SR 87/Cochran Bypass from US 23 Business to Existing 4 Lane Section

STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia

Value Engineering Study Report

December 2009

Designers

Georgia Department of Transportation

Value Engineering Consultant

Lewis & Zimmerman Associates, Inc.

an ARCADIS company

an ARCADIS company

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Mr. Matthew J. Sanders, AVS
Value Engineering Specialist
Georgia Department of Transportation - Engineering Services
One Georgia Center – 5th Floor
600 West Peachtree Street
Atlanta, Georgia 30308

Re: STP00-0003-00(625), P.I. No. 0003625
SR 87/Cochran Bypass from US 23 Business to Existing 4 Lane Section
Value Engineering Study Report

Date:
December 2, 2009

Contact:
David Hamilton

Phone:
253.229.7703

Email:
dahamilton@lza.com

Our ref:
LZ083351.0000

Dear Mr. Sanders:

Lewis & Zimmerman Associates, Inc. is pleased to submit two hard copies and one electronic copy of the referenced value engineering (VE) study report documenting the study that took place on November 17 - 20, 2009. The objective of the VE effort was to identify opportunities to enhance the value of the project and reduce impacts to the residents located along the project site.

The VE team developed several ideas which provide opportunities to reduce the cost of the temporary detour and the impact of borrow material which dominates this project. By implementing the VE alternatives, major impacts can be avoided, potentially saving the project over $2 million.

We thank you for your assistance during the course of the VE team's work. Please do not hesitate to call upon us if you or any of the reviewers have any questions regarding the information presented in this report.

Sincerely yours,

LEWIS & ZIMMERMAN ASSOCIATES, INC.
an ARCADIS company

David A. Hamilton, PE, CVS, CCE, LEED^{AP}
Vice President/VE Team Leader

Attachment

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EXECUTIVE SUMMARY

INTRODUCTION

This value engineering (VE) study report documents the events and results of the VE study conducted by Lewis & Zimmerman Associates, Inc., for the Georgia Department of Transportation (GDOT). The subject of the study was the STP00-0003-00(625), P.I. No. 0003625, State Route 87/Cochran Bypass from US 23 Business to the Existing 4 Lane Section project in Bleckley County, being designed by GDOT District 2. The preliminary design documents and an updated GDOT cost estimate were used as the basis of the VE study, which was conducted November 17 - 20, 2009, at GDOT's Atlanta, Georgia headquarters.

Comprising the VE team was a highway engineer, a bridge engineer, a construction specialist and a Certified Value Specialist (CVS) team leader. The team used the following six-phase VE job plan to guide its deliberations.

- Information Gathering Phase
- Function Identification and Analysis Phase
- Creative Idea Generation Phase
- Evaluation/Judgment of Creative Ideas Phase
- Alternative Development Phase
- Presentation Phase

PROJECT DESCRIPTION

This project widens and reconstructs the Cochran Bypass (SR 87) from MP 4.30 just south of the SR 87 Business intersection on the south side of Cochran, extending to MP 8.30 just north of the SR 87 Business intersection on the north side of Cochran, for a total project length of 4.0 miles. The existing roadway consists of two, 12-ft.-wide lanes with 8-ft.-wide rural shoulders on 130 ft. of existing right-of-way. The existing bypass corridor has experienced growth in development in recent years. The base year traffic (2012) is 10,500 vehicles per day (VPD) and the design year traffic (2032) is projected to be 16,250 VPD. With the projected increase in traffic and continued development within the corridor, the existing two lanes will be insufficient to accommodate the transportation demands.

The proposed construction will add two 12-ft.-wide lanes and a 14-ft.-wide flush median to the existing alignment, thus creating a multi lane bypass. The typical section will consist of two, 12-ft.-wide lanes in each direction separated by a 14 ft. flush median with 10 ft. rural shoulders (6.5 ft. paved to accommodate bicycle lanes) on 150 ft. of proposed right-of-way. This project will provide a grade-separated crossing over the Norfolk Southern Railroad. Improvements are proposed at the SR 126 intersection to reduce the skew angle. The east leg will form a "T" and the west leg will be modified into a cul-de-sac. The following are key design parameters.

- Proposed typical section: two 12-ft.-wide lanes in each direction separated by a 14 ft. flush median with 10-ft.-wide rural shoulders with 6.5 ft. being paved to accommodate bicycle lanes
- Proposed Design Speed Mainline: 45mph and 55mph
- Right-of-way: 150 ft.
- Number of parcels involved: 50
- Structures: New Bridge over Norfolk Southern Railroad
- Major intersections and interchanges: SR 126 and SR 26 will have new signals
- Traffic control during construction: All construction will be done under traffic except for an on-site detour at the Norfolk Southern Railroad crossing in order to construct the proposed overpass bridge. A temporary railroad crossing will also have to be constructed at this location in order to facilitate traffic during construction.
- Design variances: A design variance will be required for the flush median in the areas with 55mph design speed.

The total cost of the construction is $20.2 million, plus an additional $1.2 million for right-of-way.

CONCERNS AND OBJECTIVES

The project requires more than 460,000 CY of import material for the grade separation over the Norfolk Southern Railroad. This is a substantial amount of fill that will require months of truck hauling, grading, and compaction. The associated environmental impacts due to noise, dust, and added traffic, although not permanent, will cause some local disruption during the construction period.

The on-site detour near US 23 Business will require new right-of-way and will be in place for approximately 12 months while the grade separation over the Norfolk Southern Railroad is being constructed. Once the new bridge over the railroad is finished, the detour will be removed.

The key cost drivers for the project are the required import material, bridge, lane and shoulder width, and median width. These key elements drive much of the quantities for base, asphalt, structure, and embankment volume.

With this background, the VE team was tasked with identifying opportunities that will enhance the functionality of the project and reduce impacts to the properties located along the project site.

RESULTS OF THE STUDY

The value engineering team developed 15 alternatives to address the concerns noted above with the emphasis being on reducing the amount of import material needed for the grade separation. All of the alternatives are shown on the following Summary of Potential Cost Savings table and detailed in Section Two of the report. The following highlights those alternatives having the greatest potential impact on the project.

Some value improvement can be achieved by modifying the alignment on SR 126 where it intersects SR 87 on the north end of the project alignment. Instead of using a 1,060-ft.-long radius to improve

the skew at the intersection, a 650 ft. radius can be used; this will reduce roadway reconstruction to 560 LF from 1,000 LF in the current design. The shorter radius will require the design speed to be reduced from 45mph to 35mph, but since the traffic approaching the intersection will be in a braking condition, this appears acceptable per the GDOT Design Manual, Chapter 3, paragraph 3.3.2. The shorter radius will result in a net savings approaching $150,000.

The development of a detour around the new grade separation of the Norfolk Southern Railroad is clearly needed to allow the construction of the embankment and new bridge. The current design proposes that the detour be on site However, other possibilities exist for the detour including the use of the existing roadways at Foskey Road and Denny Coley Road. These two roads can be upgraded with a 3 in. asphalt overlay to provide a 1.3-mile-long detour on existing roadways instead of constructing a temporary facility that must be removed at the completion of the job. This convenient detour route appears to be straight and level, and has good visibility. The potential cost savings by using these existing roads is nearly $450,000.

The profile of the grade separation over the Norfolk Southern Railroad is a key driver to the volume of embankment required to be imported to the site. The current profile places a vertical curve on either side of the new bridge over the railroad and appears to add volume to the embankment required for the project. Changing the profile to use a single vertical curve, centered on the bridge, will allow the profile to be slightly lowered, reducing the amount of embankment by about 40,000CY. This results in a potential project savings of $380,000. Placing the crest of the vertical curve on the bridge is not viewed as difficult or complicating, but rather reduces the amount of coping on the bridge.

Other methods to reduce the amount of embankment would include increasing the side slopes from 2:1 to 1:1 by using stabilized slopes instead of placement of conventional fill. Numerous technologies exist for stabilization of slopes and some further investigation may be needed, but using 1:1 slopes could save nearly $500,000, reduce the construction schedule, and minimize the number of truck trips onto the site. Even after accounting for the potential of some annual slope repair, the 30 year life cycle cost is highly supportive of the 1:1 slope concept.

The cost model reveals that the single largest cost component on the project is the roadway pavement section and drainage. Various combinations of section widths for travel lanes, shoulder, and median were explored and documented by the VE team. Several of the more interesting options include using 4 ft. wide shoulders in lieu of 6.5 ft. for a potential savings of $435,000. Changing the inside lane width from 12 ft. wide to 11 ft. would result in a possible savings of nearly $700,000, and modifying the median width near the bridge from 14 ft. wide to 4 ft. wide could save approximately $440,000.

Pavement design is always a critical issue and expertise is needed to select the section to maximize durability at the lowest total life cycle cost. The current design is composed of multiple layers of asphaltic concrete without the use of graded aggregate base (GAB). Experience has shown that adding 6 in. of GAB below an asphaltic concrete section could reduce the cost by nearly $365,000. This section is also much less sensitive to the price fluctuations of the asphalt market.

The bridge over the Norfolk Southern Railroad is currently planned to be a three-span structure with dimensions of 184.5 ft. x 82 ft. The embankment on the end spans uses a 2:1 slope. To optimize this design, it is recommended that mechanically stabilized earth (MSE) wall abutments be used and the

bridge changed to a single span of 69.5 ft. The change results in a significant cost savings to the project in the range of $465,000.

SUMMARY OF POTENTIAL COST SAVINGS

SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION

PROJECT: STP00-0003-00(625), P.I. No. 0003625

Bleckley County, Georgia - Preliminary Engineering Submittal

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
ALIGNMENT (A)						
A-4	Shorten the length of the SR 126 realignment from 1,000ft to 560ft long.	$146,025	$0	$146,025		$146,025
A-6	Eliminate the right-turn lane at the private property located at STA 240+00.	$11,397	$0	$11,397		$11,397
A-8	Move the project detour to existing roadway (Foskey Rd. and Denny Coley Rd.) in lieu of building a new on-site detour.	$948,129	$496,566	$451,563		$451,563
A-10	Eliminate the two right-turn lanes along SR 87 at Cook Road/CR 220.	$45,602	$0	$45,602		$45,602
PROFILE (P)						
P-3	Adjust the profile at the railroad bridge embankment to reduce the amount of borrow material.	$380,214	$0	$380,214		$380,214
P-4	Use 1:1 stabilized slopes in lieu of the 2:1 slopes at the embankment for the railroad bridge.	$607,058	$126,499	$480,559	($61,130)	$419,429

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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SECTION (S)						
S-1	Use 4-ft.-wide paved shoulders in lieu of 6.5-ft.-wide shoulders.	$1,150,425	$715,851	$434,574		$434,574
S-3	Make the inside lanes 11 ft. wide in lieu of 12 ft. wide.	$695,738	$0	$695,738		$695,738
S-4	Make the outside lanes 11 ft. wide in lieu of 12 ft. wide.	$695,738	$0	$695,738		$695,738
S-5	Modify the parking lot pavement section to use asphaltic concrete and GAB in lieu of only asphaltic concrete.	$94,528	$64,109	$30,419		$30,419
S-6	Reduce the lane width of selected side roads from 12 ft. wide to 11 ft. wide.	$32,757	$0	$32,757		$32,757
S-7	Use a 4-ft.-wide median in the area of the railroad bridge embankment in lieu of the 14-ft.-wide median.	$438,480	$0	$438,480		$438,480
S-9	Modify the paved shoulder section to use asphaltic concrete and GAB instead of all asphaltic concrete.	$1,134,030	$769,089	$364,941		$364,941

SUMMARY OF POTENTIAL COST SAVINGS

SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION

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BRIDGE (B)						
B-1	Use 8-ft.-wide shoulders on the bridge in lieu of 10 ft. wide.	$86,745	$0	$86,745		$86,745
B-3	Use mechanically stabilized earth (MSE) wall abutments and a single 69.5 ft. long span in lieu a 185 ft. long three span bridge.	$1,848,787	$1,383,118	$465,669		$465,669
B-8	Update the bridge cost for correct area and unit prices.	DESIGN SUGGESTION				
MISCELANEOUS (M)						
M-1	Increase the unit cost for traffic signals from $47,000 to $90,000 at SR 26 and $150,000 for SR 126.	DESIGN SUGGESTION				

STUDY RESULTS

GENERAL

The results of this value engineering study conducted on the State Route 87/Cochran Bypass project portray the benefits that can be realized by GDOT, Bleckley County, the traveling public, and the GDOT District 2 design team. The results will directly affect the project's design and will require coordination among GDOT staff to determine the disposition of each alternative.

During the conduct of the study, many ideas for potential value enhance were conceived and evaluated by the team for technical merit, applicability to the project, implementability considering the project's status, and the ability to meet the owner's project value objectives. Research performed on those ideas considered to have potential to enhance the value of the project resulted in the development of individual alternatives identifying specific changes to the project as a whole, or individual elements that comprise the project. For each alternative developed the following information is provided:

- A summary of the original design
- A description of the proposed change to the project
- Sketches and design calculations, if appropriate
- A capital cost comparison and a life cycle discounted present worth cost comparison of the alternative and original design (where appropriate)
- A descriptive evaluation of the advantages and disadvantages of selecting the alternative
- A brief narrative to compare the original design and the proposed change and provide a rationale for implementing the change into the project.

The capital cost comparisons use unit quantities contained in the project cost estimate prepared by the designers, whenever possible. If unit quantities were not available, published data bases, such as the one produced by the RS Means Company, or team member or owner data bases were consulted. A composite markup of 30.6%, as described in the Value Analysis and Conclusions section of the report, was used to generate an all-inclusive project cost for the construction items being compared.

Each alternative developed is identified with an alternative number (Alt. No.) to track it through the value analysis process and thus facilitating referencing between the Creative Idea Listing and Evaluation worksheets, the alternatives, and the Summary of Potential Cost Savings table. The Alt. No. includes a prefix that refers to a major project element listed below:

PROJECT ELEMENT	PREFIX
Alignment	A
Profile	P
Section	S
Bridge	B

Summaries of the alternatives are provided on the Summary of Potential Cost Savings tables. The tables are divided into project elements for the convenience of the reviewer and are used to divide the results section. The complete documentation of the developed alternatives and design suggestions follow each of the Summary of Potential Cost Savings tables.

KEY ISSUES

This project is being developed to improve traffic operations by increasing the capacity on SR 87/Cochran Bypass and separating the Norfolk Southern Railroad line from the highway traffic. These improvements will accommodate future traffic within the area, improve safety, and reduce accidents. The capacity issue requires the widening from two lanes to four lanes and will cause some disruption along SR 87 for a number of months. Several of the key project issues are:

- The grade separation at the Norfolk Southern Railroad requires approximately 460,000CY of borrow material, which may take 8 to 10 months of trucking to complete. Although the material appears to be locally available, the effort will cause some environmental issues such as noise, dust, and added truck traffic to the area.
- The profile of the grade separation over the railroad tracks includes two vertical curves, one on each side of the new bridge. This appears to increase the volume of embankment required for the grade separation.
- The south end of the temporary detour terminates in a "T" configuration at US 23 Business, requiring a high volume of left-turn movements to reach the mainline at SR 87. A temporary signal may be necessary at this location to facilitate the left-turn movements.
- Pavement design is always a key factor in developing the scope of a project and a wide range of solutions exist to provide the needed structural values, durability, and future flexibility. Some variation in the section design may yield value improvement.
- To achieve the required project goals, it will be necessary to acquire a significant amount of right-of-way to meet the required corridor width of 150 ft. An estimated 50 parcels will be affected by the roadway widening at a total right-of-way cost of approximately $1.2M.

STUDY OBJECTIVES

To assist GDOT in achieving its project goals in a cost-effective manner, it convened this VE study. The study team was tasked with identifying specific changes to the current design that will enhance its value by improving functionality, saving cos,t or a combination of the two.

RESULTS OF THE STUDY

Research of the creative ideas identified as having potential for enhancing the value of the project resulted in the development of 15 alternatives with cost implications for consideration by the GDOT. These alternatives address the key issues described above and are detailed in the remainder of this section of the report. The alternatives with the greatest potential to impact the project are highlighted below.

ALIGNMENT (A)

Value improvement can be achieved by modifying the alignment to SR 126 where it intersects SR 87 on the north end of the project alignment. Instead of using a 1,060-ft.-long radius to improve the skew at the intersection, use a 650 ft. radius and only improve 560 LF of roadway instead of the 1,000 LF currently planned. The shorter radius will require the design speed to be reduced from 45mph to 35mph, as allowed in the GDOT Design Manual, Chapter 3, paragraph 3.3.2. Since the traffic approaching the intersection will be in a braking condition, this lower speed appears acceptable per the GDOT Design Manual and will result in a net cost savings approaching $150,000. (Ref. Alt. No. A-4).

A detour around the new grade separation of the Norfolk Southern Railroad is clearly needed to allow the construction of the embankment and new bridge. Whether this be an on-site or off-site detour is the key question asked by the VE team. Other possibilities exist for the detour including the use of the existing roadways at Foskey Road and Denny Coley Road. These two roads can be upgraded with a 3 inch asphalt overlay to provide a 1.3-mile-long detour on existing roadways instead of the construction of a temporary facility which must be removed. This convenient detour route appears to be straight and level, and has good visibility. The potential cost savings by using these existing roads is nearly $450,000. (Ref. Alt. No. A-8).

PROFILE (P)

Designing the profile of the grade separation over the Norfolk Southern Railroad requires a careful balance of several factors. The key driver of the embankment volume is the choice of vertical curve(s) used to meet the height restrictions above the railroad. The current profile places a vertical curve on either side of the new bridge over the railroad and appears to add to the volume of embankment. The high point on the profile is actually north of the bridge. Changing the profile to use a single vertical curve, centered on the bridge, will allow the profile to be slightly lowered, reducing the amount of embankment by nearly 40,000CY. This results in a potential project savings of about $380,000. Placing the crest of the vertical curve on the bridge is not viewed as difficult or impractical, and it reduces the amount of coping on the bridge. (Ref. Alt. No. P-3).

Techniques are available to reduce the amount of embankment by increasing the side slopes from 2:1 to 1:1 through the use of stabilized slopes instead of the placement of conventional fill. Numerous technologies exist for stabilization of slopes and some further investigation may be needed, but using 1:1 slopes could save nearly $500,000 in initial costs by reducing the construction schedule and minimizing the number of truck trips onto the site. (Ref. Alt. No. P-4).

SECTION (S)

Review of the project cost model reveals that the single largest cost component is the roadway pavement section and drainage. Various combinations of section widths for travel lanes, shoulder, and median were explored and documented by the VE team. Several of the more interesting options include using 4-ft.-wide shoulders in lieu of 6.5 ft. for a potential cost savings of almost $435,000. Changing the inside lane width from 12 ft. wide to 11 ft. would result in a possible savings of nearly $700,000, and modifying the median width near the bridge from 14 ft. wide to 4 ft. wide could save approximately $440,000. (Ref. Alt. Nos. S-1, S-3, and S-7 respectively).

Design of the pavement section is always a critical issue and expertise is needed to select the section to maximize durability at the lowest total life cycle cost. The current design is composed of multiple layers of asphaltic concrete without the use of graded aggregate base (GAB). Experience has shown that adding 6 inches of GAB below an asphaltic concrete section could reduce the cost by nearly $365,000. (Ref. Alt. No. S-9).

BRIDGE (B)

The bridge over the Norfolk Southern Railroad is currently planned to be a three-span structure with dimensions of 184.5ft x 82ft. The embankment on the end spans is at a 2:1 slope. To optimize this design, it is recommended that MSE wall abutments be used and the bridge changed to a single span of 69.5 ft. The change results in a potential savings to the project of approximately $465,000. (Ref. Alt. No. B-3).

COST ESTIMATE COMMENTS

The cost estimate is a critical part of the overall project management effort and several updates to the estimate are suggested. The cost of the traffic signals should be reviewed and increased to more closely match recent GDOT bid results. This project has two signals, one at SR 26 and another at SR 126. The signal at SR 26 is fairly simple, but the cost should be increased from $47,000 to approximately $90,000. The signal at SR 126 is more complicated and needs to be increased from $47,000 to $150,000. This will ensure adequate budget is available for the signal, required poles, guy wires, conduits, power feeds, and the controller.

The estimate on the bridge over the Norfolk Southern Railroad needs to be updated to reflect the current dimensions of the bridge, 184 ft. 6 in. long by 85 ft. 3 in. wide, and a slightly higher unit cost for construction of the bridge. The unit cost should be increased from the current $90/sf up to $95/sf which more closely reflects current bid prices for similar GDOT structures. The changes in dimension and unit price will increase the total bridge cost estimate from $1,116,000 to $1,494,200. Although this does affect the total project budget, it provides the project management team with current and accurate cost data.

EVALUATION OF ALTERNATIVES AND DESIGN SUGGESTIONS

When reviewing the study results, GDOT should consider each part of an alternative or design suggestion on its own merit. There may be a tendency to disregard an alternative because of a concern about one part of it. Each area within an alternative or design suggestion that is acceptable should be considered for use in the final design, even if the entire alternative or design suggestion is not implemented. Variations of these alternatives and design suggestions by the owner or designer are encouraged.

All alternatives and design suggestions were developed independently of each other to provide a broad range of options to consider for implementation. Therefore, some of them are "mutually exclusive," so acceptance of one may preclude the acceptance of another. In addition, some of the alternatives may be interrelated, so acceptance of one or more may not yield the total of the cost savings shown for each alternative. Design suggestions could also be interrelated thus precluding a

part of one or more suggestions from being implemented if another design suggestion is also implemented.

GDOT should evaluate all alternatives carefully in order to select the combination of ideas with the greatest beneficial impact on the project. Once this has been accomplished, the total cost savings resulting from the VE study can be calculated based on implementing a revised, all-inclusive design solution. In some cases, a revised construction cost estimate is needed to accurately determine the cost of the revised scope of work.

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SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION

PROJECT: STP00-0003-00(625), P.I. No. 0003625

Bleckley County, Georgia - Preliminary Engineering Submittal

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ALIGNMENT (A)						
A-4	Shorten the length of the SR 126 realignment from 1,000ft to 560ft long.	$146,025	$0	$146,025		$146,025
A-6	Eliminate the right-turn lane at the private property located at STA 240+00.	$11,397	$0	$11,397		$11,397
A-8	Move the project detour to existing roadway (Foskey Rd. and Denny Coley Rd.) in lieu of building a new on-site detour.	$948,129	$496,566	$451,563		$451,563
A-10	Eliminate the two right-turn lanes along SR 87 at Cook Road/CR 220.	$45,602	$0	$45,602		$45,602
PROFILE (P)						
P-3	Adjust the profile at the railroad bridge embankment to reduce the amount of borrow material.	$380,214	$0	$380,214		$380,214
P-4	Use 1:1 stabilized slopes in lieu of the 2:1 slopes at the embankment for the railroad bridge.	$607,058	$126,499	$480,559	($61,130)	$419,429

VALUE ENGINEERING ALTERNATIVE

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ALTERNATIVE NO.: **A-4**

DESCRIPTION: **SHORTEN THE LENGTH OF THE SR 126 REALIGNMENT FROM 1,000 FT. TO 560 FT. LONG**

SHEET NO.: **1 of 5**

ORIGINAL DESIGN: (sketch attached)

The current design realigns SR 126 and reconstructs 1,000 ft. of two- and three-lane roadway on the east side of SR 87 in Cochran, GA.

ALTERNATIVE: (sketch attached)

Realign SR 126 using a shorter radius (650 ft.) and reconstruct only 560 ft. of three-lane roadway instead of the full 1,000 ft.

ADVANTAGES:

- Saves construction cost and time
- Reduces right-of-way impacts on residential property

DISADVANTAGES:

- Lower speed design as traffic approaches a stopped condition at SR 87

DISCUSSION:

Since this intersection of SR 126 and SR 87 is a "T" intersection and has a traffic signal, lowering the design speed with a shorter horizontal curve (shorter radius) on the realignment of SR 126 should not pose a problem. The current design proposes a 1,060 ft. radius which provides a design speed of 45mph. The alternative design proposes a 650 ft. radius with a speed of 35mph. The GDOT Design Manual, Chapter 3, paragraph 3.3.2 (page 3-7) allows the curve approaching a "T" intersection to be 10mph less than the road design speed.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 146,025	—	$ 146,025
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 146,025	—	$ 146,025

SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION**
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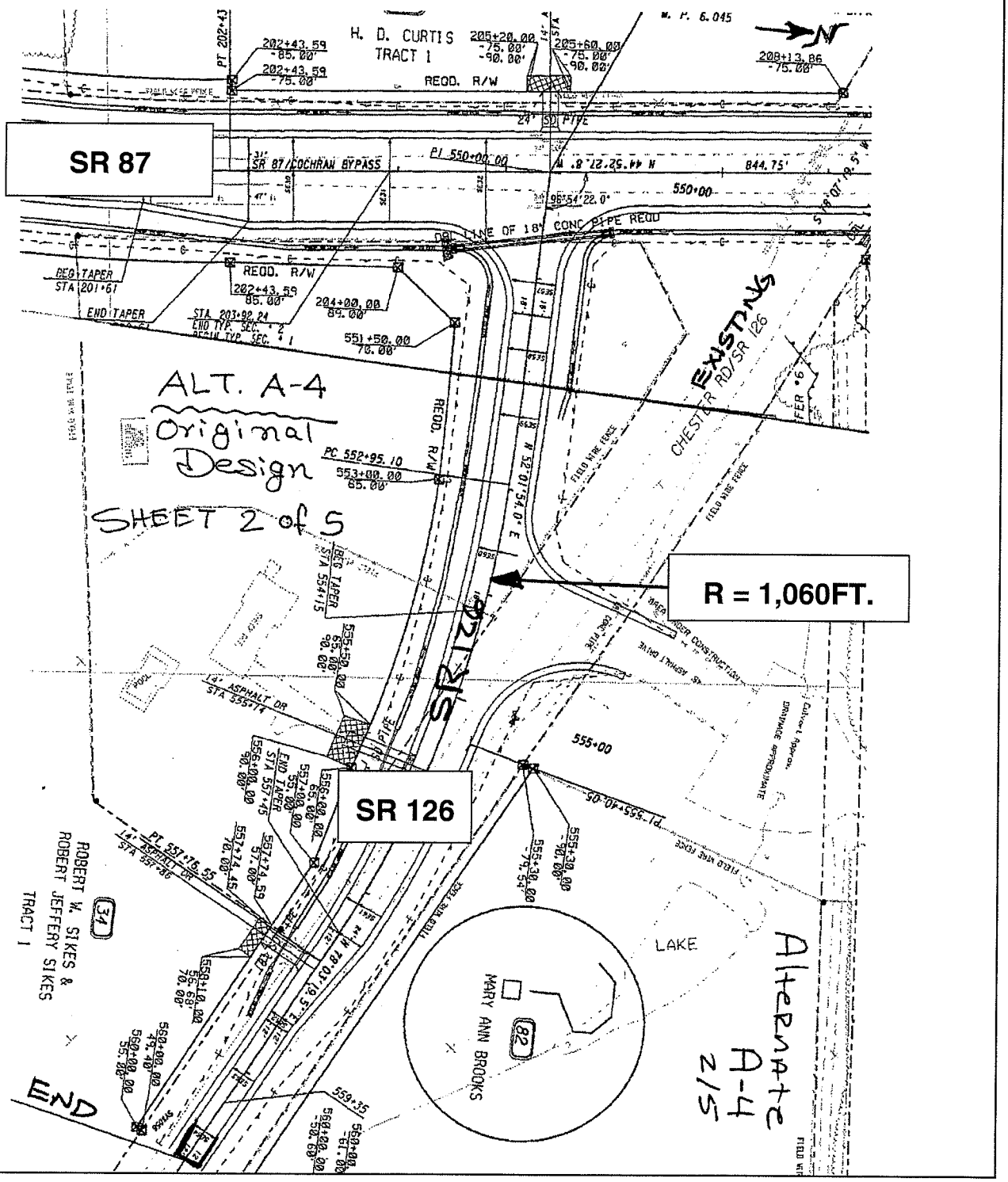
ALTERNATIVE NO.: **A-4**

ORIGINAL DESIGN ☒ ALTERNATIVE DESIGN ☐ BOTH ☐ SHEET NO.: **2 of 5**



SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
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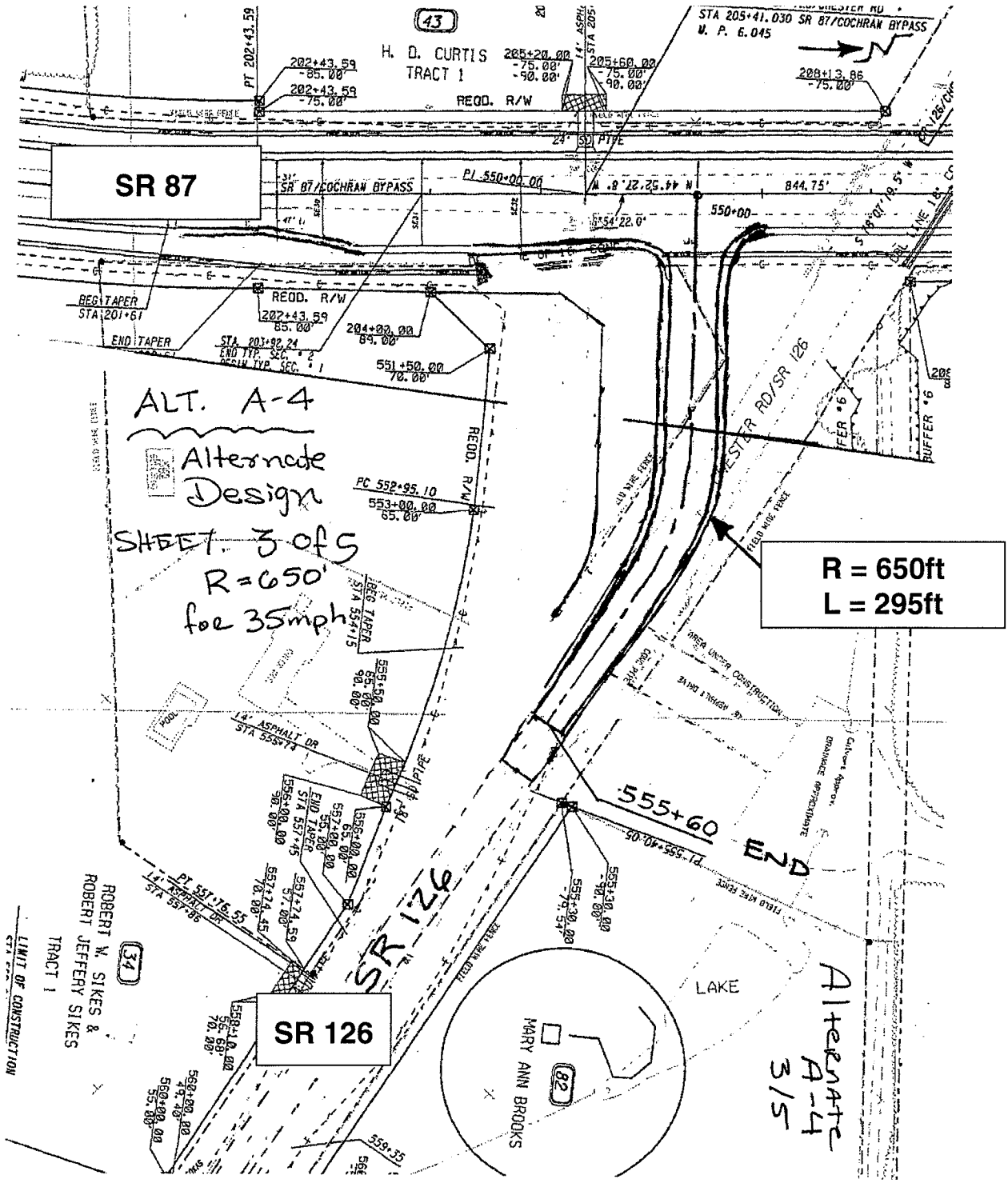
ALTERNATIVE NO.: **A-4**

ORIGINAL DESIGN ☒ ALTERNATIVE DESIGN ☐ BOTH ☐ SHEET NO.: **3 of 5**



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ALTERNATIVE NO.: **A-4**

SHEET NO.: **4 of 5**

Original realignment length = 560+00

Alternate realignment length = 556+00

Difference in length = 440 ft.

Pavement full depth area = (24 ft. x 440 ft.)/ 9 SF/SY = 1,174 SY

SY Full-Depth Pavement Cost:

135#/SY 9.5 mm Superpave:	(135/2,000)($63.70/TN)	=$ 4.30
220#/SY 19 mm Superpave:	(220/2,000)($69.50/TN)	= 7.65
880#/SY 25 mm Superpave:	(880/2,000)($65.32/TN)	= 28.74
12" GAB Base Coarse:	[9(1)(150)/2,000]($17.46/TN)	= 11.79

Total: $52.48/SY

Shoulder Paved area saved = (4 ft x 2 sides x 440 ft) 9 SF/SY = 391 SY

SY Shoulder Pavement Cost:

135#/SY 9.5 mm Superpave:	(135/2,000)($63.70/TN)	= $4.30
220#/SY 19 mm Superpave:	(220/2,000)($69.50/TN)	= 7.65
440#/SY 25 mm Superpave:	(880/2,000)($65.32/TN)	= 14.37

Total: $26.32/SY

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **A-4**

SHEET NO.: **5 of 5**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Savings in shorter realignment:							
Full-depth pavement	SY	1,174	52.48	61,612			
Paved shoulders	SY	391	26.32	10,291			
Misc. e.g. earthwork, striping, etc.	LS	1	10,000	10,000			
Construction Markup @ 30.6 %		**81,903**	**0.306**	**25,062**			
Less R/W required - area savings	SF	35,000	0.45	15,750			
R/W markup @ 148 %		**15,750**	**1.48**	**23,310**			
Subtotal				146,025			
Markup (%) at				Included			
TOTAL				146,025			

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

ALTERNATIVE NO.: **A-6**

DESCRIPTION: **ELIMINATE THE RIGHT TURN LANE AT STATION 240+00**

SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

The original design provides a right turn lane into a retail store at Station 240+00.

ALTERNATIVE: (sketch attached)

Eliminate the right turn lane and provide a driveway entrance only.

ADVANTAGES:

- Reduces construction time
- Reduces cost

DISADVANTAGES:

- Going northwest on SR 87, traffic in the right lane will have to slow down for right-turning traffic

DISCUSSION:

A right-turn lane into a retail business does not appear to be justified. Turn lanes are not provided for other businesses or for churches along the alignment. Eliminating the right turn lane at this location will have little impact on the level of service on SR 87.

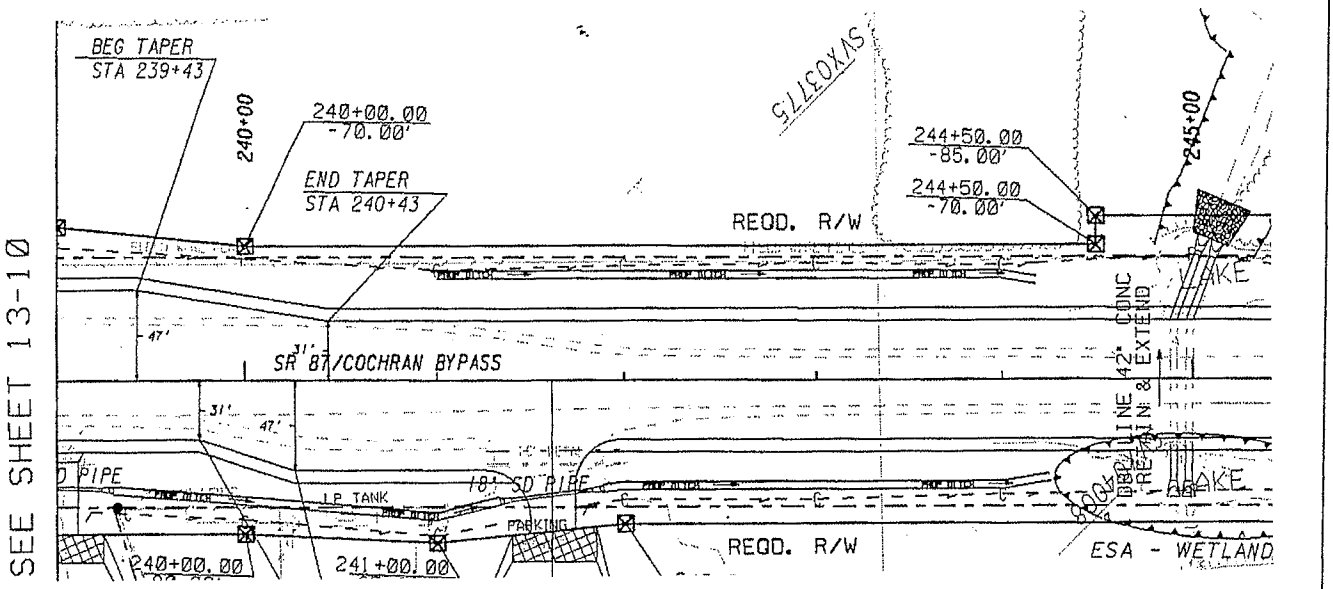
COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 11,397	—	$ 11,397
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 11,397	—	$ 11,397

SKETCH

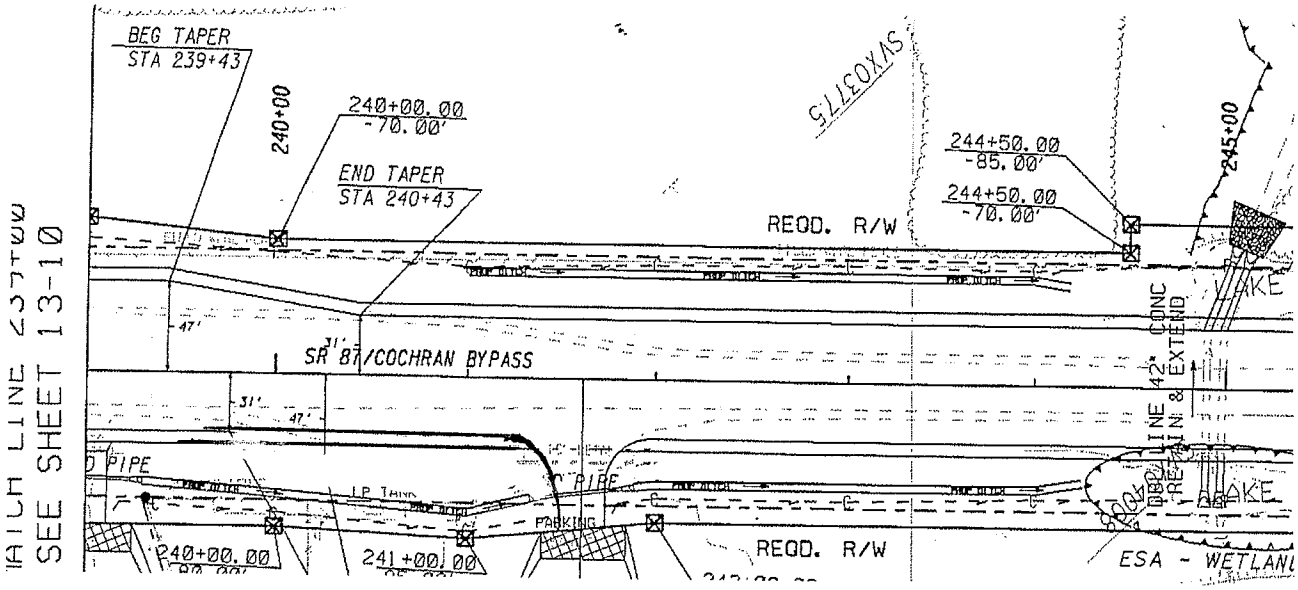
PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: A-6

ORIGINAL DESIGN ☑ ALTERNATIVE DESIGN ☐ BOTH ☐ SHEET NO.: 2 of 4



ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☑ BOTH ☐



PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **A-6**

SHEET NO.: **3 of 4**

SY Full-Depth Pavement Cost:

135#/SY 9.5 mm Superpave:	(135/2,000)($63.70/TN)	= $4.30
220#/SY 19 mm Superpave:	(220/2,000)($69.50/TN)	= 7.65
880#/SY 25 mm Superpave:	(880/2,000)($65.32/TN)	= 28.74
12" GAB Base Coarse:	[9(1)(150)/2,000]($17.46/TN)	= 11.79

Total: $52.48/SY

Right turn lane at Station 240+00:

Pavement area = [.5(50)(12) + 100(12)]/9 = 166.6 SY

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **A-6**

SHEET NO.: **4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Full-depth pavement	SY	167	52.38	8,727			
Subtotal				8,727			
Markup (%) at 30.6%				2,670			
TOTAL				11,397			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION** *STP00-0003-00(625), P.I. No. 0003625* ***Bleckley County, Georgia – Preliminary Engineering Submittal***	ALTERNATIVE NO.: **A-8**
DESCRIPTION:	**MOVE DETOUR TO ANOTHER EXISTING ROADWAY (CR 141/CR 140) INSTEAD OF BUILDING A TEMPORARY ON-SITE DETOUR/ROADWAY**	SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

The current design builds a temporary on-site detour in lieu of detouring traffic on existing local roads.

ALTERNATIVE: (sketch attached)

Route the detour on existing local roadways (CR 141 and CR 140) in lieu of using an on-site detour.

ADVANTAGES:

- Reduces project construction cost
- Reduces project right-of-way impacts and cost
- Permanent improvement to local roads
- Upgrades an existing (permanent) railroad crossing on Foskey Road

DISADVANTAGES:

- Longer detour route/travel time
- Inconvenient for local traffic

DISCUSSION:

The current design builds an on-site detour for the railroad (R/R) crossing on the SR 87 Bypass at the Norfolk Southern Railroad. The on-site detour would require building a new temporary roadway for 0.833 miles. This alternative uses an off-site detour on local roads (Foskey Road and Denny Coley Road) which would be 1.3 miles long. Even though the off-site detour would be longer, the expense to upgrade it for the additional temporary traffic would be permanent improvements for the local roads. Also there would not be a need to keep an additional R/R crossing open and any expenses for the temporary R/R signal there would be eliminated. There would still be a need for adding "bells, lights and gates" to the existing R/R crossing on Foskey Road but this would improve the safety at a permanent crossing.

Another traffic problem with the on-site detour route (as designed) is that the temporary intersection at SR 87 Bypass (detour) with US 23/SR 87 Bus and the relocated "leg" of US 23/SR 87 intersection will not function properly without a traffic signal. The use of an off-site detour would exclude the need for a traffic signal at this intersection. It is important to mention that the designers' cost estimate for pavement quantities for the on-site detour are too low for the typical section and length of detour called for in the plans. Therefore the cost of the on-site detour was recalculated. The proposed improvements for the off-site detour include a 3 in. overlay; grading/building the existing shoulders to the overlay; detour signing and upgrading the existing R/R crossing (Foskey Road).

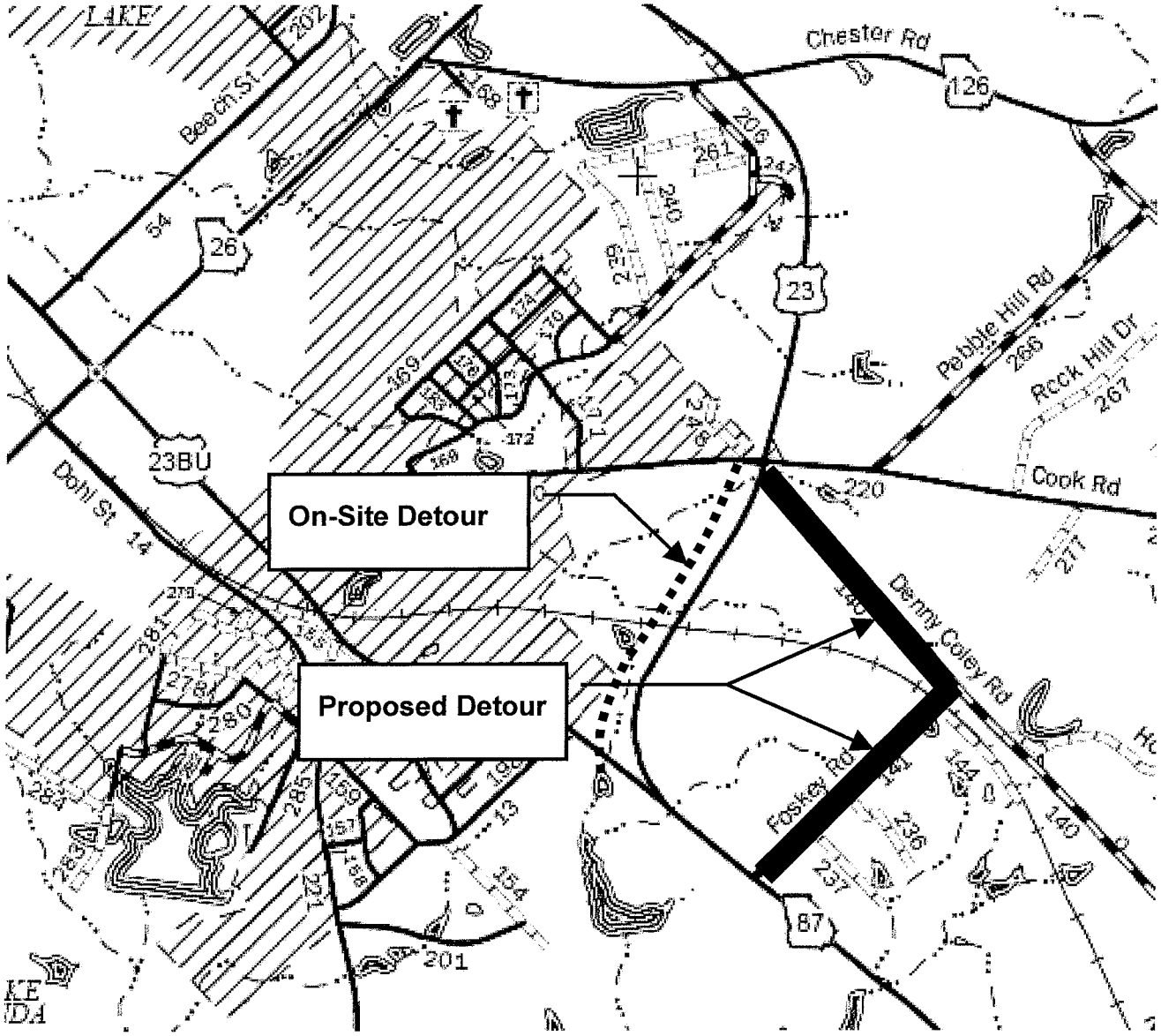
COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 948,129	—	$ 948,129
ALTERNATIVE	$ 496,566	—	$ 496,566
SAVINGS	$ 451,563	—	$ 451,563

SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **A-8**

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☐ BOTH ☒ SHEET NO.: **2 of 4**



PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **A-8**

SHEET NO.: **3 of 4**

<u>Original Design</u> Cost for the Proposed On-Site Detour:

Pavement section cost: Full-depth section:

(135 LB/SY / 2,000 LB/TN) ($63.70/TN) = $4.30/SY
(220 LB/SY / 2,000 LB/TN) ($69.50/TN) = $7.65/SY
[9 SF/SY (1 FT) (150 LB/CF)/2,000 LB/TN] ($17.46/TN) = $11.79/SY
Total = $23.74/SY

Area full-depth: [(3700 FT x 24 FT)/9 SF/SY] = 9,867SY

Pavement unit cost for overlaying portion of existing roadway to be retained for detour (2" of asphalt surface course)

(135 LB/SY / 2,000 LB/TN) ($63.70/TN) = $4.30/SY

Area overlay: [(400 FT x 24 FT)/9 SF/SY] = 1,067 SY

Construction of temporary R/R crossing = **$150,000**

Additional earthwork for on-site detour: 16,000CY

Easement required for on-site detour: 3,200 ft. x 100 ft. = 320,000 SF

Temporary detour removal cost to include pavement removal/excavation and grassing since this is temporary easement that will revert back to the property owner:
$143,000 (pavement removal/excavation) + $1,000/AC x 7 Aares (grassing) = **$150,000 (Lump Sum)**

<u>Alternative Design</u> Costs for Off-Site Detour: overlay existing route with 330 LB/SY (12.5mm asphalt mix)

(330 LB/SY / 2,000 LB/TN) ($66.00/TN) = $10.73/SY
Overlay area: [(1.3 mi x 5,250 ft/mi x 22 ft)/9 SF/SY] = 16,779 SY

Construction of upgraded R/R Crossing = **$150,000**

Additional signing for detour: **$30,000**

Grading to build existing shoulders up to 3 in. overlay:
(0.25 ft x 8 ft x 2 shldrs x 1.3 mi x 5,280 ft/mi)/ 27 CF/CY = 1,017 CY
(use $10/CY for the shoulder grading and material)

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **A-8**

SHEET NO.: **4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Pavement - 3.5" asphalt / 6" GAB	SY	9,867	23.74	234,243			
Pavement - Overlay retained rdwy	SY	1,067	4.30	4,588			
Additional earthwork	CY	16,000	6.00	96,000			
R/R Crossing signal installation	LS	1	150,000.00	150,000			
Detour removal See Calculations	LS	1	150,000.00	150,000			
Construction Markup - 30.6%		**0.306**	**634,831.00**	**194,258**			
R/W - Temporary Easement	SF	320,000	0.15	48,000			
R/W - Markup - 148 %		**1.480**	**48,000.00**	**71,040**			
Pavement Overlay - 3 in	SY				16,780	10.73	180,049
Upgrade R/R Crossing - signal installation	LS				1	150,000.00	150,000
Additional detour signing	LS				1	30,000.00	30,000
Misc items	LS				1	10,000.00	10,000
Raise shoulders to overlay	CY				1,017	10.00	10,170
Construction Markup - 30.6 %					**0.306**	**380,219.00**	**116,347**
Subtotal				948,129			496,566
(Markup included) TOTAL				948,129			496,566

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

ALTERNATIVE NO.: **A-10**

DESCRIPTION: **ELIMINATE THE TWO RIGHT-TURN LANES AT COOK ROAD/CR 220**

SHEET NO.: **1 of 5**

ORIGINAL DESIGN: (sketch attached)

Right-turn lanes are provided in both directions at the intersection of SR 87 and Cook Road.

ALTERNATIVE: (sketch attached)

Eliminate the right turn lanes at this intersection.

ADVANTAGES:

- Reduces construction time

DISADVANTAGES:

- Traffic in the right lane on SR 87 will have to slow down or change lanes for right-turning traffic

DISCUSSION:

For the design year of 2032, the maximum daily hourly vehicle in either the AM or PM making a right turn onto Cook Road is only 35. Eliminating the right-turn lanes will have little impact on the level of service on SR 87.

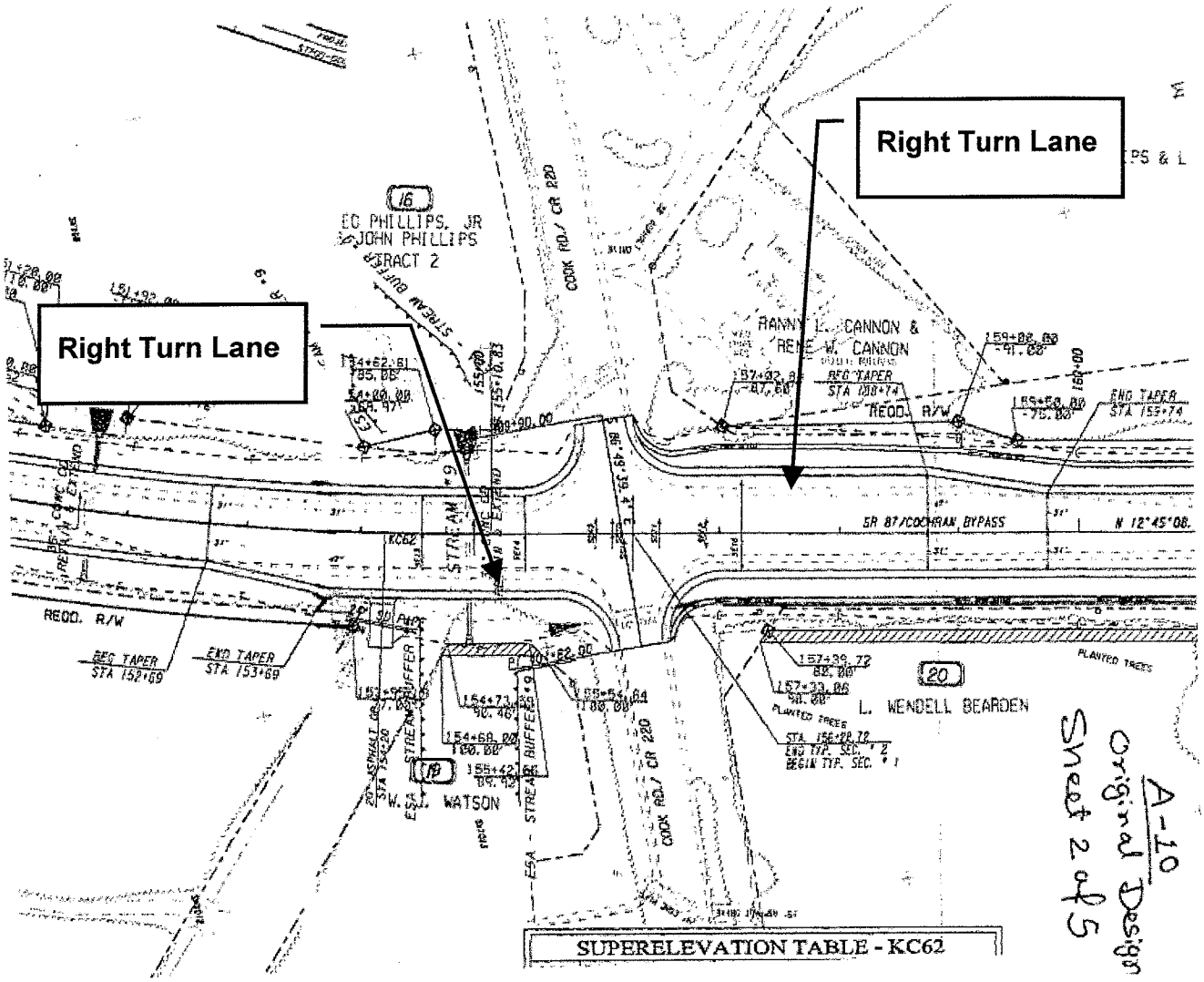
COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 45,602	—	$ 45,602
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 45,602	—	$ 45,602

SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **A-10**

ORIGINAL DESIGN ☒ ALTERNATIVE DESIGN ☐ BOTH ☐ SHEET NO.: **2 of 5**



A-10
Original Design
Sheet 2 of 5

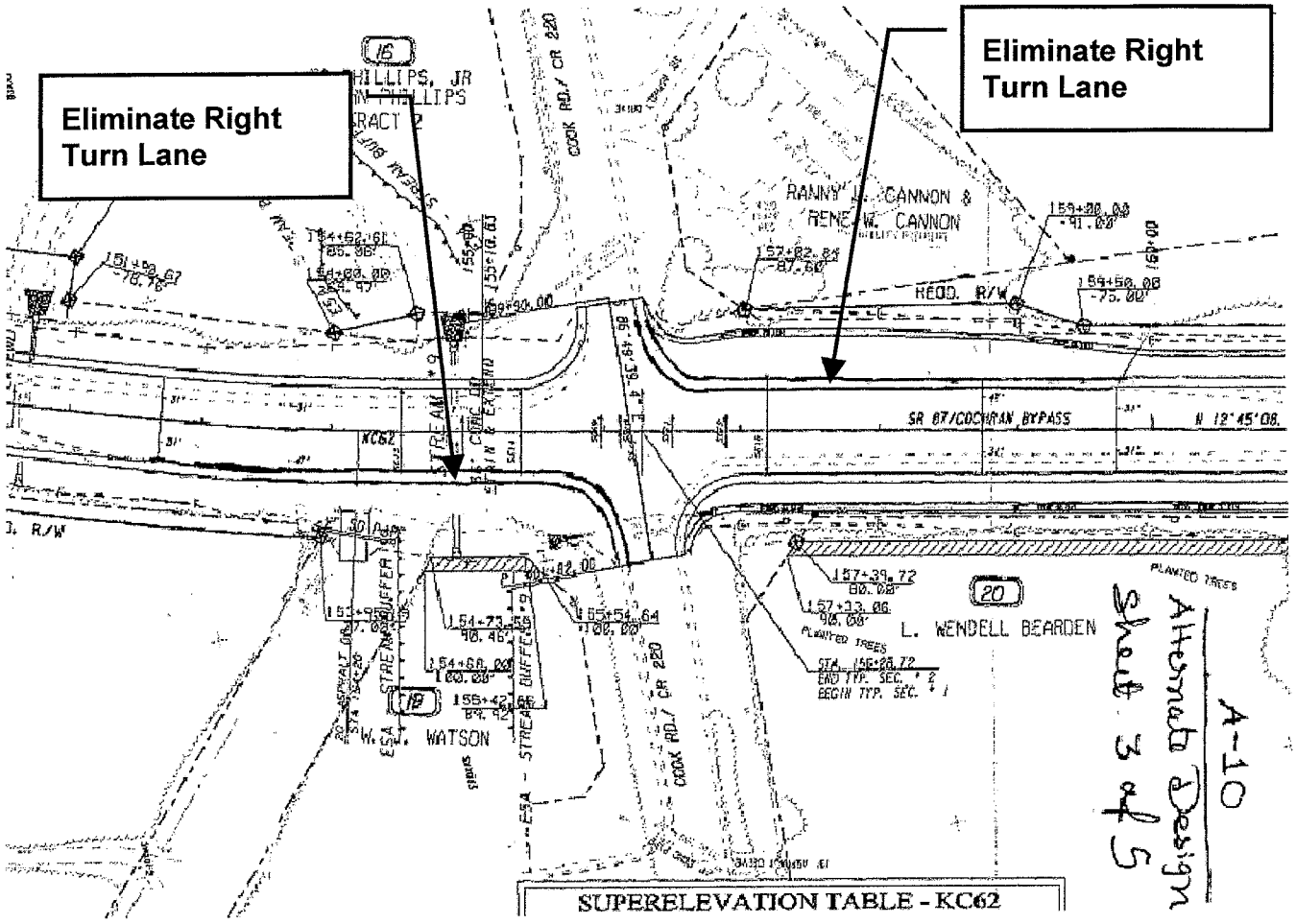
SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **A-10**

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☒ BOTH ☐

SHEET NO.: **3 of 5**



PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **A-10**

SHEET NO.: **4 of 5**

SY Full-Depth Pavement Cost:

135#/SY 9.5 mm Superpave:	(135/2,000)($63.70/TN)	=$4.30
220#/SY 19 mm Superpave:	(220/2,000)($69.50/TN)	= 7.65
880#/SY 25 mm Superpave:	(880/2,000)($65.32/TN)	=28.74
12 in. GAB Base Coarse:	[9(1)(150)/2,000]($17.46/TN)	=11.79

Total: $52.48/SY

Two right turn lanes will be eliminated.
Pavement area = 2[200(12) + .5(100)(12)]/9 = 666.6 SY

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **A-10**

SHEET NO.: **5 of 5**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Full-depth pavement	SY	667	52.38	34,917			
Subtotal				34,917			
Markup (%) at 30.6%				10,685			
TOTAL				45,602			

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

ALTERNATIVE NO.: **P-3**

DESCRIPTION: **ADJUST THE PROFILE AT THE RAILROAD BRIDGE EMBANKMENT TO REDUCE THE AMOUNT OF BORROW MATERIAL**

SHEET NO.: **1 of 9**

ORIGINAL DESIGN: (sketch attached)

In the original design, there are two vertical curves used to go over the railroad. In addition, the high point is located about 400 ft. ahead of the bridge.

ALTERNATIVE: (sketch attached)

Use a single vertical curve over the bridge and move the high point closer to the bridge.

ADVANTAGES:

- Overall lowering of the roadway profile
- Reduces embankment by 39,000CY
- Reduces construction time
- Fewer truck trips required

DISADVANTAGES:

- Profile must be changed

DISCUSSION:

The high point of the alignment should be over the railroad bridge where the clearance is critical. In the original design, the high point occurs about 400 ft. up-station of the bridge. By adjusting the profile, the high point can be moved very close to the bridge. This lowers the profile ahead of the bridge, reducing the amount of embankment required. In the alternative alignment, the low point near Cook Road is moved ahead slightly but is still very near to Stream #9. Some believe that having a vertical curve on the bridge is problematic; however, it actually is a benefit to have a crest curve on the bridge since this decreases the amount of coping.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 380,214	—	$ 380,214
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 380,214	—	$ 380,214

STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA	STP00-0003-00(625)		

NOTE:
STATION 115+00 TO STATION 155+00 WILL BE CONSTRUCTED DURING STAGE 2

450.00VC
K = 117.62
SPEED DESIGN = > 55 MPH

500.00VC
K = 123.61
SPEED DESIGN = > 55 MPH

+1.2200 %

+5.0459 %

EXISTING ROAD PROFILE

PVC STA 116+75.00
PVC EL 360.46

PVI STA 119+00.00
PVI EL 363.20

PVT STA 121+25.00
PVT EL 374.55

PVC STA 128+05.60
PVC EL 399.01

PVI STA 128+59.60
PVI EL 411.62

STAGE 1

STAGE 2

ALTERNATIVE P-3 ORIGINAL DESIGN SHEET 2 OF 9

REVISION DATES

STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
OFFICE: TENNILLE DESIGN

MAINLINE PROFILE

STP00-0003-00(625)

DRAWING No.

STAGE 2

9/28/2009
msammons

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STATE
GA

ALTERNATIVE
P-3
ORIGINAL
DESIGN
SHEET 3 OF 9

NOTE:
STATION 115+00 TO STATION 155+00 WILL BE CONSTRUCTED DURING STAGE 2

500.00VC
K = 127.63
SPEED DESIGN = > 55 MPH

PVT STA 131+05.60
PVT EL 414.12

BEGIN BRIDGE
STA. 131+38.10
EL. 414.41

PVC STA 134+50.00
PVC EL 417.53

END BRIDGE
STA 133+22.60
EL. 416.25

+1.0010 %

STA 135+71.76
EL 418.17

HIGH POINT

PVI STA 137+00.00
PVI EL 420.03

PVT STA 139+50.00
PVT EL 412.74

-2.9165 %

PVC STA 142+50.00
PVC EL 403.99

RAIL
EL = 385.40

RAIL
EL = 385.42

RAILROAD CL
EL = 385.41

EXISTING ROAD PROFILE

STAGE 2

129+00	130+00	131+00	132+00	133+00	134+00	135+00	136+00	137+00	138+00	139+00	140+00	141+00	142+00	143+00	144+00
384.21	384.93	385.91	385.86	385.91	385.75	385.58	386.27	386.35	384.35	383.60	382.97	382.32	381.55	381.24	380.69
410.25	411.49	412.54	413.38	414.02	414.55	415.08	415.58	416.05	416.58	417.05	417.55	417.98	418.14	418.15	417.96
380.13	379.58	379.27	379.12	379.08	379.11	379.22	379.86	380.60	381.47	382.50	383.57	384.57	385.95	387.15	388.34
417.58	417.01	416.28	415.27	414.10	412.74	411.23	409.82	408.37	406.90	405.45	403.99	402.60	401.34		

490	480	470	460	450	440	430	420	410	400	390	380	370	360	350	340	330	320	310

STAGE 2

REVISION DATES

STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
OFFICE: TENNILLE DESIGN
MAINLINE PROFILE
STP00-0003-00(625)
DRAWING No.

9/28/2009
msammons

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STATE
GA

ALTERNATIVE
P-3
ORIGINAL
DESIGN
SHEET 4 OF 9

NOTE:
STATION 115+00 TO STATION 155+00 WILL BE CONSTRUCTED DURING STAGE 2

500.00VC
K = 191.31
SPEED DESIGN = > 55 MPH

600.00VC
K = 341.69
SPEED DESIGN = > 55 MPH

PVI STA 145+00.00
PVI EL 396.70

PVT STA 147+50.00
PVT EL 395.94

PVC STA 150+25.00
PVC EL 395.11

STA 151+28.54
EL 394.95

LOW POINT

PVI STA 153+25.00
PVI EL 394.20

PVT STA 156+25.00
PVT EL 398.56

PVC STA 158+75.00
PVC EL 402.19

-0.3030 %

+1.4529 %

STAGE 2

STAGE 1

144+00	145+00	146+00	147+00	148+00	149+00	150+00	151+00	152+00	153+00	154+00	155+00	156+00	157+00	158+00	159+00
400.20	399.20	398.33	397.59	396.99	396.51	396.15	395.94	395.78	395.64	395.49	395.34	395.19	395.04	394.96	395.03
399.87	399.00	397.94	392.92	391.49	394.74	394.43	394.85	395.09	395.12	395.10	395.02	394.93	394.86	394.86	394.96
															394.97

151+00	152+00	153+00	154+00	155+00	156+00	157+00	158+00	159+00
395.17	395.38	395.38	395.67	396.46	396.97	397.55	398.20	398.92
395.14	395.38	395.63	395.92	396.03	396.37	396.79	397.27	397.79

159+00	160+00	161+00	162+00	163+00	164+00	165+00	166+00	167+00
398.92	399.65	400.38	401.10	401.83	402.54	403.24	403.93	404.61
398.43	399.13	399.94	400.82					

REVISION DATES		

STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
OFFICE: TENNILLE DESIGN
MAINLINE PROFILE
STP00-0003-00(625)
DRAWING No.

9/28/2009
nsammons

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STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
GA	STP00-0003-00(625)		

NOTE:
STATION 115+00 TO STATION 155+00 WILL BE CONSTRUCTED DURING STAGE 2

ORIGINAL PROFILE

NEW PROFILE

EXISTING ROAD PROFILE

PVI 120+00 EL. 364.42
LVC = 500'
K = 133

PVC 117+50
EL. 361.37

PVT 122+50
EL. 376.83

PVC 127+50
EL. 401.66

+1.2200%

+4.965%

+1.2200 K

STAGE 1

STAGE 2

STAGE 2

ALTERNATIVE
P-3
ALTERNATIVE
DESIGN
SHEET 5 OF 9

REVISION DATES		

STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
OFFICE: TENNILLE DESIGN
MAINLINE PROFILE
STP00-0003-00(625)
DRAWING No.

9/28/2009
msammons

Mon Sep 28 10:48:26 2009 C:\TMP\001\PR_KC100 stage2_2.prf
\\gdot-dsnf\gacfg\resources\Gdot2007half_Kip.tbl

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STATE
GA

ALTERNATIVE P-3

ALTERNATIVE DESIGN

SHEET 6 OF 9

NOTE:
STATION 115+00 TO STATION 155+00 WILL BE CONSTRUCTED DURING STAGE 2

PVI 132+00 EL. 424.00
LVC=900 K=1268

HIGH POINT
133+79.52
EL. 417.29

END BRIDGE
STA 133+22.60
EL. 416.25

BEGIN BRIDGE
STA. 131+38.10
EL. 414.41

+4.965%

PVT 136+50
EL. 444.40

NEW PROFILE

-2.1333%

PVI 140+00
EL. 406.93

PVT 142+00
EL. 403.80

-1.000%

NEW PROFILE

PVI 141+00 EL. 404.80
LVC=200 K=176.5

RAIL
EL. = 385.40

RAIL
EL. = 385.42

RAILROAD CL
EL. = 385.41

BRIDGE

EXISTING ROAD PROFILE

STAGE 2

STAGE 2

REVISION DATES		

STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
OFFICE: TENNILLE DESIGN

MAINLINE PROFILE

STP00-0003-00(625)

DRAWING No.

9/28/2009
msammons

Mon Sep 28 10:48:15 2009 C:\TWP\000\PR_KC100 stage2_3.prf
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C:\KCData\003625\DGN\PR_KC100 stage2.DGN ON= 1-63

STATE
GA

ALTERNATIVE
P-3
ALTERNATIVE
DESIGN
SHEET 7 OF 9

NOTE:
STATION 115+00 TO STATION 155+00 WILL BE CONSTRUCTED DURING STAGE 2

NEW PROFILE

-6.000 %

-0.3036 %

PVC 150+50
EL. 395.30

LOW POINT
152+13.07
EL. 394.48

PVI 152+50 EL. 393.30
LVC = 400
K = 163

PVT 154+50
EL. 396.21

+1.4529 %

+1.4529 %

PVC STA. 158+75.00
P/O EL. 402.19

STAGE 2

STAGE 1

STAGE 2

REVISION DATES		

STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
OFFICE: TENNILLE DESIGN
MAINLINE PROFILE
STP00-0003-00(625)
DRAWING No.

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **P-3**

SHEET NO.: **8 of 9**

Station	Orig. Ground	Orig. Profile Grade	H1 Fill Height	A1 End Area	Alt. Profile Grade	H2 Fill Height	A2 End Area	Δ Area Change	Δ Volume Change
115+50	357.77	358.93	1.16	97.8	358.32	0.55	45.7	-52.1	-193.0
116+50	358.18	360.15	1.97	169.3	359.54	1.36	115.2	-54.1	-200.3
117+50	358.79	361.61	2.82	247.1	360.76	1.97	169.3	-77.8	-288.3
118+50	359.24	363.89	4.65	424.5	362.96	3.72	332.7	-91.8	-340.1
119+50	359.78	367.02	7.24	698.5	365.31	5.53	514.6	-183.9	-681.1
120+50	360.68	371.01	10.33	1060.5	368.40	7.72	752.2	-308.2	-1141.6
121+50	361.62	375.81	14.19	1566.3	372.24	10.62	1096.4	-469.9	-1740.3
122+50	363.19	380.86	17.67	2073.4	376.83	13.64	1490.6	-582.8	-2158.6
123+50	365.11	385.91	20.80	2570.9	381.80	16.69	1925.7	-645.2	-2389.6
124+50	368.00	390.95	22.95	2935.3	386.76	18.76	2242.2	-693.1	-2567.1
125+50	371.74	396.00	24.26	3166.4	391.73	19.99	2438.4	-728.0	-2696.4
126+50	375.83	400.98	25.15	3327.3	396.69	20.86	2580.8	-746.5	-2765.0
127+50	380.09	405.29	25.20	3336.5	401.66	21.57	2699.3	-637.2	-2360.0
128+50	383.15	408.80	25.65	3419.1	406.23	23.08	2957.9	-461.2	-1708.2
129+50	384.93	411.49	26.56	3588.8	410.01	25.08	3314.6	-274.2	-1015.6
130+50	385.86	413.38	27.52	3771.3	413.00	27.14	3698.6	-72.7	-269.3
BRIDGE									
133+50	383.60	416.53	32.93	4869.0	417.25	33.65	5023.9	154.9	573.8
134+50	382.32	417.53	35.21	5366.7	417.09	34.77	5269.0	-97.7	-361.7
135+50	381.24	418.14	36.90	5749.0	416.14	34.90	5297.8	-451.2	-1671.1
136+50	380.13	417.96	37.83	5964.3	414.40	34.27	5159.0	-805.3	-2982.5
137+50	379.27	417.01	37.74	5943.3	412.27	33.00	4884.0	-1059.3	-3923.3
138+50	379.08	415.27	36.19	5587.0	410.13	31.05	4474.3	-1112.7	-4121.1
139+50	379.22	412.74	33.52	4995.8	408.00	28.78	4016.5	-979.3	-3627.0
140+50	380.60	409.82	29.22	4103.7	405.94	25.34	3362.1	-741.5	-2746.5
141+50	382.50	406.91	24.41	3193.3	404.37	21.87	2749.9	-443.4	-1642.2
142+50	384.57	403.99	19.42	2346.7	403.30	18.73	2237.5	-109.2	-404.5
143+50	387.15	401.34	14.19	1566.3	402.30	15.15	1701.3	135.1	500.2
144+50	389.87	399.20	9.33	939.2	401.30	11.43	1198.5	259.4	960.7
145+50	391.94	397.59	5.65	527.1	400.30	8.36	825.3	298.2	1104.3
146+50	393.49	396.51	3.02	265.9	399.30	5.81	543.9	278.1	1029.8
147+50	394.43	395.94	1.51	128.4	398.30	3.87	347.3	218.9	810.8
148+50	395.09	395.64	0.55	45.7	397.30	2.21	191.0	145.3	538.1
149+50	395.10	395.34	0.24	19.8	396.30	1.20	101.3	81.5	301.8
150+50	394.93	395.04	0.11	9.0	395.30	0.37	30.6	21.6	79.9
151+50	394.86	394.96	0.10	8.2	394.61	-0.25	-20.4	-28.6	-105.9
152+50	395.14	395.17	0.03	2.5	394.53	-0.61	-49.3	-51.7	-191.6
153+50	395.63	395.67	0.04	3.3	395.06	-0.57	-46.1	-49.4	-182.9
154+50	396.31	396.46	0.15	12.3	396.21	-0.10	-8.2	-20.5	-76.0
							TOTAL EMBANKMENT CHANGE (CY)		**(38,920.50)**

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **P-3**

SHEET NO.: **9 of 9**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Borrow embankment	CY	38,921	7.48	291,129			
Subtotal				291,129			
Markup (%) at 30.6%				89,085			
TOTAL				380,214			

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

ALTERNATIVE NO.: **P-4**

DESCRIPTION: **USE 1:1 STABILIZED SLOPES IN LIEU OF 2:1 SLOPES FOR THE EMBANKMENT OF THE RAILROAD BRIDGE**

SHEET NO.: **1 of 6**

ORIGINAL DESIGN: (sketch attached)

The original design uses 2:1 slopes for the railroad embankment.

ALTERNATIVE: (sketch attached)

Use 1:1 stabilized slopes.

ADVANTAGES:

- Reduces borrow excavation
- Facilitates detour construction
- Reduces footprint
- Reduces right-of-way

DISADVANTAGES:

- Maintenance of steeper slope is required

DISCUSSION:

The fill height of the embankment for the railroad bridge reaches a maximum of nearly 38 ft. The amount of embankment required can be substantially reduced by using stabilized 1:1 slopes. As various technologies can be used to achieve the 1:1 slope, some further investigation, discussion, and analysis is needed.

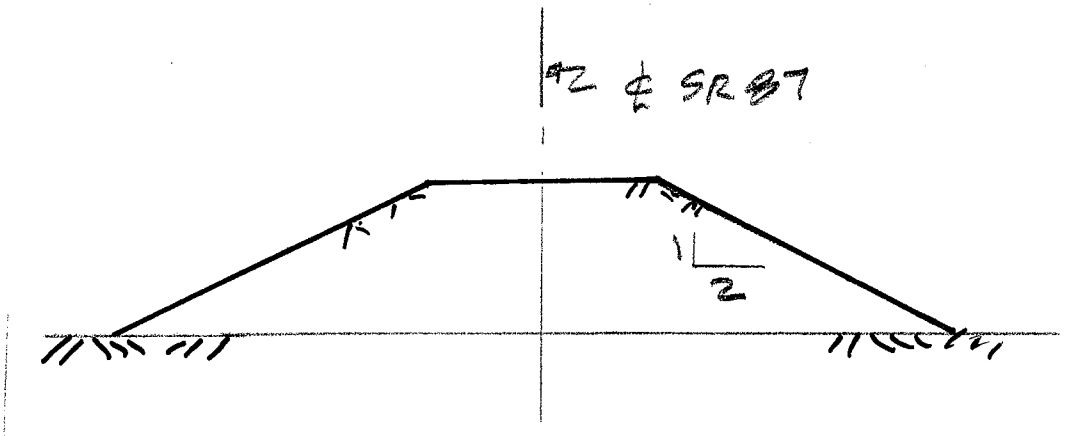
COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 607,058	$ 0	$ 607,058
ALTERNATIVE	$ 126,499	$ 61,130	$ 187,629
SAVINGS	$ 480,559	$ (61,130)	$ 419,429

SKETCH

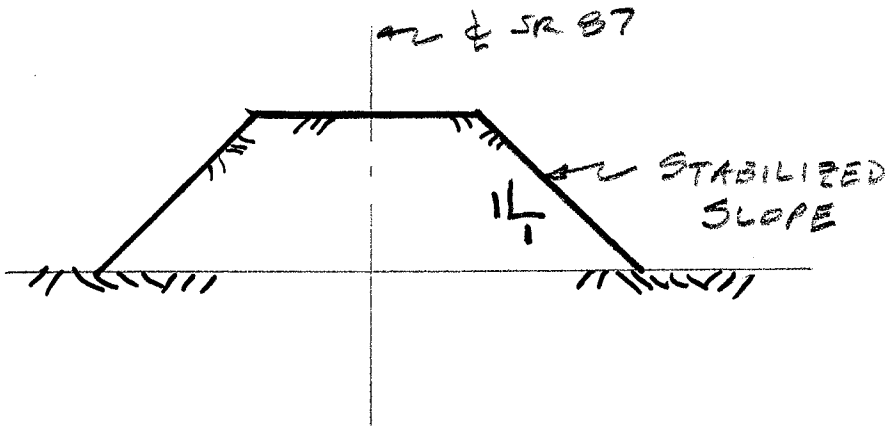
PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: P-4

ORIGINAL DESIGN ☒ ALTERNATIVE DESIGN ☐ BOTH ☐ SHEET NO.: 2 of 6



ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☒ BOTH ☐



PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **P-4**

SHEET NO.: **3 of 6**

USE $5/SY FOR THE COST OF THE SLOPE STABILIZATION.

Embankment Volume Change:

Station	Orig. Ground	Profile Grade	H Fill Height	A1 End Area	A2 End Area	Δ SF Area Change	Δ CY Volume Change
115+50	357.77	358.93	1.16	97.8	96.5	-1.3	-5.0
116+50	358.18	360.15	1.97	169.3	165.4	-3.9	-14.4
117+50	358.79	361.61	2.82	247.1	239.2	-8.0	-29.5
118+50	359.24	363.89	4.65	424.5	402.9	-21.6	-80.1
119+50	359.78	367.02	7.24	698.5	646.1	-52.4	-194.1
120+50	360.68	371.01	10.33	1060.5	953.8	-106.7	-395.2
121+50	361.62	375.81	14.19	1566.3	1364.9	-201.4	-745.8
122+50	363.19	380.86	17.67	2073.4	1761.2	-312.2	-1156.4
123+50	365.11	385.91	20.80	2570.9	2138.2	-432.6	-1602.4
124+50	368.00	390.95	22.95	2935.3	2408.6	-526.7	-1950.8
125+50	371.74	396.00	24.26	3166.4	2577.9	-588.5	-2179.8
126+50	375.83	400.98	25.15	3327.3	2694.8	-632.5	-2342.7
127+50	380.09	405.29	25.20	3336.5	2701.4	-635.0	-2352.0
128+50	383.15	408.80	25.65	3419.1	2761.2	-657.9	-2436.8
129+50	384.93	411.49	26.56	3588.8	2883.4	-705.4	-2612.7
130+50	385.86	413.38	27.52	3771.3	3014.0	-757.4	-2805.0
BRIDGE							
133+50	383.60	416.53	32.93	4869.0	3784.6	-1084.4	-4016.2
134+50	382.32	417.53	35.21	5366.7	4127.0	-1239.7	-4591.6
135+50	381.24	418.14	36.90	5749.0	4387.4	-1361.6	-5043.0
136+50	380.13	417.96	37.83	5964.3	4533.2	-1431.1	-5300.4
137+50	379.27	417.01	37.74	5943.3	4519.0	-1424.3	-5275.2
138+50	379.08	415.27	36.19	5587.0	4277.3	-1309.7	-4850.8
139+50	379.22	412.74	33.52	4995.8	3872.2	-1123.6	-4161.4
140+50	380.60	409.82	29.22	4103.7	3249.8	-853.8	-3162.3
141+50	382.50	406.91	24.41	3193.3	2597.5	-595.8	-2206.8
142+50	384.57	403.99	19.42	2346.7	1969.6	-377.1	-1396.8
143+50	387.15	401.34	14.19	1566.3	1364.9	-201.4	-745.8
144+50	389.87	399.20	9.33	939.2	852.1	-87.0	-322.4
145+50	391.94	397.59	5.65	527.1	495.2	-31.9	-118.2
146+50	393.49	396.51	3.02	265.9	256.8	-9.1	-33.8
147+50	394.43	395.94	1.51	128.4	126.1	-2.3	-8.4
148+50	395.09	395.64	0.55	45.7	45.4	-0.3	-1.1
149+50	395.10	395.34	0.24	19.8	19.7	-0.1	-0.2
150+50	394.93	395.04	0.11	9.0	9.0	0.0	0.0
151+50	394.86	394.96	0.10	8.2	8.2	0.0	0.0
152+50	395.14	395.17	0.03	2.5	2.5	0.0	0.0
153+50	395.63	395.67	0.04	3.3	3.3	0.0	0.0
154+50	396.31	396.46	0.15	12.3	12.3	0.0	-0.1
					TOTAL EMBANKMENT CHANGE (CY)		(62,142)

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **P-4**

SHEET NO.: **4 of 6**

Station	Orig. Ground	Profile Grade	H Height	Slope Area (SY)
115+50	357.77	358.93	1.16	36.5
116+50	358.18	360.15	1.97	61.9
117+50	358.79	361.61	2.82	88.6
118+50	359.24	363.89	4.65	146.1
119+50	359.78	367.02	7.24	227.5
120+50	360.68	371.01	10.33	324.6
121+50	361.62	375.81	14.19	445.9
122+50	363.19	380.86	17.67	555.3
123+50	365.11	385.91	20.80	653.7
124+50	368.00	390.95	22.95	721.2
125+50	371.74	396.00	24.26	762.4
126+50	375.83	400.98	25.15	790.4
127+50	380.09	405.29	25.20	792.0
128+50	383.15	408.80	25.65	806.1
129+50	384.93	411.49	26.56	834.7
130+50	385.86	413.38	27.52	864.9
BRIDGE				
133+50	383.60	416.53	32.93	1034.9
134+50	382.32	417.53	35.21	1106.5
135+50	381.24	418.14	36.90	1159.6
136+50	380.13	417.96	37.83	1188.9
137+50	379.27	417.01	37.74	1186.0
138+50	379.08	415.27	36.19	1137.3
139+50	379.22	412.74	33.52	1053.4
140+50	380.60	409.82	29.22	918.3
141+50	382.50	406.91	24.41	767.1
142+50	384.57	403.99	19.42	610.3
143+50	387.15	401.34	14.19	445.9
144+50	389.87	399.20	9.33	293.2
145+50	391.94	397.59	5.65	177.6
146+50	393.49	396.51	3.02	94.9
147+50	394.43	395.94	1.51	47.5
148+50	395.09	395.64	0.55	17.3
149+50	395.10	395.34	0.24	7.5
150+50	394.93	395.04	0.11	3.5
151+50	394.86	394.96	0.10	3.1
152+50	395.14	395.17	0.03	0.9
153+50	395.63	395.67	0.04	1.3
154+50	396.31	396.46	0.15	4.7
			TOTAL AREA (SY)	19,372

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **P-4**

SHEET NO.: **5 of 6**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Borrow embankment	CY	62,142	7.48	464,822			
Slope stabilization	SY				19,372	5.00	96,860
Subtotal				464,822			96,860
Markup (%) at 30.6%				142,236			29,639
TOTAL				607,058			126,499

LIFE CYCLE COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
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ALTERNATIVE NO. **P-4**

SHEET NO.: **6 of 6**

						ORIGINAL	PROPOSED
LIFE CYCLE PERIOD: 30 **years**							
INTEREST RATE: 3.20% **ESCALATION RATE:** 0.00%							
A.	**INITIAL COST**					607,058	126,499
	Useful Life (Years)						
					INITIAL COST SAVINGS		480,559
B.	**RECURRENT COSTS (Annual Expenditures)**						
	1. Maintenance and repair of slope (assumes 4 man crew x 2 days/yr x $50/hr)					-	3,200
	2. Operating						
	3. Energy						
	4.						
	5.						
	6.						
					Total Annual Costs	-	3,200
					Present Worth Factor	19.1033	19.1033
					Present Worth of RECURRENT COSTS	-	61,130
C.	**SINGLE EXPENDITURES**		**Year**	**Amount**	**PW factor**	**Present Worth**	**Present Worth**
ORIG	PROP	**< Put "x" in appropriate box (original design or proposed design)**					
		1.			1.0000	-	-
		2.			1.0000	-	-
		3.			1.0000	-	-
		4.			1.0000	-	-
		5.			1.0000	-	-
		6.			1.0000	-	-
		7.			1.0000	-	-
		8.			1.0000	-	-
D.	**SALVAGE VALUE**		**Year**	**Amount**	**PW factor**	**Present Worth**	**Present Worth**
		1.			(1.0000)	-	-
		2.			(1.0000)	-	-
					Present Worth of SINGLE EXPENDITURES	-	-
E.	**Total Recurrent Costs & Single Expenditures (B + C + D)**					-	61,130
					RECURRENT COSTS & SINGLE EXPENDITURES SAVINGS		(61,130)
					TOTAL PRESENT WORTH COST (A + E)	607,058	187,629
					TOTAL LIFE CYCLE SAVINGS		**419,429**

SUMMARY OF POTENTIAL COST SAVINGS

SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION

PROJECT: STP00-0003-00(625), P.I. No. 0003625

Bleckley County, Georgia - Preliminary Engineering Submittal

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
SECTION (S)						
S-1	Use 4-ft.-wide paved shoulders in lieu of 6.5-ft.-wide shoulders.	$1,150,425	$715,851	$434,574		$434,574
S-3	Make the inside lanes 11 ft. wide in lieu of 12 ft. wide.	$695,738	$0	$695,738		$695,738
S-4	Make the outside lanes 11 ft. wide in lieu of 12 ft. wide.	$695,738	$0	$695,738		$695,738
S-5	Modify the parking lot pavement section to use asphaltic concrete and GAB in lieu of only asphaltic concrete.	$94,528	$64,109	$30,419		$30,419
S-6	Reduce the lane width of selected side roads from 12 ft. wide to 11 ft. wide.	$32,757	$0	$32,757		$32,757
S-7	Use a 4-ft.-wide median in the area of the railroad bridge embankment in lieu of the 14-ft.-wide median.	$438,480	$0	$438,480		$438,480
S-9	Modify the paved shoulder section to use asphaltic concrete and GAB instead of all asphaltic concrete.	$1,134,030	$769,089	$364,941		$364,941

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

ALTERNATIVE NO.: **S-1**

DESCRIPTION: **USE 4-FT.-WIDE PAVED SHOULDERS INSTEAD OF 6.5-FT.-PAVED SHOULDERS**

SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

Construct 6.5 ft. wide paved shoulder and 3.5 ft. wide grassed shoulder for a total 10 ft. shoulder width.

ALTERNATIVE: (sketch attached)

Construct 4-ft.-wide paved shoulder and 6-ft.-wide grassed shoulder for a total 10 ft. shoulder width.

ADVANTAGES:

- Reduces materials needed

DISADVANTAGES:

- Narrower paved shoulder

DISCUSSION:

GDOT detail S-8 allows a 4-ft.-wide paved shoulder width. The alternate design sketch shows 8 ft. paved shoulder between the edge of the pavement and the rumble strip. The 4 ft. paved shoulder leaves 2 ft. between the edges of rumble strip and grass shoulder, which should be enough space to ride a bicycle.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,150,425	—	$ 1,150,425
ALTERNATIVE	$ 715,851	—	$ 715,851
SAVINGS	$ 434,574	—	$ 434,574

SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
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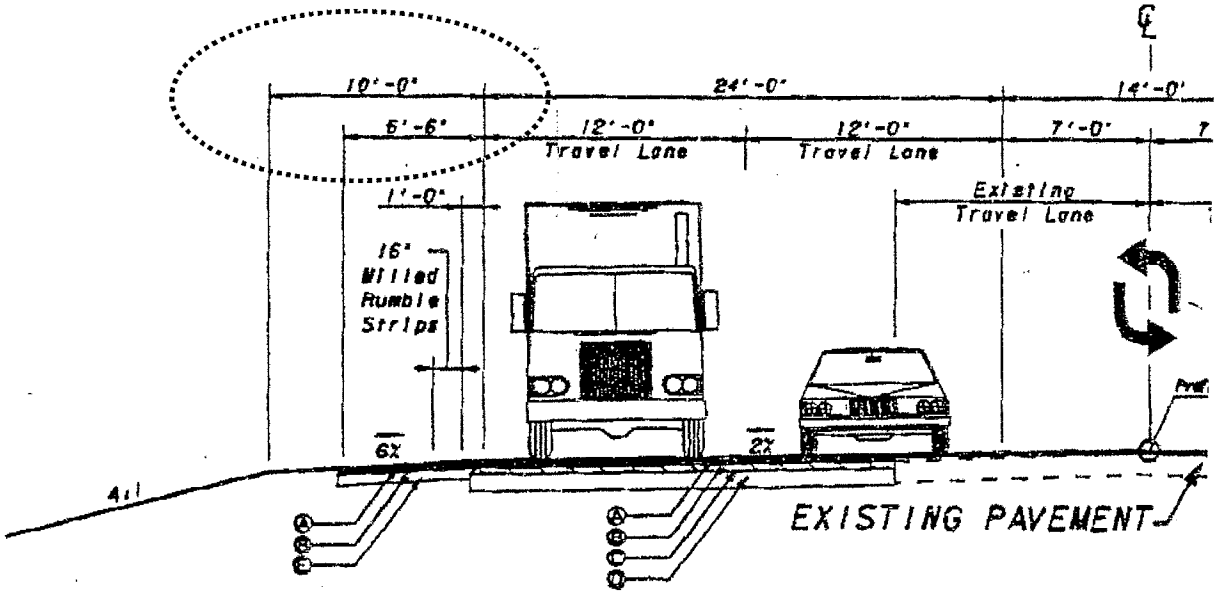
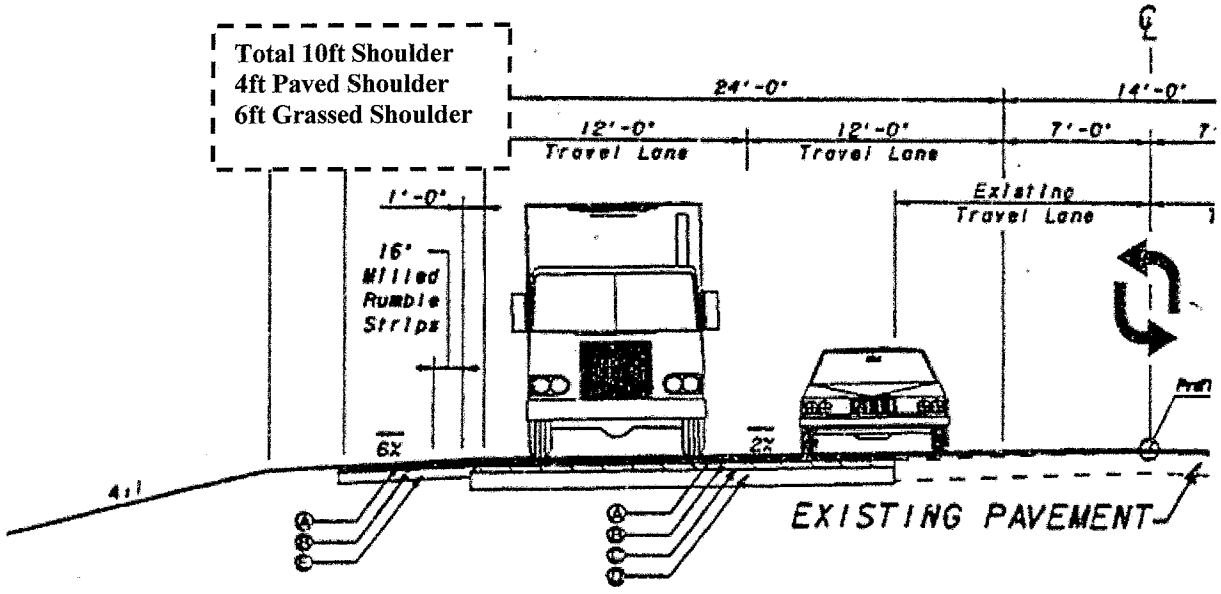
ALTERNATIVE NO.: **S-1**

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☐ BOTH ☒

SHEET NO.: **2 of 4**



ORIGINAL DESIGN



PROPOSED DESIGN

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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ALTERNATIVE NO.: **S-1**

SHEET NO.: **3 of 4**

SY Shoulder Pavement Cost:

135#/SY 9.5 mm Superpave: (135/2000)($63.70/TN)	=	$4.30
220#/SY 19 mm Superpave: (220/2000)($69.50/TN)	=	7.65
440#/SY 25 mm Superpave: (880/2000)($65.32/TN)	=	14.37

Total: $26.32/SY

Total length of paved shoulder (both sides of the road):

2[333+40 – 103+15] = 46,050 LF
Width of paved shoulder = 6.5 ft. (as designed)

Total SY area of paved shoulders (as designed)
(46,050 ft. x 6.5 ft.)/ 9SF/SY = 33,258.3 SY

Width of paved shoulder : 4 ft. (alternative design)
Total SY area of paved shoulders (alternative design)

(46,050 ft. x 4 ft.)/ 9 SF/SY = 20,466.6 SY

Grassing acreage on shoulder (as designed)
(46,050 ft. x 3.5 ft.)/ 9 SF/SY = 3.7 acres

Grassing acreage on shoulder (alternative design):
(46,050 ft. x 6 ft.)/ 9 SF/SY = 6.343 A

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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ALTERNATIVE NO.: **S-1**

SHEET NO.: **4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Paved shoulder	SY	33,258	26.32	875,358	20,466	26.32	538,665
Temporary grassing	AC	3.70	574.21	2,125	6.343	574.21	3,642
Permanent grassing	AC	3.70	917.26	3,394	6.343	917.26	5,818
Subtotal				880,877			548,125
Markup (%) at 30.6%				269,548			167,726
TOTAL				1,150,425			715,851

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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ALTERNATIVE NO.: **S-3**

DESCRIPTION: **MAKE THE INSIDE LANES 11 FT. WIDE INSTEAD OF 12 FT. WIDE**

SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

All travel lanes are currently 12 ft. wide.

ALTERNATIVE: (sketch attached)

Make the inside lanes 11 ft. wide.

ADVANTAGES:

- Reduces pavement maintenance
- Reduces construction limits

DISADVANTAGES:

- Less space between adjacent vehicles

DISCUSSION:

Eleven ft.-wide lanes have been used on other state routes and Interstates and no major problems have been noticed. With a 14 ft. paved flush median and 6.5 ft. paved outside shoulders 11-ft.-wide inside lanes should function safely.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 695,738	—	$ 695,738
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 695,738	—	$ 695,738

SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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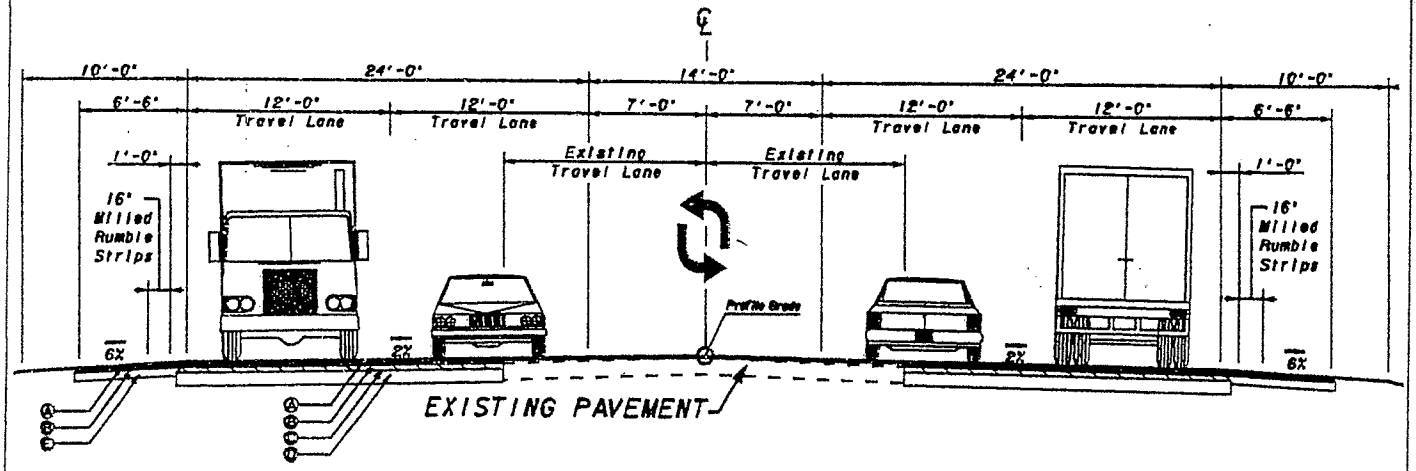
Bleckley County, Georgia - Preliminary Engineering Submittal

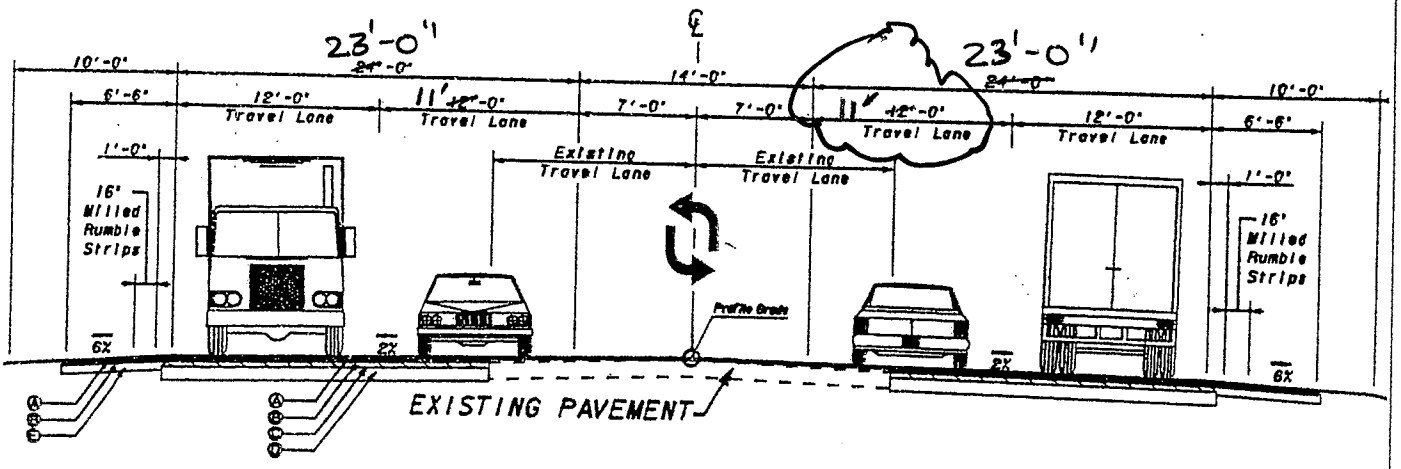
ALTERNATIVE NO.: S-3

ORIGINAL DESIGN ☑ ALTERNATIVE DESIGN ☐ BOTH ☐ SHEET NO.: 2 of 4



Rural 4-Lane 14' Flush Median
2 to 4 Symetrical
Tangent

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☑ BOTH ☐



Rural 4-Lane 14' Flush Median
2 to 4 Symetrical
Tangent

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
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ALTERNATIVE NO.: **S-3**

SHEET NO.: **3 of 4**

Total length of roadway mainline minus bridge length :

[(Sta. 333+40 – Sta. 103+15) – 185 ft.]2 = 45,680 ft.

Total in both directions of traffic: (2 ft. x 45,680 ft.)/ 9 SF/SY = 10,151 SY

SY Full-Depth Pavement Cost:

135#/SY 9.5 mm Superpave:	(135/2,000)($63.70/TN)	=	$4.30
220#/SY 19 mm Superpave:	(220/2,000)($69.50/TN)	=	7.65
880#/SY 25 mm Superpave:	(880/2,000)($65.32/TN)	=	28.74
12" GAB Base Coarse:	[9(1)(150)/2,000]($17.46/TN)	=	11.79
	Total:		**$52.48/SY**

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION**
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ALTERNATIVE NO.: **S-3**

SHEET NO.: **4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Pavement section	SY	10,151	52.48	532,724			
Subtotal				532,724			
Markup (%) at 30.6%				163,014			
TOTAL				695,738			

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

ALTERNATIVE NO.: **S-4**

DESCRIPTION: **MAKE OUTSIDE LANES 11 FT. WIDE INSTEAD OF 12 FT. WIDE**

SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

All travel lanes are currently designed at 12 ft wide.

ALTERNATIVE: (sketch attached)

Make the outside lanes 11 ft wide.

ADVANTAGES:

- Reduces password maintenance
- Reduces stormwater runoff
- Reduces construction limits

DISADVANTAGES:

- Less space between adjacent vehicles

DISCUSSION:

Eleven ft. wide lanes have been used on other state routes and interstates and no major problems have been noticed. With 6.5 ft. paved outside shoulders and a 14 ft. paved flush median 11-ft.-wide outside lanes should function safely. It is important to note that the 11 ft. outside lane is adjacent to a lane traveling in the same direction (not opposing traffic).

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 695,738	—	$ 695,738
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 695,738	—	$ 695,738

SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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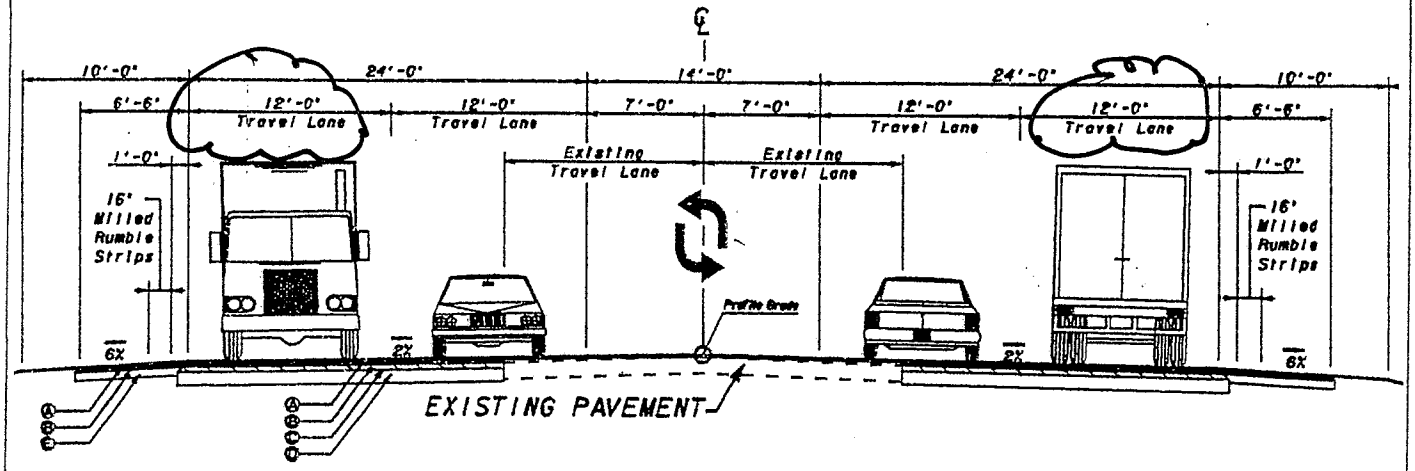
Bleckley County, Georgia - Preliminary Engineering Submittal

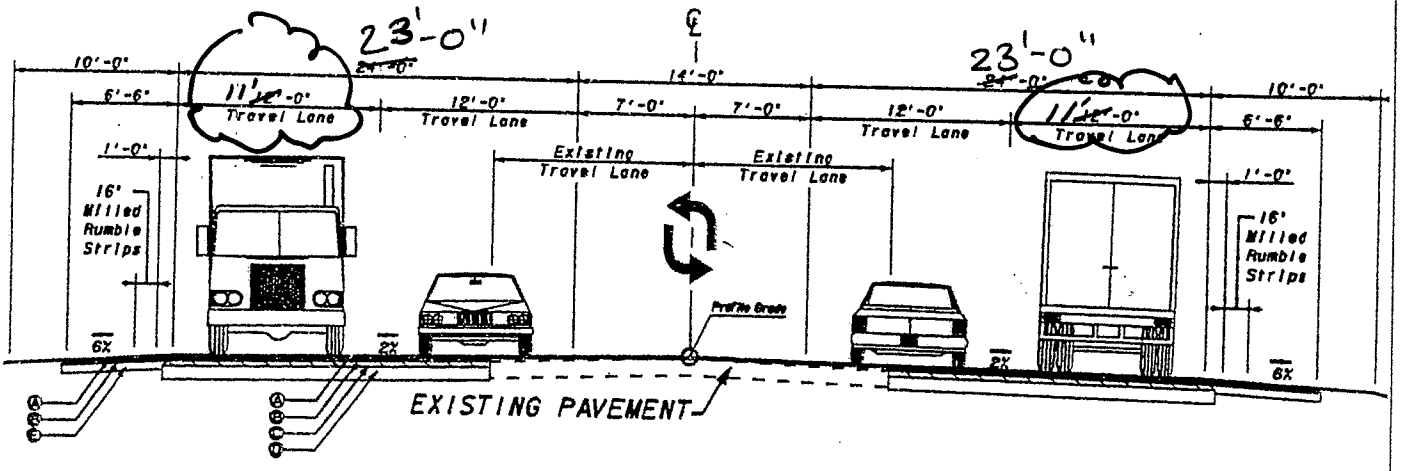
ALTERNATIVE NO.: S-4

ORIGINAL DESIGN ☑ ALTERNATIVE DESIGN ☐ BOTH ☐ SHEET NO.: 2 of 4



Rural 4-Lane 14' Flush Median
2 to 4 Symetrical
Tangent

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☑ BOTH ☐



Rural 4-Lane 14' Flush Median
2 to 4 Symetrical
Tangent

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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ALTERNATIVE NO.: **S-4**

SHEET NO.: **3 of 4**

Total length of roadway mainline minus bridge length :

[(Sta. 333+40 – Sta. 103+15) – 185 ft.]2 = 45,680 ft.

Total in both directions of traffic: (2 ft. x 45,680 ft.)/ 9 SF/SY = 10,151 SY

SY Full Depth Pavement Cost:

135#/SY 9.5 mm Superpave:	(135/2,000)($63.70/TN)	= $4.30
220#/SY 19 mm Superpave:	(220/2,000)($69.50/TN)	= 7.65
880#/SY 25 mm Superpave:	(880/2,000)($65.32/TN)	= 28.74
12" GAB Base Coarse:	[9(1)(150)/2,000]($17.46/TN)	= 11.79
	Total:	**$52.48/SY**

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
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ALTERNATIVE NO.: **S-4**

SHEET NO.: **4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Pavement section	SY	10,151	52.48	532,724			
Subtotal				532,724			
Markup (%) at 30.6%				163,014			
TOTAL				695,738			

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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Bleckley County, Georgia – Preliminary Engineering Submittal

ALTERNATIVE NO.: **S-5**

DESCRIPTION: **MODIFY THE PARKING LOT PAVEMENT SECTION TO USE ASPHALTIC CONCRETE AND GRADED AGGREGATE BASE INSTEAD OF ALL ASPHALTIC CONCRETE**

SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

The current design proposes a pavement section of 135 LB/SY (asphaltic concrete 9.5mm); 220 LB/SY (asphaltic concrete 19mm) and an additional 440 LB/SY (asphaltic concrete 19mm) for the parking lot at STA 309+00.

ALTERNATIVE: (sketch attached)

Use a pavement section of 135 LB/SY (asphaltic concrete 9.5mm); 220 LB/SY (asphaltic concrete 19mm) and 6 in. graded aggregate base (GAB) for the parking lot.

ADVANTAGES:

- Reduces the construction cost

DISADVANTAGES:

- Lower parking lot pavement structural value

DISCUSSION:

It is not uncommon to build parking lots with 3.5 in. of asphaltic concrete on a base of 6 in. of GAB. Because of the lower traffic volumes, parking lots of this alternate design depth should perform adequately.

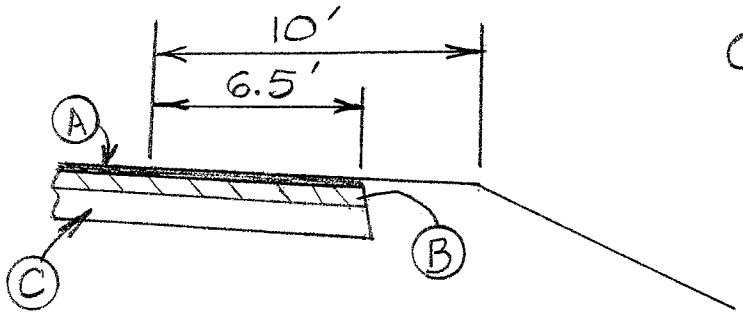
COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 94,528	—	$ 94,528
ALTERNATIVE	$ 64,109	—	$ 64,109
SAVINGS	$ 30,419	—	$ 30,419

SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: 5-5

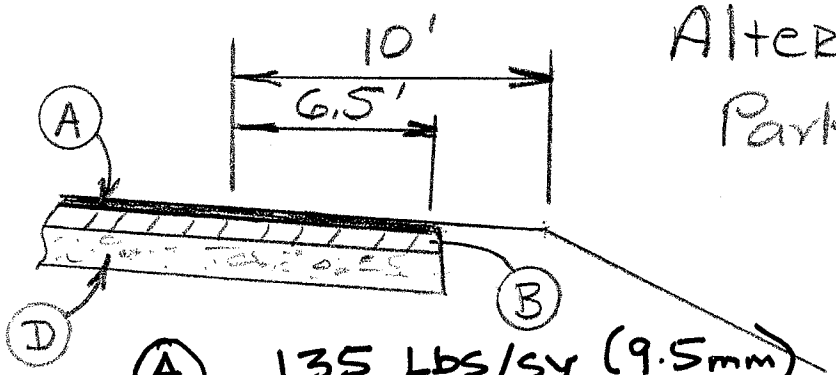
ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☐ BOTH ☒ SHEET NO.: 2 of 4



Original Parking Lot Section

(A) 135 Lbs/sy (9.5mm)
(B) 220 Lbs/sy (19mm)
(C) 440 Lbs/sy (19mm)

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☒ BOTH ☐



Alternate Parking Lot Section

(A) 135 Lbs/sy (9.5mm)
(B) 220 Lbs/sy (19mm)
(D) 6" G.A.B.

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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ALTERNATIVE NO.: **S-5**

SHEET NO.: **3 of 4**

"Original" Paved shoulder Cost:

SY Shoulder Pavement Cost:

135#/SY 9.5 mm Superpave: (135/2000)($63.70/TN) = $4.30
220#/SY 19 mm Superpave: (220/2000)($69.50/TN) = $7.65
440#/SY 25 mm Superpave: (440/2000)($65.32/TN) = $14.37

Total: $26.32/SY

"Alternate" Paved shoulder Cost:

SY Shoulder Pavement Cost:

135#/SY 9.5 mm Superpave: (135/2000)($63.70/TN) = $4.30
220#/SY 19 mm Superpave: (220/2000)($69.50/TN) = $7.65
6" GAB Base Coarse: [9(0.5)(150)/2000]($17.46/TN) = $5.90

Total: $17.85/SY

Area of Parking Lot:

[(6ft + 12ft + 27ft) x 550ft]/9 SF/SY = **2,750 SY**

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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ALTERNATIVE NO.: **S-5**

SHEET NO.: **4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Original pavement section	SY	2,750	26.32	72,380			
Alternative pavement section	SY				2,750	17.85	49,088
Subtotal				72,380			49,088
Markup (%) at 30.6%				22,148			15,021
TOTAL				94,528			64,109

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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ALTERNATIVE NO.: **S-6**

DESCRIPTION: **REDUCE SELECTED SIDE ROAD LANE WIDTHS TO 11 FT.**

SHEET NO.: **1 of 5**

ORIGINAL DESIGN: (sketch attached)

SR 87 Business, SR 126, and Daisy Adams Road (CR 54) are all reconstructed to 12-ft.-wide lanes in the vicinity of SR 87, then taper (where necessary) to match the existing roadway width.

ALTERNATIVE: (sketch attached)

Use 11 ft. lanes which will taper to match the existing width near the construction limits for US 87 Business, SR 126, and Daisy Adams Road (CR 54).

ADVANTAGES:

- Reduces required materials

DISADVANTAGES:

- Narrower travel lanes

DISCUSSION:

While SR 87 Business and SR 126 have existing 12 ft. lanes, the other two roads are narrower. Traffic on SR 87 Business and SR 126 will be moving slowly in the reconstructed area due to the proximity of the intersections with SR 87. Daisy Adams Road has design year traffic of 1350 VPD on the west side of SR 87. Reconstructing these roads with 11 ft. lanes will save money without adversely affecting traffic.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 32,757	—	$ 32,757
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 32,757	—	$ 32,757

SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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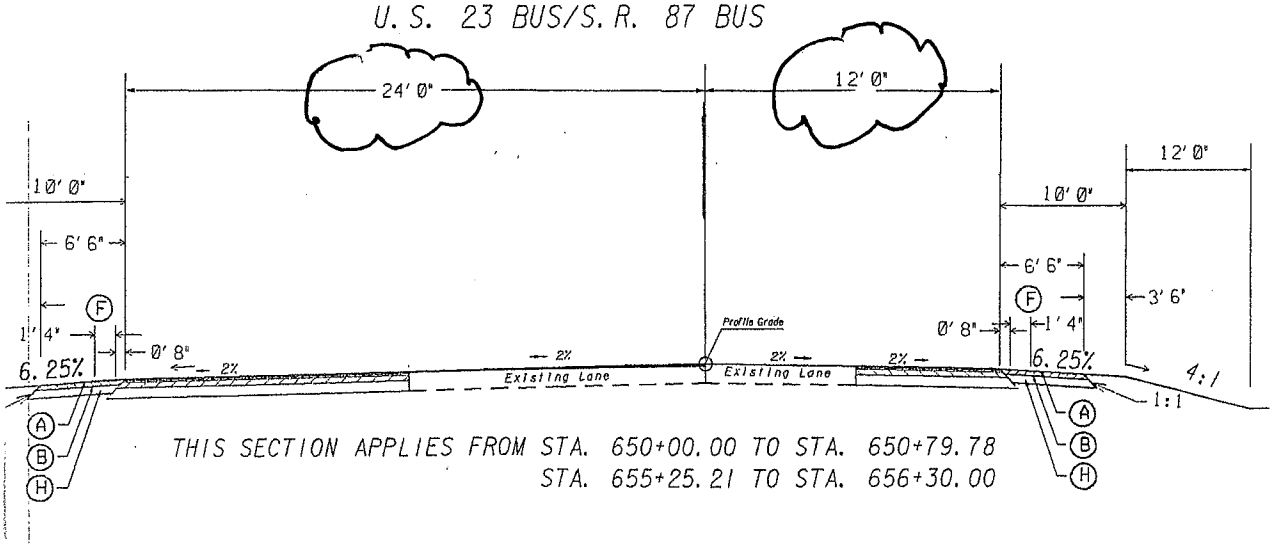
ALTERNATIVE NO.: 5-6

ORIGINAL DESIGN ☒ ALTERNATIVE DESIGN ☐ BOTH ☐

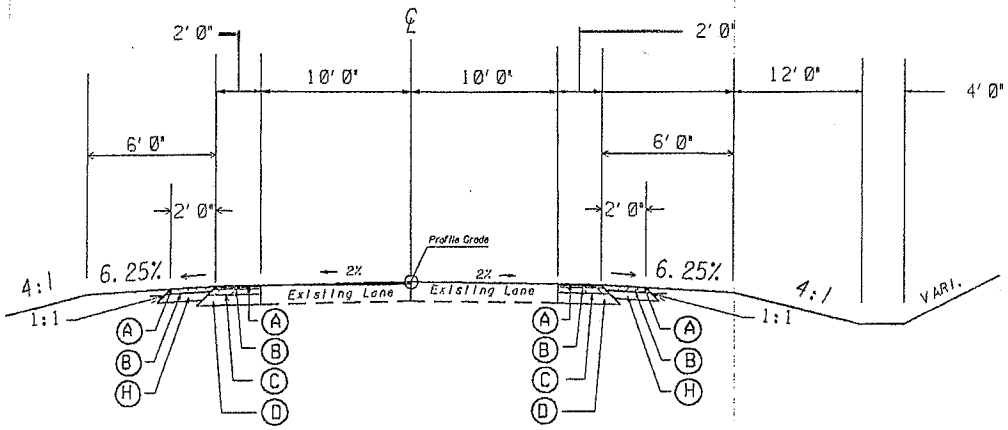
SHEET NO.: 2 of 5

U. S. 23 BUS/S. R. 87 BUS



THIS SECTION APPLIES FROM STA. 650+00.00 TO STA. 650+79.78
STA. 655+25.21 TO STA. 656+30.00

C. R. 54/DAISY ADAMS ROAD
C. R. 67/LUCAS ROAD NORTH
C. R. 67/LUCAS ROAD SOUTH
C. R. 162/RENE ROAD



SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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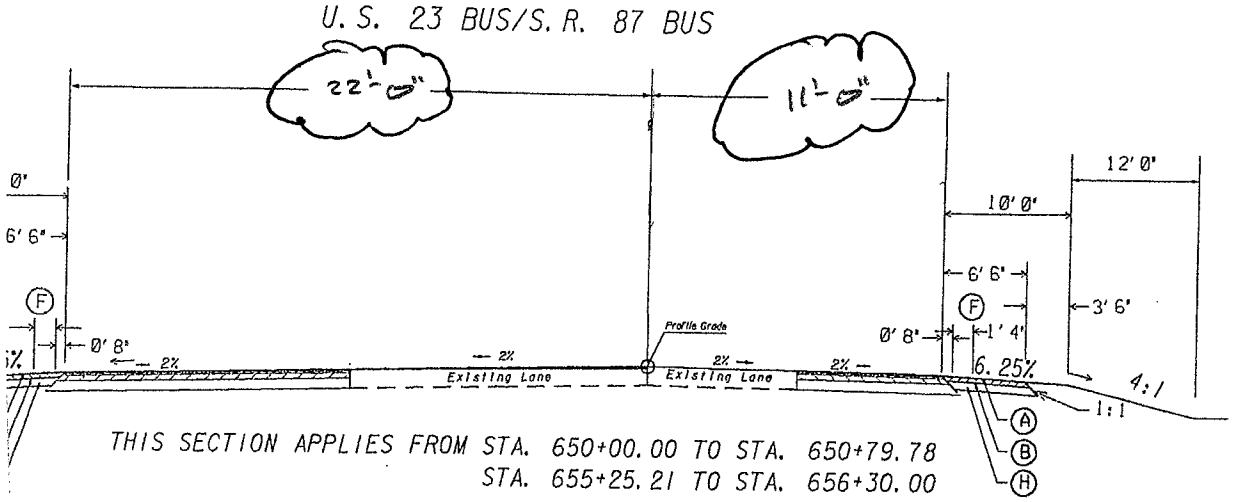
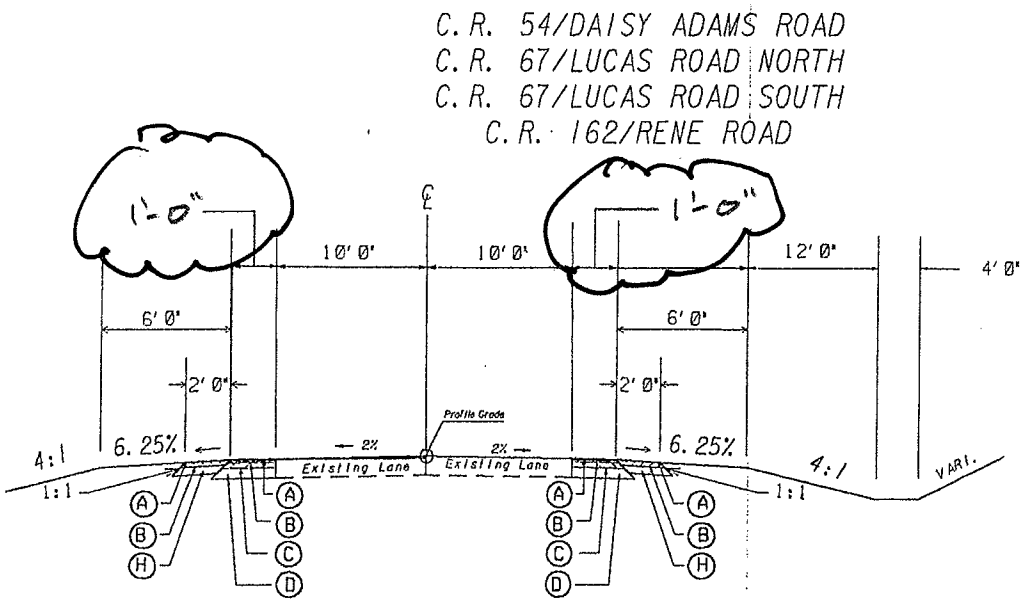
ALTERNATIVE NO.: 5-6

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☒ BOTH ☐

SHEET NO.: 3 of 5





PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
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ALTERNATIVE NO.: **S-6**

SHEET NO.: **4 of 5**

SR 87 Business:

Use 11 ft. lanes from 650+80 to 655+50, then taper to 12 ft. lanes at 656+30
Area = [3(1)(65550-65080) + (.5)(3)(65630-65550)]/9 = 170 SY

SR 126:

Use 11 ft. lanes from 551+00 to 559+00, then taper to 12 ft. lanes at 560+00; use an 11 ft. turn lane from 555+00 to 557+45.
Area = [2(1)(55900-55100+55745-55500) + .5(2)(56000-55900)]/9 = 243 SY

Daisy Adams Road (CR 54):

On the west side of SR 87, use 11 ft. lanes from 753+60 to 754+40 and taper from 11 ft. to 12 ft. from 753+00 to 753+60. On the east side of SR 87, 12-foot lanes are used from 755+90 to 757+16, and then the lanes taper to 11 ft. at 757+50. Use 11 ft. lanes for the entire length.
Area = [2(1)(75440-75360+75716-75590) + .5(2)(75360-75300+75750-75716)]/9 = 56 SY

Total = 170 + 243 + 56 = 469 SY

SY Full-Depth Pavement Cost:

135#/SY 9.5 mm Superpave: (135/2000)($63.70/TN)	=$ 4.30
220#/SY 19 mm Superpave: (220/2000)($69.50/TN)	= 7.65
880#/SY 25 mm Superpave: (880/2000)($65.32/TN)	= 28.74
12 in. GAB Base Coarse: [9(1)(150)/2000]($17.46/TN)	= 11.79
Total:	**$52.48/SY**

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION**
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ALTERNATIVE NO.: **S-6**

SHEET NO.: **5 of 5**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Full-depth pavement	SY	469	53.48	25,082			
Subtotal				25,082			
Markup (%) at 30.6%				7,675			
TOTAL				32,757			

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

ALTERNATIVE NO.: **S-7**

DESCRIPTION: **USE A 4-FT.-WIDE MEDIAN IN THE AREA OF THE RAILROAD BRIDGE EMBANKMENT IN LIEU OF A 14 FT. MEDIAN**

SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

The original design includes a 14 ft. flush median throughout the project.

ALTERNATIVE: (sketch attached)

Use a 4 ft. flush median from Station 117+00 to 147+00. Lower the speed design from 55mph to 45mph through this segment.

ADVANTAGES:

- Reduces construction materials
- Reduces construction time
- Reduces earthwork and truck trips

DISADVANTAGES:

- Perceived reduction in safety
- Reduces speed limit

DISCUSSION:

This project requires approximately 461,000 CY of borrow material. Most of this is for the bridge over the railroad embankment. Reducing the width of the median also substantially reduces the amount of borrow excavation. A 4 ft. median flush cannot be used for a design speed of 55mph, so the speed will have to be reduced to 45mph in this area. There will be a transition on the road from a 14 ft. median to a 4 ft. median on both sides of the bridge.

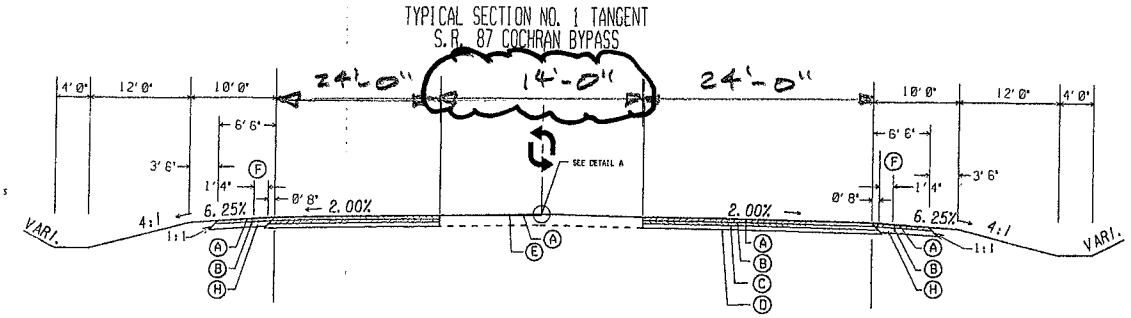
COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 438,480	—	$ 438,480
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 438,480	—	$ 438,480

SKETCH

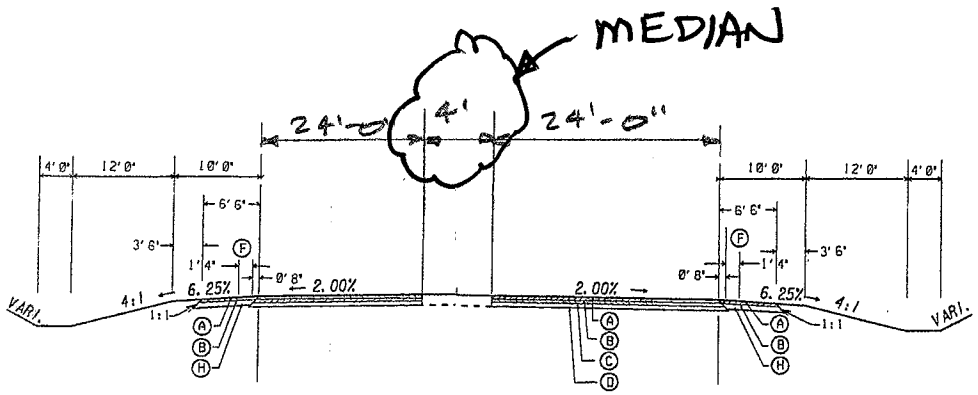
PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: 5-7

ORIGINAL DESIGN ☒ ALTERNATIVE DESIGN ☐ BOTH ☐ SHEET NO.: 2 of 4



ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☒ BOTH ☐



CALCULATIONS

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **S-7**

SHEET NO.: **3 of 4**

Station	Fill Ht.	Area=10(Ht.)	Volume=100(Area)/27
117+50	2.82	28.2	104
118+50	4.65	46.5	172
119+50	7.24	72.4	268
120+50	10.33	103.3	383
121+50	14.19	141.9	526
122+50	17.67	176.7	654
123+50	20.80	208.0	770
124+50	22.95	229.5	850
125+50	24.26	242.6	899
126+50	25.15	251.5	931
127+50	25.20	252.0	933
128+50	25.65	256.5	950
129+50	26.47	264.7	980
130+50	27.52	275.2	1019
BRIDGE			
133+50	31.68	316.8	1173
134+50	35.21	352.1	1304
135+50	36.90	369.0	1367
136+50	37.83	378.3	1401
137+50	37.74	377.4	1398
138+50	36.19	361.9	1340
139+50	33.52	335.2	1241
140+50	29.22	292.2	1082
141+50	24.41	244.1	904
142+50	19.42	194.2	719
143+50	14.19	141.9	526
144+50	9.33	93.3	346
145+50	5.65	56.5	209
146+50	3.02	30.2	112
		TOTAL	**21,501 CY**

Pavement Reduction = (14,700-11,700)(10)/9 = 3,333 SY

SY Full Depth Pavement Cost:

135#/SY 9.5 MM Superpave: (135/2000)($63.70/TN) = $ 4.30
220#/SY 19 mm Superpave: (220/2000)($69.50/TN) = 7.65
880#/SY 25 mm Superpave: (880/2000)($65.32/TN) = 28.74
12" GAB Base Coarse: [9(1)(150)/2000]($17.46/TN) = 11.79

Total: **$52.48/SY**

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **S-7**

SHEET NO.: **4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Borrow excavation	CY	21,501	7.48	160,827			
Full-depth pavement	SY	3,333	52.48	174,916			
Subtotal				335,743			
Markup (%) at 30.6%				102,737			
TOTAL				438,480			

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

ALTERNATIVE NO.: **S-9**

DESCRIPTION: **MODIFY THE PAVED SHOULDER SECTION TO USE GRADED AGGREGATE BASE**

SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

The current design uses a pavement section of 135 LB/SY (asphaltic concrete 9.5mm); 220 LB/SY (asphaltic concrete 19mm) and an additional 440 LB/SY (asphaltic concrete 19mm) for the mainline paved shoulders.

ALTERNATIVE: (sketch attached)

Use a pavement section of 135 LB/SY (asphaltic concrete 9.5mm); 220 LB/SY (asphaltic concrete 19mm) and 6 inches graded aggregate base (GAB) for the mainline paved shoulders.

ADVANTAGES:

- Reduces construction cost

DISADVANTAGES:

- Less shoulder pavement structural value

DISCUSSION:

It is not uncommon to build paved shoulders with 3.5 in. of asphaltic concrete and a base of 6 in. of GAB. Because of the lower traffic volumes, paved shoulders of this alternative design depth should be adequate.

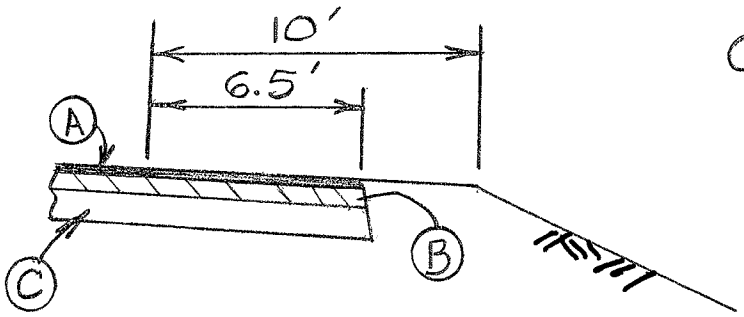
COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,134,030	—	$ 1,134,030
ALTERNATIVE	$ 769,089	—	$ 769,089
SAVINGS	$ 364,941	—	$ 364,941

SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: S-9

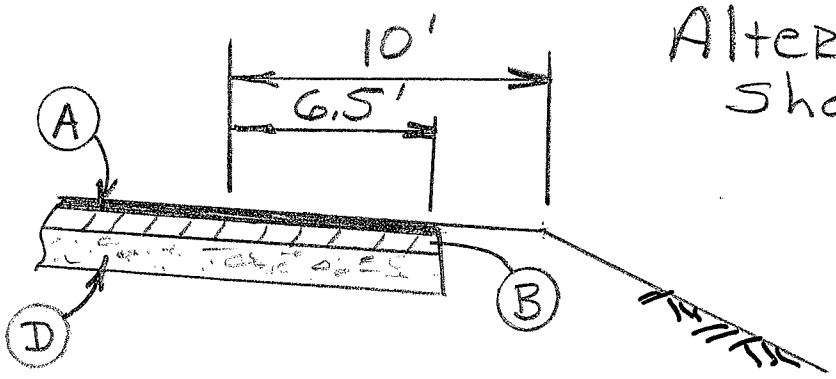
ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☐ BOTH ☒ SHEET NO.: 2 of 4



Original Shoulder

(A) 135 Lbs/sy (9.5mm) SUPERPAVE
(B) 220 Lbs/sy (19mm) "
(C) 440 Lbs/sy (19mm) "

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☒ BOTH ☐



Alternate Shoulder

(D) 6" G.A.B.

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **S-9**

SHEET NO.: **3 of 4**

Original Design Paved Shoulder Cost:

SY shoulder pavement cost:

135#/SY 9.5 mm Superpave:	(135/2,000)($63.70/TN)	=	$4.30
220#/SY 19 mm Superpave:	(220/2,000)($69.50/TN)	=	$7.65
440#/SY 25 mm Superpave:	(440/2,000)($65.32/TN)	=	$14.37

Total: $26.32/SY

"Alternate" Paved shoulder Cost:

SY Shoulder Pavement Cost:

135#/SY 9.5 mm Superpave:	(135/2000)($63.70/TN)	=	$4.30
220#/SY 19 mm Superpave:	(220/2000)($69.50/TN)	=	$7.65
6 in. GAB Base Coarse:	[9(0.5)(150)/2000]($17.46/TN)	=	$5.90

Total: $17.85/SY

Area of Paved Shoulders:

[(22,840 ft.) (6.5 ft. x 2 sides)]/(9 SF/SY) = **32,991 SY**

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **S-9**

SHEET NO.: **4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Original pavement section	SY	32,991	26.32	868,323			
Alternate pavement section	SY				32,991	17.85	588,889
Subtotal				868,323			588,889
Markup (%) at 30.6%				265,707			180,200
TOTAL				1,134,030			769,089

SUMMARY OF POTENTIAL COST SAVINGS

SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION

PROJECT: STP00-0003-00(625), P.I. No. 0003625

Bleckley County, Georgia - Preliminary Engineering Submittal

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
BRIDGE (B)						
B-1	Use 8-ft.-wide shoulders on the bridge in lieu of 10 ft. wide.	$86,745	$0	$86,745		$86,745
B-3	Use mechanically stabilized earth (MSE) wall abutments and a single 69.5 ft. long span in lieu a 185 ft. long three span bridge.	$1,848,787	$1,383,118	$465,669		$465,669
B-8	Update the bridge cost for correct area and unit prices.	DESIGN SUGGESTION				
MISCELANEOUS (M)						
M-1	Increase the unit cost for traffic signals from $47,000 to $90,000 at SR 26 and $150,000 for SR 126.	DESIGN SUGGESTION				

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

ALTERNATIVE NO.: **B-1**

DESCRIPTION: **USE 8FT SHOULDERS ON THE BRIDGE IN LIEU OF 10FT SHOULDERS**

SHEET NO.: **1 of 4**

ORIGINAL DESIGN: (sketch attached)

The original design includes 10 ft. shoulders on the bridge.

ALTERNATIVE: (sketch attached)

Provide 8 ft. shoulders in the bridge.

ADVANTAGES:

- Reduces bridge cost
- Faster bridge construction

DISADVANTAGES:

- Less shoulder on bridge

DISCUSSION:

The current GDOT Bridge Policy manual specifies 8 ft. shoulders on bridges on state routes with traffic over 2000 VPD.

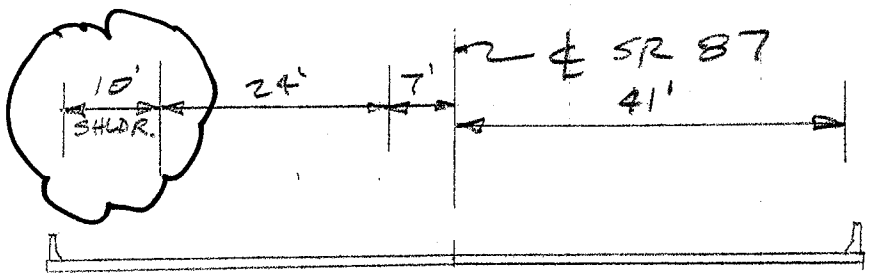
COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 86,745	—	$ 86,745
ALTERNATIVE	$ 0	—	$ 0
SAVINGS	$ 86,745	—	$ 86,745

SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

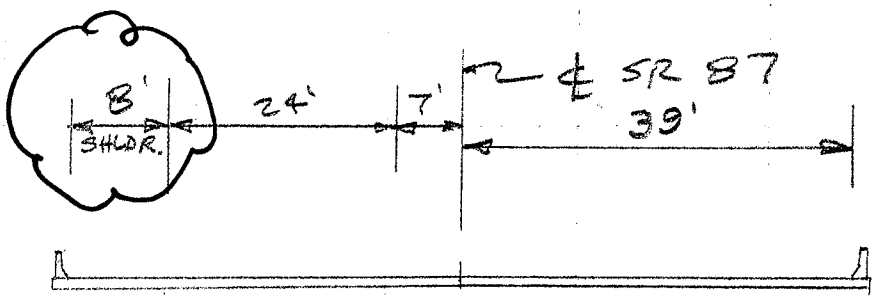
ALTERNATIVE NO.: B-1

ORIGINAL DESIGN ☒ ALTERNATIVE DESIGN ☐ BOTH ☐ SHEET NO.: 2 of 4



BRIDGE SECTION

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☒ BOTH ☐



BRIDGE SECTION

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **B-1**

SHEET NO.: **3 of 4**

Reduction in bridge area = 184.5(2)(10-8) = 738 SF

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **B-1**

SHEET NO.: **4 of 4**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bridge area	SF	738	90.00	66,420			
Subtotal				66,420			
Markup (%) at 30.6%				20,325			
TOTAL				86,745			

VALUE ENGINEERING ALTERNATIVE

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

ALTERNATIVE NO.: **B-3**

DESCRIPTION: **USE MECHANICALLY STABILIZED EARTH WALL ABUTMENTS IN LIEU OF END SPANS**

SHEET NO.: **1 of 5**

ORIGINAL DESIGN: (sketch attached)

The original design calls for three 61 ft. 6 in. spans with concrete intermediate bents. The total length of the bridge is 184.5 ft.

ALTERNATIVE: (sketch attached)

Use Mechanically Stabilized Earth (MSE) wall abutments with a single span over the railroad. The total length of the single span bridge is 69.5 ft.

ADVANTAGES:

- Reduces construction time
- Less bridge to maintain

DISADVANTAGES:

- Wall/bridge interface maintenance

DISCUSSION:

The railroad is in a tangent section at the bridge location, so there are no problems with sight distance. Constructing MSE abutments and a single span bridge will be quicker and less expensive than constructing a three-span bridge.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	$ 1,848,787	—	$ 1,848,787
ALTERNATIVE	$ 1,383,118	—	$ 1,383,118
SAVINGS	$ 465,669	—	$ 465,669

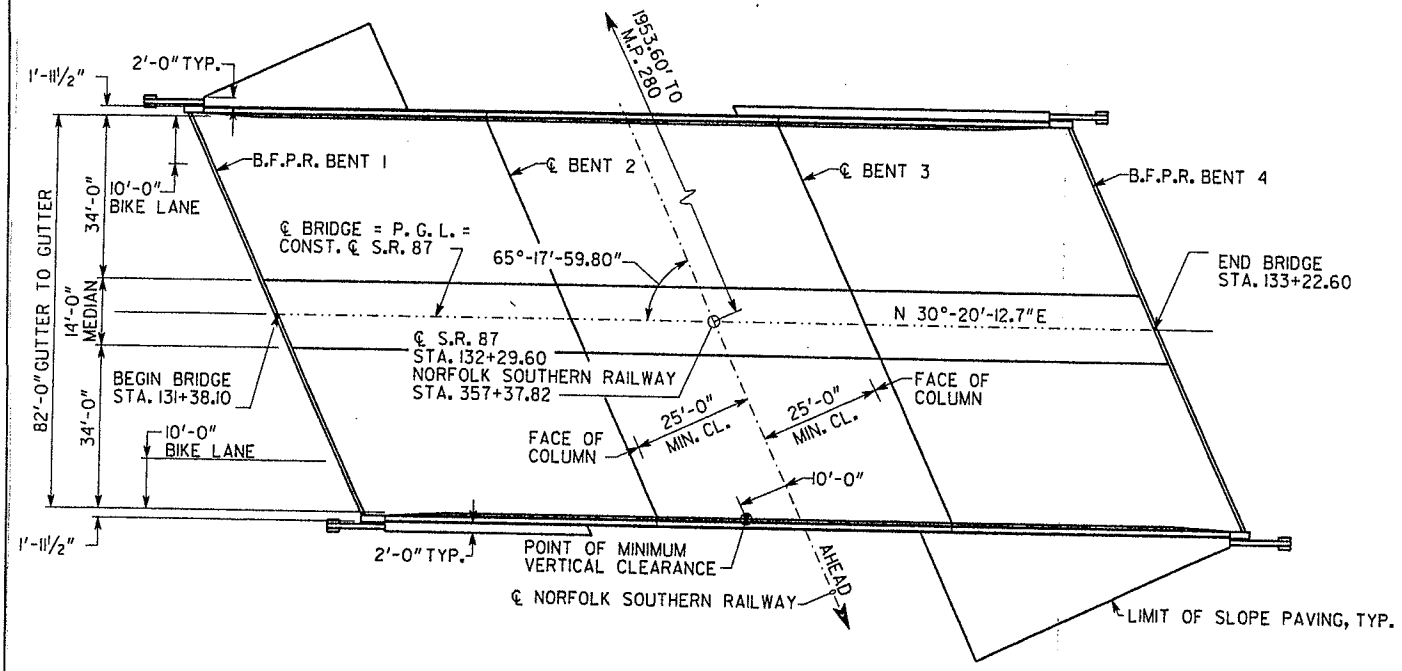
SKETCH

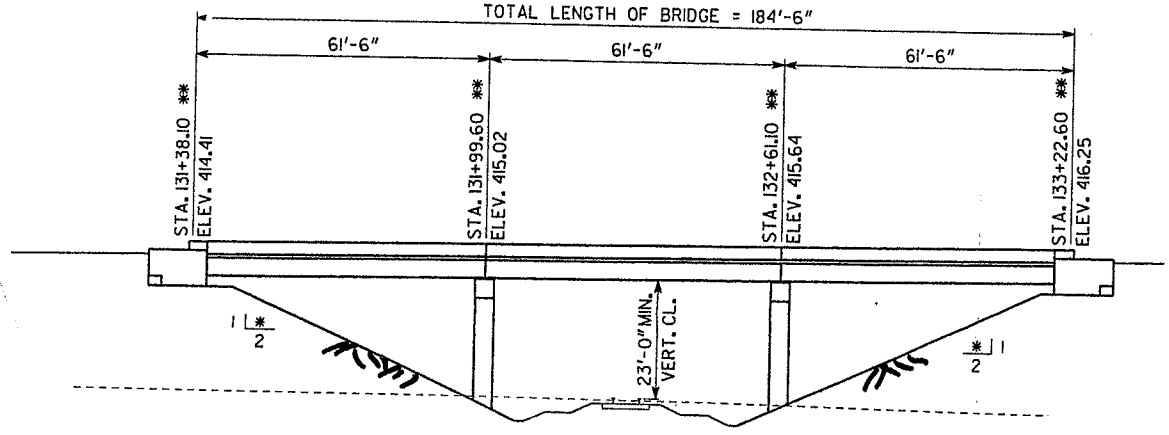
PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: B-3

ORIGINAL DESIGN ☒ ALTERNATIVE DESIGN ☐ BOTH ☐

SHEET NO.: 2 of 5





3-SPAN BRIDGE

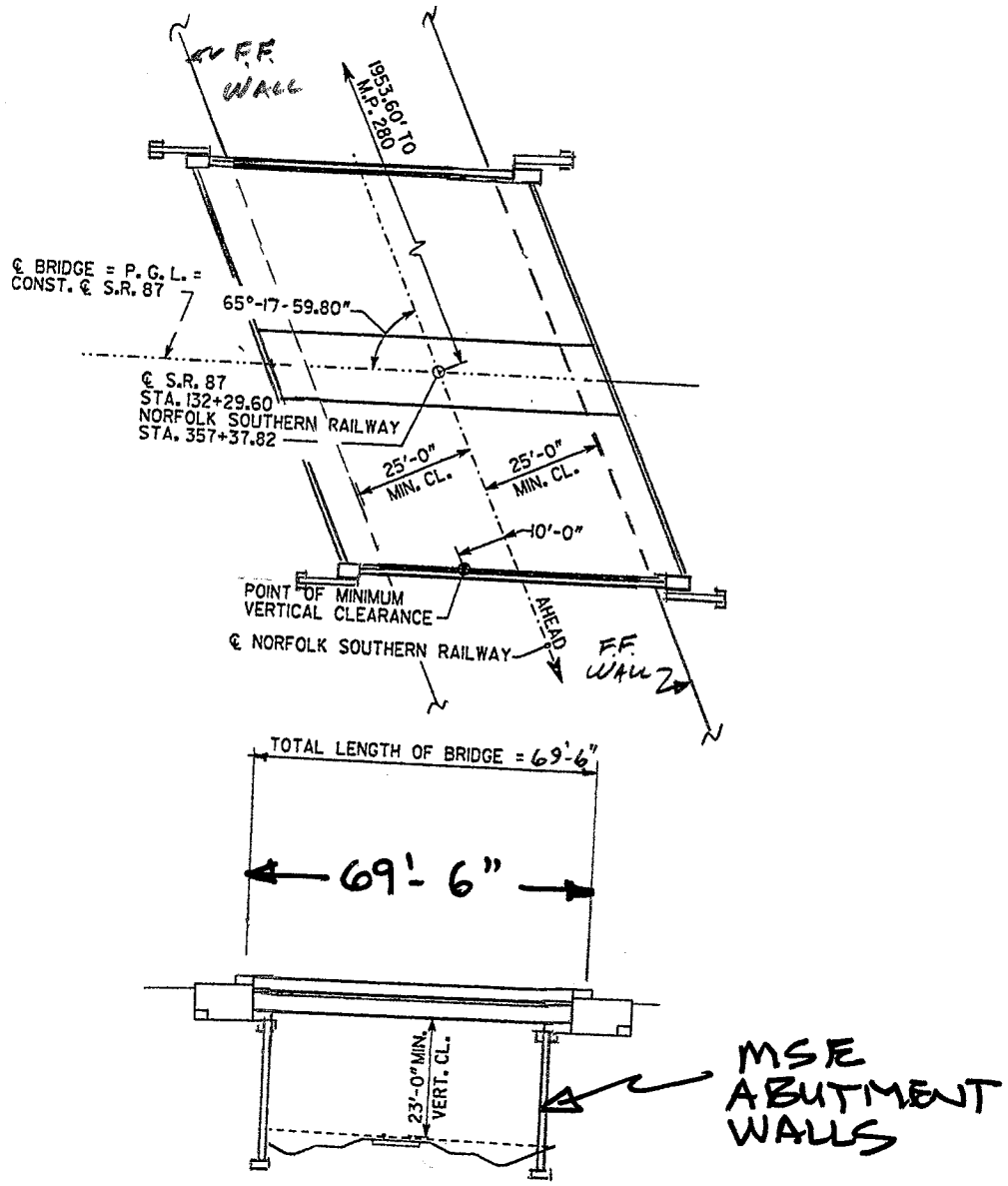
SKETCH

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: B-3

ORIGINAL DESIGN ☐ ALTERNATIVE DESIGN ☒ BOTH ☐

SHEET NO.: 3 of 5



PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **B-3**

SHEET NO.: **4 of 5**

Original Design:

Bridge area should be 85.25(184.5) = 15,729 SF

Alternative Design:

FF Wall Stations:
Bent 1: 13229.6 – 25/(sin α) = 132+02.08 Use 132+02
Bent 2: 13229.6 + 25/(sin α) = 132+57.10 Use 132+57.5

Bridge Stations
Bent 1: 13202 - 6/(sin α) = 131+95.40 Use 131+95
Bent 2: 13257.5 + 6/(sin α) = 132+64.10 Use 132+64.5

Bridge length = 13264.5 – 13195 = 69 ft. 6 in.

Bridge area = 85.25(69.5) = 5,925 SF

Wall height = 26 ft. under bridge
Wall length = [88.33/(sin α)] + 2(10) + [2(26)(2)/(sin α)] = 231.7 ft. or 232 ft.

Wall area = 97.22(26) + (232-97.22)(26)(.5) = 4,280 SF per wall = 8,560 SF

Additional pavement = 82(184.5 – 69.5)/9 = 1,048 SY

SY Full-Depth Pavement Cost:

135#/SY 9.5 mm Superpave:	(135/2,000)($63.70/TN)	= $4.30
220#/SY 19 mm Superpave:	(220/2,000)($69.50/TN)	= 7.65
880#/SY 25 mm Superpave:	(880/2,000)($65.32/TN)	= 28.74
12 in. GAB Base Coarse:	[9(1)(150)/2,000]($17.46/TN)	= 11.79
	Total:	**$52.48/SY**

COST WORKSHEET

PROJECT: **SR 87/COCHRAN BYPASS FROM US23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia - Preliminary Engineering Submittal

ALTERNATIVE NO.: **B-3**

SHEET NO.: **5 of 5**

PROJECT ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bridge area	SF	15,729	90.00	1,415,610	5,925	90.00	533,250
Wall area	SF				8,560	55.00	470,800
Full-depth pavement	SY				1,048	52.48	54,999
Subtotal				1,415,610			1,059,049
Markup (%) at 30.6%				433,177			324,069
TOTAL				1,848,787			1,383,118

PROJECT DESCRIPTION

Project Need and Purpose

The project is needed to satisfactorily accommodate the existing and future traffic demands and to correct the operational deficiencies which currently exist within the project corridor.

The purpose of the project is to solve the inconsistent lane continuity problem which could create a "bottleneck" if the proposed improvements are not completed thereby creating hazardous driving conditions. Widening the existing bypass will also improve the level of service (LOS) on the Cochran Bypass.

Project Description

State Route 87/Cochran Bypass is classified as a rural minor arterial from SR 87/US 23 Business to SR 87/US 23 Business. State Route 87/US 23, also known as Cochran Bypass, was constructed in the 1980's to divert truck and other traffic in the downtown Cochran area.

This project widens and reconstructs the Cochran Bypass (SR 87) from MP 4.30 just South of the SR 87 Business intersection on the south side of Cochran, extending to MP 8.30 just North of the SR 87 Business intersection on the north side of Cochran, for a total of 4.0 miles. The existing roadway consists of two, 12ft wide lanes with 8ft wide rural shoulders on 130ft of existing right-of way. The existing bypass corridor has been experiencing growth in development in recent years. The base year traffic (2012) is 10,500 VPD and the design year traffic (2032) is 16,250 VPD. With the projected increase in traffic and continued development within the corridor, the existing two lanes will be insufficient to accommodate the transportation demands.

The proposed construction will add two lanes and a 14-ft.-wide flush median to the existing alignment, thus creating a multilane bypass. The typical section will consist of two, 12-ft.-wide lanes in each direction separated by a 14 ft. flush median with 10 ft. rural shoulders (6.5 ft. paved to accommodate bicycle lanes) on 150 ft. of right-of-way. This project will provide a grade separated crossing over the Norfolk Southern Railroad. Improvements are proposed at the SR 126 intersection. The east leg will form a "T" and the west leg will be modified into a cul-de-sac. All construction will be done under traffic except for an on-site detour at the Norfolk Southern Railroad crossing to construct the proposed overpass bridge.

This project will connect the five-lane section being constructed under project MLP-87(43) south of Cochran to the existing four-lane section north of Cochran.

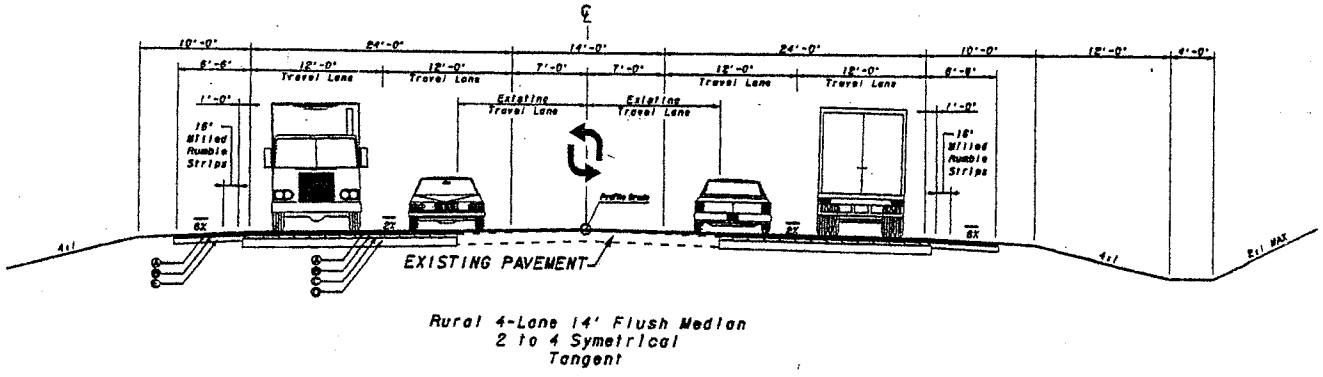
Key elements of the project include:

- Typical section: two 12-ft.-wide lanes in each direction separated by a 14 ft. flush median with 10-ft.-wide rural shoulders with 6.5 ft. being paved to accommodate bicycle lanes
- Design speed mainline: 45 mph/55 mph
- Maximum grade mainline: 5%

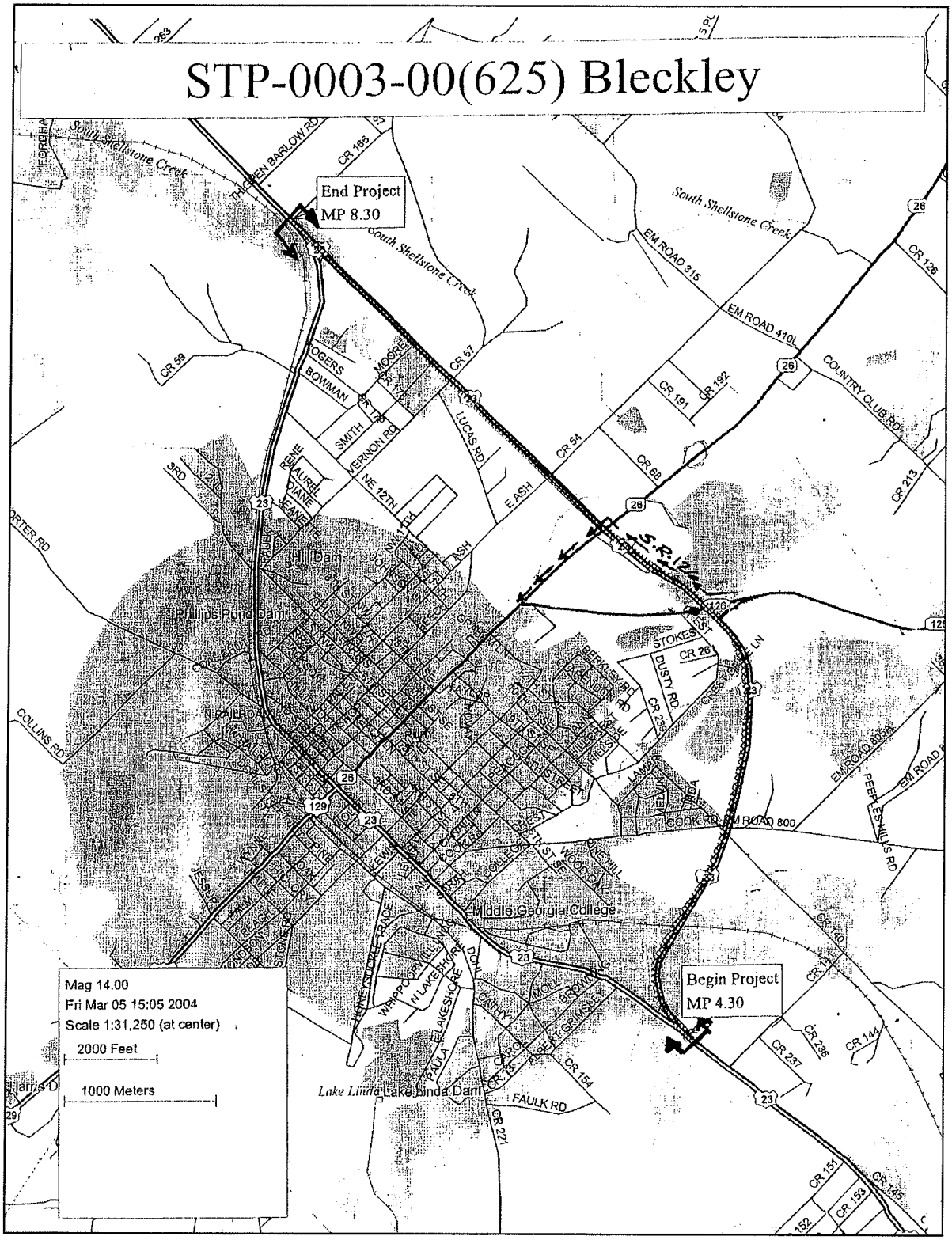
- Maximum allowable mainline: 5%
- Maximum grade side street: 5%
- Maximum grade allowable on side streets: 7%
- Maximum grade driveway: 15%
- Maximum degree of curve: 4 degrees
- Maximum degree allowable: 6 degrees
- Right-of-way: 150 ft.
- Number of parcels involved: 50
- Structures: Bridge over Norfolk Southern Railroad
- Major intersections and interchanges: SR 126 and SR 26
- Traffic control during construction: All construction will be done under traffic except for an on-site detour at the Norfolk Southern Railroad crossing in order to construct the proposed overpass bridge. A temporary railroad crossing will also have to be constructed at this location in order to facilitate traffic during construction.
- Design variances: A design variance will be required for the flush median in the areas with 55mph design speed.

The total cost of the construction is $20.2 million, plus an additional $1.2 million for right-of-way.

A typical section and vicinity map of the area follows.



Typical Section



Vicinity Map

VALUE ANALYSIS AND CONCLUSIONS

GENERAL

This section describes the value analysis (VA) procedure used during the VE study conducted for GDOT by Lewis & Zimmerman Associates, Inc., on the STP00-0003-00(625), P.I. No. 0003625, State Route 87/Cochran Bypass from US 23 Business to the Existing 4 Lane Section project, in Bleckley County. The workshop was performed at the preliminary design completion stage. GDOT District 2 is developing the project and has provided information for the VE team to use as the basis of the study.

A systematic approach was used in the VE study, which was divided into three parts: (1) Preparation Effort, (2) Workshop Effort, and (3) Post-Workshop Effort. A task flow diagram outlining each of the procedures included in the VE study is attached for reference.

Following this description of the VA procedure, separate narratives and supporting documentation identify the following:

- VE workshop participants
- Economic data
- Cost model
- Function analysis
- Creative ideas and evaluations

PREPARATION EFFORT

Preparation for the workshop consisted of scheduling workshop participants and tasks and gathering necessary project documents for team members to review before attending the workshop. Documents such as those listed below were used as the basis for generating VE alternatives and for determining the cost implications of the selected VE alternatives:

- STP00-0003-00(625), P.I. No. 0003625, State Route 87/Cochran Bypass from US 23 Business to the Existing 4 Lane Section project in Bleckley County, Preliminary Design Drawings, dated September 28, 2009, prepared by GDOT District 2
- Project Concept Report, STP00-0003-00(625), P.I. No. 0003625, State Route 87/Cochran Bypass from US 23 Business to the Existing 4 Lane Section project in Bleckley County, prepared by GDOT District 2, dated August 11, 2004
- Estimate Report for file "0003625 (STP00-0003-00(625)," prepared by GDOT District 2, dated September 10, 2009
- Updated Preliminary Right of Way Cost Estimate, dated May 6, 2009, prepared by GDOT

Information relating to the project's purpose and need, owner concerns, project stakeholder concerns, design criteria, project constraints, funding sources and availability, regulatory agency approval requirements, and the project's schedule and costs is very important as it provides the VE team with insight about how the project has progressed to its current state.

Value Engineering Study Task Flow Diagram

Preparation Effort

Coordination Project
- Verify Schedule
- Suggest Format for Designer Presentation
- Outline Project Responsibilities
- Outline Needed Background Data
- Define *Project Value Objectives*
- Identify Project Constraints

→

Prepare for Workshop
- Collect Project Data
- Distribute Data to Team Members
- Team Members Become Familiar with Project

→

Construct Cost Models
- Construct Cost Models
- Construct Graphic Function Analysis
- Outline High Cost Areas

→

LCC Model
- Roadway
- Bridges
- MOT
- Energy
- User Impact

Workshop Effort

Information Phase
- Introduction by VETL
- Project Description and Presentation by Designer
- Outline Owner Requirements
- Review Project Data
- Visit Project Site (Alt.)

→

Function Identification and Analysis Phase
- Analyze Project Costs and Energy Usage
- Perform Function Analysis and FAST Diagram
- Identify High Cost and Energy Areas
- Calculate Cost/Worth Ratios
- Identify Paradigms

List Ideas Generated During Function Analysis

→

Speculation Phase
- Introduction by VETL
- Creative Idea Listing:
  - Quantity of ideas
  - Association of Ideas
- Brainstorm
- Do Creative Thinking
  - Group Thinking
  - Individual Thinking
- Use Checklist for Ideas

→

Evaluation Phase
- Eliminate Impractical Ideas
- Rank Ideas with Advantages/ Disadvantages
- Evaluate Alternatives (Include Non-Economic considerations: Safety, Reliability, Environment, Aesthetics, O&M, etc.)
- Select Best Ideas for Implementation

→

Development Phase
- Develop Proposed Alternatives
- Prepare Alternative Design Sketches
- Estimate Costs
- Perform Life Cycle Comparison
  - Initial Cost
  - Redesign Cost
  - O&M Cost
  - LCC Cost

→

Presentation Phase
- Summarize Findings
- Present VE Ideas to Owner/ User/Designer
- Oral Presentation

Post-Workshop Effort

VE Study Report
- Develop Implementation VE Report
- Designer Prepares Responses to VE Report
- Owner Evaluates Recommendations

→

Implementation Phase
- Participate in Implementation Meeting with Owner/User/ Designer/ VE Team, as needed
- Prepare Final VE Report

→

Final Acceptance
- Redesign by Designer

Project cost information provided by the designers is used by the VE team as the basis for a comparative analysis with similar projects. To prepare for this exercise, the VE team leader used the Estimate Report for file "0003625 (STP00-0003-00(625)", prepared by GDOT, dated September 10, 2009 to develop a cost model for the project. The model was used to distribute the total project cost among the various elements of the project. The VE team used this model to identify the high-cost elements that drive the project and the elements providing little or no value so that the team could focus on reducing or eliminating their impact.

VALUE ENGINEERING WORKSHOP EFFORT

The VE workshop was a three-and-one-half-day effort beginning with an orientation/kickoff meeting on Tuesday, November 17, 2009, and concluding with the final VE Presentation on Friday, November 20, 2009. During the workshop, the VE Job Plan was followed in compliance with the U.S. Federal Highway Administration guidelines for conducting a VE study. The Job Plan guided the search for alternatives to mitigate or eliminate high-cost drivers, secondary functions providing little or no value, and potential project risks. Alternatives were also considered to specifically address the owner's project concerns and enhance value by improving operations, reducing maintenance requirements, enhancing constructability, and providing missing functions. The Job Plan includes six phases:

- Information Phase
- Function Identification and Analysis Phase
- Creative/Speculation Phase
- Evaluation of Creative Ideas Phase
- Alternative Development Phase
- Presentation Phase

Information Phase

At the beginning of the study, the decisions that have influenced the project's design and proposed construction methods had to be reviewed and understood. For this reason, the workshop began with a presentation of the project by GDOT District 2 to the VE team. The presentation highlighted the information provided in the documentation reviewed by the VE team before the workshop and expanded on it to include a history of the project's development and any underlying influences that caused the design to develop to its current state. During this presentation, VE team members were given the opportunity to ask questions and obtain clarification about the information provided.

Function Identification and Analysis Phase

Having gained some information on the project, the VE team proceeded to define the functions provided by the project, identifying the costs to provide these functions and determining whether the value provided by the functions has been optimized. 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. Elements performing support functions add cost to the project but have a relatively low worth to the basic function. Others may be underfunded, requiring additional investment to meet the needed functional requirements.

Function is defined as the intended use of a physical or process element. The team attempted to identify functions in the simplest manner using measurable noun/verb word combinations. To accomplish this, the team first looked at the project in its entirety and randomly listed its functions, which were recorded on Random Function Analysis Worksheets (provided in this section). Then the individual function(s) of the major components of the project depicted on the cost models were identified.

After identifying the functions, the team classified the functions according to the following:

Abbreviation	Type of Function	Definition
HO	Higher Order	The primary reason the project is being considered or project goal.
B	Basic	A function that must occur for the project to meet its higher order functions.
S	Secondary	A function that occurs because of the concept or process selected and that may or may not be necessary.
R/S	Required Secondary	A secondary function that may not be necessary to perform the basic function but must be included to satisfy other requirements or the project cannot proceed.
G	Goal	Secondary goal of the project.
O	Objective	Criteria to be met
LO	Lower Order	A function that serves as a project input.

Higher order and basic functions provide value, while secondary functions tend to reduce value. The goal of the next job phase is to reduce the impact of secondary functions and thereby enhance project value.

To further clarify the impact of the various functions, the team assigned costs to the functions or group of functions indicated by a specific project element using the cost estimate and cost models. Where possible, they seek to find the lowest cost, or worth, to perform the function. This is accomplished using published data from other sources or team knowledge obtained from working on other, similar projects to establish cost goals and then comparing them to the current costs. By identifying the cost and worth of a function or group of functions, cost/worth ratios were calculated. Cost/worth ratios greater than 1 indicated that less than optimum value was being provided. Those project functions or elements with high cost/worth ratios became prime targets for value improvement.

As well as looking at areas with high cost/worth ratios, the team used the cost models previously prepared to seek out the areas where most of the project funds are being applied. Because of the absolute magnitude of these high-cost elements or functions, they also became initial targets for value enhancement.

Overall, these exercises stimulated the VE team members to focus on apparently low-value areas and initially channel their creative idea development in these places.

Creative/Speculation Phase

This VE study phase involved the creation and listing of ideas. Starting with the functions or project elements with high cost/worth ratios, a high absolute cost compared to other elements in the project, and secondary functions providing little or no value and using the classic brainstorming technique, the VE

team began to generate as many ideas as possible to provide the necessary functions at a lower total life cycle cost, or to improve the quality of the project. Ideas for improving operation and maintenance, reducing project risk, and simplifying constructability were also encouraged. At this stage of the process, the VE team was looking for a large quantity of ideas and free association of ideas. A Creative Idea Listing worksheet was generated and organized by the function or project element being addressed.

GDOT may wish to review these creative lists since they may contain ideas that were not pursued by the VE team but can be further evaluated for potential use in the design.

Evaluation Phase

Since the goal of the Creative/Speculation Phase was to conceive as many ideas as possible without regard for technical merit or applicability to the project goals, the Evaluation Phase focused on identifying those ideas that do respond to the project value objectives and are worthy of additional research and development before being presented to the owner. The selection process consisted of the VE team evaluating the ideas originated during the Creative/Speculation Phase based on GDOT's value objectives identified through conversations during the opening presentation. Based on the team's understanding of the owner's value objectives, each idea was compared with the present design concept, and the advantages and disadvantages of each idea were discussed. How well an idea met the design criteria was also reviewed.

Based on the results of these reviews, the VE team rated the idea by consensus using a scale of 1 to 5, with 5 or 4 indicating an idea with the greatest potential to be technically sound and provide cost savings or improvements in other areas of the project, 3 indicating an idea that provides marginal value but could be used if the project was having budget problems, 2 indicating an idea with a major technical flaw, and 1 indicating an idea that does not respond to project requirements. Generally, ideas rated 4 and 5 are pursued in the next phase and presented to the owner during the Presentation Phase.

The team also used the designation "DS" to indicate a design suggestion, which is an idea that may not have specific quantifiable cost savings but may reduce project risk, improve constructability, help to minimize claims, enhance operability, ease maintenance, reduce schedule time, or enhance project value in other ways. Design suggestions could also increase a project's cost but provide value in areas not currently addressed. These are also developed in the next phase of the VE process.

Development Phase

In this phase, each highly rated idea was expanded into a workable solution designated as a VE alternative. The VE alternative consisted of describing the current design and the alternative solution, preparing a life cycle cost comparison where applicable, describing the advantages and disadvantages of the proposed alternative solution, and writing a brief narrative to compare the original design to the proposed change and provide a rationale for implementing the idea into the design. Sketches and design calculations, where appropriate, were also prepared in this part of the study. The VE alternatives are included in the Study Results section of this report.

Design suggestions include the same information as the alternatives except that no cost analysis is performed. They too are included in Section Two.

Presentation Phase

The goals of the last phase of the workshop were to summarize the results of the study, to prepare draft Summary of Potential Cost Savings worksheets to hand out at the presentation, and to present the key VE alternatives to GDOT. The presentation was held on Friday, November 20, 2009, at the GDOT Headquarters office in Atlanta, Georgia and District 2 design staff participated by video conferencing. The purpose of the meeting was to provide the attendees with an overview of the suggestions for value enhancement resulting from the VE study and afford them the opportunity to ask questions to clarify specific aspects of the alternatives presented. Procedures for implementing the results of the study were discussed, and arrangements were made for the reviewers of the VE report to contact the VE team in order to obtain further clarifications, if necessary. Draft copies of the Summary of Potential Cost Savings worksheets were given to the owner and design team to facilitate a timely review and speedy implementation of the selected ideas.

POST-WORKSHOP EFFORT

The post-workshop portion of the VE study consisted of the preparation of this VE Study Report. Personnel from GDOT will analyze each alternative and prepare a response, recommending incorporation of the alternative into the project, offering modifications before implementation, or presenting reasons for rejection. LZA is available at GDOT's convenience as it reviews the alternatives. Please do not hesitate to call on LZA for clarification or further information as you consider an implementation approach.

Upon completing its reviews, GDOT will decide which alternatives to implement.

VALUE ENGINEERING WORKSHOP PARTICIPANTS

The VE team was organized to provide specific expertise in the unique project elements involved with the State Route 87/Cochran Bypass from US 23 Business to the Existing 4 Lane Section project. The multidisciplinary team comprised professionals with highway design and construction experience and a working knowledge of VE procedures. The following lists the VE team members:

Participant	Specialization	Affiliation
Joe Leoni, PE	Highway Design	ARCADIS US, Inc.
John Tiernan, PE	Bridge Engineer	ARCADIS US, Inc.
Paresh J. Parikh	Constructability	Delon Hampton Associates
David Hamilton, PE, CVS, CCE	VE Team Leader/Civil	Lewis & Zimmerman Associates

DESIGNER'S PRESENTATION

An overview of the project was presented by video conference on Tuesday, November 17, 2009, by GDOT District 2 representatives. The purpose of this meeting, in addition to being an integral part of the Information Phase of the VE study, was to bring the VE team up to speed regarding the overall project specifics. Additionally, the meeting afforded the owner and design team the opportunity to highlight in greater detail those areas of the project requiring additional or special attention. An attendance list for the meeting is attached.

VALUE ENGINEERING TEAM'S PRESENTATION

A VE presentation was conducted by the VE team on Friday, November 20, 2009 at the GDOT Headquarters office in Atlanta, Georgia to review VE alternatives with the owner and representatives from the design team. Copies of the Draft Summary of Potential Cost Savings worksheet were provided to the attendees. The District 2 design team attended via video conferencing. Attendees checked off their names on the attendance list from the opening presentation.

VE STUDY SIGN-IN SHEET

Project No.: STP00-0003-00(625) **County: Bleckley** **PI Nos.: 0003625** **Date: November 17 - 20, 2009**

In-Briefing 11/17/09	Out-Briefing 11/20/09	NAME	EMPLOYEE ID NO.	DOT OFFICE OR COMPANY	PHONE NUMBER	EMAIL ADDRESS
√	√	Lisa L. Myers	00244168	Engineering Services	404-631-1770	lmyers@dot.ga.gov
√	√	Matt Sanders	00284154	Engineering Services	404-631-1752	msanders@dot.ga.gov
	√	Ron Wishon	00208180	Engineering Services	404-631-1753	rwishon@dot.ga.gov
√	√	Joe Leoni		ARCADIS-US	770-431-8666	joe.leoni@arcadis-us.com
√	√	David Hamilton		Lewis & Zimmerman	253-229-7703	dahamilton@lza.com
√	√	John P. Tiernan		ARCADIS-US	770-431-8666	john.tiernan@arcadis-us.com
√	√	Parish Parikh		Delon Hampton	404-419-8434	pparikh@delonhampton.com
√		Nabil Raad	00729514	Traffic Operations	404-635-8126	nraad@dot.ga.gov
√		Joe King	00343482	Bridge Design	404-631-1913	joking@dot.ga.gov
√		Foster Grimes	00330697	District 2 Design	478-552-4643	fgrimes@dot.ga.gov
√	√	Matthew Sammons	00880324	District 2 Design	478-553-2275	msammons@dot.ga.gov
√	√	Renee' Decker	00244888	District 2 Design	478-552-4659	ddecker@dot.ga.gov
√		Daniel P. Smith	00307152	Area 7 Construction	478-275-2756	dasmith@dot.ga.gov
√		George Brewer	00279100	District 2 Preconstruction	478-552-4629	gbrewer@dot.ga.gov
	√	Judy Meisner	00326591	Bridge Design	404-631-1899	jmeisner@dot.ga.gov

√ Check all days that apply

13 Total Attended In-Brief (Day 1)

5 District #2 Attended In-Brief (Day 1)

10 Total Attended Out-Brief (Day 4)

2 District #2 Attended Out-Brief (Day 4)

ECONOMIC DATA

The comparisons of life cycle costs between the VE alternatives and the current design solutions were performed on the basis of discounted present worth. To accomplish this, the VE team developed economic criteria to use in its calculations based on information gathered from GDOT and the design team. The following parameters were used when calculating discounted present worth:

Year of Analysis:	2009
Construction Start Date:	Unknown
Construction Completion Date:	Unknown
Planning Period (n):	30
Discount Rate (i):	3%

When computing capital costs, direct material, labor, and equipment costs are marked up using a composite markup of 30.6% that includes:

Engineering and inspection	5.0%
Total fuel adjustment	11.2%
Liquid AC adjustment	11.8%
Total compound markup	30.6%

When computing right-of-way costs, a multiplier of 248% times the raw right-of-way cost is used to account for the following:

Net right-of-way cost	$494,128
Scheduling contingency @ 55%	$271,770
Administrative/court cost @ 60%	$459,539
Total right-of-way cost	$1,225,437

The following square foot cost was developed by the VE team for all pavement work based on the values provided in the cost estimate:

SY Full-Depth Pavement Cost:

135#/SY 9.5mm asphalt Superpave:	(135LBS/2,000LBS/TON) x ($63.70/TON) =	$4.30/SY
220#/SY 19mm asphalt Superpave:	(220LBS/2,000LBS/TON) x ($69.50/TON) =	7.65/SY
880#/SY 25mm asphalt Superpave:	(880lbs/2,000LBS/TON) x ($65.32/TON) =	28.74/SY

12 in. Graded Aggregate Base Coarse:

[(9SF/SY)(150LBS/CF)/2,000LBS/TON] x ($17.46/TON) = 11.79/SY

Total: $52.48/SY

COST MODEL

The VE team prepared a Pareto Chart, or Cost Histogram, for the project that follows this page. This Cost Histogram displays the major construction elements identified in the cost estimate prepared by the designer in descending order of magnitude and thus identifies the high cost areas in the project. The high cost elements provide the VE team with one focus for its work during the study.

For this particular project, the right-of-way cost at $1.23 million is relatively modest compared to the project's construction cost of approximately $14.9 million. However, the Roadway Borrow material at $3.5M became a focus for the VE team and creative ideas were explored to reduce the profile and resulting volume of import material. With respect to the overall construction costs, items such as lane and median width are key drivers in the project.

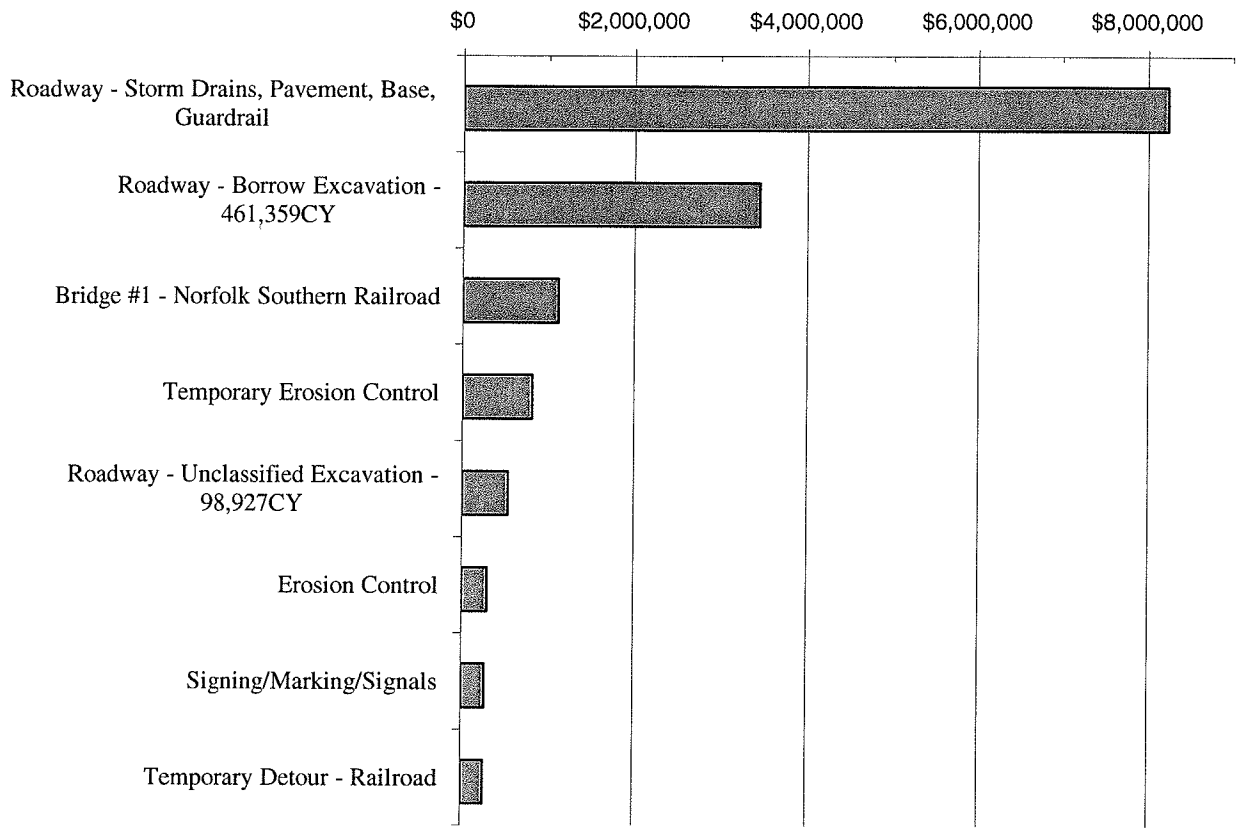
Cost/Worth Analysis

A cost/worth model was also prepared for this study to identify items which appeared at first glance to have more investment than required and also for items which may need additional investment. The "worth" was established by the VE team as a means to quickly identify areas of focus and initiate creative thought for new solutions. This is a subjective exercise that relies on the team members experience, judgment, and knowledge of highway design. Graphically, the worth is compared to the "cost" presented in the project cost estimate in the Cost/Worth ratios. Items with a Cost/Worth ratio greater than 1.0 represent areas of opportunity for value improvement, while ratios less than 1.0 may require additional investment or may be under-valued in the project cost estimate. The results of this exercise showed that the Roadway Borrow may offer some opportunity for value improvement, but the traffic signals and railroad crossings may need additional funding.

COST HISTOGRAM

PROJECT: **SR 87/COCHRAN BYPASS**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

TOTAL PROJECT		COST	PERCENT	CUM. PERCENT
Roadway - Storm Drains, Pavement, Base, Guardrail		8,233,727	55.03%	55.03%
Roadway - Borrow Excavation - 461,359CY		3,450,965	23.06%	78.09%
Bridge #1 - Norfolk Southern Railroad		1,116,000	7.46%	85.55%
Temporary Erosion Control		812,740	5.43%	90.98%
Roadway - Unclassified Excavation - 98,927CY		530,248	3.54%	94.52%
Erosion Control		293,843	1.96%	96.49%
Signing/Marking/Signals		268,490	1.79%	98.28%
Temporary Detour - Railroad		257,222	1.72%	100.00%
Construction Subtotal		***14,963,235***	100.00%	
Engineering and Construction Inspection	5.00%	748,162		
Total Fuel Adjustment	11.2%	1,765,469		
Total Liquid AC Adjustment	11.8%	2,062,594		
Right of Way (Not included in composite markup)		1,225,500		
Reimburseable Utilities		0		
TOTAL CONSTRUCTION & RIGHT OF WAY		**$ 20,764,959**	Comp Markup:	**30.6%**

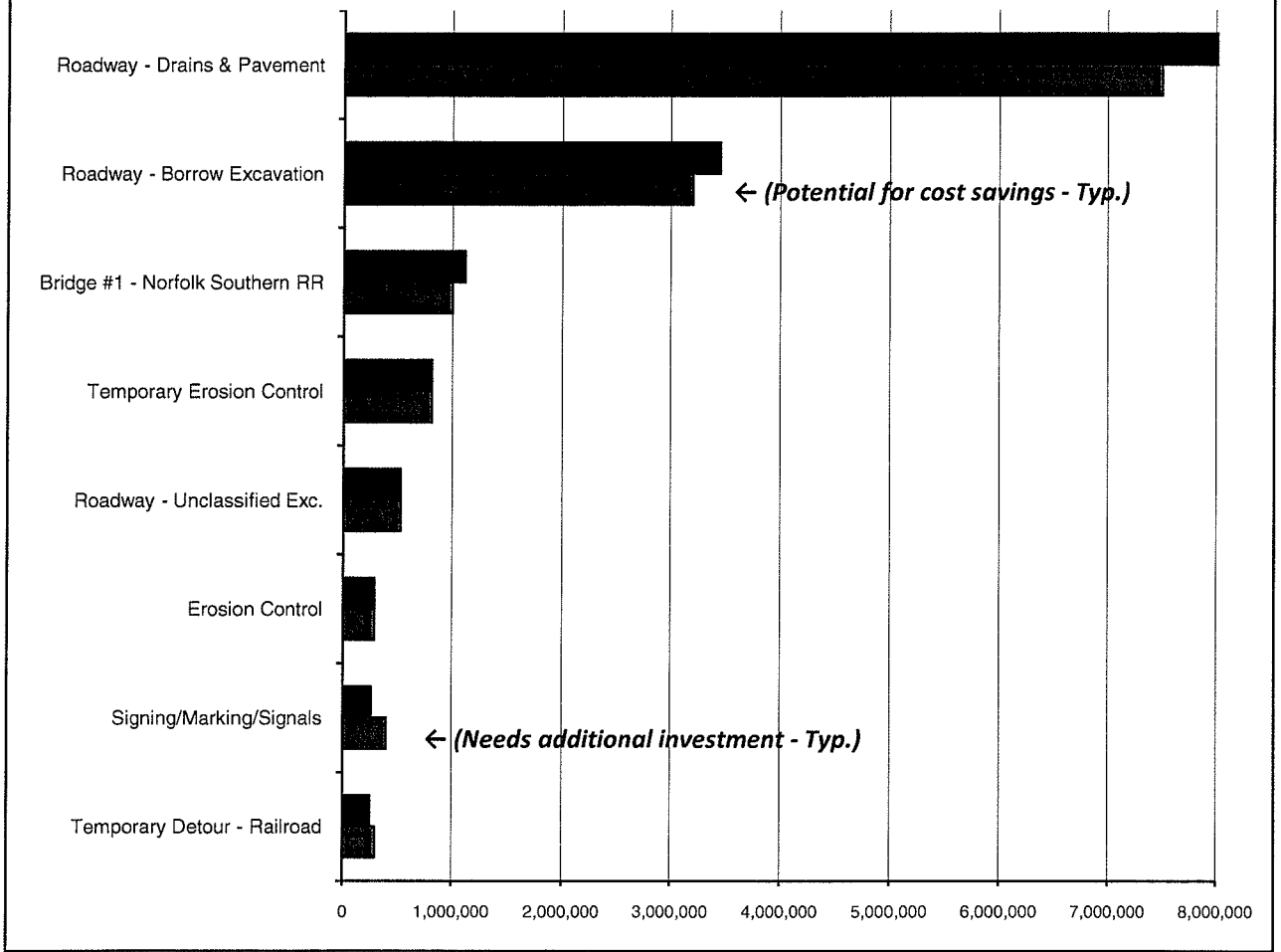


COST/WORTH ANALYSIS

PROJECT: SR 87/COCHRAN BYPASS
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

SIZE OF PROJECT: TOTAL

PROJECT ELEMENT	COST	PERCENT	CUM. PERCENT	COST PER UNIT	ESTIMATED WORTH	COST/WORTH RATIO
Roadway - Drains & Pavement	8,233,727	55.03%	55.03%	8,233,727	7,500,000	1.1
Roadway - Borrow Excavation	3,450,965	23.06%	78.09%	3,450,965	3,200,000	1.1
Bridge #1 - Norfolk Southern RR	1,116,000	7.46%	85.55%	1,116,000	1,000,000	1.1
Temporary Erosion Control	812,740	5.43%	90.98%	812,740	812,000	1.0
Roadway - Unclassified Exc.	530,248	3.54%	94.52%	530,248	530,000	1.0
Erosion Control	293,843	1.96%	96.49%	293,843	293,000	1.0
Signing/Marking/Signals	268,490	1.79%	98.28%	268,490	400,000	0.7
Temporary Detour - Railroad	257,222	1.72%	100.00%	257,222	300,000	0.9
Subtotal	**$ 14,963,235**	**100.00%**				
Engr. & Const. Inspec. 5.00%	748,162					
Total Fuel Adjustment 11.2%	1,765,469					
Liquid AC Adjustment 11.8%	2,062,594					
Right of Way LS	1,225,500					
Reimburseable Utilities	0					
TOTAL	**$ 20,764,959**				**Comp Mark-up:**	30.6%



Black = Cost/Unit; **Red** = Worth*/Unit

* Worth is as determined by the VE Team

Note: Costs in graph are marked-up.

FUNCTION ANALYSIS

A function analysis was performed to (1) understand the project purpose and need, (2) define the requirements for each project element, (3) ensure a complete and thorough understanding by the VE team of the basic function(s) needed to attain the given project purpose and need, (4) identify other public goals, and (5) identify secondary functions that should be addressed by the VE team. The Random Function Analysis worksheet completed by the team for the project in its entirety and the various elements follow.

RANDOM FUNCTION ANALYSIS

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION** SHEET NO.: **1 of 1**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

DESCRIPTION		FUNCTION		
		VERB	NOUN	KIND
PROJECT		Accommodate	Growth	HO
		Accommodate	Traffic	HO
		Increase	Capacity	HO
		Improve	Safety	HO
		Improve	LOS	HO
Pavement	$$$	Add	Lanes	B
		Support	Loads	B
		Smooth	Ride	B
Median	$$	Separate	Traffic	RS
		Control	Access	G
Bike Lanes		Accommodate	Bikes	RS
Signal	$	Control	Traffic	B
Right-of-Way Acquisition	$	Provide	Space	RS
Grading	$$$	Establish	Elevation	B
Drainage	$	Collect	Storm Water	RS
		Convey	Storm Water	RS
Bridge	$$	Span	Railroad	B
Park N' Ride		Park	Cars	RS
Embankment	$$	Separate	Modes	B
Project Goals		Protect	Environment	G
		Meet	Criteria	G
		Renew	Infrastructure	G
		Increase	Life	G

Function defined as: Action Verb, Measurable Noun

Kind: B = Basic, S = Secondary, RS = Required Secondary, HO = Higher Order, LO = Lower Order, G = Goal

CREATIVE IDEA LISTING AND EVALUATION OF IDEAS

During the Creative/Speculation Phase, numerous ideas were generated for the project using conventional brainstorming techniques. These ideas were recorded and are shown with their corresponding ranking on the attached Creative Idea Listing Worksheets. For the convenience of tracking an idea through the VA process, the ideas were grouped into the following project elements and numbered according to the order in which they were conceived. The following letter prefixes were used to identify the project elements.

PROJECT ELEMENT	PREFIX
Alignment	A
Profile	P
Section	S
Bridge	B
Miscellaneous	M

The ideas were ranked on a qualitative scale of 1 to 5 on how well the VE team believed the idea met the project purpose and need criteria. To assist the team in evaluating the creative ideas, the advantages and disadvantages of each new idea compared to the existing design solution were discussed based on the owner's value objectives for the project. The following are the top value objectives for this project:

- Enhance functionality
- Improve safety
- Maintain access during construction
- Reduce business impacts
- Reduce user impacts

After discussing each idea, the team evaluated the ideas by consensus. This produced 16 ideas rated 4 or 5 or design suggestions to research and develop into formal VE alternatives to be included in the Study Results section of the report. Highly rated ideas that were not developed further may have been combined with another related idea or discarded as a result of additional research indicating the concept as not being cost effective or technically feasible. GDOT is encouraged to review the Creative Idea Listing and Evaluation worksheet since it may suggest additional ideas that can be applied to the design.

CREATIVE IDEA LISTING

PROJECT:	**SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION** *STP00-0003-00(625), P.I. No. 0003625* ***Bleckley County, Georgia – Preliminary Engineering Submittal***	SHEET NO.:	**1 of 2**

NO.	IDEA DESCRIPTION	RATING
ALIGNMENT (A)		
A-1	Revise the US 23 intersection on the south end of the project.	4
A-2	Widen SR 87 to one side or the other in lieu of both.	2
A-3	Reduce the length of the cul-de-sac on SR 126.	3
A-4	Shorten the length of the improvements on SR 126 and realign SR 126.	4
A-5	Shorten the improvements at Daisy Adams.	3
A-6	Eliminate the right-turn lane at STA 240+00.	4
A-7	Include cost allowance for railroad "extras" at the detour crossing.	Drop
A-8	Move detour to another existing road in lieu of building a new road.	5
A-9	Add a temporary roundabout or a signal at the south end of the new detour/SR 23.	4
A-10	Eliminate the right turn lane at SR 87 and Cook Road.	4
PROFILE (P)		
P-1	Build a tunnel in lieu of a bridge.	1
P-2	Lower the railroad profile and add a bridge over the tracks for the highway.	Drop
P-3	Fine tune the profile on the embankment to use one vertical curve in lieu of two.	4
P-4	Use reinforced earth embankment with 1:1 slopes near the railroad.	4
SECTION (S)		
S-1	Use 4-ft.-wide paved shoulders in lieu of 6.5 ft.	5
S-2	Use all 11-ft.- wide lanes in lieu of 12 ft.	2
S-3	Use 11-ft.-wide inside lanes in lieu of 12 ft.	4
S-4	Use 11-ft.-wide outside lanes in lieu of 12 ft.	3
S-5	Reduce the pavement section on the Park n' Ride lot.	5
S-6	Reduce the width of all side roads from 12 ft. to 11 ft.	4
S-7	Reduce the embankment median from 14 ft. to 4 ft.	5
S-8	Use MSE walls.	2

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

CREATIVE IDEA LISTING

PROJECT: **SR 87/COCHRAN BYPASS FROM US 23 BUSINESS TO EXISTING 4 LANE SECTION**
STP00-0003-00(625), P.I. No. 0003625
Bleckley County, Georgia – Preliminary Engineering Submittal

SHEET NO.: **2 of 2**

NO.	IDEA DESCRIPTION	RATING
SECTION (S) (cont.)		
S-9	Reduce the paved shoulder section from 7¼ in. of asphalt to a mix of A/C and GAB.	5
BRIDGE (B)		
B-1	Use 8ft shoulders in lieu of 10ft wide.	4
B-2	Reduce the median on the bridge from 14ft to 4ft.	See S-7
B-3	Use MSE walls in lieu of end spans.	5
B-4	Use Type II precast beams in lieu of Type III and lower the profile slightly.	2
B-5	Use Conspan type bridge in lieu of precast concrete.	2
B-6	Consider an all precast bridge.	2
B-7	Use steel beams in lieu of precast concrete.	1
B-8	Update the bridge cost and use current bridge dimensions.	DS
MISCELLANEOUS (M)		
M-1	Increase price on traffic signals from $47K to $95K.	DS
M-2	Re-route the total bypass to a new corridor.	Drop
M-3	Review and revise the pavement quantities.	DS

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