Georgia Department of Transportation

Dublin Bypass from US 441 at 0.5 Miles North of Firetower Road Northwest to US 441 Project EDS-441(5)

Laurens County, Georgia

Value Engineering Study Report

November 2003

Design Consultant
Georgia Department of Transportation

Value Engineering Consultant

November 7, 2003

Mr. Lisa L. Myers
Design Review Engineer Manager
State of Georgia Department of Transportation
General Office
No. 2 Capitol Square, Room 266
Atlanta, Georgia 30334-1002

re: Project Number EDS-441 (5), Dublin Bypass from US 441 at 0.5 Miles North of Firetower Road Northwest to US 441 in Laurens County, Georgia
Value Engineering Study Report

Dear Ms. Myers:

Lewis & Zimmerman Associates, Inc. is pleased to submit 17 copies and one electronic copy of the referenced report.

The alternatives and design suggestion developed during this VE effort identify opportunities to improve the value of the project in terms of potential capital cost reductions, compliance with State and Federal policies, and improved constructibility.

We take this opportunity to thank you and the State of Georgia Department of Transportation participants for your efforts to assist the VE team in generating new, creative solutions for this project. We look forward to working with you on future assignments and stand ready to answer any questions you may have as you review this report and make implementation decisions.

Sincerely,

LEWIS & ZIMMERMAN ASSOCIATES, INC.

Luis M. Venegas, PE, CVS-Life
Vice President

Attachment

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EXECUTIVE SUMMARY

INTRODUCTION

This Value Engineering (VE) Study Report summarizes the events of the VE study conducted by Lewis & Zimmerman Associates, Inc. (LZA) for the State of Georgia Department of Transportation (GDOT), Atlanta, Georgia. The subject of the study was the **Dublin Bypass**, also known as **Project EDS-441(5)**. The project is located in Laurens County, Georgia and is being designed GDOT. The VE workshop was conducted October 21 – 23, 2003.

PROJECT DESCRIPTION

Project EDS-441(5), the Dublin Bypass, will construct a rural roadway of four, 12-ft. lanes with a 44-foot depressed grassed median on 250 ft. of proposed right of way. The bypass starts at SR 31/US 319/US 441 approximately 0.5 miles north of Firetower Road. It heads westerly for approximately 0.75 miles where relocated Firetower Road will tie into the new roadway. The bypass then follows Firetower Road's current northwesterly alignment with at-grade intersections at Honeysuckle Road and a partially relocated Academy Road/Waldred Industrial Boulevard to Relocated SR 257. From SR 257, the roadway will continue northwest on a new alignment and will bridge over Georgia Central Railroad and Moore Station Road. It will continue northwest with at-grade intersections at relocated Walke Dairy Road and relocated Garner Dominy Road. The bypass then turns northeastward with at-grade intersections at relocated SR 19/US 80, relocated Airport Road, relocated Mace Cannon Road, and Claxton Dairy Road. From there, the bypass turns northward with at-grade intersections at relocated SR 29/US 441 and relocated Ed Swinson Road before tying into SR 29/US 441. Long Creek is to be crossed using a box culvert. Three creeks are to be bridged: Sandy Ford, Hunger and Hardship, and Strawberry. The total project length is 8.74 miles.

The current probable cost of construction has been identified at $40,600,183 as noted on the GDOT's revised *Preliminary Cost Estimate* dated April 2003 that includes $5,141,000 for Right-of-Way purchases. As such, construction is earmarked at $35,459,183 and includes engineering and construction contingencies of 10.00% and one year inflation at 5.00%.

CONCERNS AND OBJECTIVES

Although the project is currently within budget, analyses of the cost estimate revealed three major topics for concern: (1) the quantity of recycled asphalt, (2) the amount of graded aggregate base, and (3) in-place embankment. The quantities of paving and associated base appear to be higher than normal expectations, even for a project of this size.

The greater concern is the very large amount of in-place embankment resulting from an extremely high profile for the entire route of the new highway. This situation has a domino effect on the design of the project's bridges. Adding to the complexity of the bridge designs at Strawberry and Hunger and Hardship Creeks is the requirement to accommodate wildlife crossings in accordance with the U.S. Fish and Wildlife Service's recent formulae recommendations for appropriately sized crossings avoiding a detrimental tunnel effect on larger wild animals such as deer.

It was noted during the Information Phase of the VE study that costs associated with the purchase of rights-of-way cannot be verified as the backup information and data is not available. As such, the cost appears to be low at $5,141,000 since said figure has not changed since November 1988. If a straight line appreciation were applied at 3.5% per annum, this figure could be approaching $8,600,000 in year 2003. However, the VE team could not address this situation.

Therefore, in order to accomplish the project's goals in an expeditious and cost-effective manner, and assist in ameliorating the concerns noted, GDOT engaged this VE study. The objective of the effort was to identify opportunities that would improve the value of the project in terms of potential capital cost reductions, compliance with State and Federal policies, and improved constructibility.

HIGHLIGHTS OF THE STUDY

It is noted the project is a relatively straightforward concept to establish a new four-lane partially limited access bypass highway commensurate with the desire to alleviate truck traffic through the City Dublin. It is also noted that this project is a continuation of the Governor's Road Improvement Program, better known as GRIP, and supports the continuation of uninterrupted traffic in the north-south corridor established by US 441.

Listed below are some of the more salient ideas resulting from the development of alternatives. They are provided here as a sampling of the contents of the report.

Base and Paving (BP)

In order to allow through-traffic to continue along CR360/Moore Station Road unimpeded, a bridge spanning Moore Station Road on the new Dublin Bypass was designed as part of the project. Access to the Dublin Bypass is provided by a partial intersection north of the Moore Station Road Bridge. Alternatives BP-5, BC-7 and BC-8 were combined to eliminate the bridge over Moore Station Road and provide a full crossing intersection at the same location of the current partial intersection. In so doing, not only is one bridge deleted from the project, but accessibility to the Dublin Bypass is provided at a safer intersection. This scenario maintains uninterrupted traffic flow along the new Dublin Bypass while identifying savings approaching $1,100,000. These alternatives do acknowledge that Moore Station Road traffic is now diverted to the full crossing intersection.

Grading and Drainage (GD)

A major concern the VE team encountered on this project was the apparent over-fill condition created by the current profile. Over 1.3 million cubic yards (CY) of in-place embankment must be transported to the site to accomplish the intended profile. The location of the barrow site has not been identified, and it appears the 1.3 million CY of fill material is low as it would only average about 4.5 vertical feet of new fill for the entire length and width of the project. As such, Alternatives GD-1 and GD-2 adjusted the profile at three major locations leading to a potential savings of over $1,130,000. Other locations have the potential for further reduction and should be explored by the GDOT design team. Not only will less fill material be required, but a direct positive impact will be immediately felt on the design of all of the bridges by reducing the size of columns and approach slopes.

Bridges and Culverts (BC)

The project was originally intended to provide culverts as a means of spanning wetlands and creeks. However, due to the requirement for wildlife crossings at Hunger and Hardship Creek and at Strawberry Creek, which could not be attained with culverts, bridges were substituted. This led to the use of bridges for all crossings except at Long Creek.

In an attempt to reduce the costs of the bridges, Alternative BC-5 would use a combination of culverts and bridges to span the two areas associated with wildlife crossings: Hunger and Hardship Creek and Strawberry Creek. The bridge portion of these spans would be designed in accordance with the US FWS criteria to satisfy the needed wildlife crossings and the culverts would assure appropriate water flow and roadway support. Initial savings approaching $3,300,000 are possible.

Bridge layouts for Sandy Ford, Hunger and Hardship, and Strawberry Creeks are controlled by the banks of their respective streams. As a result, the bridges are skewed to the streams resulting in more complex bridge geometry and inefficiencies. Although not additive to Alternative BC-5 above, Alternative BC-13 would modify the stream channels to improve bridge geometry at these locations. In so doing, initial savings of about $680,000 could come to fruition. It is acknowledged that additional approval for this change is required but can be done concurrently while other known required environmental process approvals are undertaken.

Finally, three of the proposed five new bridges appear to be longer than necessary: Bridge No. 2 over Moore Station Road, Bridge No. 4 over Hunger and Hardship Creek, and Bridge No. 5 over Strawberry Creek. Shortening the spans as noted on Alternative No. BC-2 could render initial savings nearing $840,000 while simplifying the design and constructibility of the facilities.

Summary of Potential Cost Savings worksheets follow this section indicating all of the alternatives and design suggestions developed by the VE team. Some of the alternatives are mutually exclusive or interrelated so that addition of all project cost savings does not equal total savings for the project. A full listing of all of the ideas can be found in the Value Analysis and Conclusions section of this report as *Creative Idea Listing* worksheets.

STUDY RESULTS

INTRODUCTION

The results are the major feature of a value engineering study since they represent the benefits that can be realized on the project by the owner, users and designer. The results will directly affect the project design and will require coordination among the designer, the user and the owner to determine the ultimate acceptance of each alternative.

The creative ideas are organized according to the order in which they were originally generated by the VE team during their function analysis and creative sessions. The following prefixes in the alternative numbers are use to designate the project element being addressed:

BP	=	**B**ase and **P**aving
GD	=	**G**rading and **D**rainage
BC	=	**B**ridges and **C**ulverts
LI	=	**L**ump **I**tem
SF	=	**S**pecial **F**eature

RESULTS OF THE STUDY

The VE team generated 28 ideas for change during the Function Analysis and Creative Ideas phases of the VE Job Plan. The evaluation of these ideas was based upon their potential for capital cost savings, probability of acceptance, availability of information to properly develop an idea, compliance with perceived quality, adherence to universally-accepted standards and procedures, life cycle cost efficiency, safety, maintainability, constructibility and soundness of the idea.

Of the 28 ideas generated, 15 were sufficiently rated to warrant further investigation. Continued research and development of these ideas yielded 10 alternatives for change with an impact on project costs and three design suggestion that will enhance the value of the project in terms of capital cost, durability, and expected life. All of these alternatives and design suggestions are presented in detail following this narrative.

EVALUATION OF ALTERNATIVES

Once the aforementioned ideas are developed, it is important to consider each part of an individual alternative on its own merit. There may be a tendency to disregard an alternative because of concern about one portion of it. Consider each of the areas within an alternative that are acceptable and implement those parts in the final design, even if the entire alternative is not implemented.

Cost is the primary basis of comparison for alternative designs. To ensure that costs are comparable within the alternatives proposed by the VE team, the designer's cost estimates, where possible, is to be used as the pricing basis.

Some of the alternatives are interrelated, so acceptance of one may preclude the acceptance of another. The reader should evaluate those alternatives carefully to select the ideas with the greatest beneficial impact to the project.

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	PRESENT WORTH OF COST SAVINGS: RECURRING COST SAVINGS	PRESENT WORTH OF COST SAVINGS: TOTAL PW LCC SAVINGS
	BASE AND PAVING (BP)					
BP-5/BC-7/ BC-8	Eliminate Moore Station Road connection	$1,524,900	$433,606	$1,091,294		$1,091,294
BP-6	Reduce the typical section at outside shoulders	$5,378,365	$5,086,082	$292,283		$292,283
	GRADING AND DRAINAGE (GD)					
GD-1/GD-2	Adjust profile and balance earthwork	$1,130,646	$0	$1,130,646		$1,130,646
GD-3	Review quantity of erosion control	DESIGN SUGGESTION				
	BRIDGES AND CULVERTS (BC)					
BC-1	Reduce the height of columns by reducing profile	$8,171,446	$7,802,684	$368,762		$368,762
BC-2	Look for opportunities to reduce bridge lengths	$4,830,943	$3,992,697	$838,246		$838,246
BC-3	Verify wildlife crossing calculations	DESIGN SUGGESTION				
BC-4	Realign crossing to eliminate closing-in of the Moore Station Road Bridge	$1,524,900	$1,333,037	$191,863		$191,863
BC-5	Replace stream crossings with culverts and bridges	$5,542,638	$2,240,344	$3,302,294		$3,302,294
BC-11	Use cast-in-place "T" beams for bridges where possible	DESIGN SUGGESTION				
BC-13	Realign streams now to simplify bridge design	$5,542,638	$4,861,596	$681,042		$681,042
	LUMP ITEMS (LI)					
LI-1	Selectively eliminate signalized intersections	$71,102	$0	$71,102		$71,102
	SPECIAL FEATURES (SF)					
SF-1	Eliminate cattle underpass	$84,771	$1,244	$83,527		$83,527

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BP-5 / BC-7&8

DESCRIPTION: **ELIMINATE BRIDGE AT MOORE STATION CROSSING**

SHEET NO.: 4 of 7

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BP-5 / BC-7&8

DESCRIPTION: **ELIMINATE BRIDGE AT MOORE STATION CROSSING**

SHEET NO.: 5 of 7

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BP-5 / BC-7&8

DESCRIPTION: **ELIMINATE BRIDGE AT MOORE STATION CROSSING**

SHEET NO.: 6 of 7

COST WORKSHEET

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

DESCRIPTION: **ELIMINATE BRIDGE AT MOORE STATION CROSSING**

ALTERNATIVE NO:
BP-5 / BC-7&8

SHEET NO. 7 of 7

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bridge No. 2 over CR 360 / Moore Station Road	SF	20,400	65.00	1,326,000			
Additional In-Place Embankment	CY				15,952	4.83	77,049
New Roadway on West Side of Dublin Bypass	LF				1,000	300.00	300,000
	Sub-total			1,326,000			377,049
Mark-up at	**15.00%**			198,900			56,557
	TOTAL			1,524,900			433,606

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BP-5 / BC-7&8

☑ AS DESIGNED ☐ ALTERNATIVE

SHEET NO.: 2 of 7

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BP-5 / BC-7&8

☐ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 3 of 7

VALUE ENGINEERING ALTERNATIVE

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BP-5/BC-7/ BC-8

DESCRIPTION: **ELIMINATE BRIDGE AT MOORE STATION CROSSING**

ORIGINAL DESIGN: (Sketch attached)

The existing design consists of a 177-ft. wide bridge on the Dublin Bypass over County Road (CR) 360/Moore Station Road. A connector providing access to the Dublin Bypass from Moore Station Road parallels the Dublin Bypass on CR 359/Edwards Lane on the east side of the Dublin Pass for about 800 feet.

ALTERNATIVE: (Sketch attached)

Eliminate the bridge on the Dublin Bypass at Moore Station Road by providing a connection to the Edward Lane connector on the west side of the Dublin Bypass. Eliminate through-traffic on Moore Station Road.

ADVANTAGES:

- Eliminates one bridge on the Dublin Bypass
- Reduces initial cost
- Common practice
- Improves safety
- Clearly defines crossing

DISADVANTAGES:

- Requires additional earthwork
- Needs additional right-of-way
- Inconveniences user
- Does not meet users expectation along Moore Station Road

DISCUSSION:

By clearly providing an at-grade intersection allowing turning movements in all directions at one location, safety is improved while permitting traffic along the new Dublin Bypass to flow unimpeded at Moore Station Road thereby meeting one of the desired functions to reduce travel time.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,524,900	—	$ 1,524,900
ALTERNATIVE	$ 433,606	—	$ 433,606
SAVINGS	$ 1,091,294	—	$ 1,091,294

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BP-6

DESCRIPTION: **REDUCE TYPICAL SECTION AT OUTSIDE SHOULDERS**

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BP-6

DESCRIPTION: **REDUCE TYPICAL SECTION AT OUTSIDE SHOULDERS**

COST WORKSHEET

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

DESCRIPTION: **REDUCE TYPICAL SECTION AT OUTSIDE SHOULDERS**

ALTERNATIVE NO: BP-6

SHEET NO. 9 of 9

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Graded Aggregate Base	TON	314,515	14.87	4,676,838	297,423	14.87	4,422,680
	Sub-total			4,676,838			4,422,680
Mark-up at	**15.00%**			701,526			663,402
	TOTAL			5,378,364			5,086,082

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BP-6

☑ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 2 of 9

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BP-6

☑ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 3 of 9

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BP-6

☑ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 4 of 9

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BP-6

☑ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 5 of 9

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BP-6

☑ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 6 of 9

VALUE ENGINEERING ALTERNATIVE

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BP-6

DESCRIPTION: **REDUCE TYPICAL SECTION AT OUTSIDE SHOULDERS**

ORIGINAL DESIGN: (Sketch attached)

The existing design documents indicate the use of a 6’ 6’’. wide outside shoulder with a 12-in. graded aggregate base located at the tangent and super-elevation sections along the mainline.

ALTERNATIVE: (Sketch attached)

Use a 6-in. graded aggregate base in lieu of the as-designed 12-in. graded aggregate base for the outside shoulders.

ADVANTAGES:

- Reduces initial cost of labor and material
- Potential reduction in construction time
- Common practice

DISADVANTAGES:

- Heavy loads may still be experienced on the outside shoulders
- Weaker shoulder depth
- Cannot be used for extended periods of time for traffic movement
- May challenge a GDOT standard/criteria

DISCUSSION:

The Dublin Bypass is being constructed to accommodate the City’s desire to preclude heavy truck traffic within the City confines. In bypassing the City, the new rural highway will connect to existing four-lane facilities at the start and terminus of the project. As further widening of US 441 in this region is not anticipated in the foreseeable future, the need for a drivable outside shoulder does not appear to be warranted.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 5,378,365	—	$ 5,378,365
ALTERNATIVE	$ 5,086,082	—	$ 5,086,082
SAVINGS	$ 292,283	—	$ 292,283

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: GD-1/GD-2

DESCRIPTION: **ADJUST PROFILE IN TO BALANCE EARTHWORK**

SHEET NO.: 5 of 8

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: GD-1/GD-2

DESCRIPTION: **ADJUST PROFILE IN TO BALANCE EARTHWORK**

SHEET NO.: 6 of 8

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: GD-1/GD-2

DESCRIPTION: **ADJUST PROFILE IN TO BALANCE EARTHWORK**

SHEET NO.: 7 of 8

COST WORKSHEET

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO: GD-1 / GD-2

DESCRIPTION: **ADJUST PROFILE IN TO BALANCE EARTHWORK**

SHEET NO. 8 of 8

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
STA 33+00 to STA 55+00	CY	82,963	4.83	400,711			
STA 227+00 to STA 238+00	CY	55,407	4.83	267,616			
STA 456+00 to STA 478+00	CY	65,185	4.83	314,844			
	Sub-total			983,171			
Mark-up at	**15.00%**			147,476			
	TOTAL			1,130,646			

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
GD-1 / GD-2

☑ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 2 of 8

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
GD-1 / GD-2

☑ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 3 of 8

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
GD-1 / GD-2

☑ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 4 of 8

VALUE ENGINEERING ALTERNATIVE

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: GD-1/GD-2

DESCRIPTION: **ADJUST PROFILE AND BALANCE EARTHWORK**

SHEET NO.: 1 of 8

ORIGINAL DESIGN: (Sketch attached)

The current design documents indicate a profile for the new Dublin Bypass using 1,317,550 cubic yards (CY) of in-place embankment.

ALTERNATIVE: (Sketch attached)

Lower the profile in an attempt to balance the necessary earthwork in the project. This is especially true between the following stations (see calculation sheets):

STA 33+00 to STA 55+00;
STA 227+00 to STA 238+00;
STA 456+00 to STA 478+00.

ADVANTAGES:

- Lowers overall profile
- Reduces requirement for in-place embankment
- Easier to construct
- Improves visual appearance of new highway
- Reduces initial cost
- Allows for the use of shorter culverts
- Helps reduce bridge lengths – see other related BC alternatives

DISADVANTAGES:

- Requires some redesign of at-grade intersections
- Changes some sight distances

DISCUSSION:

During the development of this alternative, it became apparent when comparing the existing profile to the cost estimate that the average depth of in-place embankment of the Dublin Bypass was between four to five feet. [1,317,550 CY x 27CF/CY = 35,573,850 CF. 35,573,850 CF/180 LF (average width)/8.730 miles x 5,280 LF/mile = 4.297 feet.] This figure appears to be too low and warrants further analysis since the location for obtaining the in-place embankment is not identified in the design documents. This large requirement could result in even higher costs than currently shown on the project estimate, and, therefore, this alternative could actually save even more money.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,130,646	—	$ 1,130,646
ALTERNATIVE	$ 0	—	$ 0

SAVINGS	**$ 1,130,646**	**—**	**$ 1,130,646**

VALUE ENGINEERING ALTERNATIVE

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: GD-3

DESCRIPTION: **REVIEW QUANTITY OF EROSION CONTROL**

SHEET NO.: 1 of 1

ORIGINAL DESIGN:

The current cost estimate indicates the cost of erosion control to be $601,136 after markups. This construction element consists of: baled straw erosion check and associated maintenance; silt fence - Type A and associated maintenance; silt fence - Type C and associated maintenance; slope mat; and sediment basin and associated maintenance.

ALTERNATIVE:

Consider increasing the quantity of erosion control efforts to be more in-keeping with the anticipated earthwork associated with the high profile and length of the project.

ADVANTAGES:

- Assures compliance with criteria and standards
- Improves soil conservation
- Improves GDOT's good neighbor image
- Reduces potential environmental concerns

DISADVANTAGES:

- Added cost of additional erosion control
- May not be required
- Increases demobilization costs – minor

DISCUSSION:

It appears the dollar amount associated with erosion control is low when considering the proposed profile and the large quantity of in-place embankment of 1.3 million cubic yards. The eight-mile stretch of new highway with its 250-foot right-of-way also contributes to this perception along with three creek crossings and 11 at-grade intersections.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-1

DESCRIPTION: **REDUCE HEIGHT OF BRIDGE COLUMNS AND ELIMINATE OR REDUCE RETAINING WALLS BY ADJUSTING PROFILE OF DUBLIN BYPASS**

SHEET NO.: 3 of 5

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-1

DESCRIPTION: **REDUCE HEIGHT OF BRIDGE COLUMNS AND ELIMINATE OR REDUCE RETAINING WALLS BY ADJUSTING PROFILE OF DUBLIN BYPASS**

SHEET NO.: 4 of 5

COST WORKSHEET

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

DESCRIPTION: **REDUCE HEIGHT OF BRIDGE COLUMNS AND ELIMINATE OR REDUCE RETAINING WALLS BY ADJUSTING PROFILE OF DUBLIN BYPASS**

ALTERNATIVE NO: BC-1

SHEET NO. 5 of 5

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bridge No. 1, Over Georgia Central	%	959,920	100%	959,920	959,920	100%	959,920
Railroad							
Bridge No. 2, Over CR 360 / Moore	%	1,326,000	100%	1,326,000	1,326,000	100%	1,326,000
Station Road							
Bridge No. 3, Over Sandy Ford Branch	%	1,776,565	100%	1,776,565	1,776,656	96%	1,705,590
Bridge No. 4, Over Hunger and	%	1,313,780	100%	1,313,780	1,313,780	96%	1,261,229
Hardship Creek							
Bridge No. 5, Over Strawberry Creek	%	1,508,390	100%	1,508,390	1,508,390	96%	1,448,054
Wall @ Sandy Ford Creek	SF	3,740	45.00	168,300	1,870	45.00	84,150
Wall @ Strawberry Creek	SF	1,170	45.00	52,650		45.00	
	Sub-total			7,105,605			6,784,943
Mark-up at	**15.00%**			1,065,841			1,017,741
	TOTAL			8,171,446			7,802,684

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441** ***Preliminary Design Development***	ALTERNATIVE NO.: BC-1
DESCRIPTION:	**REDUCE HEIGHT OF BRIDGE COLUMNS AND ELIMINATE OR REDUCE RETAINING WALLS BY ADJUSTING PROFILE OF DUBLIN BYPASS**	SHEET NO.: 1 of 5

ORIGINAL DESIGN:

The Dublin Bypass project has five bridge structures in the current design. These are: (1) Dublin Bypass over Georgia Central Railroad; (2) Dublin Bypass over CR360/Moore Station Road; (3) Dublin Bypass over Sandy Ford Creek; (4) Dublin Bypass over Hunger and Hardship Creek; and (5) Dublin Bypass over Strawberry Creek.

ALTERNATIVE:

(1) Dublin Bypass over Georgia Central Railroad - This bridge is set based on achieving a minimum vertical clearance over the railroad tracks of 23 ft. The main span shown is a 75 ft. AASHTO Type III beam which is appropriate for this structure. No optimization of column height is achievable for this structure.

(2) Dublin Bypass over CR360/Moore Station Road - This bridge is set based on achieving a minimum vertical clearance over the roadway of 17 ft. The main span shown is a 95 foot long Bulb-T (54-in. depth). The clear zones that are specified for this roadway seem excessive and this will be further evaluated in Alternative **BC-2**. No optimization of column height is achievable for this structure.

(3) Dublin Bypass over Sandy Ford Creek - This bridge is set based on achieving a minimum vertical clearance over the 50 and 100 year storm for the creek. The main span shown is a 75 ft. long AASHTO Type III beam which is appropriate for this span; however, the length of the bridge could be adjusted by adjusting the geometry and reducing the hydraulic opening. Optimization of column height is achievable for this structure. The end of the bridge uses a wrap-around retaining wall to reduce the impact to the stream from the fill. While a portion of the wall will remain, it can be reduced in height.

(4) Dublin Bypass over Hunger and Hardship Creek - This bridge is set based on achieving a minimum vertical clearance over the 50 and 100 year storm for the creek. The main span shown is a 105 ft. long Bulb-T (54-inch depth). The current profile precludes pile bents. Improvement to the profile can be made to lower the bridge; however, because of the alignment of the stream, it is anticipated that the main span will remain. The end spans can be reduced in length due to the lowering of the profile. This will be further evaluated in Alternative **BC-2.** Optimization of column height is achievable on this structure.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 8,171,446	—	$ 8,171,446
ALTERNATIVE	$ 7,802,684	—	$ 7,802,684

SAVINGS	**$ 368,762**	**—**	**$ 368,762**

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441** ***Preliminary Design Development***	ALTERNATIVE NO.: BC-1
DESCRIPTION:	**REDUCE HEIGHT OF BRIDGE COLUMNS AND ELIMINATE OR REDUCE RETAINING WALLS BY ADJUSTING PROFILE OF DUBLIN BYPASS**	SHEET NO.: 2 of 5

ALTERNATIVE Continued:

5) Dublin Bypass over Strawberry Creek - This bridge is set based on achieving a minimum vertical clearance over the 50 and 100 year storm for the creek. The main span shown is a 97 ft. long Bulb-T (54-inch depth). The span and beam type are appropriate for this span; however, the length of the bridge could be adjusted by adjusting the geometry and reducing the hydraulic opening. Optimization of column height is achievable for this structure. There is a short wall near the end of the bridge to protect the stream from the end fill. This wall will be eliminated by lowering the profile.

ADVANTAGES:

- Reduces initial cost
- Reduces potential stream impacts
- Simplifies design
- Simplifies construction

DISADVANTAGES:

- None apparent

DISCUSSION:

Experience indicates that a reduction in the profile of a new facility, except at the obvious tie-in points, i.e., the beginning and terminus of the project, can achieve bridge cost reductions by as much as 4% due to consequential column length reductions.

The walls at Strawberry Creek and Sandy Ford Branch were not itemized in the cost estimate. The square foot costs for these bridges were reduced to compensate for this lack of information.

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-2

DESCRIPTION: **LOOK FOR OPPORTUNITIES TO REDUCE BRIDGE LENGTH**

SHEET NO.: 5 of 8

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-2

DESCRIPTION: **LOOK FOR OPPORTUNITIES TO REDUCE BRIDGE LENGTH**

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-2

DESCRIPTION: **LOOK FOR OPPORTUNITIES TO REDUCE BRIDGE LENGTH**

COST WORKSHEET

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

DESCRIPTION: **LOOK FOR OPPORTUNITIES TO REDUCE BRIDGE LENGTH**

ALTERNATIVE NO: BC-2

SHEET NO. 8 of 8

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bridge No. 2 Over CR 360 / Moore Station Road	SF	20,400	65.00	1,326,000	17,518	65.00	1,138,670
Bridge No. 4 Over Hunger and Hardship Creek	SF	20,212	65.00	1,313,780	18,563	65.00	1,206,595
Bridge No. 5 Over Strawberry Creek	SF	24,016	65.00	1,561,040	17,333	65.00	1,126,645
	Sub-total			4,200,820			3,471,910
Mark-up at	**15.00%**			630,123			520,787
	TOTAL			4,830,943			3,992,697

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-2

☑ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 2 of 8

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-2

☑ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 3 of 8

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-2

☑ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 4 of 8

VALUE ENGINEERING ALTERNATIVE

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-2

DESCRIPTION: **LOOK FOR OPPORTUNITIES TO REDUCE BRIDGE LENGTH**

ORIGINAL DESIGN: (Sketch attached)

The Dublin Bypass project has five bridge structures in the current design:

(1) Dublin Bypass over Georgia Central Railroad - current spans are: 52 feet – 75 feet – 52 feet.
(2) Dublin Bypass over CR360/Moore Station Road - current spans are: 45 feet – 95 feet – 37 feet.
(3) Dublin Bypass over Sandy Ford Creek - current spans are: 40 feet – 40 feet – 40 feet – 40 feet -75 feet.
(4) Dublin Bypass over Hunger and Hardship Creek - current spans are: 70 feet – 105 feet – 70 feet.
(5) Dublin Bypass over Strawberry Creek - current spans are: 97 feet – 97 feet - 97 feet.

ALTERNATIVE: (Sketch attached)

(1) Dublin Bypass over Georgia Central Railroad – no change.
(2) Dublin Bypass over CR360/Moore Station Road – alternative spans are: 45 feet – 70 feet – 37 feet. Note the current bridge is sized for a 34 ft. clear zone; however, AASHTO clear zone requirements for a bridge of this type is approximately 16 feet to 20 feet. As such, the as-designed clear zone appears to be excessive.
(3) Dublin Bypass over Sandy Ford Creek - no change.
(4) Dublin Bypass over Hunger and Hardship Creek - alternative spans are: 60 feet – 105 feet – 60 feet.
(5) Dublin Bypass over Strawberry Creek - alternative spans are: 40 feet – 40 feet - 90 feet – 40 feet.

ADVANTAGES:

- Reduces initial cost
- Simplifies design
- Simplifies construction

DISADVANTAGES:

- None apparent

DISCUSSION:

In general, three of the proposed five new bridges appear to be longer than necessary. The advantages of shorter bridges, in addition to reducing costs, include ease of construction and long-term maintenance. Shorter spans also provide wider opportunities for better pricing during bidding as their availability is more "off-the-shelf" than longer structural units.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 4,830,943	—	$ 4,830,943
ALTERNATIVE	$ 3,992,697	—	$ 3,992,697
SAVINGS	$ 838,246	—	$ 838,246

VALUE ENGINEERING ALTERNATIVE

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-3

DESCRIPTION: **VERIFY WILDLIFE CROSSING CALCULATIONS**

ORIGINAL DESIGN:

Original design uses a formula for derivation of wildlife crossing openings provided by the U.S. Fish and Wildlife Service (FWS) and attached for reference.

ALTERNATIVE:

Bridges should be sized for their hydraulic opening requirements and not wildlife crossing since the perceived formula provided by the US FWS only applies to culverts.

ADVANTAGES:

- Reduces cost
- Simplifies design
- Simplifies construction
- More in keeping with standard bridge design

DISADVANTAGES:

- None apparent

DISCUSSION:

After a telephone conversation with Ms. Kathy Chapman, FWS, it was determined the above-noted criteria does not apply to bridges. Ms. Chapman requested bridges be sized such that there is adequate room on the banks of the creeks for wildlife passage. A 10-ft. offset at the top of the bank is standard procedure and was acceptable to Ms. Chapman.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		
SAVINGS			

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-4

DESCRIPTION: **REALIGN CROSSING TO ELIMINATE CLOSING-IN THE MEDIAN OF THE MOORE STATION ROAD BRIDGE**

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-4

DESCRIPTION: **REALIGN CROSSING TO ELIMINATE CLOSING-IN THE MEDIAN OF THE MOORE STATION ROAD BRIDGE**

SHEET NO.: 4 of 5

COST WORKSHEET

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

DESCRIPTION: **REALIGN CROSSING TO ELIMINATE CLOSING-IN THE MEDIAN OF THE MOORE STATION ROAD BRIDGE**

ALTERNATIVE NO: BC-4

SHEET NO. 5 of 5

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bridge No. 2 Over CR 360	SF	20,400	65.00	1,326,000	14,603	65.00	949,163
Additional Roadway	LF				700	300.00	210,000
	Sub-total			1,326,000			1,159,163
Mark-up at	**15.00%**			198,900			173,874
	TOTAL			1,524,900			1,333,037

VALUE ENGINEERING ALTERNATIVE

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-4

DESCRIPTION: **REALIGN CROSSING TO ELIMINATE CLOSING-IN THE MEDIAN OF THE MOORE STATION ROAD BRIDGE**

SHEET NO.: 1 of 5

ORIGINAL DESIGN: (Sketch attached)

Because of left-turning lanes in the median, the current design requires the medians on Dublin Bypass over Moore Station Road and Dublin Bypass over Sandy Ford Creek to be closed in.

ALTERNATIVE: (Sketch attached)

By relocating the intersection of Moore Station Road connector such that the left turn lanes are developed off of the bridge, the center median can remain open.

It does not appear technically feasible to eliminate the left turn lanes at Sandy Ford Creek.

ADVANTAGES:

- Reduces bridge cost
- Common practice
- Simplifies construction
- Simplifies design
- Improves sight distance
- Eases turning movements
- Improves safety

DISADVANTAGES:

- Increases roadway cost
- Length of connection from Dublin Bypass to Moore Station Road increases
- Perceived driver inconvenience
- Requires additional right-of-way

DISCUSSION:

An at-grade intersection for access to/from Moore Station Road is already part of the project along the west side of the Bypass. By relocating the same intersection an additional ±700-ft. north, the need to close-in the median of the Moore Station Road Bridge is eliminated. In so doing, improved sight distance is achieved facilitating ingress/egress from the Bypass and improving safety.

Additional right-of-way will be required along CR 359/Edwards Lane; however, not to the point of having to relocate a home owner or precluding access to any parcel along said portion of Edwards Lane.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,524,900	—	$ 1,524,900
ALTERNATIVE	$ 1,333,037	—	$ 1,333,037

SAVINGS	**$ 191,863**	**—**	**$ 191,863**

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-5

DESCRIPTION: **REPLACE STREAM CROSSINGS WITH CULVERTS AND BRIDGES**

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-5

DESCRIPTION: **REPLACE STREAM CROSSINGS WITH CULVERTS AND BRIDGES**

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-5

DESCRIPTION: **REPLACE STREAM CROSSINGS WITH CULVERTS AND BRIDGES**

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-5

DESCRIPTION: **REPLACE STREAM CROSSINGS WITH CULVERTS AND BRIDGES**

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-5

DESCRIPTION: **REPLACE STREAM CROSSINGS WITH CULVERTS AND BRIDGES**

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-5

DESCRIPTION: **REPLACE STREAM CROSSINGS WITH CULVERTS AND BRIDGES**

COST WORKSHEET

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO: BC-5

DESCRIPTION: **REPLACE STREAM CROSSINGS WITH CULVERTS AND BRIDGES**

SHEET NO. 15 of 15

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bridge No. 3, Over Sandy Ford Branch	SF	29,921	65.00	1,944,865			
Bridge No. 4, Over Hunger and	SF	20,212	65.00	1,313,780			
Hardship Creek							
Bridge No. 5, Over Strawberry Creek	SF	24,016	65.00	1,561,040			
Culvert @ Sandy Ford (3 - 8' X 8')							
Reinforcing Steel	LB				82,320	0.52	42,806
Concrete	CY				727	388.09	282,033
Wingwall	EA				2	#######	25,000
Add'l Earthwork	CY				15,703	4.83	75,845
Culvert @ Strawberry (2 - 6' X 6')							
Reinforcing Steel	LB				34,075	0.52	17,719
Concrete	CY				317	388.09	122,830
Wingwall	EA				2	5,000.00	10,000
Add'l Earthwork	CY				30,839	4.83	148,952
Culvert @ H&H (4 - 5' X 5')							
Reinforcing Steel	LB				53,688	0.52	27,918
Concrete	CY				451	388.09	174,920
Wingwall	EA				2	7,500.00	15,000
Add'l Earthwork	CY				26,315	4.83	127,101
Wildlife Crossing at Hunger and	SF				6,600	65.00	429,000
Hardship Creek							
Wildlife Crossing @ Strawberry Ck	SF				6,600	65.00	429,000
Trail enhancement	LS				20,000	1.00	20,000
Sub-total				4,819,685			1,948,125
Mark-up at 15.00%				722,953			292,219
TOTAL				5,542,638			2,240,344

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-5

☑ AS DESIGNED ☐ ALTERNATIVE

SHEET NO.: 2 of 15

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-5

☐ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 3 of 15

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-5

☑ AS DESIGNED ☐ ALTERNATIVE

SHEET NO.: 5 of 15

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-5

☐ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 6 of 15

VALUE ENGINEERING ALTERNATIVE

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-5

DESCRIPTION: **REPLACE STREAM CROSSINGS WITH CULVERTS AND BRIDGES**

ORIGINAL DESIGN: (Sketch attached)

The current design calls for bridge structures at the following stream crossing locations: (1) Dublin Bypass over Sandy Ford Creek; (2) Dublin Bypass over Hunger and Hardship Creek, and (3) Dublin Bypass over Strawberry Creek.

Prior to this current configuration, the hydraulic report supported the use of culverts at these locations. These culvert sizes are as follows: (1) Dublin Bypass over Sandy Ford Creek (triple 8-foot x 8-foot), (2) Dublin Bypass over Hunger and Hardship Creek (quadruple 5-foot x 5-foot), and (3) Dublin Bypass over Strawberry Creek (double 6-foot x 6-foot). These were discounted due to a project requirement of providing wildlife crossings at the Dublin Bypass over Hunger and Hardship Creek and at the Dublin Bypass over Strawberry Creek. Culverts of sufficient length to clear the side slopes would not satisfy the minimum aspect ratio required in the Tunnel Effect formula provided by the U.S. Fish & Wildlife Service (FWS).

It is assumed that providing a similar "openness" was desired at the Sandy Ford Creek location as well.

ALTERNATIVE: (Sketch attached)

Replace the bridges with the culverts specified in the hydraulic report. Add one 40-foot span bridge at the Hunger and Hardship and at the Strawberry Creek Locations to provide a wildlife crossing.

ADVANTAGES:

- Reduces bridge cost
- Satisfies project requirement without extreme measures
- Simplifies construction
- Simplifies design

DISADVANTAGES:

- Perceived to be not as wildlife friendly
- Increases maintenance
- Combination of bridge spans and culverts

DISCUSSION:

As noted above, the current design used a formula for derivation of wildlife crossing openings provided by the FWS. As noted on Alternative BC-3, the bridges should be sized for their hydraulic opening requirements and not wildlife crossing since the aforementioned FWS formula only applies to culverts.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 5,542,638	—	$ 5,542,638
ALTERNATIVE	$ 2,240,344	—	$ 2,240,344
SAVINGS	$ 3,302,294	—	$ 3,302,294

VALUE ENGINEERING ALTERNATIVE

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-11

DESCRIPTION: **USE CAST-IN-PLACE T-BEAMS WHERE POSSIBLE**

SHEET NO.: 1 of 1

ORIGINAL DESIGN:

The current design calls for use of "T" beams on the Sandy Ford Creek bridge.

ALTERNATIVE:

If major changes can be made to the profiles, especially as noted on Alternatives GD-1/GD-2 across Hunger and Hardship Creek and Strawberry Creek, it would be possible to design these bridges as cast-in-place concrete "T" beams.

ADVANTAGES:

- Reduces initial cost
- In-keeping with GDOT practices

DISADVANTAGES:

- Dependent of profile change
- Mixes numerous type bridges on one project

DISCUSSION:

Historically, cast-in-place "T" beam bridges are the most economical bridge superstructure for Georgia bridges. The cost advantage according to GDOT -1999 Bridge Costs is approximately $3.00 per square foot.

The maximum span allowed is 40 ft. Generally these bridges are used when there is not a controlling feature crossed and the column heights are such that pile bents can be used - generally less than or equal to 20 ft.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	DESIGN SUGGESTION		

SAVINGS	

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-13

DESCRIPTION: **REALIGN STREAMS TO SIMPLIFY BRIDGE GEOMETRY**

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-13

DESCRIPTION: **REALIGN STREAMS TO SIMPLIFY BRIDGE GEOMETRY**

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-13

☑ AS DESIGNED ☐ ALTERNATIVE

SHEET NO.: 2 of 10

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-13

☐ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 3 of 10

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-13

☑ AS DESIGNED ☐ ALTERNATIVE

SHEET NO.: 4 of 10

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-13

☐ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 5 of 10

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-13

☑ AS DESIGNED ☐ ALTERNATIVE

SHEET NO.: 6 of 10

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
BC-13

☐ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 7 of 10

VALUE ENGINEERING ALTERNATIVE

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: BC-13

DESCRIPTION: **REALIGN STREAMS TO SIMPLIFY BRIDGE GEOMETRY**

ORIGINAL DESIGN: (Sketch attached)

Bridge layouts for Sandy Fork Branch, Hunger and Hardship Creek and Strawberry Creek are controlled by the banks of their respective streams. As a result, the bridges are skewed to the streams resulting in more complex bridge geometry and inefficiencies.

ALTERNATIVE: (Sketch attached)

Modify the stream channels to improve bridge geometry.

ADVANTAGES:

- Reduces initial bridge costs
- Simplifies design
- Simplifies construction
- In-keeping with standard bridge designs

DISADVANTAGES:

- Requires more project permitting
- Additional rip-rap may be required
- Additional earthwork as a result of reduced bridge length

DISCUSSION:

Design simplification of the aforementioned bridges should be undertaken not just for the cost savings, but from a construction view point as more normalized bridges are easier to erect, maintain and repair. Less angular skews also result in shorter bridges furthering the rationale for implementation.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 5,542,638	—	$ 5,542,638
ALTERNATIVE	$ 4,861,596	—	$ 4,861,596
SAVINGS	$ 681,042	—	$ 681,042

CALCULATIONS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
LI-1

DESCRIPTION:

SHEET NO.: 2 of 3

COST WORKSHEET

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO: LI-1

DESCRIPTION:

SHEET NO. 3 of 3

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Traffic Signal Installation - Mainline	EA	1	30,914	30,914			
at CR 337 / Firetower Road							
Traffic Signal Installation - Mainline	EA	1	30,914	30,914			
at CR 336 / Waldrep Ind. Blvd. -							
Academy Avenue							
	Sub-total			61,828			
Mark-up at	15.00%			9,274			
	TOTAL			71,102			

VALUE ENGINEERING ALTERNATIVE

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: LI-1

DESCRIPTION: **SELECTIVELY ELIMINATE SIGNALIZATION OF INTERSECTIONS**

SHEET NO.: 1 of 3

ORIGINAL DESIGN:

The current design documents indicate 11 at-grade intersections along the mainline/bypass at: (1) SR 31/US 441/US 319; (2) CR 337/Firetower Road; (3) CR 336/Waldrep Industrial Drive – Academy Avenue; (4) SR 257; (5) CR 360/Moore Station Road; (6) CR 338/Walke Dairy Road; (7) SR 19/SR 26/US 80; (8) CR 339/Airport Road; (9) CR 402/Mace Cannon Road; (10) CR 530/Claxton Dairy Road; and (11) SR 29/US 441. Of these intersections, five are to be signalized: (1) SR 31/US 441/US 319; (2) CR 337/Firetower Road; (3) CR 336/Waldrep Industrial Drive – Academy Avenue; (4) SR 256; and (5) SR 19/SR 26/US 80.

ALTERNATIVE:

Eliminate signalization at the following two intersections: (1) CR 337/Firetower Road and (2) CR 336/Waldrep Industrial Drive – Academy Avenue as traffic counts do not appear to warrant their signalization.

ADVANTAGES:

- Simplifies design and construction
- Reduces initial cost
- Improves through-traffic time
- Reduces O&M costs associated with signals and appurtenances

DISADVANTAGES:

- Loss of traffic control devices
- Complicates some vehicular turning movements

DISCUSSION:

One of the benefits of using the proposed bypass is to reduce travel time. An impediment to lowering travel time is the potential of having to stop at controlled intersections. Five of the 11 at-grade intersections are currently earmarked for signalization. Elimination of two of the five signalizations will improve travel time and is consistent with driver expectations.

The added delays associated with left turns onto the mainline from Firetower Road do not come to pass until the year 2024.

An alternative solution could be to delay signalization of all the intersection until the need arises with the exception of SR 31/US 441/US 319 at the beginning of the project.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 71,102	—	$ 71,102
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 71,102	—	$ 71,102

COST WORKSHEET

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO: SF-1

DESCRIPTION:

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Class A Concrete	CY	159	388.09	61,706			
Bar Reinforcing	LB	18,307	0.52	9,520			
Foundation Backfill Material, TP 2	CY	65	38.28	2,488			
In-Place Embankment	CY				224	4.83	1,082
	Sub-total			73,714			1,082
Mark-up at	**15.00%**			11,057			162
	TOTAL			84,771			1,244

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
SF-1

☑ AS DESIGNED ❑ ALTERNATIVE

SHEET NO.: 2 of 4

SKETCHES

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.:
SF-1

☐ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 3 of 4

VALUE ENGINEERING ALTERNATIVE

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

ALTERNATIVE NO.: SF-1

DESCRIPTION: **ELIMINATE CATTLE UNDERPASS**

SHEET NO.: 1 of 4

ORIGINAL DESIGN: (Sketch attached)

The current design calls for the use of a cattle underpass comprised of a double, 7-ft. x 6-ft. x 135-ft. concrete box culvert at station 357+66.95.

ALTERNATIVE: (Sketch attached)

Eliminate the double concrete box culvert acting as a cattle underpass.

ADVANTAGES:

- Simplifies design
- Simplifies construction
- Reduces initial cost
- Precludes inadvertent passage by unauthorized personnel
- Precludes potential early slope deterioration

DISADVANTAGES:

- Loss of amenity
- Complicates movement of cattle from one parcel to another
- Effectively severs parcel of land

DISCUSSION:

Although acknowledging the loss of access between two parcels of land severed by the new highway, the use of the underpass as a cattle crossing could result in higher maintenance costs if sloughing or erosion of slopes occur at this location. Herding of domesticated animals in this relatively confined area could lead to early slope deterioration and sloughing thus detrimentally affecting the highway's operation.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 84,771	—	$ 84,771
ALTERNATIVE	$ 1,244	—	$ 1,244
SAVINGS	$ 83,527	—	$ 83,527

PROJECT DESCRIPTION

GENERAL INFORMATION

The entire concept of providing a Dublin Bypass has been in development since 1986. The need for the bypass is the result of heavy truck traffic within the City limits as United States Route 441 (US 441) traverses the City from south to north and vice versa. Truck traffic is generated not only from the corridor established by US 441 and its combination with US 319, State Road 31 (SR 31) and SR 29, but also from the YKK Corporation Plant and the Best Buys Warehouse and Distribution Center, both located within Dublin. This situation is further aggravated by heavy logging and kaolin mining operations.

PROJECT DESCRIPTION

Project EDS-441(5), the Dublin Bypass, will construct a rural roadway of four, 12-ft. lanes with a 44-ft. depressed grassed median on 250 ft. of proposed right of way. The bypass starts at SR 31/US 319/US 441 approximately 0.5 miles north of Firetower Road. It heads westerly for approximately 0.75 miles where relocated Firetower Road will tie into the new roadway. The bypass then follows Firetower Road's current northwesterly alignment with at-grade intersections at Honeysuckle Road and a partially relocated Academy Road/Waldred Industrial Boulevard to Relocated SR 257. From SR 257, the roadway will continue northwest on a new alignment and will bridge over Georgia Central Railroad and Moore Station Road. It will continue northwest with at-grade intersections at relocated Walke Dairy Road and relocated Garner Dominy Road. The bypass then turns northeastward with at-grade intersections at relocated SR 19/US 80, relocated Airport Road, relocated Mace Cannon Road, and Claxton Dairy Road. From there, the bypass turns northward with at-grade intersections at relocated SR 29/US 441 and relocated Ed Swinson Road before tying into SR 29/US 441. Long Creek is to be crossed using a box culvert. Three creeks are to be bridged: Sandy Ford, Hunger and Hardship, and Strawberry. The total project length is 8.74 miles.

PROJECT COST

The current probable cost of construction has been identified at $40,600,183 as noted on the State of Georgia Department of Transportation's revised *Preliminary Cost Estimate* dated April 2003 and includes $5,141,000 for right-of-way purchases. As such, construction is earmarked at $35,459,183 and includes engineering and construction contingencies of 10.00% and one year inflation at 5.00%.

VALUE ANALYSIS AND CONCLUSIONS

GENERAL

This section describes the value analysis procedure used during the value engineering study. It is followed by separate narratives and conclusions concerning:

- Value Engineering Study Agenda
- Value Engineering Workshop Participants
- Economic Data
- Cost Estimate Summary and Cost Histograms
- Function Analysis
- Creative Idea Listing and Judgment of Ideas

A systematic approach was used in the VE study and the key procedures involved were organized into three distinct parts: 1) preparation; 2) VE workshop; and 3) post-study. A Task Flow Diagram that outlines each of the procedures included in the VE study is attached for reference.

PREPARATION EFFORT

Pre-study preparation for the VE effort consisted of scheduling study participants and tasks; gathering necessary background information on the facility; and compiling project data into a cost model and graphic cost histogram. Information relating to the design, construction, and operation of the facility is important as it forms the basis of comparison for the study effort. Information relating to funding, project planning operating needs, systems evaluations, basis of cost, soil conditions, and construction of the facility was also a part of the analysis.

VALUE ENGINEERING WORKSHOP EFFORT

The VE workshop was a three-day effort (see attached agenda). During the workshop, the VE job plan was followed. The job plan guided the search for high cost areas in the project and included procedures for developing alternative solutions for consideration. It includes six phases:

- Information Phase
- Function Identification and Analysis Phase
- Creative Phase
- Evaluation Phase
- Development Phase
- Presentation Phase *(Not conducted)*

Information Phase

At the beginning of the study, the conditions and decisions that have influenced the development of the project must be reviewed and understood. For this reason, the development manager presented information about the project to the VE team on first day of the session. Following the presentation, the VE team discussed the project using the following documents:

- *Half-Size Preliminary Design Submittal Drawings* entitled Plan and Profile of proposed partial limited access ***Dublin Bypass***, *Laurens County, EDS-441(5) Laurens County*, prepared by the Department of Transportation, State of Georgia, dated November 12, 2002;
- Numerous Interdepartment Correspondence with *Concept Reports* for the **Dublin Bypass** dated between July 5, 1988 and January 13, 1994;
- Special Provisions 108 (Prosecution and Progress) and 150 (Traffic Control) for **Project EDS-441(5)**, Laurens County PI# 262404;
- Revised *Preliminary Cost Estimate* for **Project EDS-441(5)**, prepared by Georgia Department of Transportation, dated April 2003;
- *Item Mean Summary for 01/2003 to 09/2003*, prepared by Georgia Department of Transportation, dated October 1, 2003;
- Fax Transmittal Sheet from the United States Fish & Wildlife Service to Georgia Department of Transportation Office of Environmental/Location containing *Rational for the Recommendation for Wildlife Crossings* dated September 9, 2002; and
- *Engineer Service Let Status for 262404-EDS-441(5)* prepared by the Georgia Department of Transportation dated October 22, 2003.

Function Identification and Analysis Phase

Based on historical and background data, a cost model and graphic function analysis were developed for this project by major construction elements. They were used to distribute costs by project element; serve as a basis for alternative functional categorization; and to assign worth to the categories, where worth is the least cost to provide the required function, as determined by the VE team. The VE team identified the functions of the various project elements and subsystems by using random function generation techniques resulting in the attached Random Function Analysis worksheet and Function Analysis Systems Technique (F.A.S.T.) diagram.

Creative Phase

This VE study phase involved the creation and listing of ideas. Creative idea worksheets were organized by project element. During this phase, the VE team developed as many ideas as possible to provide the necessary functions within the project at a lower cost to the owner, or to improve the quality of the project. Judgment of the ideas was restricted at this point. The VE team was looking for a large quantity of ideas and association of ideas.

The Georgia Department of Transportation representatives may wish to review the creative list since it may contain ideas that can be further evaluated for potential use in the design.

Evaluation Phase

During this phase of the workshop, the VE team judged the ideas generated during the creative phase. Advantages and disadvantages of each idea were discussed to find the best ideas for development. Ideas found to be irrelevant or not worthy of additional study were discarded. Those that represented the greatest potential for cost savings or improvement to the project were then developed further.

The VE team would like to develop all ideas, but time constraints usually limit the number that can be developed. Therefore, each idea was compared with the present schematic design concepts, in terms of how well it met the design intent. Advantages and disadvantages were discussed, and each team member rated the ideas on a scale of zero to five, with the best ideas rated five. Total scores were summed for each idea and only highly-rated ideas were developed into alternatives. In cases where there was little cost impact, but an improvement to the project was anticipated, the designation DS, for design suggestion, was used. The design team should review this listing for possible incorporation of ideas into the project.

The creative listing was re-evaluated frequently during the process of developing alternatives. As the relationship between creative ideas became more clearly defined, their importance and ratings may have changed, or they may have been combined into a single alternative. For these reasons, some of the originally high-rated items may not have been developed into alternatives.

Development Phase

During the development phase, each highly rated idea was expanded into a workable solution. The development consisted of a description of the alternative, life cycle cost comparisons, where applicable, and a descriptive evaluation of the advantages and disadvantages of the proposed alternatives. Each alternative was written with a brief narrative to compare the original design to the proposed change. Sketches and design calculations, where appropriate, were also prepared in this part of the study. The VE alternatives are included in the section entitled *Study Results*.

Presentation Phase

The last phase of the VE study was the presentation of the alternatives. The VE alternatives were screened by the VE team before draft copies of the *Summary of Potential Cost Savings* worksheets were provided to GDOT representatives. The VE alternatives were arranged in the same order as the idea listing sheets to facilitate cross-referencing.

POST-WORKSHOP EFFORT

The post-study portion of the VE study includes the preparation of this Value Engineering Study Report. Personnel from GDOT will analyze each alternative and prepare a short response, recommending either incorporating the alternative into the project, offering modifications before implementation, or presenting reasons for rejection. Lewis & Zimmerman Associates, Inc. is available at your convenience as you review the alternatives. Please do not hesitate to call on us for clarification or further information as you consider an implementation approach.

VALUE ENGINEERING STUDY AGENDA

Lewis & Zimmerman Associates, Inc. (LZA) will conduct a 24-hour VE Study on the **Dublin Bypass From US 441 at 0.5 Miles North of Firetower Road Northwest to US 441, Project No. EDS-441(5) 262404** located in Laurens County, Georgia. It is expected the owner, the Georgia Department of Transportation (GDOT) will be available to make a formal presentation concerning the project at the beginning of the workshop and be available to answer questions during the VE study effort.

VE Study Agenda

The VE study will follow the outline described below and be conducted October 21 - 23, 2003, in the Bridge Design Conference Room GDOT's General Office located at No. 2 Capitol Square Street, Atlanta, Georgia 30334. The point-of-contact is Lisa L. Myers, Design Review Engineer Manager, who can be reached at 404-651-7468.

Tuesday, October 21st

9:00 am - 9:15 am **General Introduction of all Parties and review of the VE Process**

9:15 am - 11:10 am **Owner's/Designer's Presentation**

GDOT is to present information concerning the project including, but not necessarily limited to: rationale for design; criteria for specific areas of study, project constraints and the reasons for design decisions.

12:00 noon - 1:00 pm **Lunch**

1:00 pm - 2:00 pm **Function Analysis Phase**

The VE team will continue their familiarization with the cost models and project data for each area of study. The cost model(s) will be refined, as necessary; define the function of each project element or system in the cost model, select the primary or basic functions, and determine the worth, or least cost, to provide the function. Cost/worth or value index ratios will be calculated, and high cost/low worth areas for study identified. In addition, the VE team will continue defining the function of each element/system to gain a thorough understanding of the project's needs and requirements.

2:00 pm - 4:30 pm **Creative Phase**

The VE team will conduct a brainstorming session and list as many ideas as possible for consideration. The aim is to obtain a large quantity of ideas through free association, by eliminating roadblocks to creativity and deferring judgment.

Wednesday, October 22nd

8:00 am - 10:00 am **Conclude Creative Phase and Complete Evaluation/Analytical Phase**

The VE team will analyze the ideas listed in the creative phase and select the best ideas for further development.

10:00 am - 12:00 noon **Development Phase**

VE team will develop creative ideas into alternate design solutions. Initial and life cycle cost estimates comparing original and proposed alternatives will be prepared. Selected alternatives for change will be developed and supported with sketches, calculations and written substantiation.

12:00 noon - 1:00 pm **Lunch**

1:00 pm - 4:30 pm **Continue Development Phase**

Thursday, October 23rd

8:00 am - 12:00 am **Continue Development Phase**

12:00 noon - 1:00 pm **Lunch**

1:00 pm - 4:00 pm **Conclude Development Phase and Commence Summary Worksheets**

Upon completion of the Development Phase, the VE facilitator will commence preparation of the summary worksheets based on the alternatives developed by the VE team. The summary work sheets form the basis of the informal oral presentation.

4:00 – 4:30 pm **Finalize Summary Worksheets**

The VE team will provide draft copies of the *Summary of Potential Cost Savings* worksheets to GDOT representatives and be available to clarify any points.

VALUE ENGINEERING STUDY
PARTICIPANTS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

DATE: **October 21 – 23, 2003**

NAME & E-MAIL (PLEASE PRINT)	ORGANIZATION/TITLE	PHONE/FAX
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Michael D. Nash em: mike.nash@dot.state.ga.us	GDOT, Office of Traffic and Safety Design (OTSD) OTSD	ph: 404-635-8146 fx: 404-635-8116

VALUE ENGINEERING STUDY
PARTICIPANTS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRE TOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

DATE: **October 21 – 23, 2003**

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VALUE ENGINEERING WORKSHOP PARTICIPANTS

The VE team was organized to provide specific expertise on the project elements involved. Team members consisted of a multidisciplinary group with professional design experience and a working knowledge of VE procedures. The VE team included the following professionals:

Gregory C. Grant, PE	Bridge Engineer	HNTB
William H. Saddler	Civil Engineer	Williams-Russell and Johnson, Inc.
Gregory Snipes	Constructibility	Williams-Russell and Johnson, Inc.
Luis M. Venegas, PE, CVS	VE Facilitator	Lewis & Zimmerman Associates, Inc.

OWNER'S/DESIGNER'S PRESENTATION

Representatives from the State of Georgia Department of Transportation administration, design team, and area representatives presented an overview of the project on Tuesday, October 21, 2003. The purpose of this meeting, in addition to being an integral part of the Information Gathering Phase of the VE Study, was to bring the VE team "up-to-speed" regarding the overall project. Additionally, the meeting afforded the design team the opportunity to highlight in greater detail, those areas of the project requiring additional or special attention.

VALUE ENGINEERING TEAM'S FINAL PRESENTATION

The VE team did not conduct a final, oral presentation on Thursday, October 23, 2003 to GDOT. However, copies of the draft *Summary of Potential Cost Savings* worksheets were provided for interim use by GDOT personnel.

A copy meeting participants is attached for reference.

ECONOMIC DATA

The VE team developed economic criteria used for evaluation with information gathered from the State of Georgia Department of Transportation. To express costs in a meaningful manner, the VE team alternatives are presented on the basis of discounted present worth. Criteria for planning project period interest rates are based on the following parameters:

Year of Analysis:	2003
Construction Start Up:	2005 (Per Engineer Service Let Status for 262040-EDS-441(5))
Construction Duration:	24 Months
Economic Planning Life:	35 years starting in 2007 pavements
Economic Planning Life:	50 years starting in 2007 bridges
Discount Rate/Interest:	5.10% (U.S. OMB Circular A-94)
Inflation/Escalation Rate:	5.00% (GDOT)
Uniform Present Worth (UPW) Factor:	16.1696 for 35 years 17.9774 for 50 years
Cost of Power:	$0.07/kWHr (kilowatt hour) (assumed)
Operation and Maintenance Costs *(Industry Norms)*:	
Equipment - With Many Moving Parts	5.00%-5.50%+ of Capital Cost
Equipment - With Minimal Moving Parts	3.50%-4.00% of Capital Cost
Equipment - Electronic	3.00% of Capital Cost
Structural	1.00%-2.00% (or less) of Capital Cost
Overall Composite Mark-Up: *(Composed of: Engineering and Construction at 10.00% and Inflation at 5.00%)*	15.00% (1.1000)

COST ESTIMATE SUMMARY AND COST HISTOGRAMS

The VE team prepared various cost models for the project that are included following this page. The cost models are arranged in the Pareto Charting/Cost Histogram format to aid in identifying high cost areas and are based on a reasonable facsimile developed by the VE team of the *Preliminary Cost Estimate* prepared by the Georgia Department of Transportation, dated April 2003, and updated prior to commencing the VE study on October 21, 2003. As can be expected, judgments at this stage of the study are based on experience and intuition rather than fact, which is not uncovered until well along in the analysis of function. As a result of these qualified hypotheses, there appears to be a potential for initial savings in the following areas:

DESIGNER'S COST ESTIMATE

The VE team realizes this is a preliminary design development submittal and as such, the cost estimate should be relatively complete with some omissions, incompleteness, assumptions and minimal "lump sum" items. Such has been the case with sufficient information and detail to permit a proper VE analysis.

It was noted during the Information Phase of the VE study that costs associated with the purchase of rights-of-way cannot be verified as the backup information and data is not available. As such, the cost appears to be low at $5,141,000 since said figure has not changed since November 1988. If a straight line appreciation were applied at 3.5% per annum, this figure could be approaching $8,600,000* in year 2003.

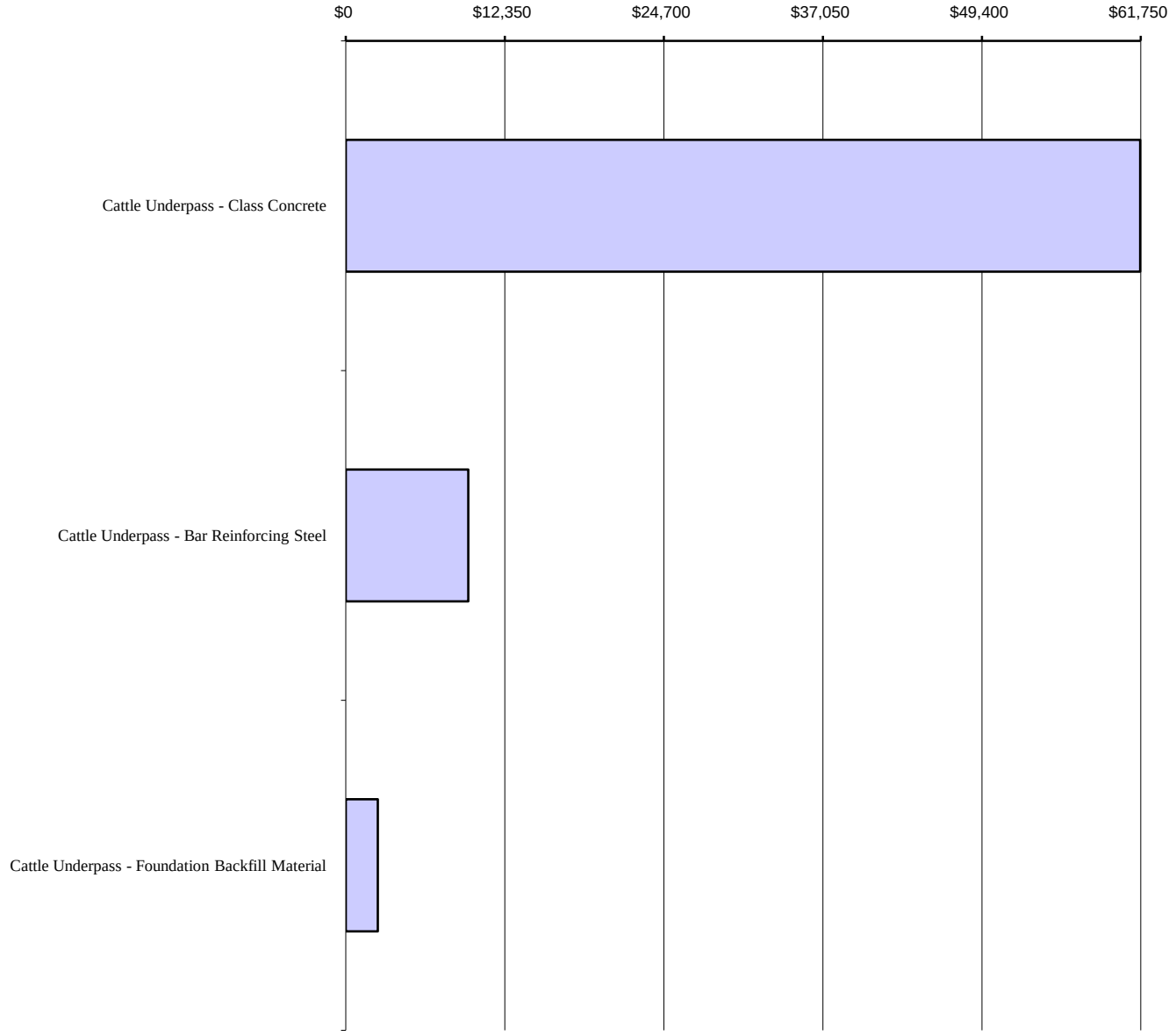
** [1+i^n x P where i = interest, n = period of time in years, and P = principal amount; therefore 1.035^15 x $5,141,000 = $8,612,968.]*

COST HISTOGRAM

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**

Preliminary Design Development

SPECIAL FEATURES	COST	PERCENT	CUM. PERCENT
Cattle Underpass - Class Concrete	61,706	83.71%	83.71%
Cattle Underpass - Bar Reinforcing Steel	9,520	12.91%	96.62%
Cattle Underpass - Foundation Backfill Material	2,488	3.38%	100.00%
Subtotal	73,714	100.00%	
E&C at 10.00%	7,371		
Inflation at 5.00%	3,686		
TOTAL	**$ 84,771**	Comp Markup:	15.00%



Costs in graph are not marked-up.

FUNCTION ANALYSIS

A function analysis was performed to: (1) define the requirements for each project element, and (2) to ensure a complete and thorough understanding by the VE team of the basic function(s) needed to attain a given requirement. A *Random Function Analysis* worksheet for the project is attached. This part of the function analysis stimulated the VE team members to think in terms of the areas in which to channel their creative idea development.

Function Analysis is a means of evaluating a project to see if the expenditures actually perform the requirements of the project, or if there are disproportionate amounts of money spent on support functions. These elements add cost to the final product, but have a relatively low worth to the basic function.

In addition to the random function analysis, the VE Facilitator worked with members of the study team to develop a Function Analysis System Technique (F.A.S.T.) diagram. The F.A.S.T. diagram was used to show the flow of function within the project. It helps to confirm the project is addressing those issues that have been voiced by the owner as being important. The diagram was generated by asking the key question: "What is the most important function to be accomplished by this phase?" The answer is characterized by a verb/noun pair. In turn, another question is asked: "Why?" The answer is again listed in a verb/noun pair, and the process continued from left to right. If the result is a true F.A.S.T. diagram, the flow of functions from right to left will answer the question "Why?" No F.A.S.T. diagram is ever completed. The readers of this report may wish to challenge themselves to see how far they can carry the construction of the F.A.S.T. diagram.

This F.A.S.T. diagram notes the critical function path and identifies the project's basic function as: **DIVERT/TRAFFIC** and is included at the end of this section of the report.

RANDOM FUNCTION ANALYSIS

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

SHEET NO.: 1 of 1

DESCRIPTION	FUNCTION		
	VERB	NOUN	KIND
DUBLIN BYPASS	Divert	Traffic	B
	Bypass	City	B
	Increase	Capacity	S
	Span	Wetland	RS
	Separate	Grade	S
	Reduce	Travel Time	S
	Improve	Safety	RS
	Restrict	Land Use	U
	Facilitate	Wildlife Crossing	RS
	Facilitate	Expansion	S
	Promote	Economic Development	HO

Function defined as: Action Verb / Measurable Noun

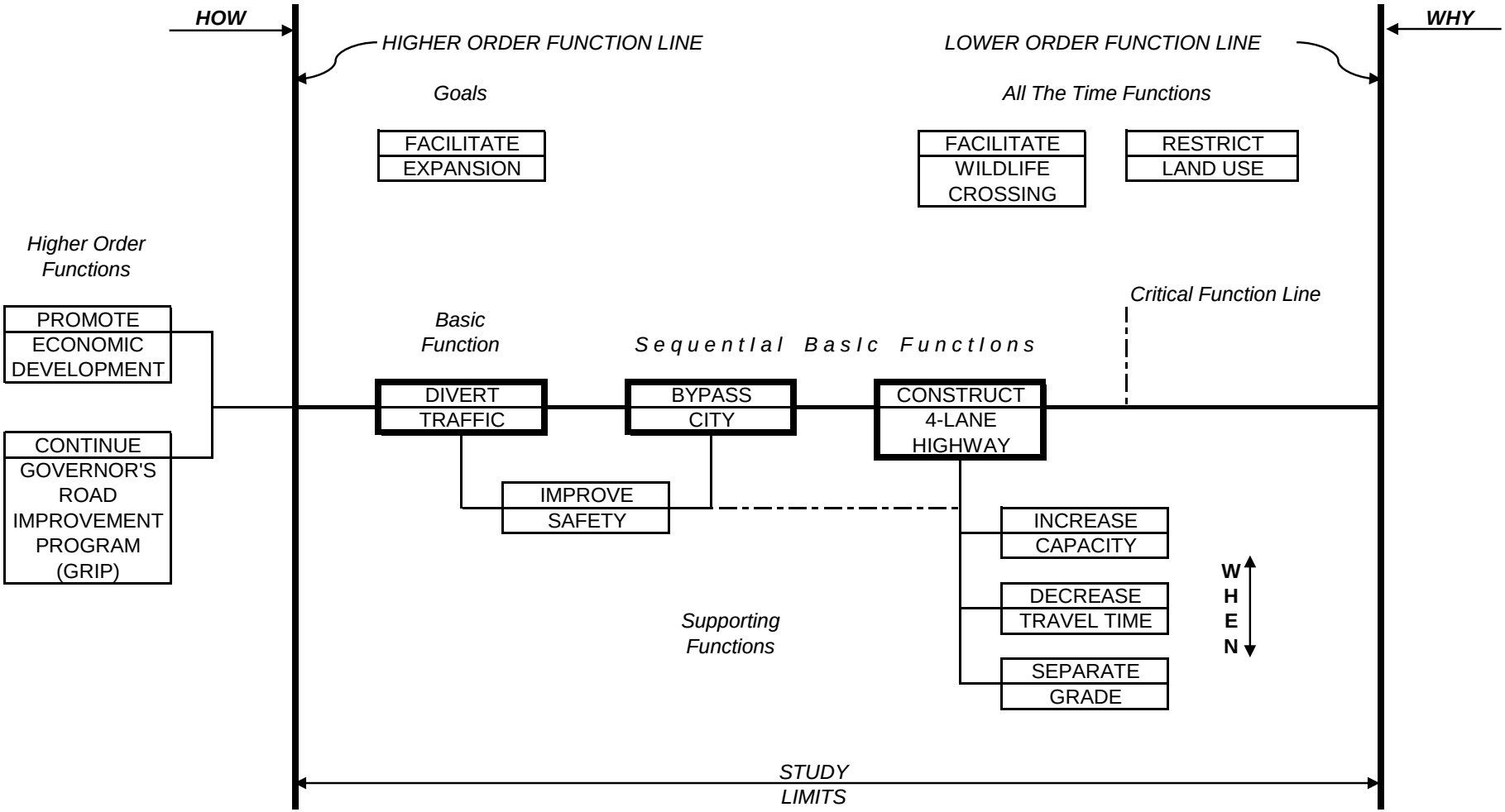
Kind: B = Basic; S = Secondary; RS = Required Secondary; HO = Higher Order; LO = Lower Order; O = Objective; G = Goal; U = Unwanted

FUNCTION ANALYSIS SYSTEMS TECHNIQUE (F. A. S. T.)

DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441

Georgia Department of Transportation, District 2

Laurens County, City of Dublin, Georgia



CREATIVE IDEA LISTING AND JUDGMENT OF IDEAS

During the creative phase, numerous ideas, alternative proposals and/or recommendations were generated using conventional brainstorming techniques as recorded on the following pages.

These ideas were then discussed and the advantages/disadvantages of each listed. The VE design team compared each of the ideas with the concept solution determining whether it improved value, was equal in value, or lessened the value of the solution.

The ideas were then ranked on a scale of one to five on how well the VE design team believed the idea met necessary criteria and program needs. The higher rated ideas were then developed into formal alternatives and included in the VE workshop. Some ideas were judged to have minimal cost impacts on the project but provided enhancements in the form of improved operations, efficiency, constructibility or potential to save unknown or hidden costs. These were given the designation "DS" which indicates a design suggestions. This designation is also used when an idea is difficult to price but improves the functionality of the project or system, and is deemed to be of significant value to the owner, user, operator or designer.

Typically, all ideas rated four or above are included in the Study Report. When this is not the case, an idea was combined with another related idea or discarded, as a result of additional research that indicated the concept as not being cost-effective or technically feasible.

The reader is encouraged to review the *Creative Idea Listing and Evaluation* worksheets since they may suggest additional ideas that can be applied to the design.

CREATIVE IDEA LISTING

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

SHEET NO.: 1 of 2

NO.	IDEA DESCRIPTION	RATING
	BASE AND PAVING (BP)	
BP-1	Use a two-lane bypass in lieu of a four-lane bypass	1
BP-2	Use concrete/rigid pavement in lieu of asphalt	2
BP-3	Reduce the median width	3
BP-4	Reduce the shoulder widths	2
BP-5	Eliminate County Road (CR) 360/Moor Station Road connection (Combine with Alternatives BC-7 and BC-8)	4
BP-6	Reduce the typical section at shoulders	4
BP-7	Provide no at-grade intersections	2
BP-8	Reduce length of approach slabs	2
BP-9	Reduce width of drive lanes to 11.5 feet	<3
BP-10	Use “new” asphalt	2
	GRADING AND DRAINAGE (GD)	
GD-1	Adjust profile (Combined with Alternative GD-2)	5
GD-2	Balance earthwork (Combined with Alternative GD-1)	5
GD-3	Review quantity of erosion control	DS
	BRIDGES AND CULVERTS (BC)	
BC-1	Reduce height of columns by reducing profile	4
BC-2	Look for opportunities to reduce bridge lengths	4
BC-3	Verify wildlife calculations influencing bridge designs	4
BC-4	Realign crossings to preclude median closings (left and “U” turns)	4
BC-5	Use three-sided culverts in lieu of bridges	3
BC-6	Use a causeway at wetlands in lieu of bridges	2
BC-7	Use an at-grade intersection at CR360/Moore Station Road in lieu of bridge (Combine with Alternatives BP-5 and BC-8)	4
BC-8	Sever CR360/Moore Station Road (Combine with Alternatives BP-5 and BC-7)	4
BC-9	Eliminate grade separations (See Alternatives BP-5, BC-7 and BC-8)	N/A

Rating: 1→2 = Not to be Developed; 3→4 = Varying Degrees of Development Potential; 5 = Most likely to be Developed;
DS = Design Suggestion; ABD = Already Being Done; N/A = Not Applicable

CREATIVE IDEA LISTING

PROJECT: **DUBLIN BYPASS FROM US 441 AT 0.5 MILES NORTH OF FIRETOWER ROAD NORTHWEST TO US 441**
Preliminary Design Development

SHEET NO.: 2 of 2

NO.	IDEA DESCRIPTION	RATING
	BRIDGES AND CULVERTS (BC) (Continued)	
BC-10	Use steel superstructures at bridges	2
BC-11	Use cast-in-place "T" beams for bridges where possible	4
BC-12	Increase the use of mechanically stabilized earth (MSE) walls where possible	3
BC-13	Realign streams now to simplify bridge designs	4
	LUMP ITEMS (LI)	
LI-1	Selectively eliminate signalized intersections	4
	SPECIAL FEATURES (SF)	
SF-1	Eliminate cattle underpass	4

Rating: 1→2 = Not to be Developed; 3→4 = Varying Degrees of Development Potential; 5 = Most likely to be Developed;
DS = Design Suggestion; ABD = Already Being Done; N/A = Not Applicable