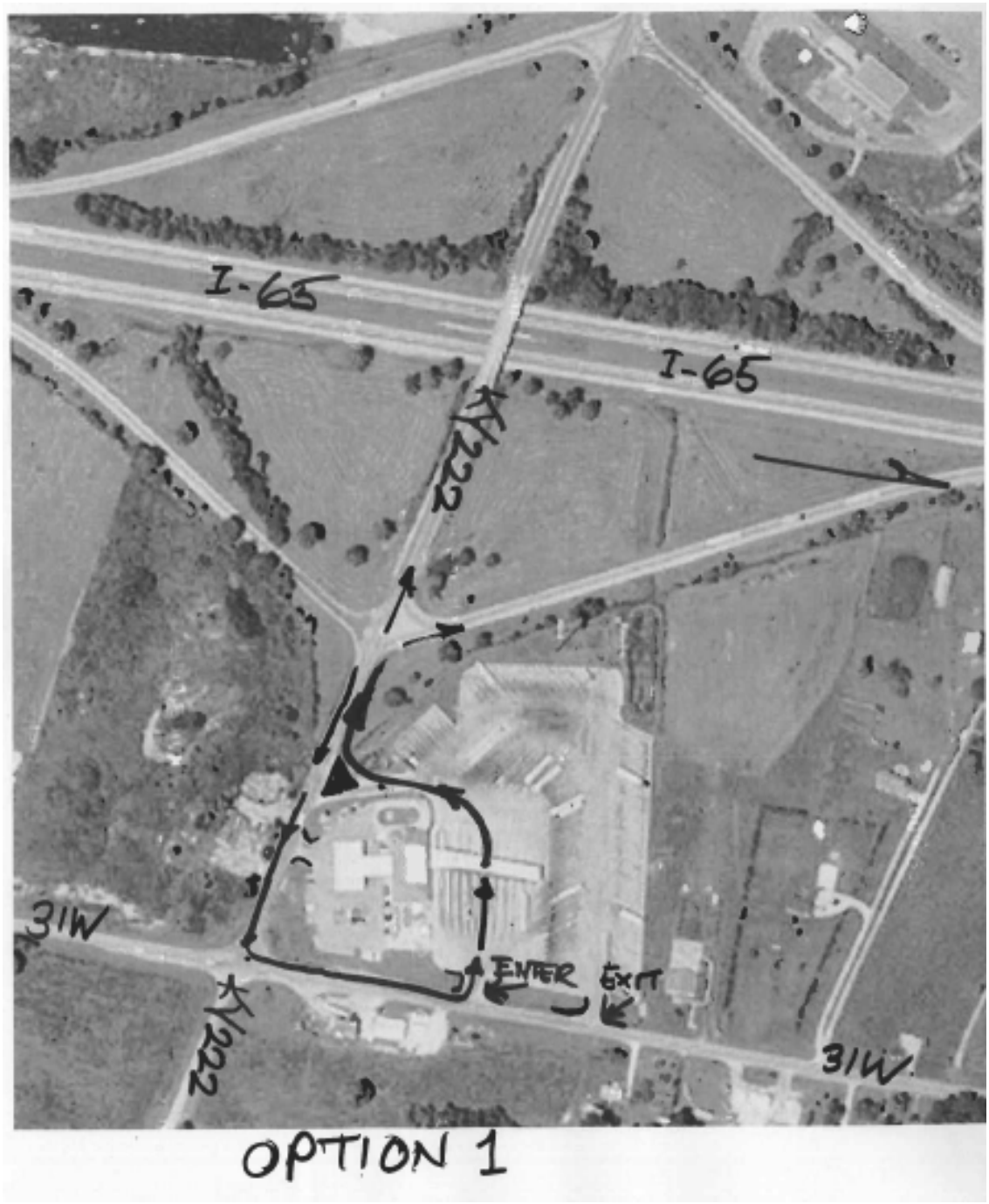
Alternative No.: IO-4

☑ Original ☐ Alternative

Sketch

Alternative No.: IO-4

☐ Original ☑ Alternative



Sketch

Alternative No.: IO-4

☐ Original ☑ Alternative

Construction Cost Estimate

Alternative No.: IO-4

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Switch master/slave pump locations	EA	10,000.00			10	$100,000
Contingency (15%)		0.15				$15,000
TOTALS						$115,000
NET SAVINGS						($115,000)

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Value Alternative

Project: I-65 & KY 222 Interchange
Location: Hardin County

Alternative No:
IO-5

Title:
Use a partial cloverleaf at the existing interchange location

Description of Original Concept:

The original concept is to realign KY 222 and construct a SPUI south of the existing interchange with I-65.

Description of Alternative Concept:

The alternative concept is to maintain the alignment of KY 222 and build a partial cloverleaf interchange at I-65. Access points to the businesses along KY 222 would be moved further from the interchange ramp intersections.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 8,414,000
O&M Savings:	$ 0
Life Cycle Cost Savings:	$ 8,414,000

Advantages/Disadvantages

Alternative No.: IO-5

Advantages of Alternative Concept

- Access control issues are improved since driveways are relocated (reducing crashes)
- Provides free-flow movements for interstate entrance ramps
- Interstate exit ramp intersections will operate at A/B and B/C LOS in the design year assuming the development site is occupied
- Reuses three of the four existing diamond leg ramps
- Less additional right-of-way will be needed
- Does not move the interchange away from the truckstops
- Would not require the relocation of a “blue-line” stream that is being relocated in the Preferred Alternative

Disadvantages of Alternative Concept

- Low speed loop ramps (25 mph) for westbound to southbound and eastbound to northbound entrance ramps
- Closes several commercial driveways
- Construction sequencing / maintenance of traffic will be more difficult

Discussion

Alternative No.: IO-5

In the alternative concept KY 222 would remain on its existing alignment and widened roadbed in lieu of a new alignment. The project would begin on the west near Robey Drive.

A new intersection on KY 222 would be created just west of the Petro truck stop by constructing a new north-south (NS) roadway. The driveways for the Petro (both truck and car entrances) as well as the driveways to Glendale Economy Inn and Country Style Plaza would be relocated to this new NS roadway. The new NS roadway would provide access to the potential future industrial development site. The existing commercial driveways along KY 222 would be closed to provide approximately 1,200 feet between the ramp intersection and the NS roadway.

The Petro parking lot would likely need to be re-striped to change the circulation for trucks traveling to the gas pumps.

The interchange entrance ramps would be free-flow in this alternative.

- The eastbound to southbound entrance ramp diverges from KY 222 approximately 750 feet east of the new NS roadway. This ramp will use the existing ramp roadbed.

- The eastbound to northbound entrance ramp would use a new low-speed loop ramp. This ramp would begin west of the bridge over I-65, travel over the bridge, and diverge from KY 222 after the bridge structure.

- The westbound to southbound entrance ramp would be on a new alignment shifting the ramp west and closer to the interstate. This shift moves the ramp away from the Pilot Travel Center. This shift creates an opportunity to allow the Pilot Travel Center to expand its parking lot if a reduction in another area is needed.

- The westbound to northbound entrance ramp would use a new low-speed loop ramp. This ramp would begin east of the bridge over I-65, travel over the bridge, and diverge from KY 222 after the bridge structure.

The interchange exit ramps would intersect KY 222 with a roundabout or signalized intersection. Both the northbound and southbound exit ramps would use the existing ramp roadbeds. These existing intersections are separated by 1,200 feet.

The existing bridge structure on KY 222 would need to be replaced. The new two-span bridge would be 100 feet wide to accommodate two through lanes (one in each direction), the tapering loop ramp lanes in each direction, and shoulders. The new bridge structure would need to be 225 feet long to accommodate the ultimate six lanes for I-65 as well as the tapering loop ramp deceleration lanes.

The stream relocation proposed in the Preferred Alternative would not be needed in this alternative with the addition of a 48-inch pipe under the westbound to southbound loop ramp.

Discussion

Alternative No.: IO-5

Both commercial driveways on KY 222 accessing the Pilot Travel Center would be closed in this alternative concept. Entering trucks would be directed north on US 31W into a left turn lane into the northernmost existing entrance. The trucks would circulate counterclockwise towards the pumps and out through the existing exit driveway on US 31W. Car traffic would enter and exit the Pilot Travel Center through a new driveway on US 31W 250 feet north of the KY 222 and US 31W intersection.

Land vacated by the westbound to northbound entrance ramp could be considered to use as an expansion of the Pilot Travel Center parking lot. These could be used to replace parking spaces and the oil change facility which may be lost due to the proposed change in circulation pattern.

This alternative includes relocating the eastern leg of KY 222 at the US 31W intersection. This is due to the high eastbound turning movements and very low westbound traffic approaching from the east on KY 222. The eastern KY 222 connection would be provided 1,200 feet south across from the 1E-Town Auto Auction driveway.

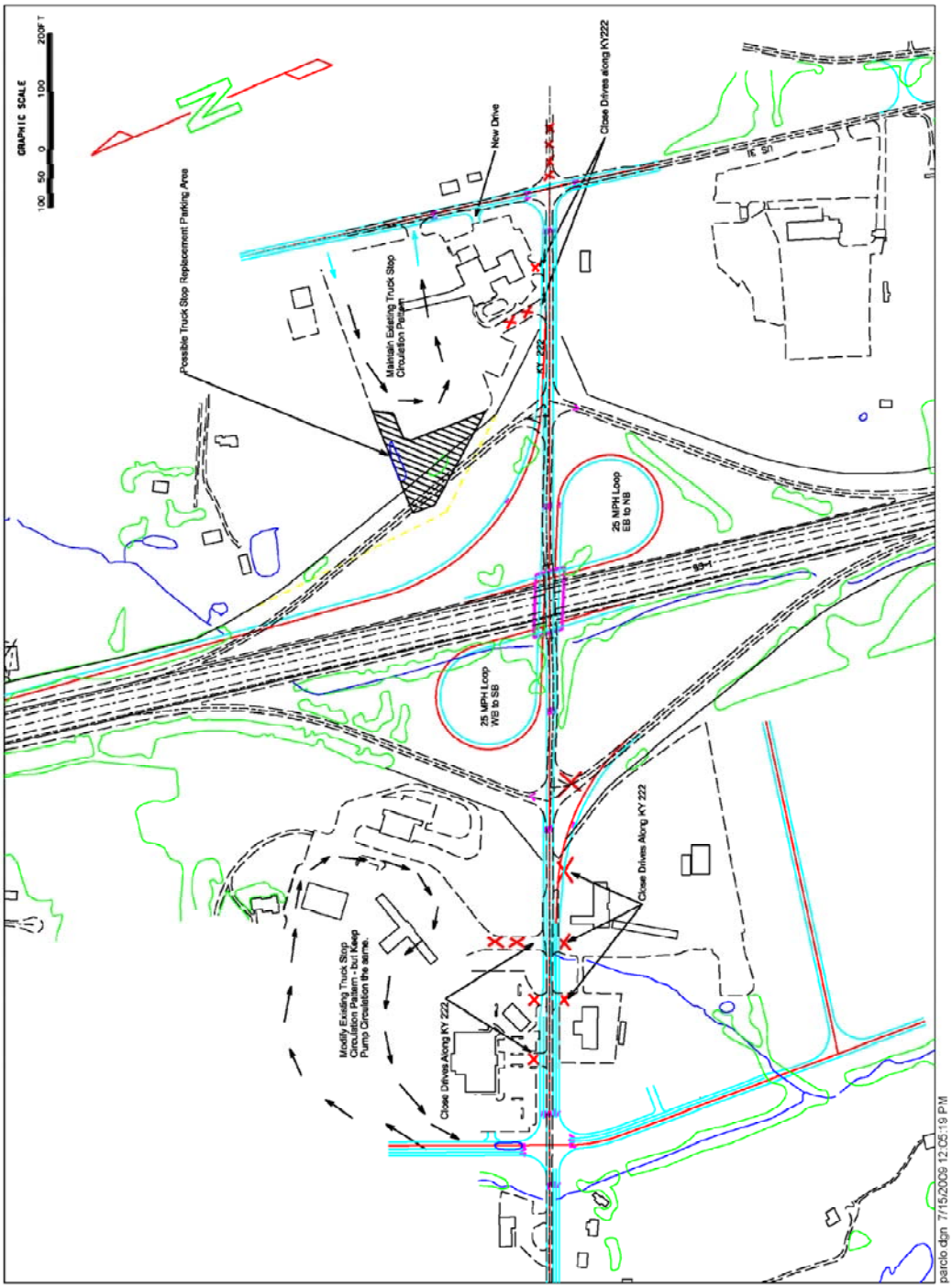
Construction sequencing of this concept would require partial width construction of most features of this project. The bridge, ramps, KY 222, and US 31W would need to be constructed half at a time to maintain traffic.

Traffic operations in the design year 2030, assuming the development site is operating, the ramp intersections in the AM peak hour will operate at a LOS A/B and in the PM peak hour will operate at a LOS C/B.

Sketch

Alternative No.: IO-5

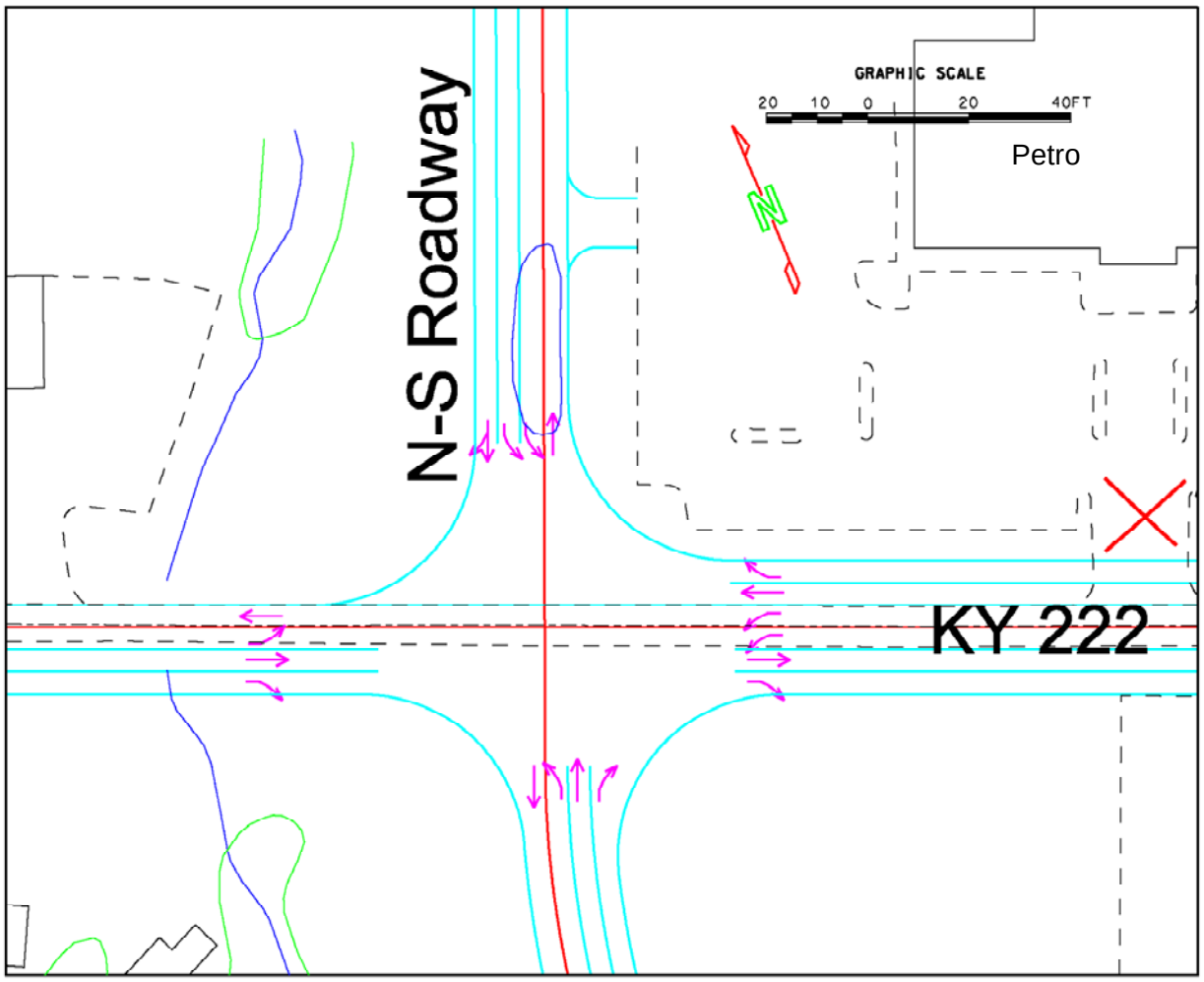
☐ Original ☑ Alternative



Sketch

Alternative No.: IO-5

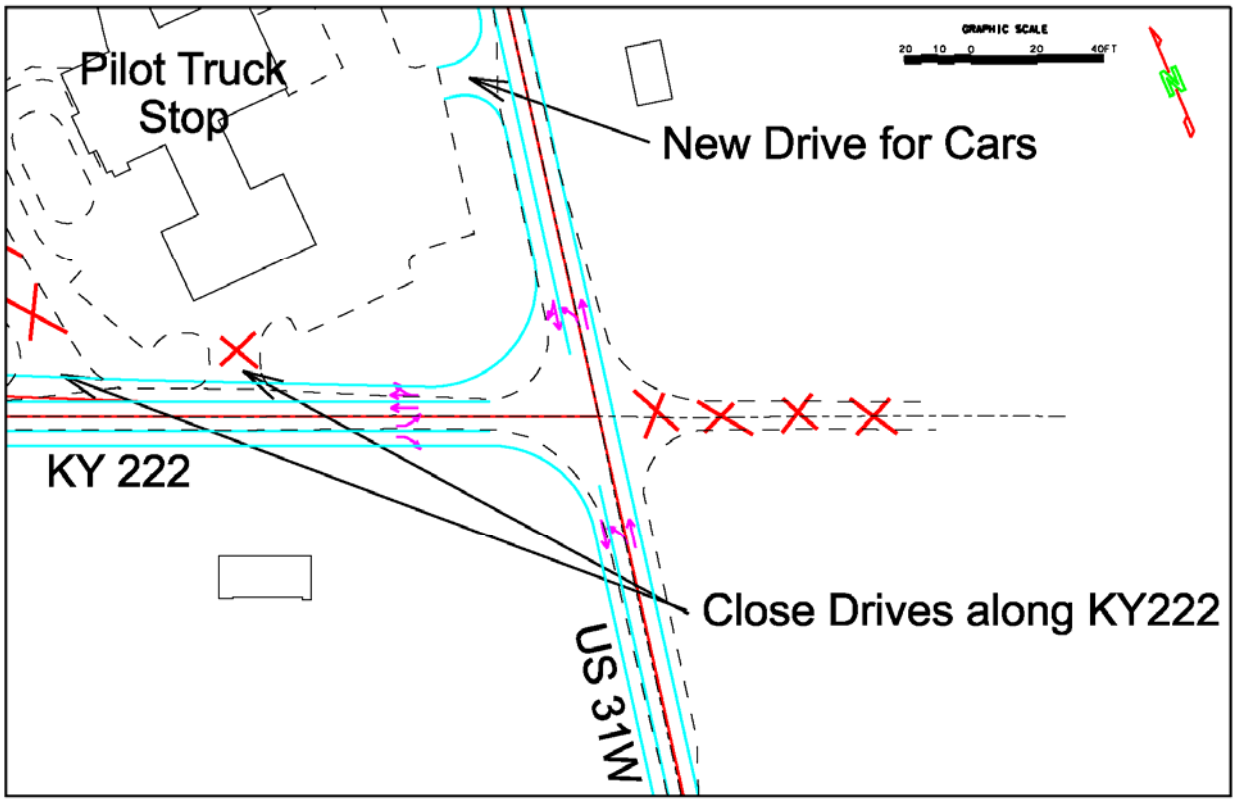
☐ Original ☑ Alternative



Sketch

Alternative No.: IO-5

☐ Original ☑ Alternative



Calculations

Alternative No.: IO-5

☐ Original ☑ Alternative

Pavement Quantity – Assume full depth shoulder

US 31W	8,963 sy
KY 222 E of I-65	10,336 sy
KY 222 W of I-65 and E of NW Rd	12,922 sy
KY 222 N of NS Rd	3,530 sy
KY 222 in NS Rd 1/5	1,736 sy
NS Rd N of KY 222	4,079 sy
NS Rd S of KY 222	10,323 sy
SB Exit Ramp	8,975 sy
WB NB Entrance	10,498 sy
WB SB Entrance	5,182 sy
NB Exit Ramp	9,489 sy
EB NB Entrance	5,220 sy
EB SB Entrance	9,126 sy
	100,379 sy

Calculations

Alternative No.: IO-5

☐ Original ☑ Alternative

Pavement Quantity

US 31W

DGA	=	4 in depth; 8,963 sy area		
	=	996 cy material x 1.89 ton/cy	=	1,882 ton
Drainage blanket			=	none
Asphalt Base				
	=	12.75 in depth, assume 1,402.5 #/sy		
	=	8,963 sy x 1,402.5#/sy x 1 ton/2,000#	=	6,285 ton
Asphalt Surface				
	=	1.25 in depth, assume 137.5 #/sy		
	=	8,963 sy x 137.5 #/sy x 1 ton/2,000#	=	616 ton
NS Road		4,079 sy + 10,323 sy	=	14,402 sy
DGA	=	4 in depth; 14,402 sy area		
	=	1,600 cy material x 1.89 ton/cy	=	3,024 ton
Drainage blanket (4 in depth)				
	=	0.21 ton/sy for 4 in	=	3,024 ton
Asphalt Base				
	=	14 in depth, assume 1,540 #/sy		
	=	14,402 sy x 1,540 #/sy x 1 ton/2,000#	=	11,090 ton
Asphalt Surface				
	=	1.25 in depth, assume 137.5 #/sy		
	=	14,402 sy x 137.5 #/sy x 1 ton/2,000#	=	990 ton

Calculations

Alternative No.: IO-5

☐ Original ☑ Alternative

Pavement Quantity

KY 222

Area	=	10,336 sy + 12,922 sy + 3,530 sy + 1,736 sy=		28,524 sy
DGA	=	4 in depth; 28,524 sy area		
	=	3,169 cy material x 1.89 ton/cy	=	5,990 ton
Drainage blanket				
	=	4 in depth	=	28,524 sy
	=	0.21 ton/sy for 4 in	=	5,990 ton
Asphalt Base				
	=	14 in depth, assume 1,540 #/sy		
	=	28,524 sy x 1,540 #/sy x 1 ton/2,000#	=	21,963 ton
Asphalt Surface				
	=	1.25 in depth, assume 137.5 #/sy		
	=	28,524 sy x 137.5 #/sy x 1 ton/2,000#	=	1,961 ton

Calculations

Alternative No.: IO-5

☐ Original ☑ Alternative

Pavement Quantity

Ramps

Area	=	8,975 + 10,498 + 5,182 + 9,489 + 5,220		
		+ 9,126 sy	=	48,490 sy
DGA	=	4 in depth; 48,490 sy area		
	=	5,388 cy material x 3,780 #/cy x 1 ton/2,000#	=	10,183 ton
Drainage blanket				
	=	4 in depth	=	48,490 sy
	=	0.21 ton/sy for 4 in	=	10,183 ton
Asphalt Base				
	=	14 in depth, assume 1,540 #/sy		
	=	48,490 sy x 1,540 #/sy x 1 ton/2,000#	=	37,337 ton
Asphalt Surface				
	=	1.25 in depth, assume 137.5 #/sy		
	=	48,490 sy x 137.5 #/sy x 1 ton/2,000#	=	3,334 ton

Calculations

Alternative No.: IO-5

☐ Original ☑ Alternative

Pavement Removal (removing commercial drives)

531 sy

26 sy

61 sy

1,124 sy

989 sy

682 sy

148 sy

3,562 sy

MSE Walls along Glendale Economy Inn and Country Style Plaza

240 lf + 470 lf	=	710 lf
Avg 3 ft tall	=	2,130 sf
Signals	=	4
Bridge removal	=	same
Bridge – 2 span	=	22,500 sf

Calculations

Alternative No.: IO-5

☐ Original ☑ Alternative

Earthwork

SB exit ramp – use existing

= 8,975 sy x 1.5 ft ÷ 3 ft/yd = 4,488 cy cut

WB SB entrance loop

14 ft fill, average 7 ft

= 5,182 sy x 7 ft fill ÷ 3 ft/yd = 12,091 cy fill

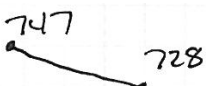
EB SB entrance - 700 ft new alignment approximately 2,644 sy, at grade, assume same as if on existing road bed

= 9,126 sy x 1.5 ft cut ÷ 3 ft/yd = 4,563 cy cut

NB exit ramp – use existing

= 9,489 sy x 1.5 ft ÷ 3 ft/yd = 4,745 cy cut

EB NB entrance loop

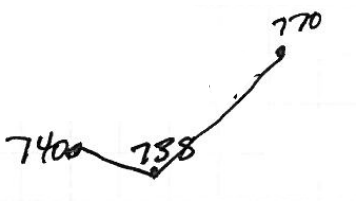


9.5 ft average

= 5,220 sy x 9.5 ft fill ÷ 3 ft/yd = 16,530 cy fill

WB NB entrance – assume 3 ft fill average

= 10,498 sy x 3 ft ÷ 3 ft/yd = <u>10,498 cy fill</u>



= 13,796 cy cut

= 39,119 cy fill

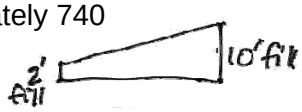
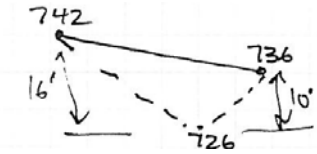
Calculations

Alternative No.: IO-5

☐ Original ☑ Alternative

Earthwork

For reconstruction on existing road bed, assume excavation of 18-inch required

US 31W	8,963 sy x 18 in	=	4,482 cy cut
KY 222 E of I-65	10,336 sy x 18 in	=	5,168 cy cut
KY 222 W of I-65 & E of NW Rd	12,922 sy x 18 in	=	6,461 cy cut
KY 222 W of NS Rd	3,530 sy x 18 in	=	1,765 cut
KY 222 in NS Rd 1/5	1,736 sy x 18 in	=	868 cy cut
NS Rd Wy N of KY 222			
1/6 at 742, lot at 750, exgrade approximately 740		=	Avg 6 ft fill
Area = 4,079 sy x 6 ft fill		=	8,158 cy fill
NS Rd S of KY 222			
1/5 at 742, lot at 736, exgrade 742			
Area = 10,323 sy x 13 ft fill		=	<u>44,733 cy fill</u>
		=	18,744 cy cut
		=	52,891 cy fill

Calculations

Alternative No.: IO-5

☐ Original ☑ Alternative

Pipes

NS Connector – 72-inch pipe, 230 feet

KY 222

36 in pipe	80 ft	
54 in pipe	200 ft	
18 in pipe	200 ft	

Ramp

SB Exit	-	
NB Exit	-	
WB SB	15 in	200 ft
WB NB	18 in	200 ft
EB SB	54 in	200 ft
EB ND	36 in	200 ft

US 31W

18 in	200 ft	
18 in	200 ft	
18 in	200 ft	
36 in	100 ft	
18 in	100 ft	

Construction Cost Estimate

Alternative No.: IO-5

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Preferred Alternate	LS	27,748,000	1	$27,748,000		
Value Alternative						
Sheet 1	LS	7,890,000			1	$7,890,000
Sheet 2	LS	746,000			1	$746,000
Sheet 3	LS	4,478,000			1	$4,478,000
Sheet 4	LS	6,220,000			1	$6,220,000
TOTALS				$27,748,000		$19,334,000
NET SAVINGS						$8,414,000

Construction Cost Estimate

Alternative No.: IO-5

Sheet 1 of 4

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Paving						
DGA Base	TON	19.45			21,079	$409,987
Drainage Blanket Type II Asph	TON	51.61			19,197	$990,757
Crushed Agg Size #2	TON	20.79			2,995	$62,266
Asph Base	TON	47.33			76,675	$3,629,028
Asph Surface	TON	71.10			6,901	$490,661
Fabric - Geotextile Type IV	SQYD	2.04			14,262	$29,094
Roadway						
Lip Curb and Gutter	LF	16.35				
Island Curb and Gutter	LF	17.66				
Standard Barrier Median Type 5	SQYD	181.27				
Remove Pavement	SQYD	4.73			3,562	$16,848
Embankment in Place	CUYD	6.58			124,550	$819,539
Water	MGAL	0.05			7,000	$350
Fence - Woven Wire Type 1	LF	5.37			18,000	$96,660
Guardrail - Steel W Beam S Face	LF	21.09			3,615	$76,240
Guardrail Connector to Bridge End TY A	EACH	2,129.52			2	$4,259
Guardrail End Treatment Type 2a	EACH	648.87			3	$1,947
Guardrail connector to Bridge End Ty A-1	EACH	488.90			2	$978
Guardrail End Treatment Type 4A	EACH	2,094.26			3	$6,283
RW Marker Rural Type 1A	EACH	85.00			39	$3,315
RW Marker Rural Type 3	EACH	85.00			11	$935
Clearing and Grubbing	EACH	200,000.00			1	$200,000
Edge Key	LF	66.54			144	$9,582
Milled Rumble Strips	LF	0.69			18,000	$12,420
Contingency (15%)		0.15				$1,029,172
TOTALS						$7,890,000

Construction Cost Estimate

Alternative No.: IO-5

Sheet 2 of 4

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Drainage						
Entrance Pipe - 15 in	LF	39.34			200	$7,868
Entrance Pipe - 18 in	LF	56.44				
Entrance Pipe - 24 in	LF	56.82				
Culvert Pipe - 18 in	LF	57.51			1,100	$63,261
Culvert Pipe - 24 in	LF	91.82				
Culvert Pipe - 30 in	LF	117.78				
Culvert Pipe - 36 in	LF	87.90			380	$33,402
Culvert Pipe - 54 in	LF	151.57			400	$60,628
Culvert Pipe - 72 in	LF	286.63			230	$65,925
Perforated Pipe - 4 in	LF	5.88			10,000	$58,800
Sloped Box Outlet Type 1-18 in	EACH	1,493.02			10	$14,930
Sloped Box Outlet Type 1-24 in	EACH	2,044.94				
S & F Box Inlet - Outlet - 18 in	EACH	2,226.53				
S & F Box Inlet - Outlet - 24 in	EACH	2,798.90				
S & F Box Inlet - Outlet - 36 in	EACH	4,907.71			6	$29,446
Drop Box Inlet Type 1	EACH	2,826.55				
Safety Box Inlet - 18 in SDB-1	EACH	2,716.67				
Cored Hole Drainage Box Con 4 in	EACH	112.01				
Temp Ditch	LF	0.82				
Channel Lining Class II	TON	26.83				
Channel Lining Class III	TON	33.52				
Temp Silt Fence	LF	2.08			24,646	$51,264
Silt Trap Type A	EACH	361.29			627	$226,529
Silt Trap Type B	EACH	173.64			106	$18,406
Silt Trap Type C	EACH	168.25			106	$17,835
Contingency (15%)		0.15				$97,244
TOTALS						$746,000

Construction Cost Estimate

Alternative No.: IO-5

Sheet 3 of 4

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Drainage (Cont.)						
Clean Silt Trap Type A	EACH	27.47			981	$26,948
Clean Silt Trap Type B	EACH	42.27			318	$13,442
Clean Silt Trap Type C	EACH	4.93			318	$1,568
Clean Temp Silt Fence	LF	0.40			24,646	$9,858
Erosion Control Blanket	SQYD	1.01			78,900	$79,689
Temp Mulch	SQYD	0.15			759,905	$113,986
Seeding and Protection	SQYD	0.29			759,905	$220,372
Sodding	SQYD	4.80			2,580	$12,384
Concrete Class A	CUYD	834.19				
Steel Reinforcement	LB	1.58				
4' x 4' Box Culvert	CUFT	16.00				
5' x 4' Box Culvert	CUFT	16.00				
6' x 6' Box Culvert	CUFT	16.00				
8' x 6' Box Culvert	CUFT	16.00				
Bridge						
Removed Structure	LS	150,000.00			1	$150,000
KY 222 2-Span Bridge over I-65	SQFT	120.00			22,500	$2,700,000
Signing						
MOT Signs	SQFT	8.10			3,100	$25,110
Install Project ID Signs	EACH	66.73			2	$133
Perm Road Signs	LS	140,000.00			1	$140,000
Signalization						
Install Actuated Traffic Signal with Loop	EACH	100,000.00			4	$400,000
Contingency (15%)		0.15				$584,024
TOTALS						$4,478,000

Construction Cost Estimate

Alternative No.: IO-5

Sheet 4 of 4

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Lighting						
Highmast Lighting	LS	450,000.00			1	$450,000
Miscellaneous						
Install Temp Conc Med Barrier	LF	12.00			30,000	$360,000
Maintain & Control Traffic	LS	500,000.00			1	$500,000
Lane Closure	EACH	1,078.52			56	$60,397
Portable Changeable Message Sign	EACH	6,568.85			8	$52,551
Staking	LS	150,000.00			1	$150,000
Pave Striping - Perm Paint - 4 in	LF	0.24			59,235	$14,216
Pave Striping - Thermo - 6 in W	LF	0.66			51,020	$33,673
Pave Striping - Thermo - 6 in Y	LF	0.81			28,245	$22,878
Pavement Marker Type V-B W/R	EACH	20.80			710	$14,768
Pavement Marker Type V-B Y/R	EACH	23.12			960	$22,195
Lot Pay Adjustment	DOLL	1.00			169,924	$169,924
Fuel Adjustment	DOLL	1.00			196,898	$196,898
Asphalt Adjustment	DOLL	1.00			305,863	$305,863
Mobilization & Demobilization						
Mobilization	LS	632,198.16			1	$632,198
Demobilization	LS	316,099.08			1	$316,099
Miscellaneous Construction	LS	2,107,327.19			1	$2,107,327
Contingency (15%)		0.15				$811,348
TOTALS						$6,220,000

Value Alternative

Project: I-65 & KY 222 Interchange
Location: Hardin County

Alternative No:
IO-11

Title:
Use Alternate 1

Description of Original Concept:

In the original concept, the Preferred Alternative proposes a single-point urban interchange (SPUI) on a new alignment for KY 222.

Description of Alternative Concept:

The alternative concept constructs a diamond interchange on a new KY 222 alignment in place of the proposed SPUI. This alternative is shown as Alternate 1 in the Preliminary Line and Grade alternatives evaluated by the design team.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 2,900,000
O&M Savings:	$0
Life Cycle Cost Savings:	$ 2,900,000

Advantages/Disadvantages

Alternative No.: IO-11

Advantages of Alternative Concept

- Simplified interchange design
- Achieves LOS and functional performance at a lower cost
- Avoids relocation of a “blue-line” stream

Disadvantages of Alternative Concept

- None identified

Discussion

Alternative No.: IO-11

The alternative concept uses a traditional diamond interchange in place of the proposed SPUI. This alternative reduces structure costs and eliminates the need to relocate the blue-line stream to the west of the interchange that is affected by the Preferred Alternative.

Project costs estimated by the project team are $40.4 M which includes approximately $10M worth of improvements required to widen I-65. Improvements on I-65 were eliminated from the Preferred Alternative and it is recommended that these improvements not be made in conjunction with the diamond interchange.

Level of service and queue analysis was conducted to compare the operations of the diamond and single-point designs. The results of the LOS analysis are presented in the table below. System wide performance is summarized in a second table. Queue analysis indicated that queuing between intersections would not be an issue with either option, critical queue lengths are shown in the attached figures.

Level of Service Summary

Intersection	LOS Results Alternative 1: Diamond Interchange		LOS Results Alternative 2: SPUI (Preferred Alternate)	
	AM Peak	PM Peak	AM Peak	PM Peak
KY 222 and Connector #2	B	B	B	B
KY 222 and I-65 NB Ramps	B	B	C	C
KY 222 and I-65 SB Ramps	B	B		
KY 222 and US 31W	B	B	B	A

Discussion

Alternative No.: IO-11

Simtraffic System Performance Summary

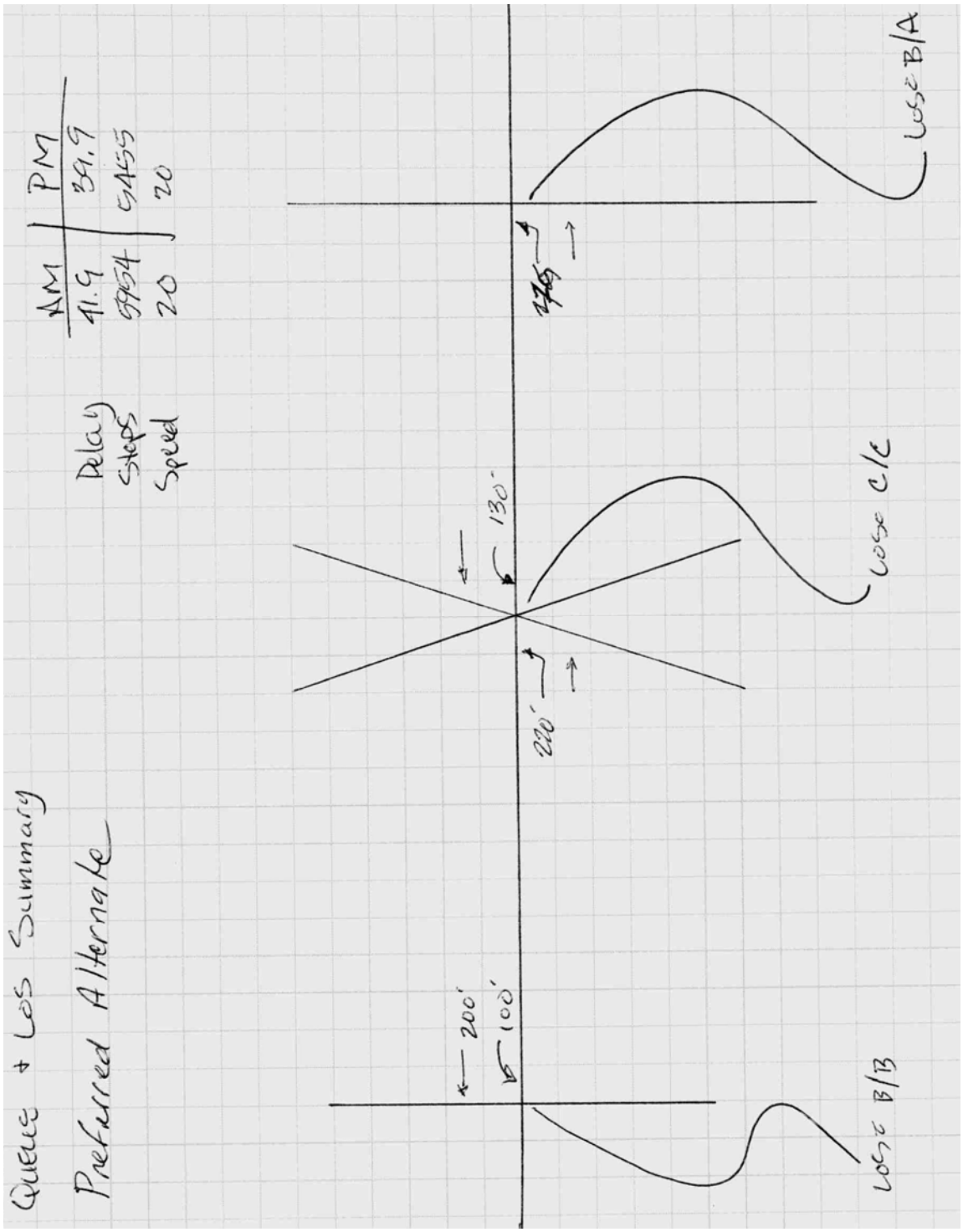
MOE	System Performance Alternative 1: Diamond Interchange		System Performance Preferred Alternate	
	AM Peak	PM Peak	AM Peak	PM Peak
Delay (sec/veh)	53.2	50.7	41.9	39.9
Stops	6722	6435	5954	5455
Average Speed (mph)	20	20	20	20

Evaluation of the operational analysis indicates that there will not be any operational deficiencies either as a result of delay and/or queuing. System performance for the diamond interchange shows an average of 10 seconds per vehicle higher than the proposed alternative and approximately a 17 percent increase in stops. These increases are attributable to the additional signal required by the diamond interchange. However, the average estimated speed through the corridor is the same for both alternatives. Overall the diamond provides an adequate level of service for the new alignment of KY 222.

Sketch

Alternative No.: IO-11

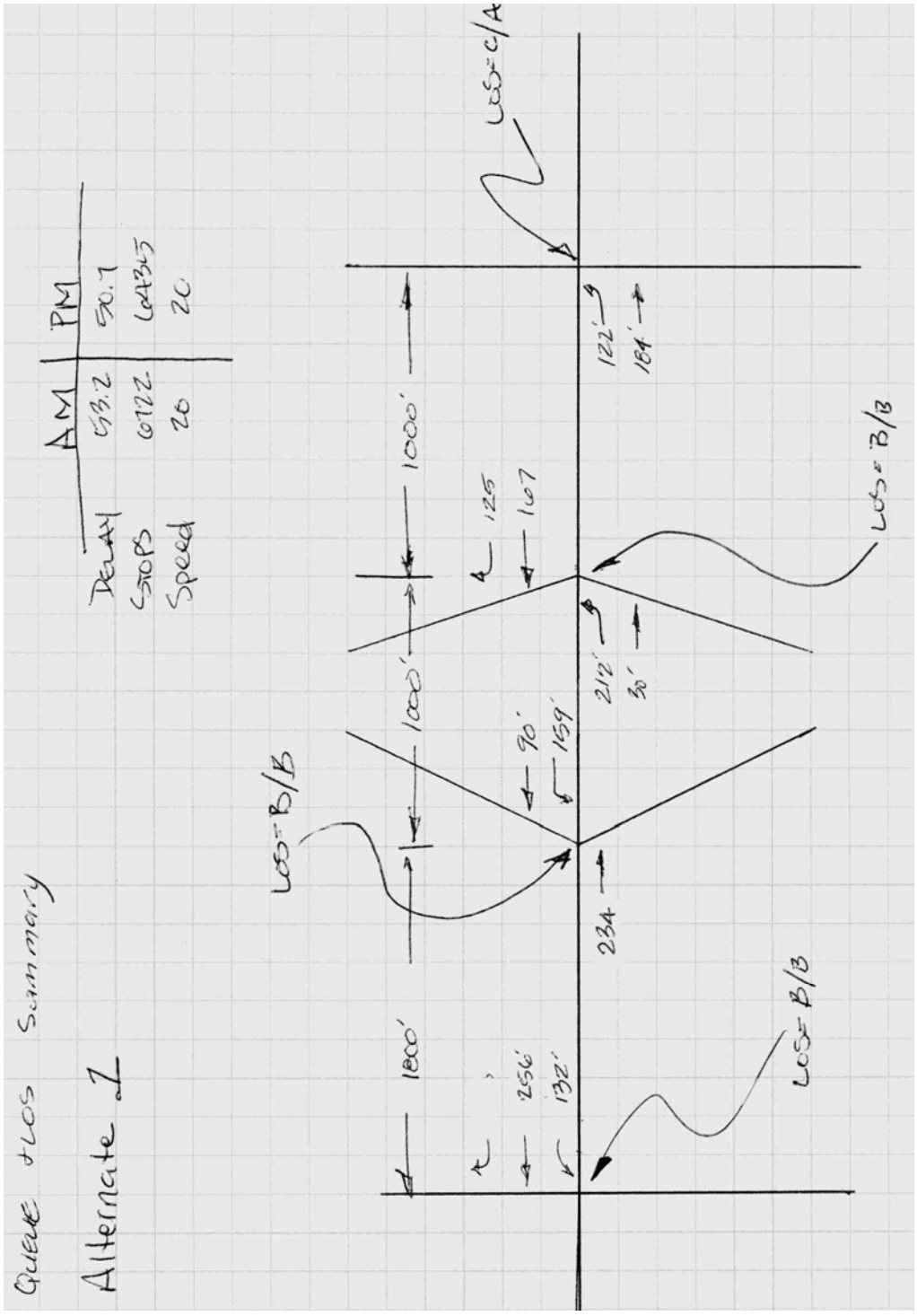
☑ Original ☐ Alternative



Sketch

Alternative No.: IO-11

☐ Original ☑ Alternative



Construction Cost Estimate

Alternative No.: IO-11

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Total Projects	EA			32,200,000		29,280,000
TOTALS				32,200,000		29,280,000
NET SAVINGS						2,900,000

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Value Alternative

Project: I-65 & KY 222 Interchange
Location: Hardin County

Alternative No:
IO-12

Title:
Reconstruct interchange as a diamond on the existing alignment

Description of Original Concept:

The original concept is to realign KY 222 and construct a SPUI south of the existing interchange with I-65.

Description of Alternative Concept:

The alternative concept is to improve on the existing alignment of KY 222 and use a diamond interchange at KY 222 and I-65.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 7,250,000
O&M Savings:	$ 0
Life Cycle Cost Savings:	$ 7,250,000

Advantages/Disadvantages

Alternative No.: IO-12

Advantages of Alternative Concept

- Reduces right-of-way cost by attempting to stay within existing right-of-way
- Reduced earthwork and construction cost
- Less impact on surroundings and environment
- Maintains existing access to development off of KY 222, especially the Pilot Travel Center and Petro truck stops on the east and west of I-65

Disadvantages of Alternative Concept

- Would require part width construction
- During construction, the access to existing businesses along KY 222 will be interrupted

Discussion

Alternative No.: IO-12

The alternative concept is very similar to Alternate 1-1 offered in Phase 1A. IO-12 is a diamond interchange at the same location as the existing interchange. The diamond interchange of IO-12 offers a better LOS compared to the SPUI offered in the Preferred Alternative. The diamond interchange offers a LOS of B/B on the southbound ramps and B/B on the northbound ramps. The SPUI has a LOS of C/C at the single point. The diamond interchange offers a LOS of B/B at the intersection of KY 222 and the entrance to the Glendale Development Site while the Preferred Alternative also had a B/B LOS. IO-12 has LOS of C/A at the intersection of KY 222 and US 31W while the Preferred Alternative offers a LOS of B/A.

IO-12 consists of two variations of a diamond interchange, 12A and 12B.

IO-12A consists of KY 222 remaining along the existing alignment with the interchange remaining at the same location and the ramp alignments being the same. 12A is concerned mostly with widening and improving the existing facility.

IO-12B reconstructs the KY 222 interchange at the same location with a tighter diamond. This allows for better access to the existing businesses along KY 222 near the interchange and increased storage and capacity.

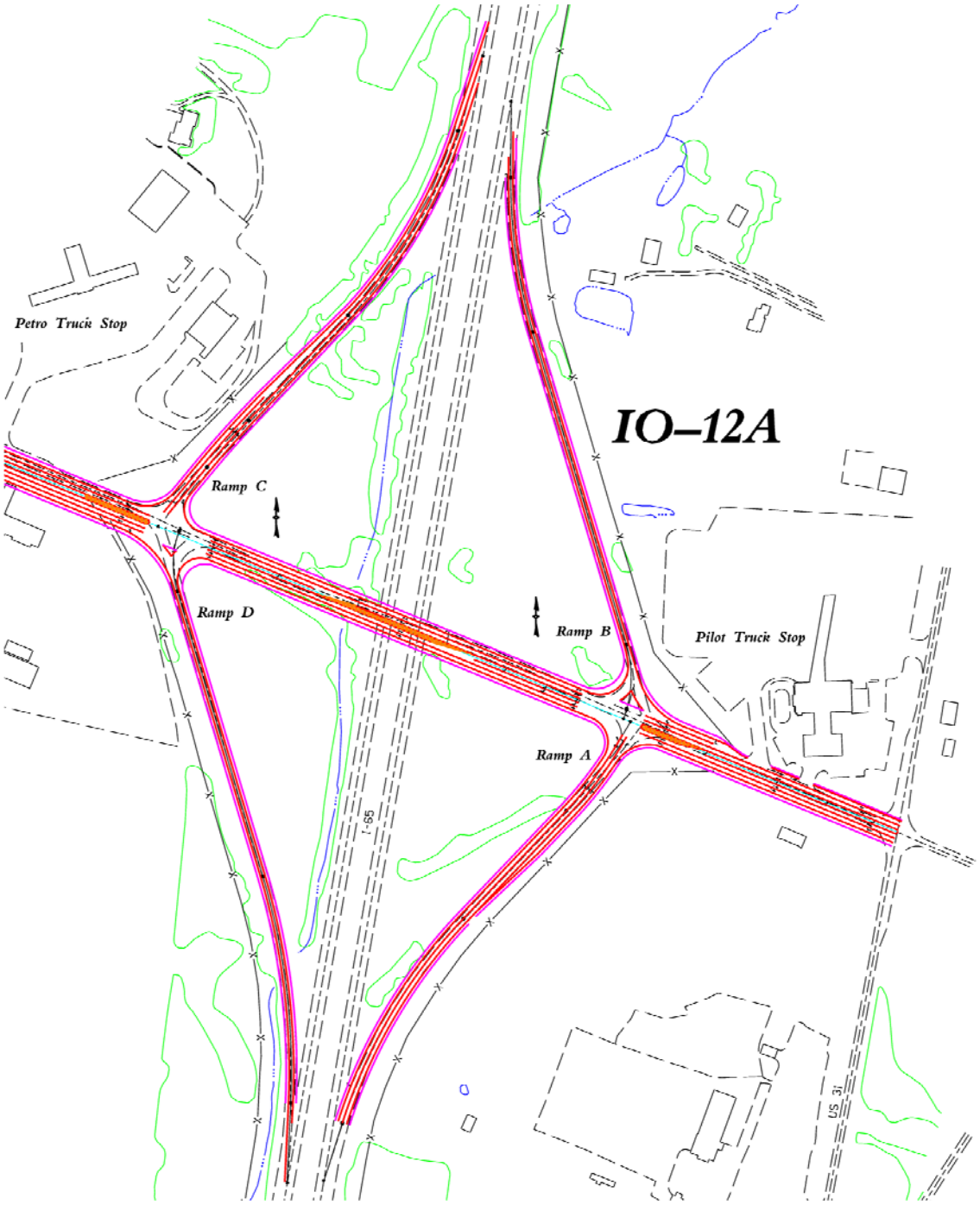
Summary of Total Project Costs

Alternate	R/W	U	C	Total
SPUI	$3,600,000	$850,000	$27,750,000	$32,200,000
IO-12A	$900,000	$650,000	$20,500,000	22,050,000
IO-12B	$900,000	$650,000	$21,900,000	$23,450,000

Sketch

Alternative No.: IO-12

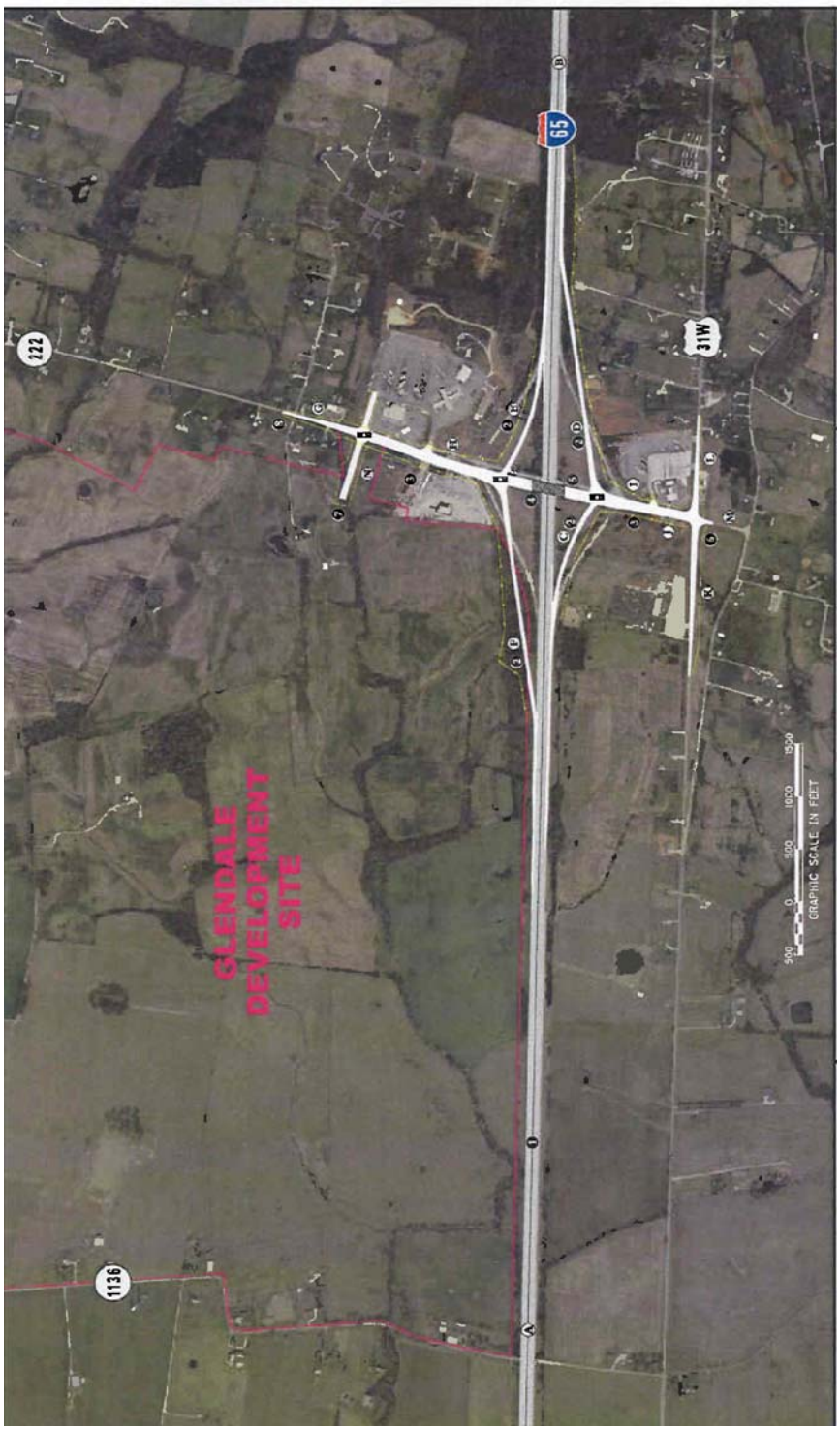
☐ Original ☑ Alternative



Sketch

Alternative No.: IO-12

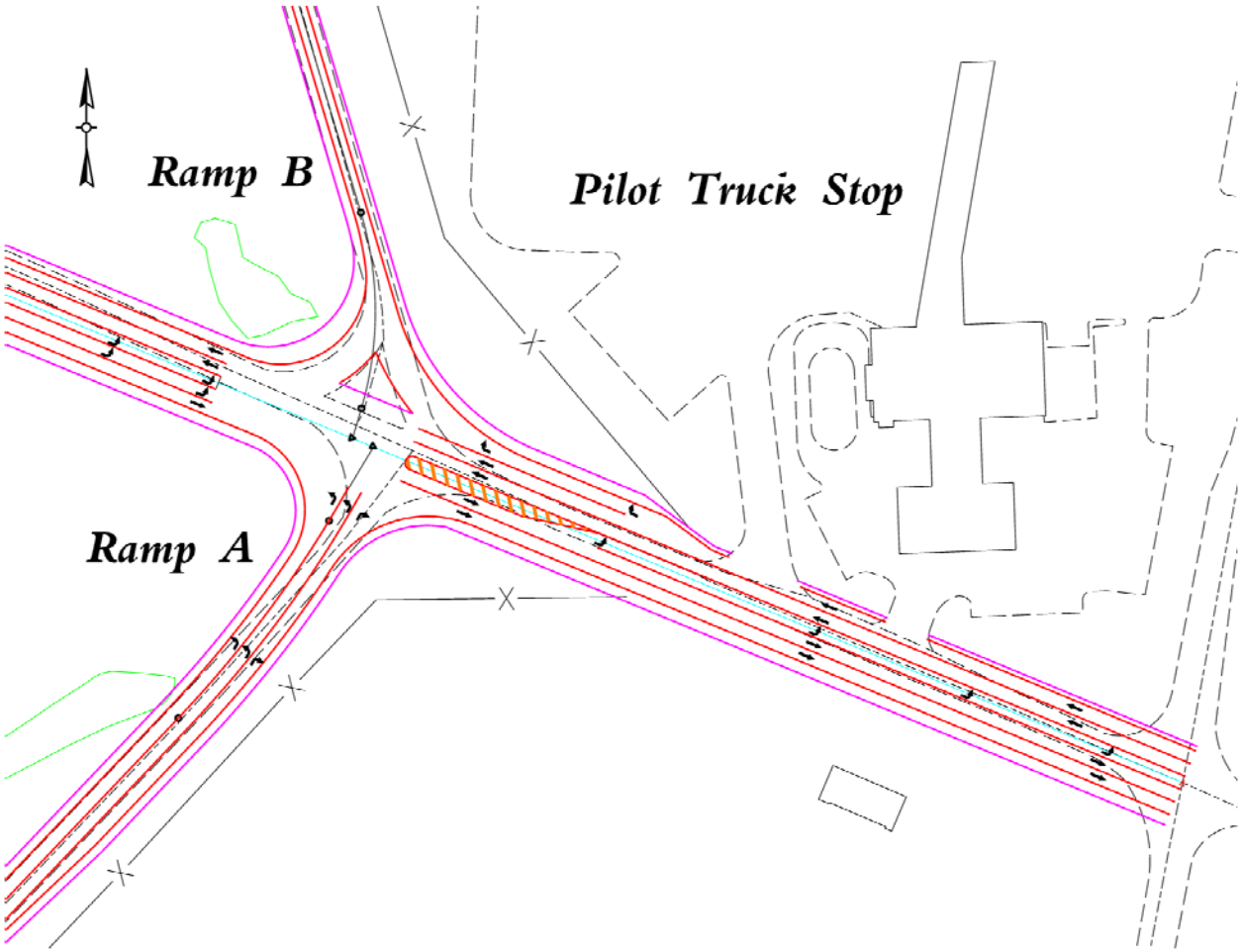
☐ Original ☑ Alternative



Sketch

Alternative No.: IO-12

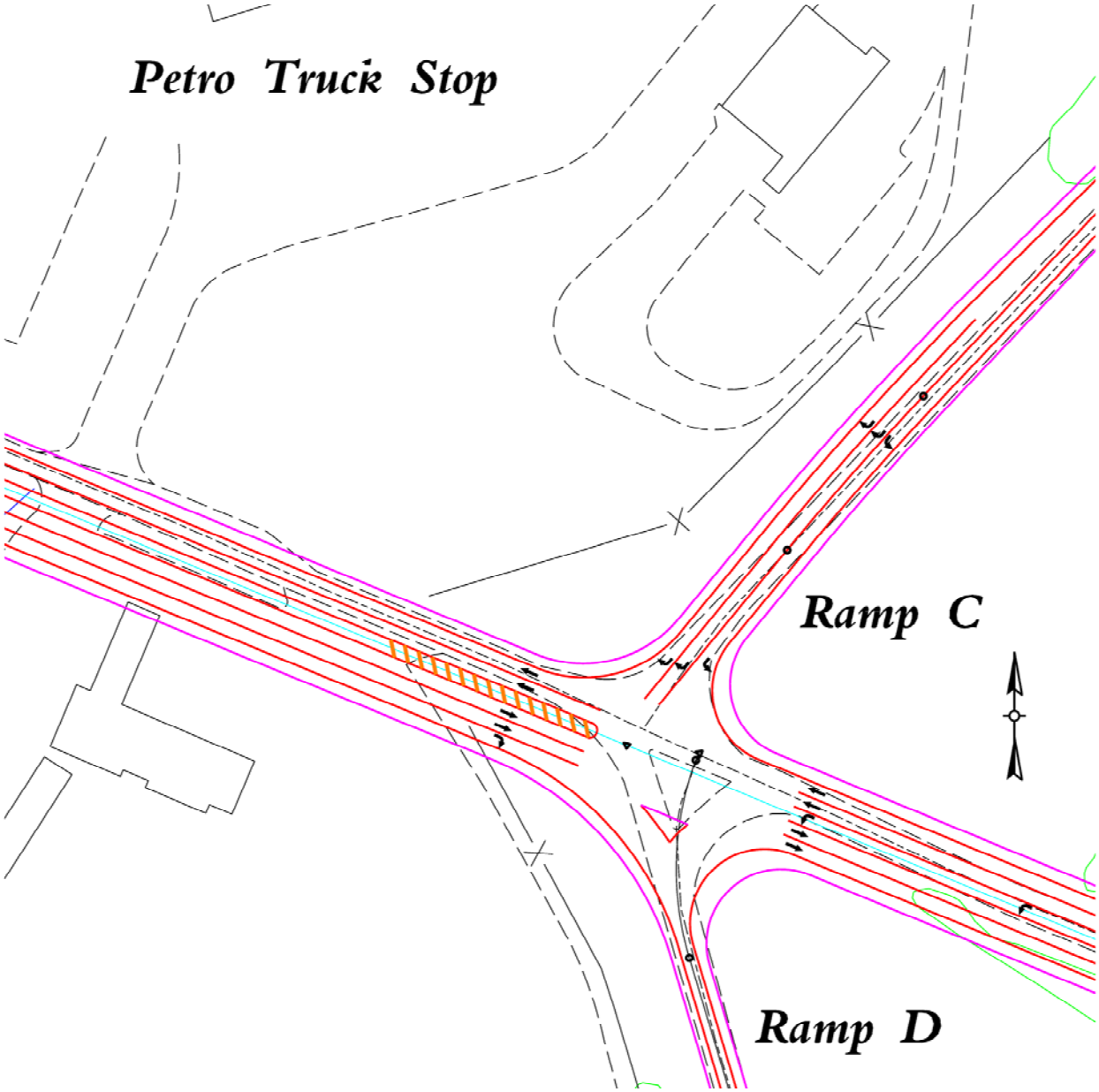
☐ Original ☑ Alternative



Sketch

Alternative No.: IO-12

☐ Original ☑ Alternative



Construction Cost Estimate

Alternative No.: IO-12

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
SPUI	LS	$27,750,000	1	$27,750,000		
IO-12A	LS	$20,500,000			1	$20,500,000
TOTALS				$27,750,000		$20,500,000
NET SAVINGS						$7,250,000

Value Alternative

Project: I-65 & KY 222 Interchange
Location: Hardin County

Alternative No:
IO-15

Title:
Tie KY 222 back into existing alignment east of Robey Drive

Description of Original Concept:

The original concept is to realign KY 222 and construct a SPUI south of the existing interchange with I-65.

Description of Alternative Concept:

The alternative concept is to use the original concept but tie-in the realigned part of KY 222 just east of the commercial properties west of the interchange.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 1,680,000
O&M Savings:	$ 0
Life Cycle Cost Savings:	$ 1,680,000

Advantages/Disadvantages

Alternative No.: IO-15

Advantages of Alternative Concept

- Uses the Preferred Alternative
- Reduces the footprint of re-aligned KY 222
- Eliminates residential relocation and barn acquisition
- Eliminates wetland impacts of farm pond
- Eliminates property acquisition from 12 residential properties west of interchange

Disadvantages of Alternative Concept

- Acquires the Glendale Economy Inn

Discussion

Alternative No.: IO-15

In the alternative concept, the Preferred Alternative would remain nearly unchanged. The difference between the two alternatives is the alignment of KY 222 west of I-65. In this alternative KY 222 would tie back into existing KY 222 immediately after the commercial properties west of I-65.

The design speed of KY 222 would be 45 mph in this alternative with a 6% maximum superelevation.

Total acquisition of the Glendale Economy Inn commercial property would be needed. However, the acquisition of the residence, barn, and strips of land from 12 other residential properties would not be needed.

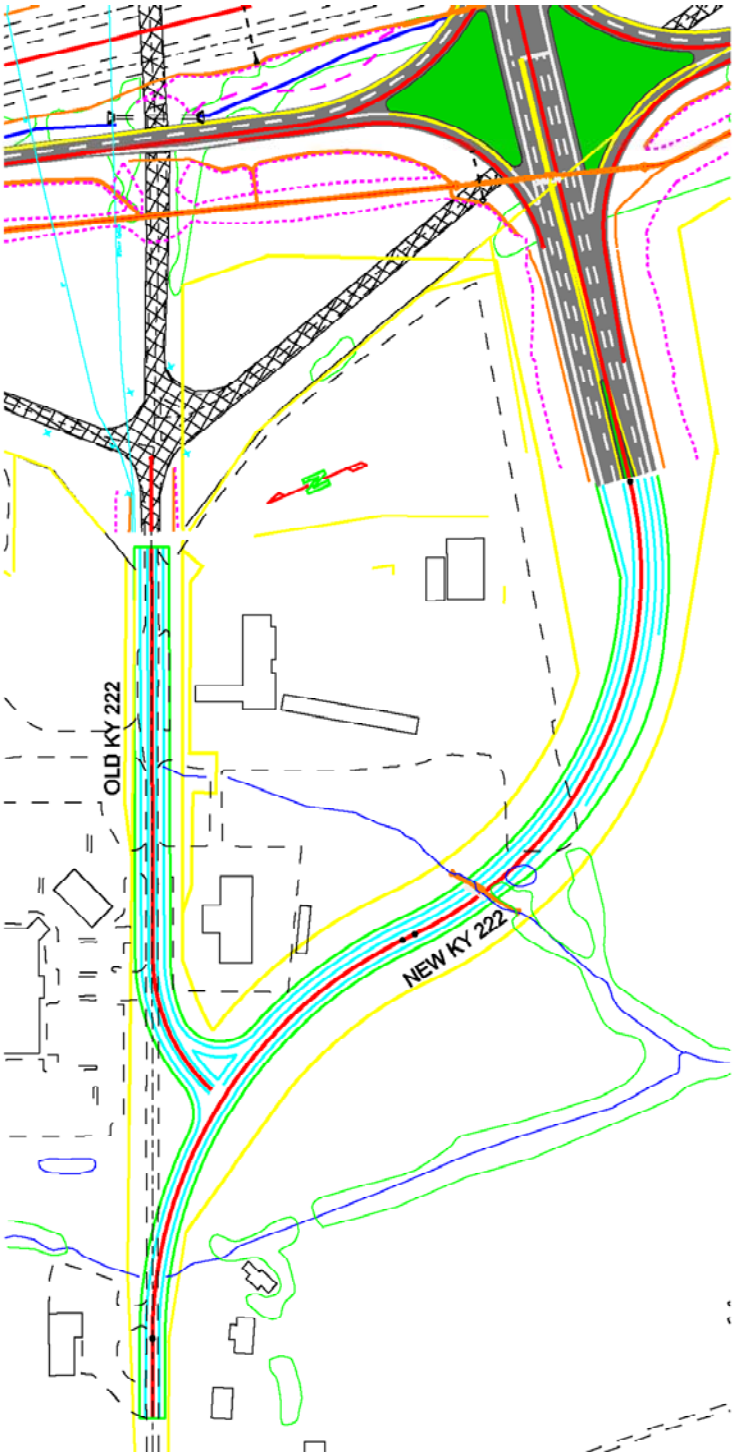
The alternative concept would not impact the farm pond thus eliminating the corresponding wetland impacts expected in the original concept.

This alternative eliminates the west roundabout shown in the Preferred Alternative.

Sketch

Alternative No.: IO-15

☐ Original ☑ Alternative



Construction Cost Estimate

Alternative No.: IO-15

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
DGA Base	TON	19.45	8,137	$158,258	3,566	$69,359
Drainage Blanket Type II Asph	TON	51.61	8,137	$419,933	3,566	$184,042
Asph Base	TON	47.33	29,834	$1,412,063	13,075	$618,857
Asph Surface	TON	71.10	2,664	$189,395	1,167	$83,005
Entrance Pipe - 15 in	LF	39.34	255	$10,032		
Entrance Pipe - 18 in	LF	56.44	115	$6,491		
Culvert Pipe - 30 in	LF	117.78	130	$15,311		
Culvert Pipe - 36 in	LF	87.90			120	$10,548
Culvert Pipe - 72 in	LF	286.63	312	$89,429		
5' x 4' Box Culvert	CUFT	16.00			400	$6,400
6' x 6' Box Culvert	CUFT	16.00	4,032	$64,512		
8' x 6' Box Culvert	CUFT	16.00	11,136	$178,176		
Acquisition of Glendale Economy Inn	EA	250,000.00			1	$250,000
Acquisition of residence	EA	100,000.00	1	$100,000		
Acquisition of barn	EA	40,000.00	1	$40,000		
Contingency (15%)		0.15		$402,540		$183,332
TOTALS				$3,086,000		$1,406,000
NET SAVINGS						$1,680,000

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Value Alternative

Project: I-65 & KY 222 Interchange
Location: Hardin County

Alternative No:
IO-31

Title:
Keep existing interchange; reverse flow through the Pilot Travel Center; signalize US 31W and ramps; move west access points to the west of Petro

Description of Original Concept:

The original concept is to realign KY 222 and construct a SPUI south of the existing interchange with I-65.

Description of Alternative Concept:

The alternative concept is to implement minimal improvements to KY 222 to improve operations to an acceptable LOS. These improvements would include signalizing KY 222 intersections with US 31W and ramp terminals, relocating several commercial driveways, and creating a short turn lane.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☐ Maintained	☐ Maintained
☑ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 24,164,000
O&M Savings:	$ 0
Life Cycle Cost Savings:	$ 24,164,000

Advantages/Disadvantages

Alternative No.: IO-31

Advantages of Alternative Concept

- Access control issues are improved since driveways are relocated (reducing crashes)
- Reduced costs from the Preferred Alternative
- Interstate ramp terminals will operate at LOS A/B with no more than 20 seconds of delay in the design year assuming the future development site is not occupied
- Does not require changes to truck stop gas pumps
- Reuses the existing ramps and bridge over I-65
- Little to no additional right-of-way will be needed

Disadvantages of Alternative Concept

- Defers improvements needed if the potential future industrial development site develops
- Closes several commercial driveways

Discussion

Alternative No.: IO-31

In the alternative concept, KY 222 and its interchange with I-65 would remain nearly unchanged, but spot improvements would be constructed to improve operations.

A new intersection would be created just west of the Petro truck stop. A new North-South (NS) roadway would be constructed with a roundabout or signalized intersection. The driveways for the Petro (both truck and car entrances) as well as the driveways to Glendale Economy Inn and Country Style Plaza would be relocated to this new NS roadway. The new NS roadway could provide access to the potential future industrial development site. The existing commercial driveways along KY 222 would be closed to provide approximately 1,200 feet between the ramp intersection and the NS roadway.

The Petro parking lot would likely need to be re-striped to change the circulation of trucks traveling to the gas pumps.

The interchange ramps would remain unchanged in this alternative with the exception of adding signals to each intersection.

The existing bridge structure over I-65 would remain in place.

A signal would be added to the existing intersection of KY 222 and US 31W.

Both commercial driveways on KY 222 accessing the Pilot Travel Center would be closed in this alternative. Entering trucks would be directed north on US 31W into a left turn lane into the northernmost existing entrance. The trucks would circulate counterclockwise towards the pumps and out through the existing exit driveway on US 31W. Car traffic would enter and exit the Pilot Travel Center through a new driveway on US 31W 250 feet north of the KY 222 and US 31W intersection.

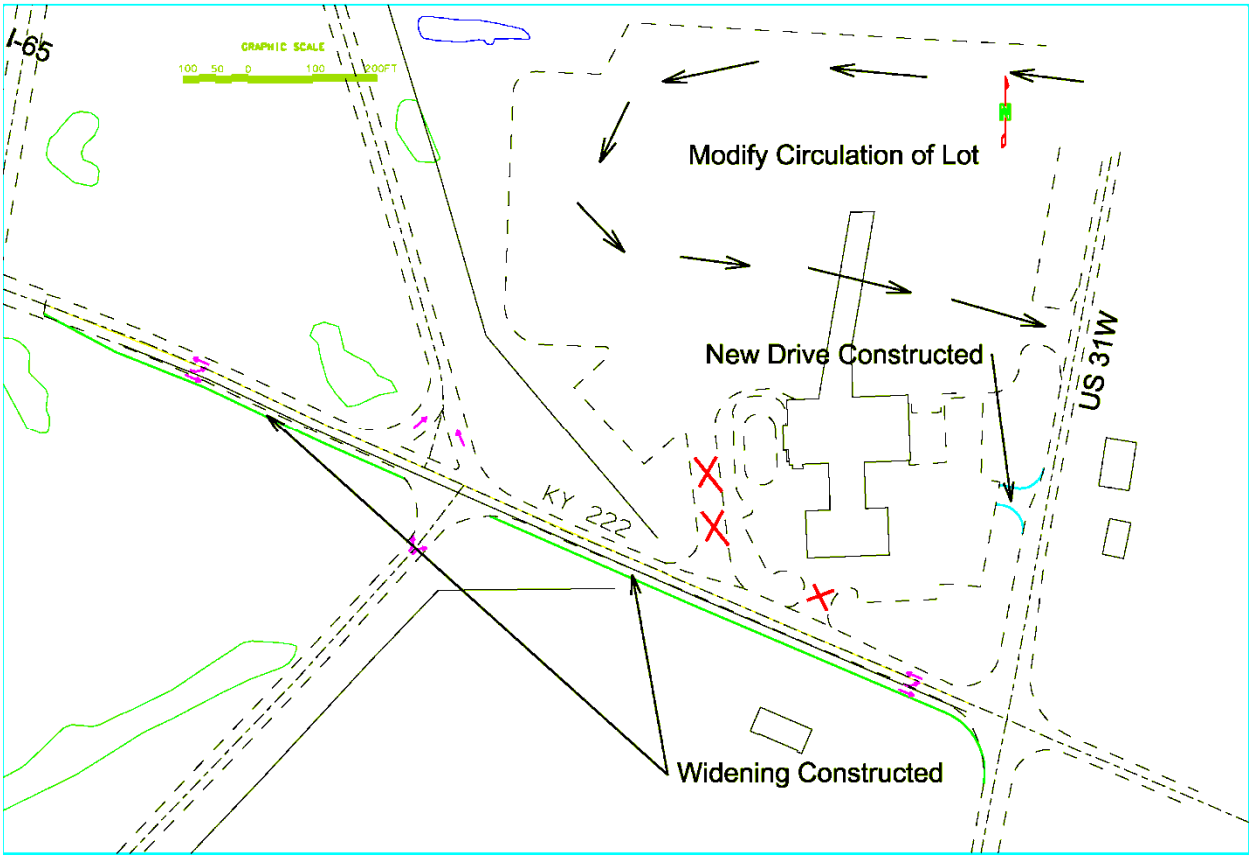
Construction sequencing of this concept would require partial width construction of most features of this project. The bridge, ramps, KY 222, and US 31W would need to be constructed half at a time to maintain traffic.

Traffic operations in the design year 2030, assuming the development site is not operating, the ramp intersections will operate at a LOS A/B with no more than 20 seconds of delay.

Sketch

Alternative No.: IO-31

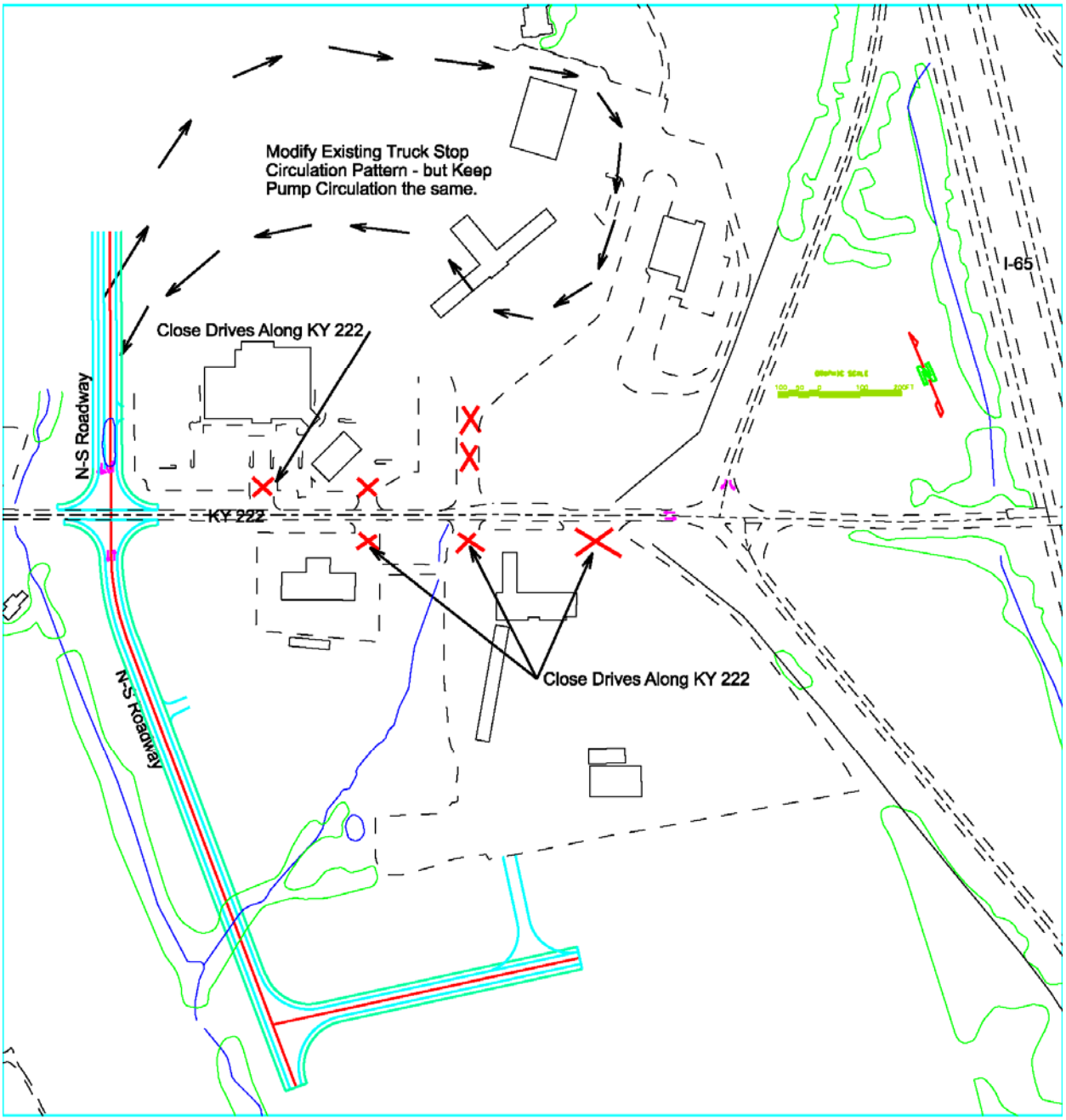
☐ Original ☑ Alternative



Sketch

Alternative No.: IO-31

☐ Original ☑ Alternative



Calculations

Alternative No.: IO-31

☐ Original ☑ Alternative

Paving Quantity

Asphalt Base

KY 222

= 275,654 sy x 1,540 #/sy x 1 ton/2,000# = 2,122 ton

NS Road

= 13,858 sy x 1,540 #/sy x 1 ton/2,000# = 10,671 ton

Asphalt Surface

KY 222

= 2,756 sy x 137.5 #/sy x 1 ton/2,000# = 189 ton

NS Road

= 13,858 sy x 137.5 #/sy x 1 ton/2,000# = 953 ton

Paving Area

NS Road

= 3,775 sy + 10,083 sy = 13,858 sy

Widening along KY 222 = 2,756 sy

Assume shoulder same pavement section as lanes

DGA (4 in depth)

NS Road

= $\frac{4 \text{ in}}{36 \text{ in}/\text{yd}}$ x 13,858 sy x 1.89 ton/cy = 2,910 ton

KY 222 Widening

= $\frac{4 \text{ in}}{36 \text{ in}/\text{yd}}$ x 2,756 sy x 1.89 ton/cy = 579 ton

Calculations

Alternative No.: IO-31

☐ Original ☑ Alternative

Paving Quantity

Drainage blanket (4 in depth)

NS Road

= $\frac{4\text{ in}}{36\text{ in}/\text{yd}}$ x 13,858 sy x 1.89 ton/cy = 2,910 ton

KY 222 Widening

= $\frac{4\text{ in}}{36\text{ in}/\text{yd}}$ x 2,756 sy x 1.89 ton/cy = 579 ton

Construction Cost Estimate

Alternative No.: IO-31

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Preferred Alternative	LS	27,748,000	1	$27,748,000		
Value Alternative						
Sheet 1	LS	1,751,000			1	$1,751,000
Sheet 2	LS	147,000			1	$147,000
Sheet 3	LS	722,000			1	$722,000
Sheet 4	LS	964,000			1	$964,000
TOTALS				$27,748,000		$3,584,000
NET SAVINGS						$24,164,000

Construction Cost Estimate

Alternative No.: IO-31

Sheet 1 of 4

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Paving						
DGA Base	TON	19.45			3,489	$67,861
Drainage Blanket Type II Asph	TON	51.61			3,489	$180,067
Crushed Agg Size #2	TON	20.79				
Asph Base	TON	47.33			12,793	$605,493
Asph Surface	TON	71.10			1,142	$81,196
Fabric - Geotextile Type IV	SY	2.04				
Roadway						
Lip Curb and Gutter	LF	16.35				
Island Curb and Gutter	LF	17.66				
Standard Barrier Median Type 5	SY	181.27				
Remove Pavement	SY	4.73			3,562	$16,848
Embankment in Place	CY	6.58			53,891	$354,603
Water	MGAL	0.05			500	$25
Fence - Woven Wire Type 1	LF	5.37				
Guardrail - Steel W Beam S Face	LF	21.09			500	$10,545
Guardrail Connector to Bridge End TY A	EA	2,129.52			1	$2,130
Guardrail End Treatment Type 2a	EA	648.87			1	$649
Guardrail connector to Bridge End Ty A-1	EA	488.90				
Guardrail End Treatment Type 4A	EA	2,094.26				
RW Marker Rural Type 1A	EA	85.00				
RW Marker Rural Type 3	EA	85.00				
Clearing and Grubbing	EA	200,000.00			1	$200,000
Edge Key	LF	66.54			50	$3,327
Milled Rumble Strips	LF	0.69				
Contingency (15%)		0.15				$228,412
TOTALS						$1,751,000

Construction Cost Estimate

Alternative No.: IO-31

Sheet 2 of 4

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Drainage						
Entrance Pipe - 15 in	LF	39.34				
Entrance Pipe - 18 in	LF	56.44				
Entrance Pipe - 24 in	LF	56.82				
Culvert Pipe - 18 in	LF	57.51				
Culvert Pipe - 24 in	LF	91.82				
Culvert Pipe - 30 in	LF	117.78				
Culvert Pipe - 36 in	LF	87.90				
Culvert Pipe - 54 in	LF	151.57				
Culvert Pipe - 72 in	LF	286.63			230	$65,925
Perforated Pipe - 4 in	LF	5.88				
Sloped Box Outlet Type 1-18 in	EA	1,493.02				
Sloped Box Outlet Type 1-24 in	EA	2,044.94				
S & F Box Inlet - Outlet - 18 in	EA	2,226.53				
S & F Box Inlet - Outlet - 24 in	EA	2,798.90				
S & F Box Inlet - Outlet - 36 in	EA	4,907.71				
Drop Box Inlet Type 1	EA	2,826.55				
Safety Box Inlet - 18 in SDB-1	EA	2,716.67				
Cored Hole Drainage Box Con 4 in	EA	112.01				
Temp Ditch	LF	0.82				
Channel Lining Class II	TON	26.83				
Channel Lining Class III	TON	33.52				
Temp Silt Fence	LF	2.08			4,000	$8,320
Silt Trap Type A	EA	361.29			100	$36,129
Silt Trap Type B	EA	173.64			50	$8,682
Silt Trap Type C	EA	168.25			50	$8,413
Contingency (15%)		0.15				$19,120
TOTALS						$147,000

Construction Cost Estimate

Alternative No.: IO-31

Sheet 3 of 4

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Drainage (Cont.)						
Clean Silt Trap Type A	EA	27.47			300	$8,241
Clean Silt Trap Type B	EA	42.27			150	$6,341
Clean Silt Trap Type C	EA	4.93			150	$740
Clean Temp Silt Fence	LF	0.40			4,000	$1,600
Erosion Control Blanket	SY	1.01			12,000	$12,120
Temp Mulch	SY	0.15			100,000	$15,000
Seeding and Protection	SY	0.29			100,000	$29,000
Sodding	SY	4.80			500	$2,400
Concrete Class A	CY	834.19				
Steel Reinforcement	LB	1.58				
4' x 4' Box Culvert	CF	16.00				
5' x 4' Box Culvert	CF	16.00				
6' x 6' Box Culvert	CF	16.00				
8' x 6' Box Culvert	CF	16.00				
Bridge						
Removed Structure	LS	150,000.00				
KY 222 2-Span Bridge over I-65	SF	120.00				
Signing						
MOT Signs	SF	8.10			1,550	$12,555
Install Project ID Signs	EA	66.73			2	$133
Perm Road Signs	LS	140,000.00			1	$140,000
Signalization						
Install Actuated Traffic Signal with Loop	EA	100,000.00			4	$400,000
Contingency (15%)		0.15				$94,220
TOTALS						$722,000

Construction Cost Estimate

Alternative No.: IO-31

Sheet 4 of 4

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Lighting						
Highmast Lighting	LS	450,000.00				
Miscellaneous						
Install Temp Conc Med Barrier	LF	12.00				
Maintain & Control Traffic	LS	100,000.00			1	$100,000
Lane Closure	EA	1,078.52			50	$53,926
Portable Changeable Message Sign	EA	6,568.85			2	$13,138
Staking	LS	150,000.00			1	$150,000
Pave Striping - Perm Paint - 4 in	LF	0.24			59,235	$14,216
Pave Striping - Thermo - 6 in W	LF	0.66			51,020	$33,673
Pave Striping - Thermo - 6 in Y	LF	0.81			28,245	$22,878
Pavement Marker Type V-B W/R	EA	20.80			710	$14,768
Pavement Marker Type V-B Y/R	EA	23.12			960	$22,195
Lot Pay Adjustment	DOLL	1.00			18,692	$18,692
Fuel Adjustment	DOLL	1.00			18,692	$18,692
Asphalt Adjustment	DOLL	1.00			28,039	$28,039
Mobilization & Demobilization						
Mobilization	LS	71,982.56			1	$71,983
Demobilization	LS	35,991.28			1	$35,991
Miscellaneous Construction	LS	239,701.92			1	$239,702
Contingency (15%)		0.15				$125,684
TOTALS						$964,000

Value Alternative

Project: I-65 & KY 222 Interchange
Location: Hardin County

Alternative No:
IO-35

Title:
Reduce median, shoulder and lane widths on Preferred Alternative (realigned KY 222). Eliminate rumble strips on non-interstate facilities.

Description of Original Concept:

The original concept is:

	Median Width Grass/Total	Shoulder Width Paved/Total	Lane Width	# Lanes
Sta 88+00 to 130+00	-	2/8	12	2
Sta 130+00 to 145+00	18.5/24	10/12	12	4
Sta 145+00 to 157+00	-	12	12	6
Sta 157+00 to 164+00	0/10	10/12	12	4
Sta 164 to 168 (NB US 31W)	-	4/6	12	2
Sta 36 to 45 (SB US 31W)	-	10/12	12	2

Description of Alternative Concept:

The alternative concept is:

	Median Width Grass/Total	Shoulder Width Paved/Total	Lane Width	# Lanes
Sta 88+00 to 130+00	-	2/8	11	2
Sta 130+00 to 145+00	0/10	6/8	11	4
Sta 145+00 to 157+00	-	6/8	11	6
Sta 157+00 to 164+00	0/10	8	11	4
Sta 164 to 168 (NB US 31W)	-	4/6	11	2
Sta 36 to 45 (SB US 31W)	-	4/6	11	2

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 1,084,000
O&M Savings:	$ 0
Life Cycle Cost Savings:	$ 1,084,000

Advantages/Disadvantages

Alternative No.: IO-35

Advantages of Alternative Concept

- Reduced initial construction cost
- Reduced maintenance and repaving cost due to less pavement and mowing
- Keeps median for access control

Disadvantages of Alternative Concept

- Increased cost of median
- Removal of the grass for aesthetics

Discussion

Alternative No.: IO-35

KY 222 is classified as a rural minor collector. US 31W is classified as a rural major collector. Volumes on KY 222 in the vicinity of the I-65 interchange were 5500 ADT in 2008. It tapers down to 2400 ADT east of the project limits. The project considers growth due to potential development in the southwest quadrant. Access is being controlled, partially by the use of a raised median between the interchange area and US 31W to the east and Connector #2 to the west.

The goals of the project can be met by reducing the widths of the travel lanes, shoulders and median.

This Value Alternative is to provide lane widths of 11 feet for all the travel lanes of KY 222, US 31W, and the connector roads. Further, reduce the shoulder widths on KY 222 to eight feet total, six feet of which would be paved. This is a reduction of four feet of pavement width for each shoulder.

The median width between the connector road and southbound ramp terminal will be reduced from 24 feet total to 10 feet. This would better control turning, u-turn and left, movements. The lip curb would be replaced by an island curb. The grass section would be reduced from 18.5 feet to 6 feet wide. If the lip curbs remains, the cost savings would be negligible.

In this low speed environment of KY 222, there is no need for rumble strips to improve or maintain a safe driving environment. If there are no separate bicycle facilities that are created, then it is advantageous to remove the rumble strips for bicyclists.

Calculations

Alternative No.: IO-35

☐ Original ☑ Alternative

Lane Width (pavement/bridge only – no earthwork, right-of-way)

	Length	Lanes	SF Reduction	CF (9in depth)	Tons
Sta 88+00 to 130+00	4,200	2	8,400	6300	
Sta 130+00 to 145+00	1,500	4	6,000		
Sta 145+00 to 157+00	900 300 bridge	6	5,400 1,800 bridge		
Sta 157+00 to 164+00	700	4	2,800		
Sta 164 to 168 (NB US 31W)	400	2	800		
Sta 36 to 45 (SB 31W)	900	2	1,800		
			25,200 asphalt 1,800 bridge	18,900	945

Shoulder Width (pavement/bridge only – no earthwork, right-of-way)

	Length	Width Reduction	SF Reduction	CF (9in depth)	Tons
Sta 130+00 to 145+00	1,500	4 ft x2	12,000		
Sta 145+00 to 157+00	900 300 bridge	4 ft x2	7,200 2,400 bridge		
Sta 157+00 to 164+00	700	4 ft x2	5,600		
Sta 36 to 45 (SB US 31W)	900	4 ft x2	7,200		
			32,000 2,400 bridge	24,000	1,200

Calculations

Alternative No.: IO-35

☐ Original ☐ Alternative

Median Width

Total cross section width reduction		=	12 ft
Subtract lip curb & gutter		=	3,000 lf
Add island curb & gutter		=	3,000 lf

This does not include earthwork or reduced right-of-way.

Rumble Strips	8,900 ft x 2	=	17,800 lf

Construction Cost Estimate

Alternative No.: IO-35

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Asphalt Pavement	SY	45.00	6,356	$286,000		
Bridge	SF	165.00	4,200	$693,000		
Lip Curb & Gutter	LF	20.00	3,000	$60,000		
Island Curb & Gutter	LF	35.00			3,000	$105,000
Rumble Strips	LF	0.50	17,800	$8,900		
Contingency (15%)		0.15		$157,185		$15,750
TOTALS				$1,205,000		$121,000
NET SAVINGS						$1,084,000

Value Alternative

Project: I-65 & KY 222 Interchange
Location: Hardin County

Alternative No:
IO-39

Title:
Eliminate northwest leg of Pilot roundabout and close existing truck entrance on KY 222

Description of Original Concept:

The original concept proposes a four leg roundabout with the northwest leg serving the Pilot Travel Center.

Description of Alternative Concept:

This alternative would eliminate the northwest leg of the roundabout serving the Pilot Travel Center; redirecting truck traffic onto US 31W. Internal circulation patterns at the Pilot Travel Center would be revised in order to allow entry at the northern Pilot Travel Center access on US 31W; egress operations would remain at the southern access point. Passenger car traffic would be served by a new access point north of the proposed roundabout. US 31W would be widened to serve northbound left turning into the truck stop.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☑ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☐ Decreased

Cost Savings Summary

First Cost Savings:	($ 34,000)
O&M Savings:	$ 0
Life Cycle Cost Savings:	($ 34,000)

Advantages/Disadvantages

Alternative No.: IO-39

Advantages of Alternative Concept

- Truck traffic circulation would be improved by eliminating overlap of truck circulation routes

Disadvantages of Alternative Concept

- Requires additional widening on US 31W

Discussion

Alternative No.: IO-39

The Preferred Alternative would use the existing circulation patterns for the Pilot Travel Center. Traffic would be served by a fourth leg of a proposed roundabout. As a result of the proposed circulation pattern, entering traffic from KY 222 would turn left at the roundabout across southbound US 31W traffic. Truck traffic would then circulate through the truck stop and egress onto US 31W southbound; across the entering flow of traffic. This conflict in the ingress and egress movements decreases the capacity of the intersection and may affect flow from KY 222.

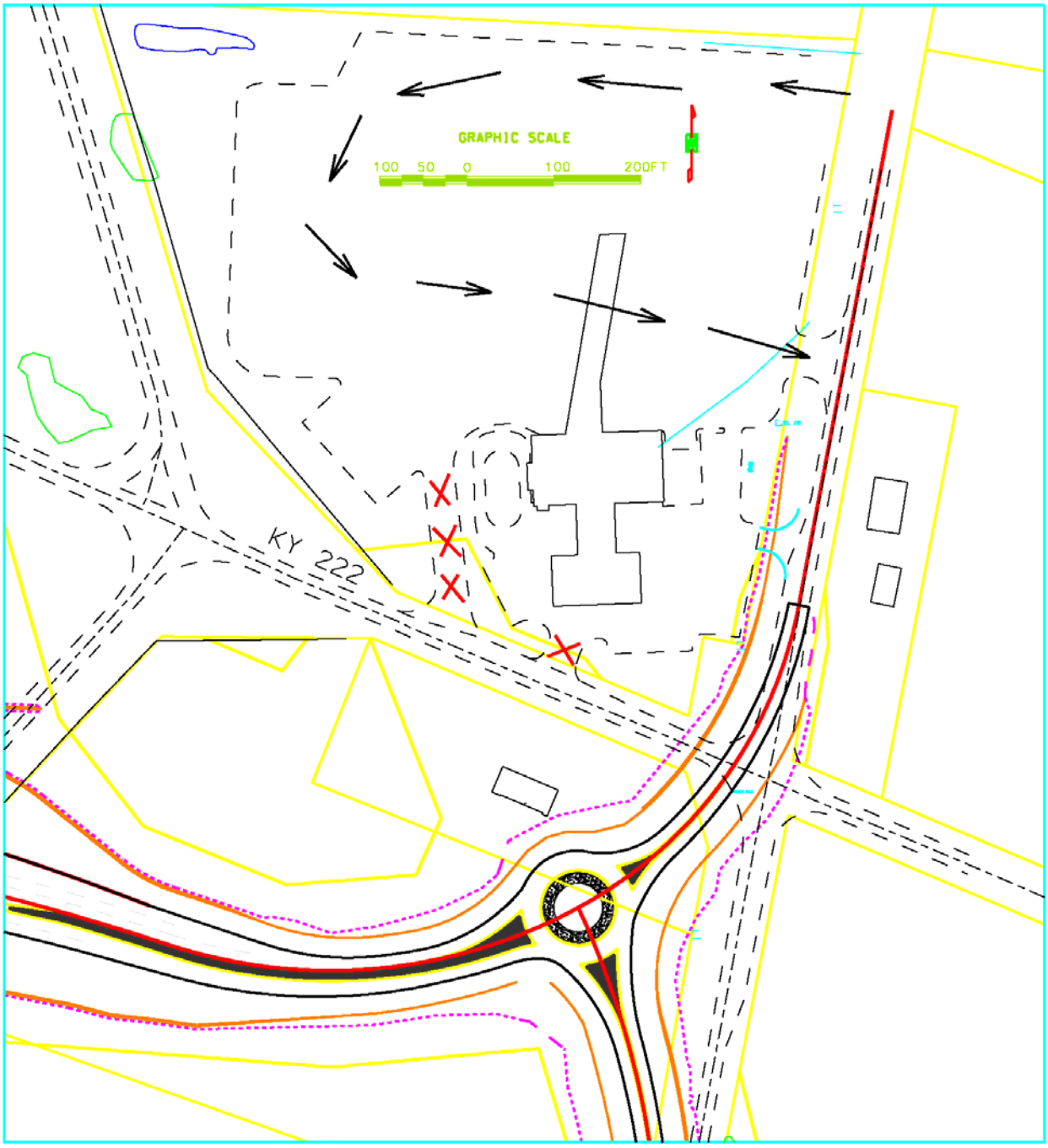
The alternative concept eliminates this circulation conflict by reversing the direction of flow at the northern parking area of the Pilot Travel Center. Ingress traffic on US 31W would be served through the construction of a left turn lane on US 31W by widening to the west of US 31W across the Pilot Travel Center and Calvary Mission Church property.

This minor change in design would improve the level of service of the KY 222 & US 31W intersection.

Sketch

Alternative No.: IO-39

☐ Original ☑ Alternative



Construction Cost Estimate

Alternative No.: IO-39

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Pavement	SY	45.00	2,565	$115,425	3,000	$135,000
Right-of-way	EA	5,000.00			2	$10,000
Contingency (15%)		0.15		$17,314		$21,750
TOTALS				$133,000		$167,000
NET SAVINGS						($34,000)

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Value Alternative

Project: I-65 & KY 222 Interchange
Location: Hardin County

Alternative No:
IO-56

Title:
Use concrete to better accommodate truck turning movements

Description of Original Concept:

The original concept is to use asphalt pavement on the proposed I-65 & KY 222 SPUI and the relocated KY 222. The proposed SPUI and relocation of KY 222 are means of improving safety, and relieving the worsening congestion of traffic due to heavy truck traffic associated with the Petro truck stop and Pilot Travel Center.

Description of Alternative Concept:

The alternative concept uses concrete pavement in lieu of asphalt in areas which will experience heavy truck traffic.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	($ 1,581,000)
O&M Savings:	$ 1,991,000
Life Cycle Cost Savings:	$ 410,000

Advantages/Disadvantages

Alternative No.: IO-56

Advantages of Alternative Concept

- Improves the functional performance of pavement under heavy truck traffic and other traffic loads
- Durability of concrete minimizes the need for annual repairs or maintenance

Disadvantages of Alternative Concept

- Extensive long term repairs due to differential slab settlement or cracking
- Increased initial cost associated with rigid pavement intersections

Discussion

Alternative No.: IO-56

Which is better, concrete or asphalt can be an open ended debate never concluded. The fact is there is no concrete answer unless site specific conditions are considered to determine a cost effective option for the long run.

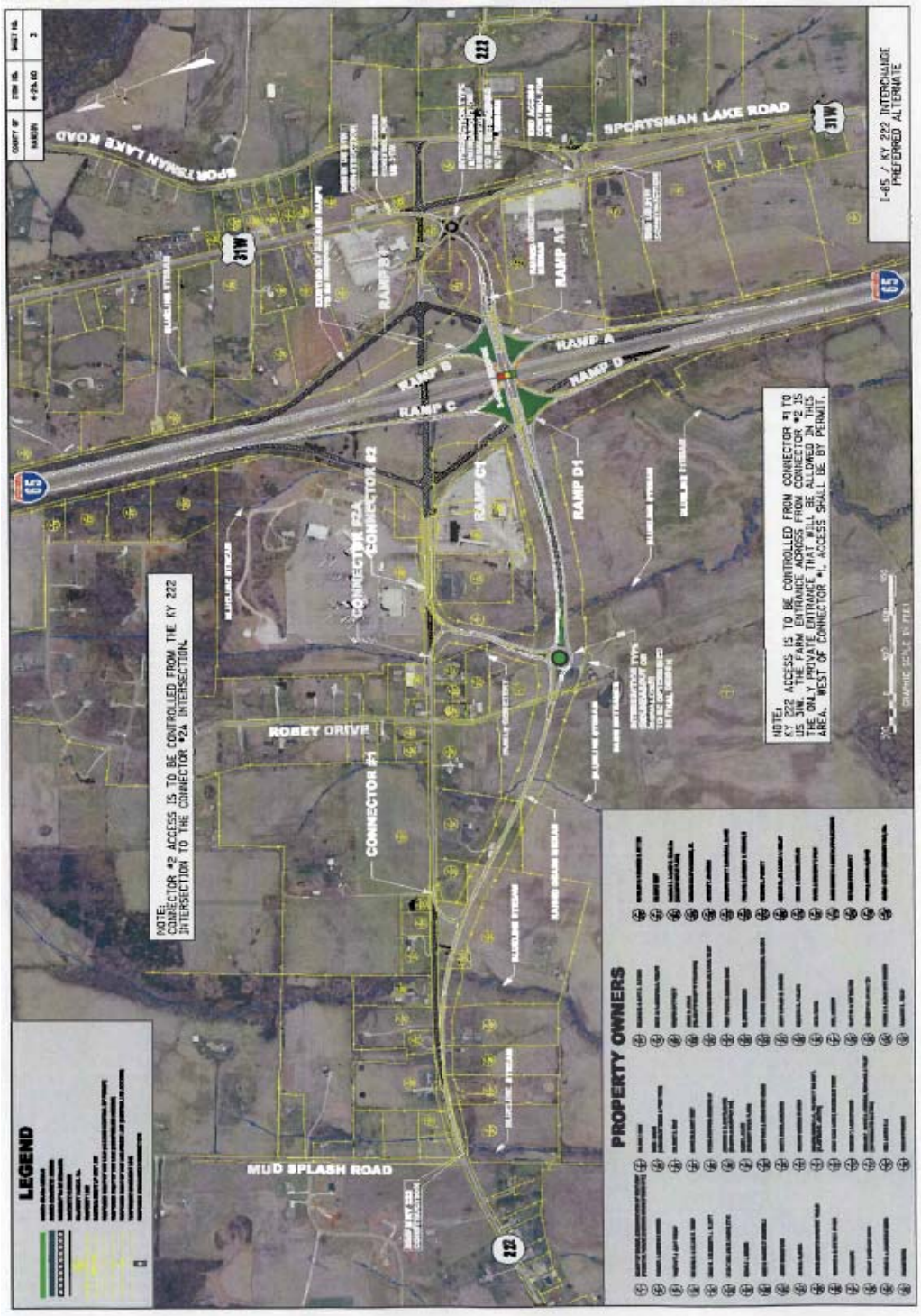
Concrete, in this case where a high percentage of traffic volumes are heavy trucks and a new interchange and road (KY 222) are being constructed is a better long term choice. Concrete pavement does away with frequent rutting and repairs associated with asphalt pavement under heavy truck traffic. Concrete pavement provides for more traction for rapidly accelerating or decelerating ramp traffic which improves safety. Concrete is durable and often outlasts its intended life expectancy which, depending upon the system needs can range from 10 to 50 years. Concrete pavement in spite of the added initial cost at the intersections can be constructed rapidly which is ideal in cutting construction time. Concrete surface remains smooth long after construction which is important to the users. Concrete surface reflects light which provide for better visibility. Concrete never ruts. Therefore there is no safety risk of wet spray particularly that caused by heavy trucks on regular vehicles or hydroplaning due to water accumulated in the rut.

This alternative concept recommends concrete pavement for areas under potential heavy truck traffic. The section of new KY 222 west of the proposed roundabout at Connector #2 would remain asphalt pavement. However, concrete and asphalt cost depending on market condition may be roughly the same in which case it is recommended the entire project be paved in concrete.

Sketch

Alternative No.: IO-56

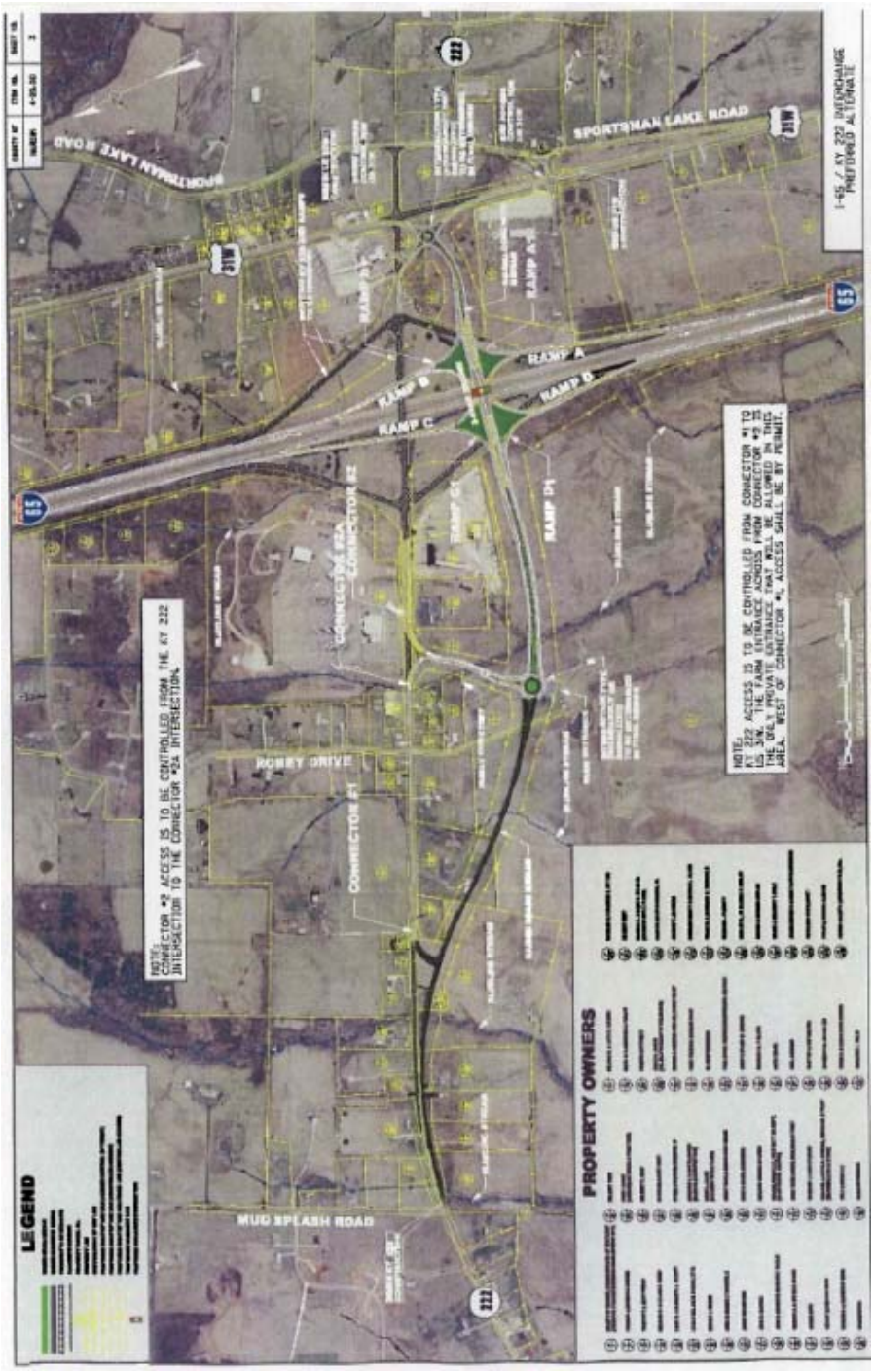
☑ Original ☐ Alternative



Sketch

Alternative No.: IO-56

☐ Original ☑ Alternative



Calculations

Alternative No.: IO-56

☐ Original ☑ Alternative

Total Pavement Surface:

10,846 ton proposed asphalt surface at 1.25 inches

$$\frac{10{,}846 \text{ ton x } 2{,}000\ {}^{\text{lb}}/_{\text{ton}}}{110\ {}^{\text{lb}}/_{\text{sy}}/_{\text{in}} \text{ x } 1.25 \text{ in}} = 157{,}760 \text{ sy total pavement surface}$$

Asphalt surface KY 222 west of roundabout at Connector No. 2:

Sta. 90+77.85 – Sta. 126+00.00 = 3,522 x 40/9	=	5,653 sy
300 x 80/9 = 2,666 sy four-lane section just west of the roundabout		
15,653 + 2,666	=	18,319 sy

Connector no. 1:

Sta. 46+00.00 to Sta. 49+44.80 → 344.8 X 36/9	=	1,379 sy

Entrances:

30 x 15 x 2/9	=	100 sy
10 x 50/9	=	56 sy
10 x 40/9	=	44 sy
10 x 80/9	=	89 sy
170 x 12/9	=	227 sy
70 x 10/9	=	78 sy
Subtotal Entrance Surface		594 sy

Calculations

Alternative No.: IO-56

☐ Original ☑ Alternative

Total Asphalt Surface

18,319 + 1,379 + 594 = 20,292 sy x $45/sy	=	$913,140

Total Concrete Surface

157,760 - 20,292 = 137,468 sy x $55/sy	=	$7,560,740

Total Estimated Pavement Cost

$913,140 + $7,560,740	=	$8,473,880

Construction Cost Estimate

Alternative No.: IO-56

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Asphalt Paving	SY	45.00	157,760	$7,099,200	20,292	$913,140
Concrete Paving	SY	55.00			137,468	$7,560,740
Contingency (15%)		0.15		$1,064,880		$1,271,082
TOTALS				$8,164,000		$9,745,000
NET SAVINGS						($1,581,000)

Life Cycle Cost Analysis

Alternative No.: IO-56

LIFE CYCLE PERIOD 20 YEARS ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST			ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			$8,164,000		$9,745,000	
Capital Cost Savings					($1,581,000)	

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Generalized (% of Capital Cost)								
		SUB-TOTAL			$0			$0

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Mill Surface and Overlay	10	0.6756	394,400	266,000		0
assume 50% of paving				0		0
Salvage Value at End of Economic Life						
Concrete Pavinrg	20	0.4564		0	3,780,500	(1,725,000)
(assume 50% of orignial cost)						
		SUB-TOTAL		$266,000		($1,725,000)
		TOTAL PRESENT WORTH		$266,000		($1,725,000)

PRESENT WORTH SAVINGS ON O&M $1,991,000

LIFE CYCLE COST SAVINGS $410,000

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Value Alternative

Project: I-65 & KY 222 Interchange
Location: Hardin County

Alternative No:
IO-59

Title:
Re-evaluate need for two-lane ramps for I-65 operations

Description of Original Concept:

The original concept provides a two-lane entry ramp and exit ramp from/to the I-65 & KY 222 interchange. The Preferred Alternative proposes 2,400 feet of off-ramp and 9,200 feet of on-ramp.

Description of Alternative Concept:

The alternative concept provides one-lane entry and exit ramps with a length of 2,400 feet and 1,400 feet respectively.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 1,253,000
O&M Savings:	$ 0
Life Cycle Cost Savings:	$ 1,253,000

Advantages/Disadvantages

Alternative No.: IO-59

Advantages of Alternative Concept

- Entry and exit ramp area would be reduce by more than 50 percent

Disadvantages of Alternative Concept

- Entry ramp dual left turn movements would be required to merge on the ramp

Discussion

Alternative No.: IO-59

The dual lane exit ramps would be replaced with a single lane exit. This would significantly reduce the pavement area of the northbound and southbound off ramps. The dual turn lanes required at the SPUI would be developed closer to the interchange. The exit volumes for the design year do not warrant a double lane exit. Level of service (LOS) in this area is controlled by the length of the diverge lane on the mainline. Using LOS of C for the design year, a 1,400 foot diverge lane is required for a single lane exit and a 1,550 foot diverge lane is required for a two-lane exit.

The dual entry lanes would be reduced to a single lane on ramp by merging the second lane on the ramp; this provides 500 feet of dual lanes and a 600 foot merge. The resulting single lane on ramp can be accommodated with a 2,400 foot merge lane operating at LOS C. This configuration would eliminate over 2,300 feet of the merge lanes and the two-lane section for a total reduction of 4,600 feet of lane.

If it is decided to not reduce the number of lanes on the entry ramps, the merge area may be reduced to the minimum length of 2,500 feet while maintaining adequate LOS C.

Calculations

Alternative No.: IO-59

☑ Original ☐ Alternative

On Ramp Pavement

	2,300 ft x 24	=	55,200		
+	2,300 ft x 12	=	27,600		
+	600 ft x 24	=	14,400		
			97,200 sf/9	=	10,800 sy

Off Ramp Pavement

	3,000 ft x 15 ft	=	45,000		
+	1,200 ft x 35 ft	=	42,000		
			87,000 sf/9	=	9,666 sy

Calculations

Alternative No.: IO-59

☐ Original ☑ Alternative

On Ramp Pavement

	2,400 ft x 12	=	28,800 sf/9	=	3,200 sy

Off Ramp Pavement

	1,500 ft x 15 ft	=	22,500		
+	1,200 ft x 20 ft	=	24,000		
			46,500 sf/9	=	5,200 sy

Construction Cost Estimate

Alternative No.: IO-59

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Asphalt Pavement						
Southbound Off-Ramp	SY	45.00	9,700	$436,500	5,200	$234,000
Northbound Off-Ramp	SY	45.00	9,700	$436,500	5,200	$234,000
Northbound On-Ramp	SY	45.00	10,800	$486,000	3,200	$144,000
Southbound On-Ramp	SY	45.00	10,800	$486,000	3,200	$144,000
Contingency (15%)		0.15		$276,750		$113,400
TOTALS				$2,122,000		$869,000
NET SAVINGS						$1,253,000

Value Alternative

Project: I-65 & KY 222 Interchange
Location: Hardin County

Alternative No:
IO-63

Title:
Build new KY 1136 Interchange north of Camp Nevin and collector distributor between KY 1136 /KY 222 interchange. Implement minor modifications to existing KY 222 interchange. Two-step phased implementation.

Description of Original Concept:

The original concept focuses solely on building a new KY 222 interchange just south of the existing interchange.

Description of Alternative Concept:

The alternative concept provides for a new interchange just north of, but tying into KY 1136. Because of the short spacing between the new interchange and existing KY 222, access to each will be provided by a collector-distributor road that connects each.

This concept provides for a two phase implementation. To address current access, mobility and safety needs, improvements to the current KY 222 interchange would include the addition of traffic signals at the ramp terminals, widening of the bridge to three lanes and access management improvements between Robey Drive and US 31W.

The ultimate implementation would provide a new access to KY 1136 via a new interchange, which would provide access to the potential future industrial development site owned by the Commonwealth of Kentucky.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☑ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☐ Decreased

Cost Savings Summary

First Cost Savings:	($ 9,700,000)
O&M Savings:	$ 0
Life Cycle Cost Savings:	($ 9,700,000)

Advantages/Disadvantages

Alternative No.: IO-63

Advantages of Alternative Concept

- Much reduced initial construction cost for phase I of project
- Continued use of existing resource – KY 222
- Improvement to operation and safety of KY 222
- Right-sized solution to meet the needs of the area, allowing for growth without overdesigning and only if needed
- Allows separation of Glendale Economy Inn access and some industrial site
- Redundancy in highway network
- Two interchange capacity operating like a single interchange from I-65

Disadvantages of Alternative Concept

- May be difficult for local FHWA office to accept
- Dealing with property owners on closing access
- May be difficult for KYTC and other state leaders to accept that a 2/3 lane cross section of KY 222 will give acceptable long-term operations

Discussion

Alternative No.: IO-63

The current traffic volume on KY 222 is low and really does not warrant a major effort to improve capacity; however, there is a potential that the large industrial site owned by the Commonwealth of Kentucky could attract a large manufacturer in the future. This alternative concept allows for the reconstruction of the interchange to allow for a future I-65 widening and improves the current operations (capacity and safety). Designing a second phase with collector-distributor roads and a new interchange allows access to the industrial site with the necessary capacity, only if it is needed in the future.

Improvements to KY 222 include the bridge replacement with a three-lane structure. The ramp terminals would be signalized. KY 222 would remain a two-lane road but would include a ten-foot raised median between intersections. Intersection control at US 31W and for access to the industrial site could either be a traffic signal or roundabout. For traffic signals, turning lanes would need to be tapered in at both intersections on KY 222. Left turn lanes would be added on each ramp from I-65 to KY 222. Access to the properties within the influence area of the interchange are eliminated and/or reconfigured. Access to the Pilot Travel Center would be given from US 31W. The project would terminate at the industrial site intersection.

The above design was based on a targeted performance level for the design year's design hour volumes of LOS D. The traffic analysis was done on the KY 222 ramp intersections and had the following results: southbound ramp intersection: AM: LOS B, PM: LOS C; northbound ramp intersection: AM: LOS D, PM: LOS D

The collector-distributor road would begin and end as part of the ramps for each interchange (see diagram). Four of the eight movements would be directly to or from the collector-distributor road. In essence, the interchange pair would operate as a single interchange from I-65. The C-D lanes will be separated from the mainline I-65 lanes by a barrier wall.

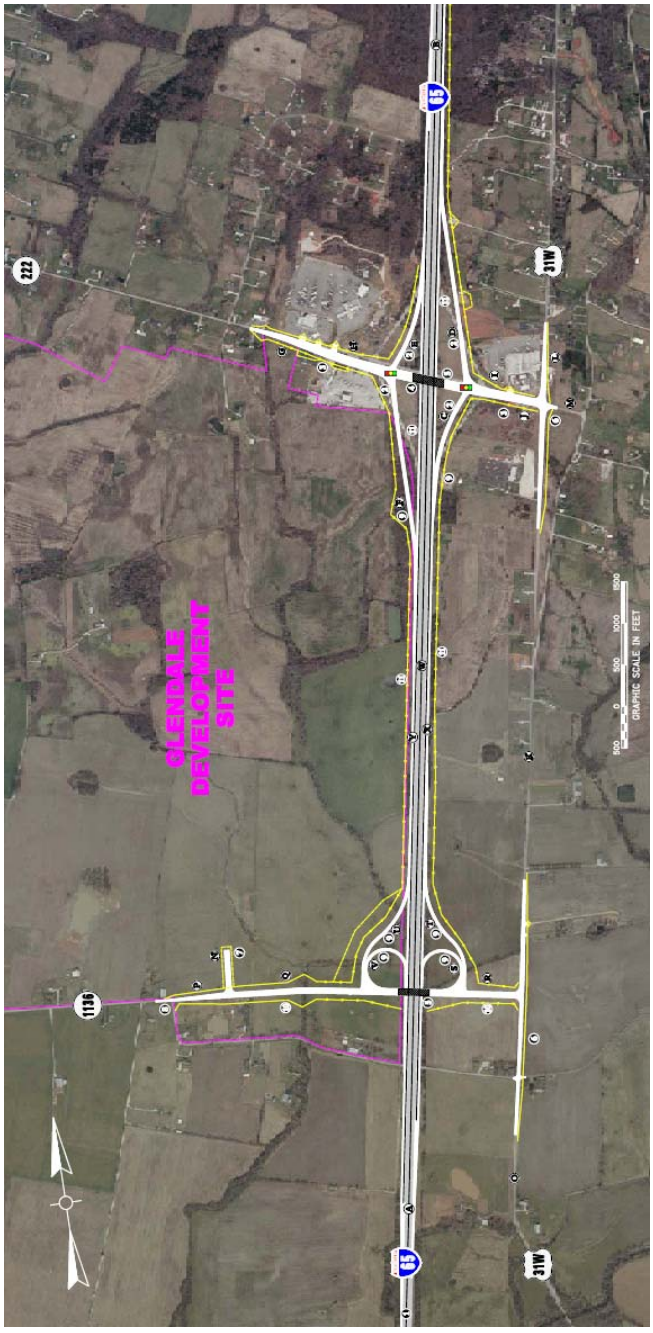
The KY 1136 interchange was developed with a folded diamond configuration north of KY 1136 to minimize impacts to the Camp Nevin historic resource that is in the area.

The alternate concept was considered in Phase 1a of the preliminary design stage but was not carried forward into Phase 1b. No documentation exists as to why this was not considered further.

Sketch

Alternative No.: IO-63

☐ Original ☑ Alternative



Calculations

Alternative No.: IO-63

☐ Original ☑ Alternative

Phase 1: KY 222 Modifications	=	$3,584,000 (as calculated in IO-31)
Phase 2: C-D construction and KY 1136 interchange		
Original Estimate for 2-2A	=	$62,250,000
Subtract Original Estimate for Alt 1-2	=	$28,350,000
		$33,900,000
Total Cost for 2 Phases	=	$37,484,000
Original Cost	=	$27,748,000
Change in Cost	=	($9,700,000)

SECTION 5

DESIGN SUGGESTIONS

SECTION 5
DESIGN SUGGESTIONS

In addition to the Value Alternatives in the previous section, the team generated several other ideas that we have termed design suggestions. These are presented to bring attention to areas of the plan which, in the opinion of the team, should be changed. In general these ideas were designated as design suggestions rather than Value Alternatives for one of two reasons:

1. The value improvement opportunity is relatively small

2. The concept could not be adequately evaluated or developed within the constraints of the workshop resources

Design suggestions typically are associated with issues such as:

Improved operation

Ease of maintenance

Easier construction

Reduced risk of construction claims

Clarification of construction documents

Or safer working conditions

IO-29 KYTC to partner with Hardin County to develop a comprehensive land use plan

With the vision of a new, large industry in the southwest quadrant of the interchange, there is a distinct possibility that the land use in the immediate vicinity could change substantially. Ancillary and support businesses, residential homes and apartments for workers and commercial development could result by the construction of a major anchor industry. Should this happen, it will have a major impact on the flow of traffic on KY 222, KY 1136, US 31W and the interchanges with I-65.

To support a logical, orderly development pattern that minimizes negative impacts on traffic, the VE Team recommends the funding of developing a small-area land-use plan that would be adopted by the Hardin County Planning and Development Commission. The plan would be developed with the Commission staff taking the lead. The plan would contain a future vision for the development/redevelopment of the area. Future land use maps and categories and supporting local transportation network would be created to assist the Commission and staff in future planning decisions. Land use would address the housing needs for future workers, roadway connectivity, mixing of land uses, and biking and walking facilities. The planners should be encouraged to work closely with those involved in site planning for the industrial site in order for incorporation of mixed land uses.

IO-30 Enter into a Memorandum of Understanding with local government to protect access

The issues with safety and traffic flow at the current interchange are a result of poor access location and design. The alternatives that have been recommended incorporate improvements that eliminate access points and improve traffic circulation. To protect this investment, the VE Team recommends that a Memorandum of Understanding (MOU) be developed that identifies the current and future access points that will be allowed, including when land is subdivided or combined in the future. The MOU may also spell out desired access spacing in order to reach the desired mobility and safety goals for the area. The MOU would be between KYTC, Hardin County and possibly the City of Glendale and the Radcliff-Elizabethtown MPO.

There is precedence in creating this type of MOU in Kentucky, including one that was developed in Elizabethtown on US 31W.

IO-36 Modify Connector #1 and delete some driveway connections to new KY 222

The VE Team believes that access control is necessary on KY 222 to protect the road integrity for safety and mobility between the interchange and Glendale. Eliminating unnecessary driveways is part of that access control strategy.

If the Preferred Alternative is kept, the old route will be severed where it intersects the new alignment to the west. Properties along the north side of the route (parcel P113 and all eastward) should tie into the old KY 222, which would then serve as an access road. Slight changes to the driveways may be needed to make this feasible.

In addition, the alignment of Connector #1 will need to be changed to create a T intersection with the old route. This suggestion will create little change in the current cost estimate.

IO-45 Integrate bicycle and pedestrian traffic considerations

If this area is to develop as is anticipated, there is potential for many employment sites and residences to be built. With this, there will be a much greater demand for residents to walk or bike to work and other locations. It is important that this project adequately design necessary facilities for pedestrians and bicyclists. Clarity on the needed connections will come should design suggestion IO-29 be implemented to identify future land uses. It appears that land to the east of US 31W and west of Robey Drive would be likely for predominantly residential uses. If that is the case, a shared-use path along KY 222 connecting them, commercial development and employment will become an appropriate facility type along this access controlled roadway.

Connections from the shared-use path to the adjacent land should also be included in the design, especially to the proposed industrial site. Many of these connections can be identified in the comprehensive plan.

Finally, finding the best way to cross pedestrians and bicyclists across the interchange will be the biggest challenge. The primary issue arises with a conflict between pedestrians and traffic entering KY 222 from a free flow ramp. For a partial cloverleaf design a promenade pedestrian facility in the median between the ramp signal intersections could be included. This would separate pedestrians from vehicles by using a decorative concrete barrier. Pedestrians could access the median by crossing at the signals.

IO-54 Do not eliminate landscaping; get agreement with City and developers

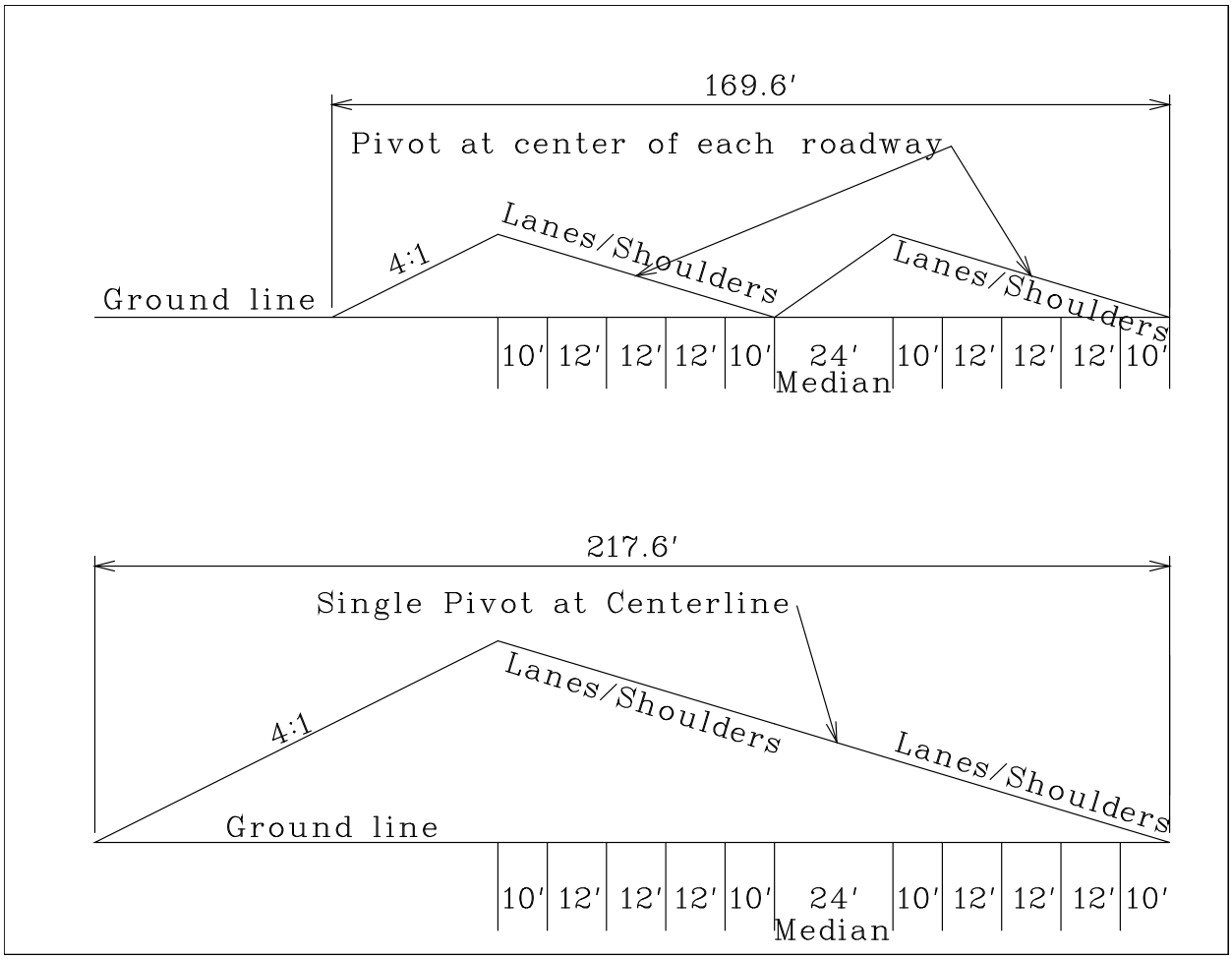
The original Preferred Alternative had included a set of aesthetic amenities including a berm, trees and a wooden four-rail fence. Considering that this is an important gateway to the historic city of Glendale, the VE Team recommends that landscaping be added back into the design. This should include the trees and fence. A shared use path may be included in the vicinity of them. Additional landscaping may be possible if an agreement can be reached with the local government to maintain it.

IO-58 Move super pivot point to the center of the driving lane to reduce earthwork

Move superelevation pivot point to the center of the driving lanes to reduce earthwork and right-of-way width.

Since realigned KY 222 is divided by a median, it may be possible to create superelevation pivot points on the center of each of the eastbound and westbound lanes. In this case each roadway will rotate independently.

In the sample sketch below, there is a reduction of 28% of right-of-way width and 32% earthwork volume at this cross section. This section is drawn as full 6% superelevation.



APPENDICES

APPENDIX
A – PARTICIPANTS

I-65 & KY 222 Interchange
Hardin County
July 13 – 17, 2009

Name:	Company:	Phone:	Email:	Introduction	Mid-Point Review	VE Presentation
John Robinson	Strategic Value Solutions, Inc.	(816) 795-0700	John@SVS-inc.net	X	X	X
Chuck Allen PE	Kentucky Transportation Cabinet	(502) 546-3280	chuck.allen@ky.gov		X	X
Gilberto De Leon	FHWA	(502) 223-6757	gilberto.deleon@dot.gov			X
Brad Eldridge	Kentucky Transportation Cabinet		brad.eldridge@ky.gov	X		X
Ben Edelen	HDR Engineering, Inc.	(859) 223-3755	ben.edelen@hdrinc.com	X		X
Jennifer Goins PE	HNTB Corporation	(317) 636-4682	jgoins@hntb.com	X	X	X
Wes Hagerman PE	Kentucky Transportation Cabinet	(502) 564-4560	wes.hagerman@ky.gov	X		
Barry House	Kentucky Transportation Cabinet	(502) 564-7183	barry.house@ky.gov	X		X
Jeff Jasper	Kentucky Transportation Cabinet		jeff.jasper@ky.gov			X
Adam Kirk PE, PTOE, AICP	Kentucky Transportation Cabinet University of Kentucky	(859) 257-7310	akirk@engr.uky.edu	X	X	X
John Moore	Kentucky Transportation Cabinet – D04		johnw.moore@ky.gov	X	X	X
Arlen Sandlin	Parson Brinckerhoff	(859) 245-3867	sandlin@pbworld.com			X
Siamak Shafaghi	Kentucky Transportation Cabinet	(502) 564-3280	siamak.shafaghi@ky.gov	X	X	X
Steve Slade	Parsons Brinckerhoff, Inc.	(859) 245-3862	slade@pbworld.com	X	X	
Brent Sweger PE	Kentucky Transportation Cabinet	(502) 564-7183	brent.sweger@ky.gov	X	X	X
Scott Walker	Parsons Brinckerhoff	(859) 245-3873	walkersc@pbworld.com			X
Scott Wolf	FHWA	(502) 223-6734	scott.wolf@dot.gov			X

APPENDIX
B – COST INFORMATION

IN PDF FILE

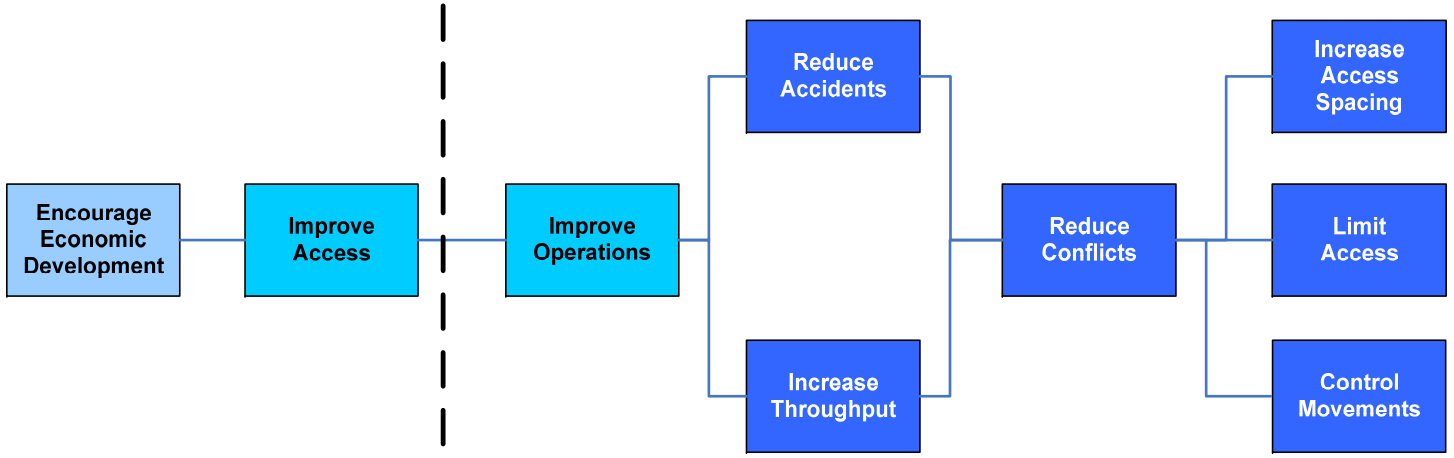
APPENDIX
C – FUNCTION ANALYSIS

FAST Diagram

HOW?

WHY?

WHEN?



Scope Lines

Higher Order Function (Mission)

Basic Function

Secondary Function

Required Secondary Function

I-65 & KY 222 Interchange
Hardin County

APPENDIX
D – CREATIVE IDEA LISTING

CREATIVE IDEA LISTING

Idea No.	Description	Votes
Improve Operations (IO)		
IO-1	Buy out truck stops and make minor modifications to existing interchange	2
IO-2	Move the Pilot Travel Center to the southwest quadrant with common access for both truck stops	0
IO-3	Close the truck entrance on KY 222 for the Pilot Travel Center	1
IO-4	Reverse the truck flow through the Pilot Travel Center	3
IO-5	Use a partial cloverleaf at the existing interchange location	3
IO-6	Use roundabouts at the ramp terminals of the existing interchange	2
IO-7	Add another bridge to the south of the existing structure	1
IO-8	Make KY 222 a four lane from 31 W through the access point for the new development	0
IO-9	Use a trumpet interchange for access to development between Camp Nevin and KY 222	0
IO-10	Add a truck access ramp from southbound I-65 to westbound KY 222 with a new interchange	0
IO-11	Use Alternate 1	3
IO-12	Reconstruct interchange as a diamond on the existing alignment	6
IO-13	Shift ramps C and D to the west to avoid the stream relocation	0
IO-14	Use walls on ramps C and D to avoid the magnitude of the stream work	1
IO-15	Tie KY 222 back into existing alignment east of Robey Drive	3
IO-16	Realign KY 222 to T-intersection with US 31W and leave existing structure as a service road between truck stops; new service ramp	0
IO-17	Relinquish KY 222 to the county	2
IO-18	Add a median to KY 222 with the existing interchange	0
IO-19	Move access to Petro and Country Plaza to the west of Petro with a new signalized intersection	2
IO-20	Move roundabout south of hotel and connect KY 222 back to existing alignment west of Robey Drive	0
IO-21	Move the Pilot Travel Center to the Country Plaza location and provide an underpass to connect with Petro	0
IO-22	Acquire select parcels to prevent development	0
IO-23	Use a collector distributor system between the existing interchange and a new parallel interchange to the south	0
IO-24	Do IO-25 and make existing KY 222 one-way and new road one-way	0

Idea No.	Description	Votes
IO-25	Use signalized intersections instead of roundabouts	0
IO-26	Reduce on KY 222 (new)	0
IO-27	Reduce dual lane turning ramps to single lamp	0
IO-28	Reduce LOS from A to D in the design year	2
IO-29	KYTC to partner with Hardin County to develop a comprehensive land use plan	DS
IO-30	Enter into a Memorandum of Understanding with local government to protect access	DS
IO-31	Keep existing interchange; reverse flow through Pilot Travel Center; signalize US 31W and ramps; move west access points to the west of Petro	3
IO-32	Not used	0
IO-33	Not used	0
IO-34	Remove sight-distance issue on KY 222 between existing interchange and Pilot Travel Center	0
IO-35	Reduce median, shoulder and lane widths on Preferred Alternative (realigned KY 222). Eliminate rumble strips on non-interstate facilities.	3
IO-36	Modify Connector #1 and delete some driveway connections to new KY 222	DS
IO-37	Eliminate Connector #1	2
IO-38	Make Connector #2A connect on a tangent	0
IO-39	Eliminate northwest leg of Pilot Travel Center roundabout and close existing truck entrance on KY 222	5
IO-40	Maintain existing northbound on ramp to use as a frontage road	1
IO-41	Maintain existing southbound on ramp to use as a frontage road	1
IO-42	Do IO-39 with an access road around the perimeter of the Pilot Travel Center parking area	0
IO-43	Plan for a parallel overpass to development area from US 31W with an additional road parallel to US 31W	1
IO-44	Create a split-diamond interchange to provide direct access into the development area and maintain the northern half of the existing interchange	2
IO-45	Integrate bicycle and pedestrian traffic considerations	DS
IO-46	Move roundabout to connect with Robey Drive	0
IO-47	Realign Pilot Travel Center roundabout to improve connection with KY 222 to the east	2
IO-48	Reduce median widths leading to roundabouts	2
IO-49	Widen the existing interchange to the north	2

Idea No.	Description	Votes
IO-50	Build a roundabout on existing KY 222 west of Petro and eliminate realignment of KY 222 to the west	2
IO-51	Reduce number of lanes across the bridge	2
IO-52	Replace grass median with stamped concrete or pavers	0
IO-53	Enlarge radius of roundabouts to better match truck traffic	0
IO-54	Do not eliminate landscaping; get agreement with City and developers	DS
IO-55	Integrate a multi-use path	0
IO-56	Use concrete to better accommodate truck turning movements	3
IO-57	Use standard curb instead of lip curb	0
IO-58	Move super pivot point to the center of the driving lane to reduce earthwork	DS
IO-59	Re-evaluate need for two-lane ramps for I-65 operations	3
IO-60	Use 16-foot single lane ramps	0
IO-61	Reduce turning lanes to 12 foot	0
IO-62	Replace high mast lighting with conventional street lighting	2
IO-63	Build new KY 1136 Interchange north of Camp Nevin and collector distributor between KY 1136 /KY 222 interchange. Implement minor modifications to existing KY 222 interchange. Two-step phased implementation.	4
IO-64	Make bridge for SPUI symmetrical to simplify fabrication	0
IO-65	Allow precast structures	1
IO-66	Move new interchange south of Auto Auction with new road tying back into KY 222 further west	1

DS – Indicates the Idea was selected to be written as a Design Suggestion and is included in the Design Suggestion Section of this report

APPENDIX
E – MATERIALS PROVIDED

MATERIALS PROVIDED

Document	Prepared by	Date
Design Executive Summary, I-65 & KY 222 Interchange, Hardin County, Item No. 4-20.00	PB Americas, Inc.	
Excel Sheet - Preferred Alternate Pavement Design and ESAL Summary	Kentucky Transportation Cabinet	
Various Aerial Photos		
Categorical Exclusion Report	Kentucky Transportation Cabinet	March 23, 2009
Improved Access At Glendale, Hardin County, Item No. 4-20.00, Phase 1B Design Preliminary Line & Grade Plans	Parsons Brinckerhoff in association with Quest Engineers	January 2007
I-65 / KY 222 Interchange, Hardin County – Item No. 4-20.00,	Parsons Brinckerhoff	October 29, 2008
Interchange Modification Report, I-65 / KY 222 Interchange, Hardin County – Item No. 4-20.00	PB Americas, Inc.	January 2008
Improved Access at Glendale, Hardin County Item No. 4-20.00, Phase 1B Design, Revised Traffic Forecast Summary	PB Americas, Inc.	September 2007
Revised Roundabout Feasibility Review, I-65 / KY 222 Interchange, Hardin County – Item No. 4-20.00	PB Americas, Inc.	October 2007
Final Report – GPS Control Survey, Kentucky Transportation Cabinet, Hardin County, KY, Item No. 4-10.50, Hyundai Plant – Glendale, KY	Woolpert LLP	April 2002