VALUE ENGINEERING STUDY

OF

KY 313 EXTENSION

KY 1500 TO US 60

ITEM NUMBER: 4-297.21
ITEM NUMBER: 4-297.23
ITEM NUMBER: 4-297.27

Hardin & Meade Counties, Kentucky

February 11-15, 2008

Prepared by:

VE GROUP, L.L.C.

In Association With:

KENTUCKY TRANSPORTATION CABINET

VALUE ENGINEERING STUDY
TEAM LEADER

THOMAS A. HARTLEY, P.E., C.V.S.
C.V.S. Registration No. 20010901

DATE

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I. EXECUTIVE SUMMARY

INTRODUCTION

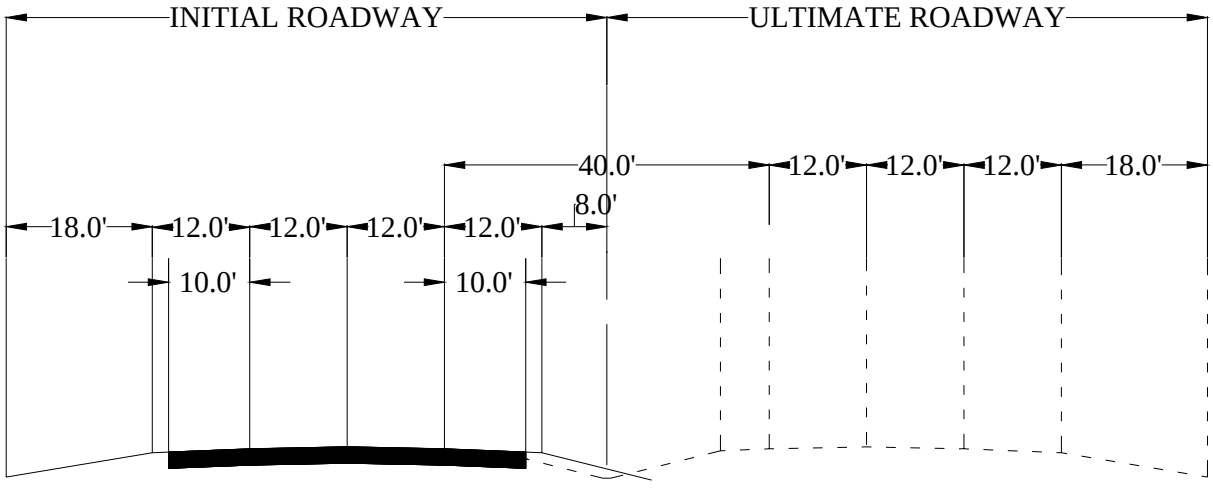
This Value Engineering report summarizes the results of the Value Engineering Study performed by VE Group for the Kentucky Transportation Cabinet. The study was performed during the week of February 11 – 15, 2008.

The subject of the study was the extension of SR 313 from west of Radcliff, KY to US 60 on a new alignment.

PROJECT DESCRIPTION

There are 3-construction sections within the limits of this study, for a total of approximately 8 miles of new roadway. The roadway will be on new alignment, with an ultimate 4-lane divided highway and depressed median typical. This new alignment crosses a Karst area with numerous sinkholes and will require special attention for the construction the roadway.

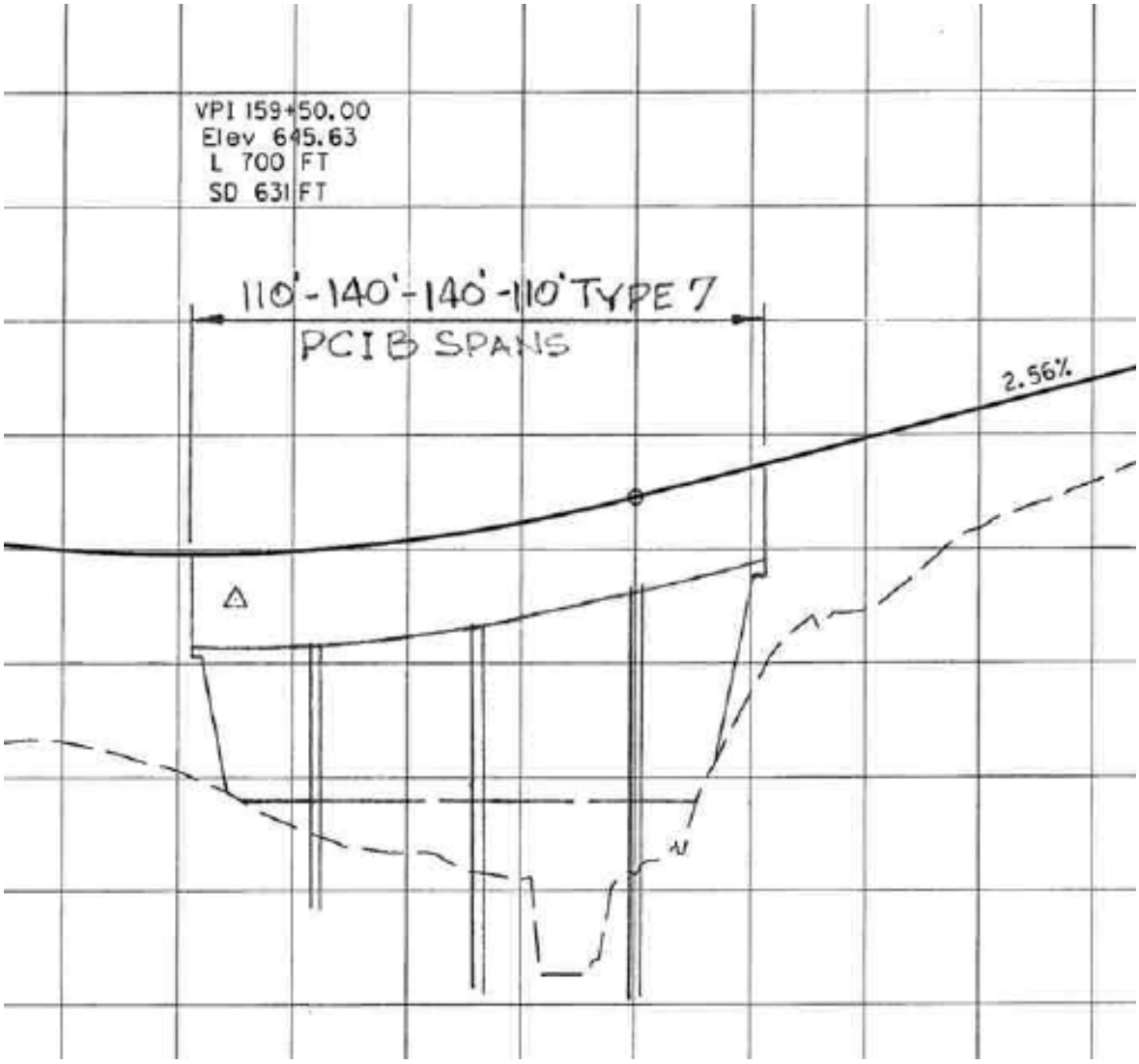
The initial design is a 2-lane – 2-way roadway that will be constructed first and the other 2-lanes will be constructed at a later date to meet future traffic demands. In addition to the roadway a 500’ +/- 4-span Type “7” PCI Beam bridge (110’, 140’, 140’, 110’) will be constructed to cross Otter Creek and its flood plane in Section 1 of the project.



AP PROPOSED TYPICAL

I. EXECUTIVE SUMMARY

PROJECT DESCRIPTION



AS PROPOSED BRIDGE OVER OTTER CREEK & FLOOD PLAIN

I. EXECUTIVE SUMMARY

METHODOLOGY

The Value Engineering Team followed the basic Value Engineering procedure for conducting this type of analysis.

This process included the following phases:

1. Investigation
2. Speculation
3. Evaluation
4. Development
5. Presentation
6. Report Preparation

Evaluation criteria identified as a basis for the comparison of alternatives included the following:

- Traffic Control
- Construction Time
- Service Life
- Future Maintenance Cost
- Construction Cost
- Utility Impacts

I. EXECUTIVE SUMMARY

RESULTS – AREAS OF FOCUS

The following areas of focus were analyzed by the Value Engineering team and from these areas the following Value Engineering alternatives were developed and are recommended for Implementation:

Recommendation Number1:

The Value Engineering Team recommends that Value Engineering Alternative be implemented. This alternative proposes to construct 12' shoulder with 5' paved and 7' grassed

If this recommendation can be implemented, there is a possible savings of ***$ 530,509.***

Recommendation Number 2:

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative purposes to use "Geo-Grid" reinforcement in the pavement base.

If this recommendation can be implemented, there is a possible savings of ***$ 178,370.***

Recommendation Number 3:

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative proposes to construct a 4-span Type "7" PCI Beam bridge over Otter Creek (80', 120', 120', 80' spans) with vertical abutments.

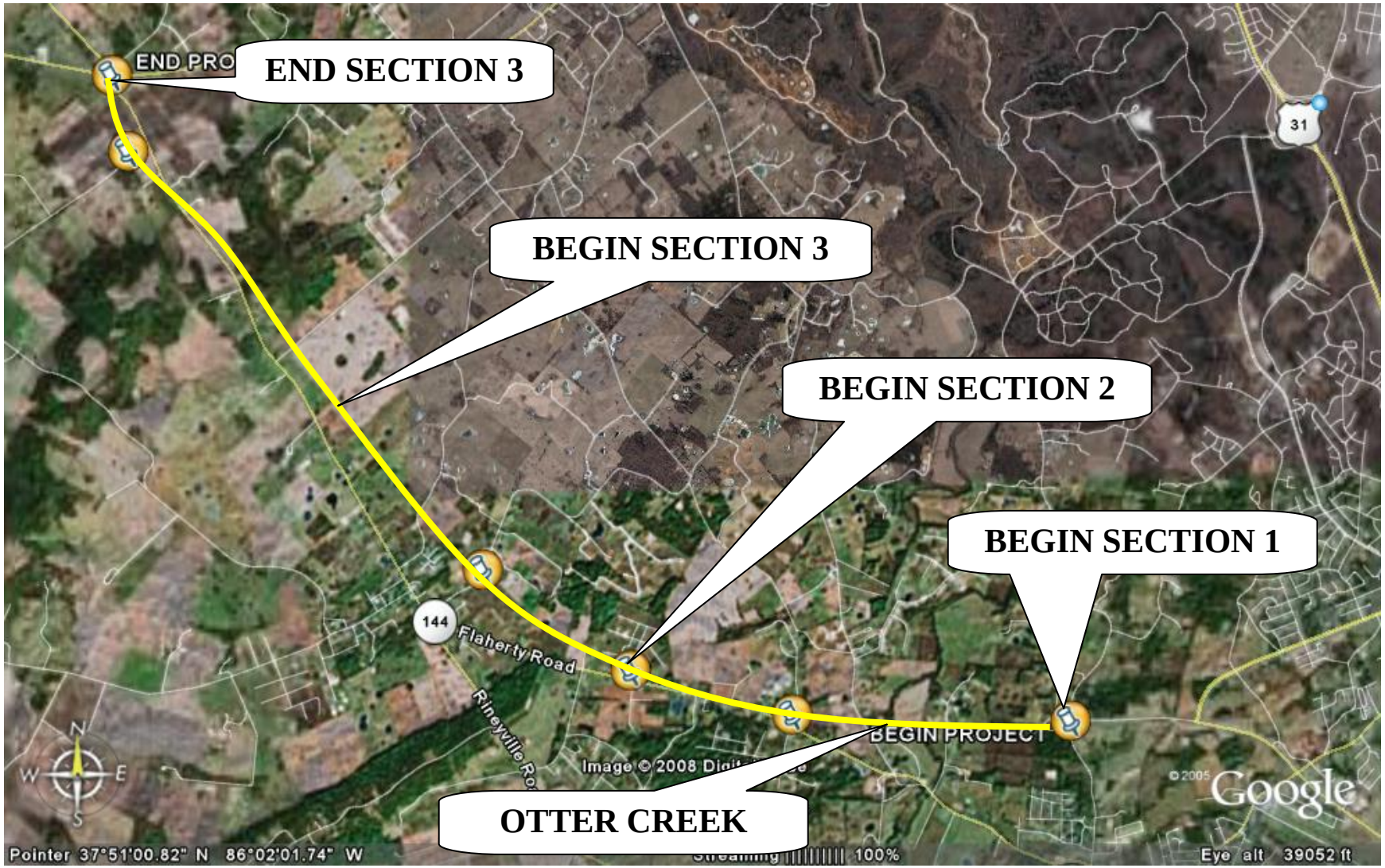
If this recommendation can be implemented, there is a possible savings of ***$ 460,738.***

Recommendation Number 4:

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative proposes to adjust the profile to reduce the amount of earthwork and balance each section.

If this recommendation can be implemented, there is a possible savings of ***$ 25,106.***

II. LOCATION OF PROJECT



III. TEAM MEMBERS AND PROJECT DESCRIPTION

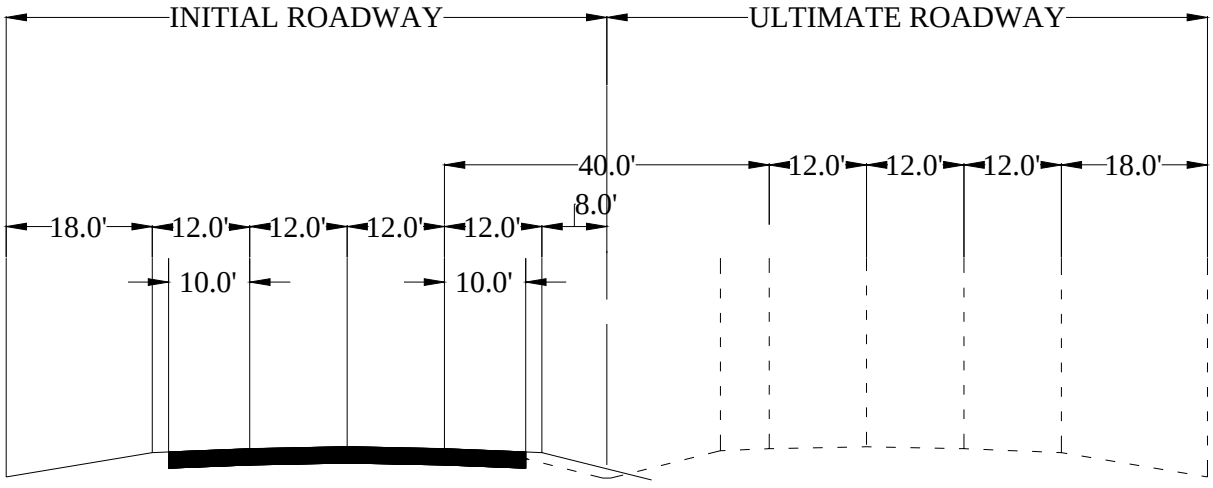
TEAMMEMBERS

NAME	AFFILIATION	EXPERTISE	PHONE
Tom Hartley, P.E., C.V.S.	VE Group	Team Leader	850/627-3900
Richard Elliott, P.E.	VE Group	Structures	850/627-3900
Bill Keating, P.E.	VE Group	Roadway/Construction	850/627-3900
Duncan Silver, P.E.	VE Group	Pavement/Traffic	850/627-3900
Mindy Rockwell	KYTC	Program Performance	502/564-4555

PROJECT DESCRIPTION

There are 3-construction sections within the limits of this study, for a total of approximately 8 miles of new roadway. The roadway will be on new alignment, with an ultimate 4-lane divided highway and depressed median typical. This new alignment crosses a Karst area with numerous sinkholes and will require special attention for the construction the roadway.

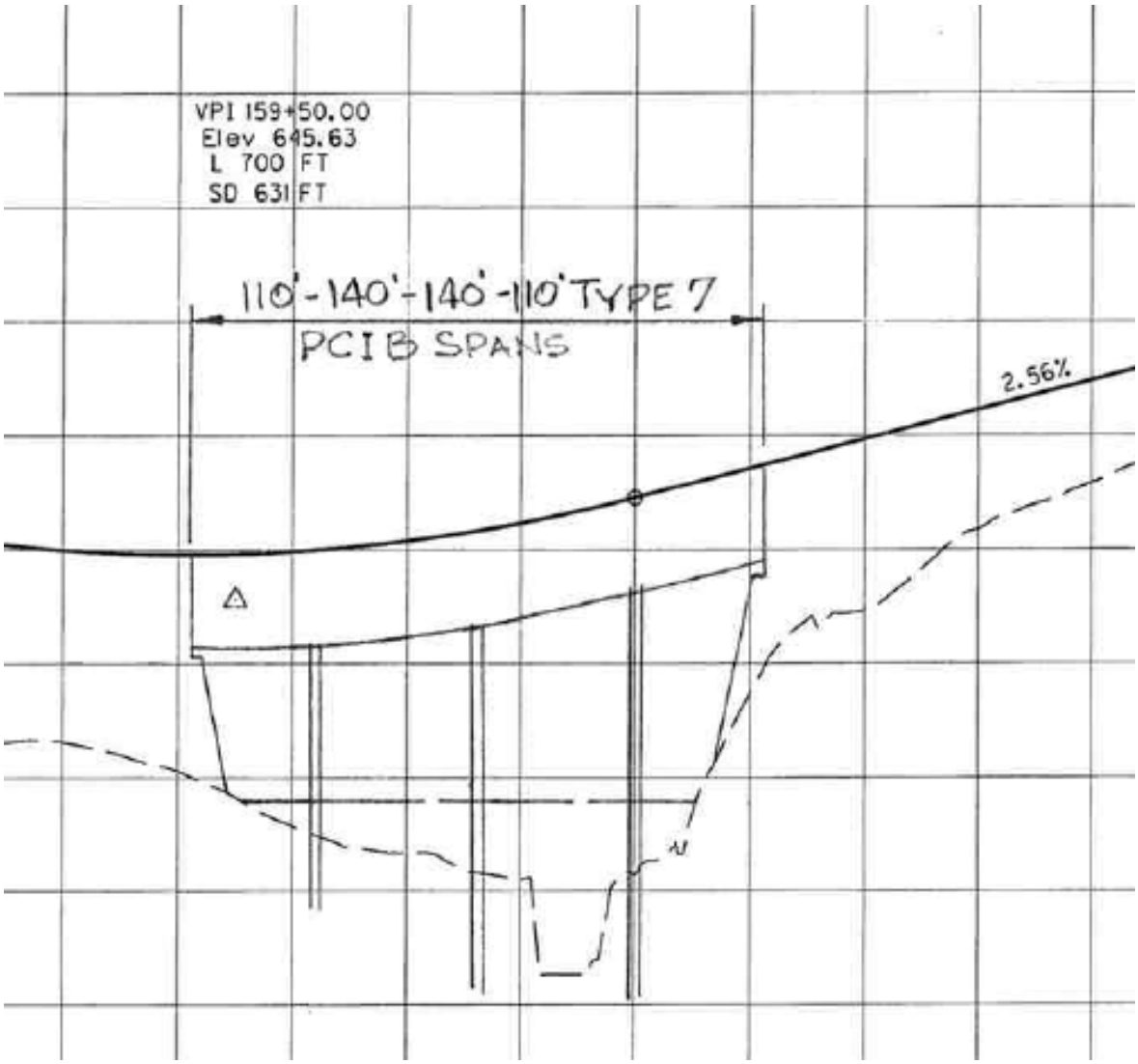
The initial design is a 2-lane – 2-way roadway that will be constructed first and the other 2-lanes will be constructed at a later date to meet future traffic demands. In addition to the roadway a 500’ +/- 4-span Type “7” PCI Beam bridge (110’, 140’, 140’, 110’) will be constructed to cross Otter Creek and its flood plane in Section 1 of the project.



AP PROPOSED TYPICAL

III. TEAM MEMBERS AND PROJECT DESCRIPTION

PROJECT DESCRIPTION *(continued)*



AS PROPOSED BRIDGE OVER OTTER CREEK & FLOOD PLAIN

IV. INVESTIGATION PHASE

KY 313 EXTENSION VALUE ENGINEERING STUDY BRIEFING February 11, 2008		
NAME	**AFFILIATION**	**PHONE**
Thomas Hartley	VE GROUP, LLC	850/627-3900
John Ledbetter	VE GROUP, LLC	850/627-3900
Jerry Love	VE GROUP, LLC	850/627-3900
Bill Keating	VE GROUP, LLC	850/627-3900
Charles Raymer	WMB, Inc.	859/299-5226
Danny Jasper	KYTC	502/564-4780
Mindy Rockwell	KYTC	502/564-4555
Gary Valentine	KYTC	270/766-5066
Robert T. Semones	KYTC	502/564-4555
Michael Hill	KYTC	502/564-4555

KY 313 EXTENSION STUDY RESOURCES February 11-15, 2008		
NAME	**AFFILIATION**	**PHONE**
Tim Roundtree	LPA Group	919/986-0386
Al Frank	KYTC Structures	502/564-4560
Ryan Griffin	KYTC Estimator	502/564-3280
Joe Bailey	Tensar	770/330-8237
Jon Kuon	Tensar	770/330-8237
Danny Jasper	KYTC Construction	502/564-4780

IV. INVESTIGATION PHASE

FUNCTIONAL ANALYSIS WORKSHEET

KY 313 EXTENSION

February 11, 2008

ITEM	FUNCT. VERB	FUNCT. NOUN	* TYPE	COST	WORTH	VALUE INDEX
Right of Way	Acquire	Rights	B	$17,000,000	$17,000,000	1.00
Pavement	**Support** **Support**	**Loads** **Vehicles**	**B** **B**	**$7,859,000**	**$7,000,000**	**1.12**
Earthwork	**Set**	**Grades**	**B**	**$3,641,000**	**$3,000,000**	**1.21**
Structure	**Eliminate**	**Conflict**	**B**	**$1,600,000**	**$1,200,000**	**1.33**
Clearing & Grubbing	Prepare	Site	B	$1,365,000	$1,365,000	1.00
Drainage	Convey	Water	S	$1,100,000	$1,100,000	1.00

***B – Basic S - Secondary**

** Note: This worksheet is a tool of the Value Engineering process and is only used for determining the areas that the Value Engineering team should focus on for possible alternatives. The column for COST indicates the approximate amount of the cost as shown in the cost estimate. The column for WORTH is an estimated cost for the lowest possible alternative that would provide the FUNCTION shown. Many times the lowest cost alternatives are not considered implementable but are used only to establish a worth for a function. A value index greater than 1.00 indicates the Value Engineering team intends to focus on this area of the project.

IV. INVESTIGATION PHASE

The following areas have a value index greater than 1.00 on the proceeding Functional Analysis Worksheet and therefore have been identified by the Value Engineering Team as areas of focus and investigation for the Value Engineering process:

A. PAVEMENT

B. STRUCTURE

C. EARTHWORK

V. SPECULATION PHASE

Ideas generated, utilizing the brainstorming method, for performing the functions of previously identified areas of focus.

A. PAVEMENT

- Construct 12’ shoulder with 5’ paved and 7’ grassed
- Construct 12’ shoulder with 5’ paved, 5’ gravel and 2’ grassed
- Use “Geo-Grid” reinforcement in base

B. STRUCTURE

- Construct 4-span Type “7” PCI Beam bridge over Otter Creek (80’, 120’, 120’, 80’ spans) with vertical abutments
- Construct 2-span steel plate girder bridge over Otter Creek (200’, 200’spans) with vertical abutments

C. EARTHWORK

- Adjust the profile to reduce the amount of earthwork and balance each section.

VI. EVALUATION PHASE

A. ALTERNATIVES

The following alternatives were formulated during the "eliminate and combine" portion of the Evaluation Phase.

A. PAVEMENT

Value Engineering Alternative Number 1: ***Construct 12' shoulders with 5' paved.***

Value Engineering Alternative Number 2: ***Use GEO-GRID to reinforce base.***

B. STRUCTURE

Value Engineering Alternative Number 1: ***Construct 4-span (80', 120', 120', 80') 400' long bridge with Vertical MSE end abutments.***

Value Engineering Alternative Number 2: ***Construct 2-span (200", 200') 400' long bridge with Vertical MSE end abutments and steel plate girders.***

C. EARTHWORK

Value Engineering Alternative: ***Adjust profile to reduce cuts and fills.***

VI. EVALUATION PHASE

B. ADVANTAGES AND DISADVANTAGES

The following Advantages and Disadvantages were developed for the Value Engineering Alternatives previously generated during the speculation phase. It also includes the Advantages and Disadvantages for the "As Proposed".

A. PAVEMENT

"As Proposed": **Construct 2-lane roadway with 2-12' shoulders (10' Paved) using 2" asphalt surface course, 15' of asphalt base and 4" DGA for roadway and 2" asphalt surface course, 3 ½" of asphalt base course, and 15 ½" of DGA**.

Advantages

- Full width paved shoulder encourages disabled vehicles to park completely off of the travel lane.
- Minimizes maintenance of shoulder edges.
- Minimizes maintenance at guardrail locations.
- May be useful during future Maintenance of Traffic operations.

Disadvantages

- High construction cost.
- More impervious area.

Conclusion

Carry forward for further evaluation.

Value Engineering Alternative Number 1: Construct 12' shoulders with 5' paved.

Advantages

- Lower construction cost.
- Less impervious area.

Disadvantages

- More maintenance.
- Possible rutting of grassed shoulder.

Conclusion

Carry forward for further evaluation.

A. PAVEMENT *(continued)*

Value Engineering Alternative Number 2: Use GEO-GRID to reinforce base.

Advantages

- Lower construction cost.
- Quicker construction.
- Less excavation.

Disadvantages

- None apparent.

Conclusion

Carry forward for further evaluation.

B. STRUCTURE

"As Proposed": **Construct 4-span (110', 140', 140', 110') 500' long bridge with 2:1 end abutment slopes using Type "7" prestressed girders.**

Advantages

- Low uplift at end bents.
- Provides for more than 100-year event.

Disadvantages

- High construction cost.

Conclusion

Carry forward for further evaluation.

Value Engineering Alternative Number 1: ***Construct a 4-span (80', 120', 120', 80') 400' long bridge with Vertical MSE end abutments using Type "7" prestressed girders.***

Advantages

- Lower construction costs.
- Shorter spans.

Disadvantages

- None Apparent.

Conclusion

Carry forward for further evaluation.

Value Engineering Alternative Number 2: ***Construct 2-span (200", 200') 400' long bridge with Vertical MSE end abutments and steel plate girders.***

Advantages

- Fewer spans.

Disadvantages

- Deeper beams.
- Higher construction costs.

Conclusion

Carry forward for further evaluation.

C. EARTHWORK

"As Proposed": **Earthwork is balanced in Sections 1 & 3 by cutting 524,600 CY and placing 503,500 CY of embankment.**

Advantages

- None apparent.

Disadvantages

- May be higher fills.
- Higher earthwork costs.
- More disturbed earth.
- May be deeper cuts.

Conclusion

Carry forward for further evaluation.

Value Engineering Alternative: ***Adjust profile to reduce cuts and fills.***

Advantages

- Move less earth.
- Less disturbed earth.
- Reduces earthwork costs.

Disadvantages

- None apparent.

Conclusion

Carry forward for further evaluation.

VII. DEVELOPMENT PHASE

A. PAVEMENT

(1) AS PROPOSED
(2) VALUE ENGINEERING ALTERNATIVE NUMBER 1
(3) VALUE ENGINEERING ALTERNATIVE NUMBER 2

B. STRUCTURE

(1) AS PROPOSED
(2) VALUE ENGINEERING ALTERNATIVE NUMBER 1
(3) VALUE ENGINEERING ALTERNATIVE NUMBER 2

C. EARTHWORK

(1) AS PROPOSED
(2) VALUE ENGINEERING ALTERNATIVE

D. DESIGN COMMENTS

VII. DEVELOPMENT PHASE

A. PAVEMENT

1. "As Proposed"

According to Consultants WMB, the pavement cost estimate for KY 313 was made based on information from a project to upgrade a section of US 60 in Meade County, which this project, KY 313, ties into. The Meade County US 60 soils, typical section, and other conditions are assumed to be similar to those expected on KY 313. At this time, there is no subsurface data available for KY 313. Twenty year ESAL's for KY 313 average about 3 million, and the Design CBR taken from Meade County is 2.

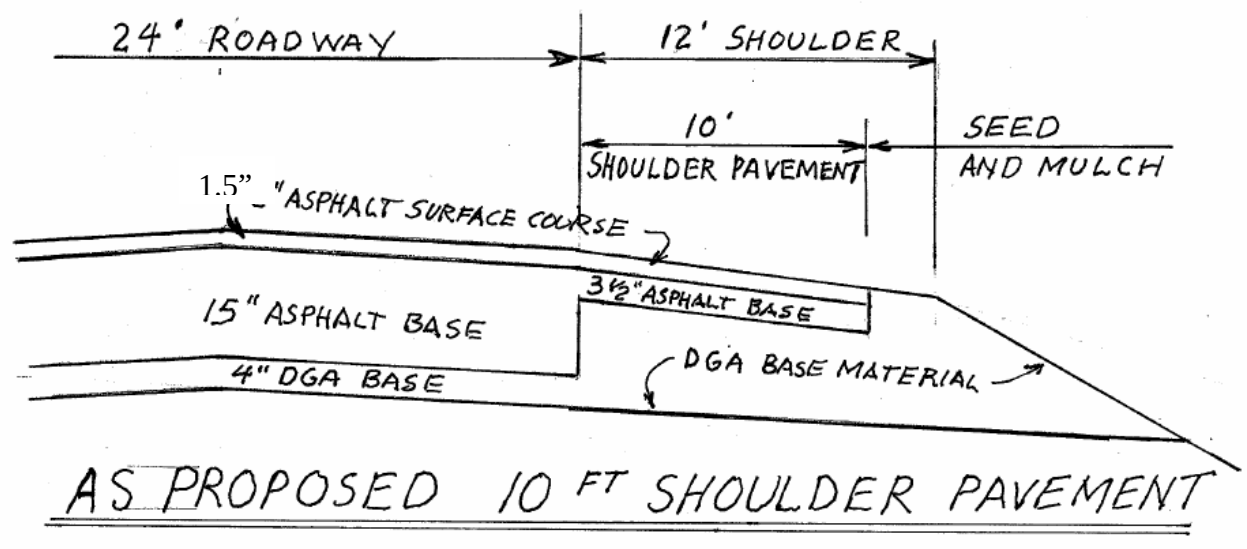
The resulting pavement design for SR 313 is:

- 4" of crushed stone base
- 15" of asphalt base
- 1 ½" of asphalt surface.

The ESAL's for Meade County were 1.89 million. Using the Meade County pavement design and considering the quantities listed in the KY 313 estimate dated 1/3/08, a proposed traffic lane pavement design for KY 313 was derived and is as follows:

The total shoulder width is 12' from the edge of the travel lane to the shoulder break point. The paved shoulder width is 10'. The shoulder pavement design is:

- 1 ½ " Asphalt Surface Course
- 3 ½ " Asphalt Base Course
- 15 ½ " Dense Graded Aggregate (DGA)



VII. DEVELOPMENT PHASE

A. PAVEMENT

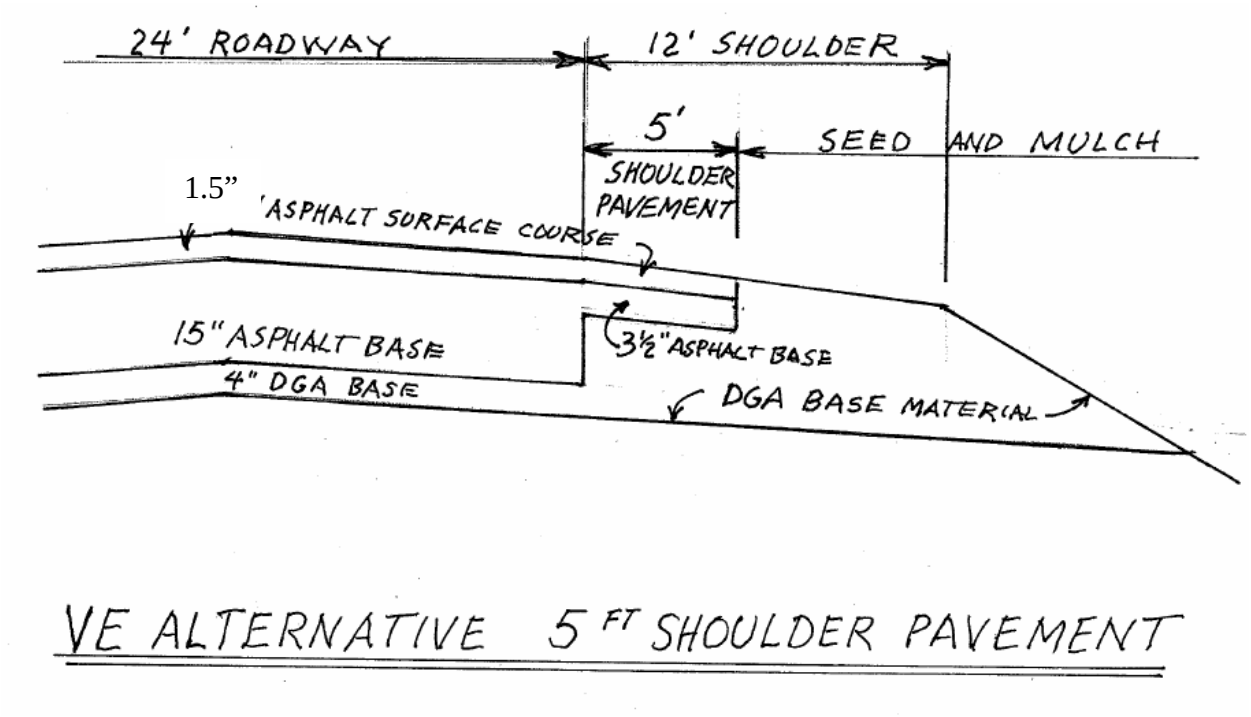
2. Value Engineering Alternative Number 1

Value Engineering Alternative A recommends that only a 5' width of the shoulder be paved.

The remainder of the 12' shoulder area would be grassed upon the Dense Graded Aggregate shoulder surface.

The shoulder pavement design is the same as the "As Proposed".

The Value Engineering Team feels that the 5' paved shoulder is adequate for the cyclist and the occasional pedestrian, and to protect the edge of the travel lane pavement.



KY 313 - SHOULDER PAVEMENT WIDTH
VALUE ENGINEERING ALTERNATIVE A
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
ITEM 0001 - DGA BASE	TON	$ 16.57	0.0	$ 0	12,135.0	$ 201,077
ITEM 0223 - ASPHALT BASE CRS	TON	$ 41.50	16,668.0	$ 691,722	8,334.0	$ 345,861
ITEM 0339 - ASPHALT SURF CRS	TON	$ 66.11	9,544.0	$ 630,954	4,772.0	$ 315,477
ITEM 5985 - SEED & PROTECT	SY	$ 0.27	0.0	$ 0	47,036.0	$ 12,700
ITEM 5966 - FERTILIZER	TON	$ 447.93	0.0	$ 0	3.5	$ 1,568
SUBTOTAL				**$ 1,322,676**		**$ 876,682**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$ 65,472	4.5%	$ 43,396
MISCELLANEOUS			4.0%	$ 52,907	4.0%	$ 35,067
CONTINGENCY			10.0%	$ 132,268	10.0%	$ 87,668
GRAND TOTAL				**$ 1,573,323**		**$ 1,042,814**

POSSIBLE SAVINGS: $ 530,509

VII. DEVELOPMENT PHASE

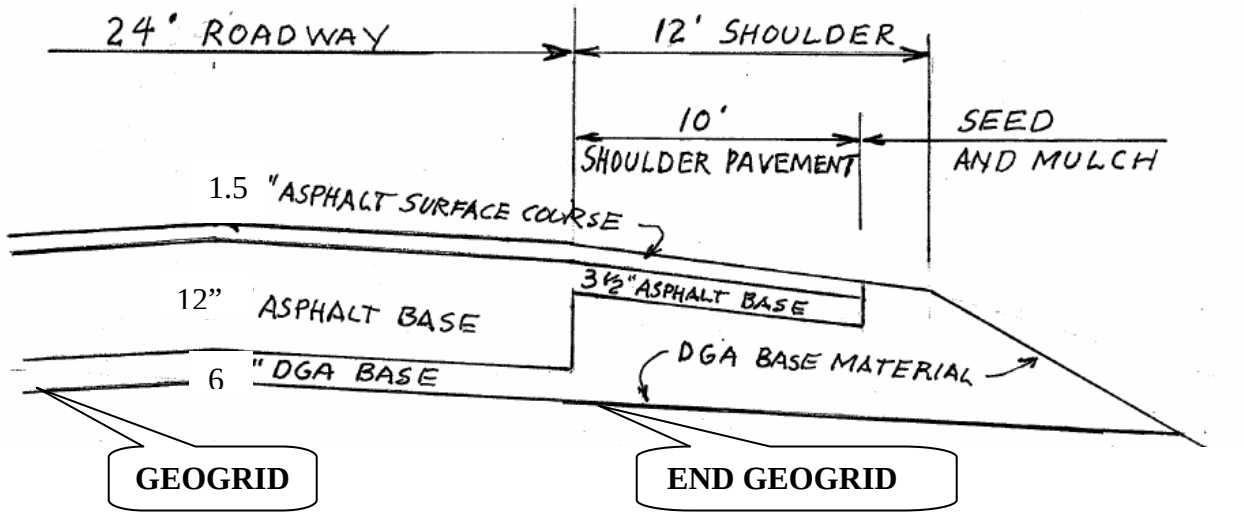
A. PAVEMENT

3. Value Engineering Alternative Number 2

The Value Engineering Alternative Pavement Design consists of:

- Tensar BX 1200 Geogrid placed on the subgrade.
- 6”+/- of dense graded aggregate over the Geogrid.
- 12”+/- of CL3 ASPH BASE 0.75D PG64-22.
- The surface treatment is 1.5”+/- of CL3 ASPH SURF 0.38D PG64-22.

The Value Engineering Alternative increased the thickness of the proposed dense graded aggregate from 4 to 6” and decreased the proposed asphalt treated base from 15 to 12”. The increase in thickness of the dense graded aggregate underlain by the geogrid provides a stiffer construction platform than the thinner DGA proposed. This will provide better protection for the subgrade from construction equipment operations.



VALUE ENGINEERING ALTERNATIVE PAVEMENT DESIGN

PAVEMENT-GEOGRID REINFORCEMENT
VALUE ENGINEERING ALTERNATIVE NUMBER 2
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
4" Dense Graded Aggregate	Tons	$ 16.57	21,384.0	$ 354,333	0.0	$ 0
15" CL3 ASPH BASE 0.75D PG64-22	Tons	$ 41.50	93,020.0	$ 3,860,330	0.0	$ 0
1.5" CL3 ASPH SURF 0.38D PG64-22	Tons	$ 66.11	9,302.0	$ 614,955	0.0	$ 0
6" Dense Graded Aggregate	Tons	$ 16.57	0.0	$ 0	32,076.0	$ 531,499
12" CL3 ASPH BASE 0.75D PG64-22	Tons	$ 41.50	0.0	$ 0	74,416.0	$ 3,088,264
1.5" CL3 ASPH SURF 0.38D PG64-22	Tons	$ 66.11	0.0	$ 0	9,302.0	$ 614,955
Roadway Excaxation	CY	$ 3.55	576,000.0	$ 2,044,800	572,832.0	$ 2,033,554
BX 1200 GEOGRID	SY	$ 4.00	0.0	$ 0	114,048.0	$ 456,192
SUBTOTAL				**$ 6,874,418**		**$ 6,724,464**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$ 340,284	4.5%	$ 332,861
MISCELLANEOUS			4.0%	$ 274,977	4.0%	$ 268,979
CONTINGENCY			10.0%	$ 687,442	10.0%	$ 672,446
GRAND TOTAL				**$ 8,177,120**		**$ 7,998,750**

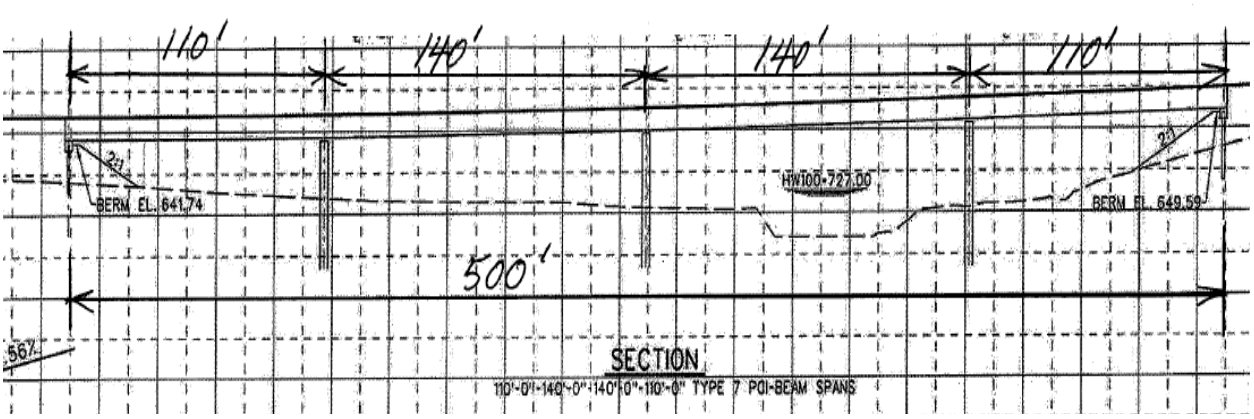
POSSIBLE SAVINGS **$ 178,370**

VII. DEVELOPMENT PHASE

B. STRUCTURE

1. "As Proposed"

The "As Proposed" bridge is a 500' long structure made up of 110', 140', 140', & 110' spans. The girders are Type 7 PCI-Beams continuous under live load supporting a 44' wide roadway. The End Bents are of the spill through type with 2 to 1 end slopes. The Interior Bents are post and beam type using 3 columns. The bridge is in a 700' sag vertical curve with the VPI near End Bent #1; the grades are –2.03% and +2.56%, and the horizontal alignment is a tangent section. At End Bent #1 the bottom of the girder clears the 100 yr. high water elevation by about 15'. Otter Creek is approximately 60' wide, bank to bank, and is 12' +/- deep from the bank top to the bottom of the channel. The center of the bridge is at Sta 161 + 61.50. Otter Creek passes under the bridge through the third span, which is 140' long, and there are no Interior Bents in the stream. It is mandated that the rise in backwater over the no bridge condition resulting from the 100 yr flood impacting the proposed bridge is zero. Therefore, the proposed bridge spans the entire flood area. It should be noted that the approach fills might be on soft ground associated with the Otter Creek flood plain.



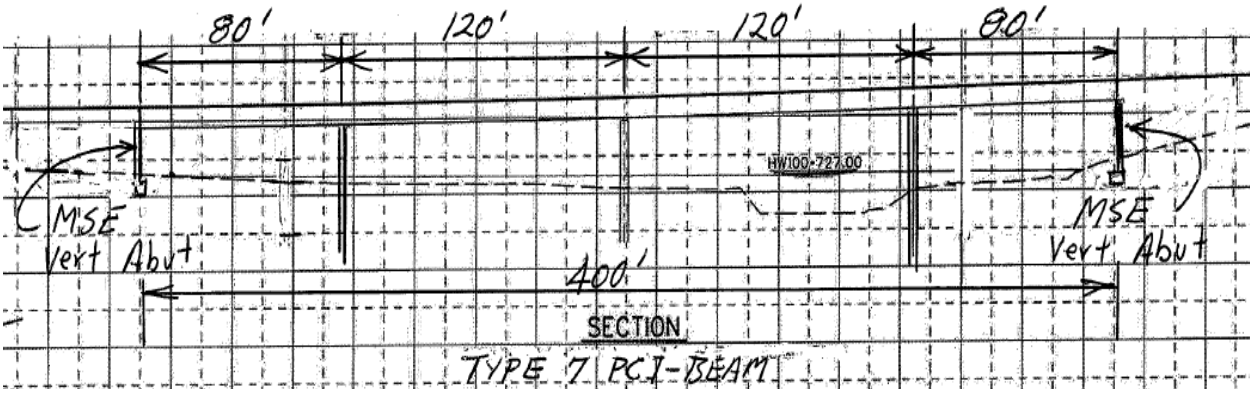
AS PROPOSED BRIDGE OVER OTTER CREEK

VII. DEVELOPMENT PHASE

B. STRUCTURE

Value Engineering Alternative Number 1

This Value Engineering Alternate consists of a 400’ structure made up of 80’, 120’, 120’, and 80’ spans. The girders are Type 7 PCI-Beams continuous under live load supporting a 44’ wide roadway. The interior bents are post and beam type. The End Bents are pile supported in/on MSE vertical abutments. Settlement of the MSE abutment due to soft soils is likely in the flood plain and should be mitigated with a waiting period before driving end bent piles through cans or providing some means to reduce the down drag on the piles. The MSE wall face extends at 90 degrees to the Center Line from under the bridge out to the toe of the 2 to 1 side slope. There are no Interior Bents in the stream. Although the value engineering alternate is shorter than the proposed bridge, it is believed that the MSE abutments are founded above the 100 yr. high water elevation.



VALUE ENGINEERING ALTERNATIVE NUMBER 1 BRIDGE OVER OTTER CREEK

STRUCTURE-VERTICAL MSE ABUT PCI-BEAM
VALUE ENGINEERING ALTERNATIVE NUMBER 1
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
500’ Type 7 PCI-Beam Bridge	SF	$ 125.00	23,500.0	$ 2,937,500	0.0	$ 0
400’ Type 7 PCI-Beam Bridge	SF	$ 125.00	0.0	$ 0	18800.0	$ 2,350,000
MSE Vertical Abutments	SF	$ 60.00	0.0	$ 0	2,988.0	$ 179,280
Base and Pavement	SF	$ 45.00	0.0	$ 0	489.0	$ 22,005
Embankment	CY	$ 3.55	0.0	$ 0	1,500.0	$ 5,325
SUBTOTAL				**$ 2,937,500.0**		**$ 2,556,610**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$ 145,406	4.5%	$ 126,552
MISCELLANEOUS			4.0%	$ 117,500	3.7%	$ 94,595
CONTINGENCY			10.0%	$ 293,750	10.0%	$255,661
GRAND TOTAL				**$ 3,494,156**		**$ 3,033,418**

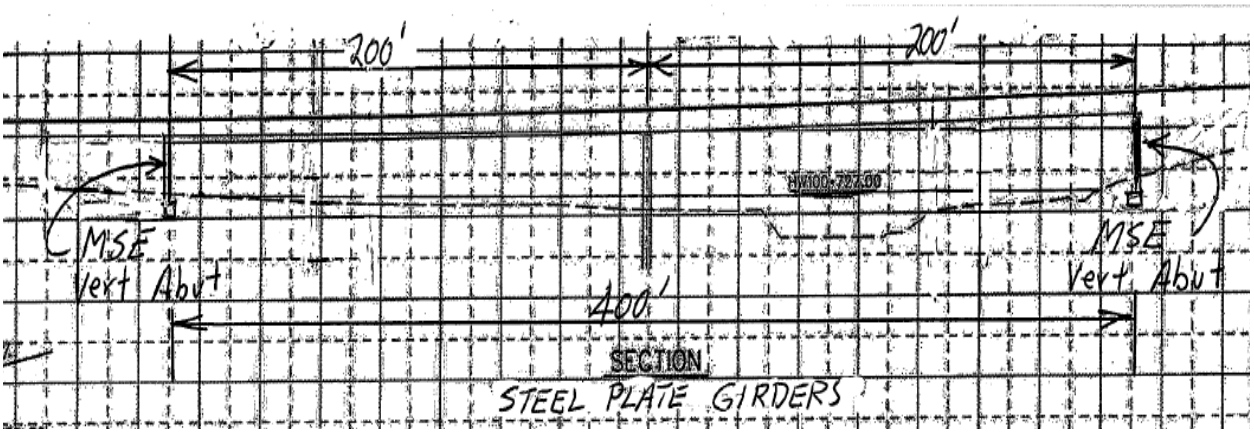
POSSIBLE SAVINGS: $ 460,738

VII. DEVELOPMENT PHASE

B. STRUCTURE

3. Value Engineering Alternative Number 2

This Value Engineering Alternative consists of a 400’ structure made up of two 200’ spans. The beams are continuous steel plate girders supporting a 44’ wide roadway. The interior bent is a post and beam. The End Bents are pile supported in/on MSE vertical abutments. Settlement of the MSE abutment due to soft soils is likely in the flood plain and should be mitigated with a waiting period before driving end bent piles through cans or providing some means to reduce the down drag on the piles. The MSE wall face extends at 90 degrees to the Center Line from under the bridge out to the toe of the 2 to 1 side slope. There are no Interior Bents in the stream. Although the value engineering alternate is shorter than the proposed bridge, it is believed that the MSE abutments are founded above the 100 yr. high water elevation.



VALUE ENGINEERING ALTERNATIVE NUMBER 2 BRIDGE OVER OTTER CREEK

STRUCTURE-VERT MSE ABUT- STEEL PLATE GIRDER
VALUE ENGINEERING ALTERNATIVE NUMBER 2
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
500’ Type 7 PCI-Beam Bridge	SF	$ 125.00	23,500.0	$ 2,937,500		
400’ Steel Plate Girder Bridge	SF	$ 150.00			18,800.0	$ 2,820,000
MSE Vertical Abutments	SF	$ 60.00			2,754.0	$ 165,240
Base and Pavement	SY	$ 45.00			489.0	$ 22,005
Embankment	CY	$ 3.55			1,500.0	$ 5,325
SUBTOTAL				**$ 2,937,500**		**$ 3,012,570**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)			4.5%	$ 145,406	4.5%	$ 149,122
MISCELLANEOUS			4.0%	$ 117,500	4.0%	$ 120,503
CONTINGENCY			10.0%	$ 293,750	10.0%	$ 301,257
GRAND TOTAL				**$ 3,494,156**		**$ 3,583,452**

POSSIBLE ADDITIONAL COST: $ 89,296

VII. DEVELOPMENT PHASE

C. EARTHWORK

1. "As Proposed"

Based on the earthwork data provided at the project briefing, preliminary mass diagrams were prepared by the design consultant for each of the three construction sections of the project. Utilizing a 20 % shrinkage factor for the excavation quantities, the earthwork quantities developed are summarized as follows for each of the three construction sections:

Section	Excavation	Embankment
1	274,500	223,100
2	303,400	250,300
3	250,100	280,400

Factors affecting the earthwork quantities in each of the construction sections are briefly described in the following paragraphs:

SECTION 1

The preliminary mass diagram indicates that the earthwork quantities in this section are reasonably balanced on either side of Otter Creek. However, there is a possible waste quantity in the vicinity of the east end of the project that can be readily utilized as embankment for the adjacent future roadway. Right of way is being initially acquired for the ultimate four-lane divided roadway.

From Sta 121 to Sta 142 there is a proposed cut section with a maximum depth of approximately 23' that will provide adequate material for the embankment to be constructed on the east side of Otter Creek. The maximum height of this embankment that extends from Sta 142 to Sta. 162 is approximately 33'.

The maximum profile grade in this section is 2.56 %.

SECTION 2

The earthwork quantities for this construction section are well balanced with a profile that closely follows the existing ground line without any significantly large cuts or fills.

SECTION 3

There are six areas in this section requiring embankment construction and six areas requiring excavation. However, the required embankment quantities exceed the available excavation quantities by approximately 86,000 CY necessitating either off site borrowing or profile adjustments to balance the earthwork. The maximum grade in this section is 3.0%.

The as proposed profiles in the areas being considered by the Value Engineering Team for possible adjustments have been shown on the drawings with the Value Engineering Alternative adjusted profiles.

C. EARTHWORK

2. Value Engineering Alternative

After reviewing the as proposed profile and the earthwork quantities, the Value Engineering Team concluded that some economy could possibly be realized by making adjustments to the profile. The primary objective of these profile adjustments is to reduce the earthwork quantities and at the same time balance excavation and embankment. The proposed profile adjustments evaluated by the Value Engineering Team in each of the construction sections are described in the following paragraphs.

SECTION 1

The as proposed profile at the crossing of Otter Creek is at elevation 653.38(approx) whereas the elevation of the 100-year flood is 627.00. Utilizing the design criterion of 1' of clearance above the 100 year flood elevation to the bottom of the bridge girders and a superstructure bridge depth of approximately 8', the roadway profile at Otter Creek could be lowered to elevation 636.00' or approximately 17' below the as proposed profile elevation. The Value Engineering Team therefore concluded that the profile could be adjusted downward in the vicinity of Otter Creek thereby reducing the embankment requirements from Sta 142 to Sta 171.

The earthwork computations developed by the Value Engineering Team are based on balancing the earthwork on both sides of Otter Creek.

Earthwork Quantities East of Otter Creek

The revised Value Engineering profile is shown on the exhibits on following pages and is described as follows:

Sta 103+50 to Sta 135+00	Change grade from -0.77% to - 0.4432%
Sta 135+00	800' crest vertical curve
Sta 135 to Sta 157+00	Change grade from -2.03% to -2.50%
Sta 157+00	800' sag vertical curve
Sta 157+00 to Sta 174 +50	Maintain existing +2.56 % grade

The earthwork quantities associated with this profile revision as well as the as proposed quantities are as follows:

	Excavation	**Embankment**
As Proposed	**207,000**	**153,000**
VE Alternative	**160,000**	**142,000**
Possible Reduction	**47,000**	**11,000**

C. EARTHWORK

2. Value Engineering Alternative

With the Value Engineering Alternative revisions to the profile east of Otter Creek, the earth quantities are approximately in balance. Another advantage of the profile revision is the location of the Otter Creek Bridge is that it will be on a tangent section in lieu of the sag vertical curve. The Value Engineering Alternative will also result in minor reductions in the quantities for the following items:

- Clearing and Grubbing
- Guardrail
- Right of Way
- Drainage items
- Earthwork Quantities West of Otter Creek

The as proposed profile west of Otter Creek provides a reasonable balance for the earthwork and therefore does not warrant any significant revisions. However, some minor profile revisions are probably warranted as the final design progresses to more accurately balance the excavation and

Section 2

After reviewing the as proposed profile for this construction section, the Value Engineering Team concluded that it closely follows the existing terrain and since the excavation and embankment quantities are reasonably balanced no profile modifications are deemed appropriate.

Section 3

Based on the preliminary mass diagram, this construction section will require approximately 86,000 CY of offsite borrow to construct the embankments in this section. As shown on the profile drawings, a cut section extends from Sta 423 to Sta 442 with a cut in the 10’ to 30’ range. Additional excavation can be readily obtained in this area by lowering the elevation of the crest of the proposed 2,900’ vertical curve approximately 3’ with adjustments to the connecting grades at the PVC and the PVT. It is appropriate to note that these profile adjustments will slightly reduce the as proposed 3% grades to 2.9% and 2.88%.

Since cross sections were not available to the Value Engineering Team, it was not feasible to more accurately determine the required vertical profile adjustments to balance the earthwork quantities. Further refinements of the as proposed profile may be desirable as the design progresses to the final design stage. However, with the Value Engineering proposed grade adjustments, the earthwork quantities for Section 3 are approximately balanced as shown in the following earthwork quantity summation.

Earthwork Quantities within Profile Adjustment Area:

	Excavation	Embankment
As Proposed	206,852	31,840
VE Alternate	282,269	21,992

2. Value Engineering Alternative

Earthwork Quantities Outside Profile Adjustment Area

43,248	248,560

Section 3 Earthwork Quantities With Profile Adjustment

325,517	270,552

Utilizing a shrinkage factor of 20%, the earthwork quantities with the Value Engineering profile adjustment are approximately in balance (324,662 vs. 325,517) for Section 3, thereby eliminating the need for any offsite borrow. With the adjusted profile, the excavation quantities for this section increase from 250,000 CY to 325,000 CY.

Sketches showing the as proposed profile and the Value Engineering Alternative profile adjustment at the crest of the vertical curve are included on a following page.

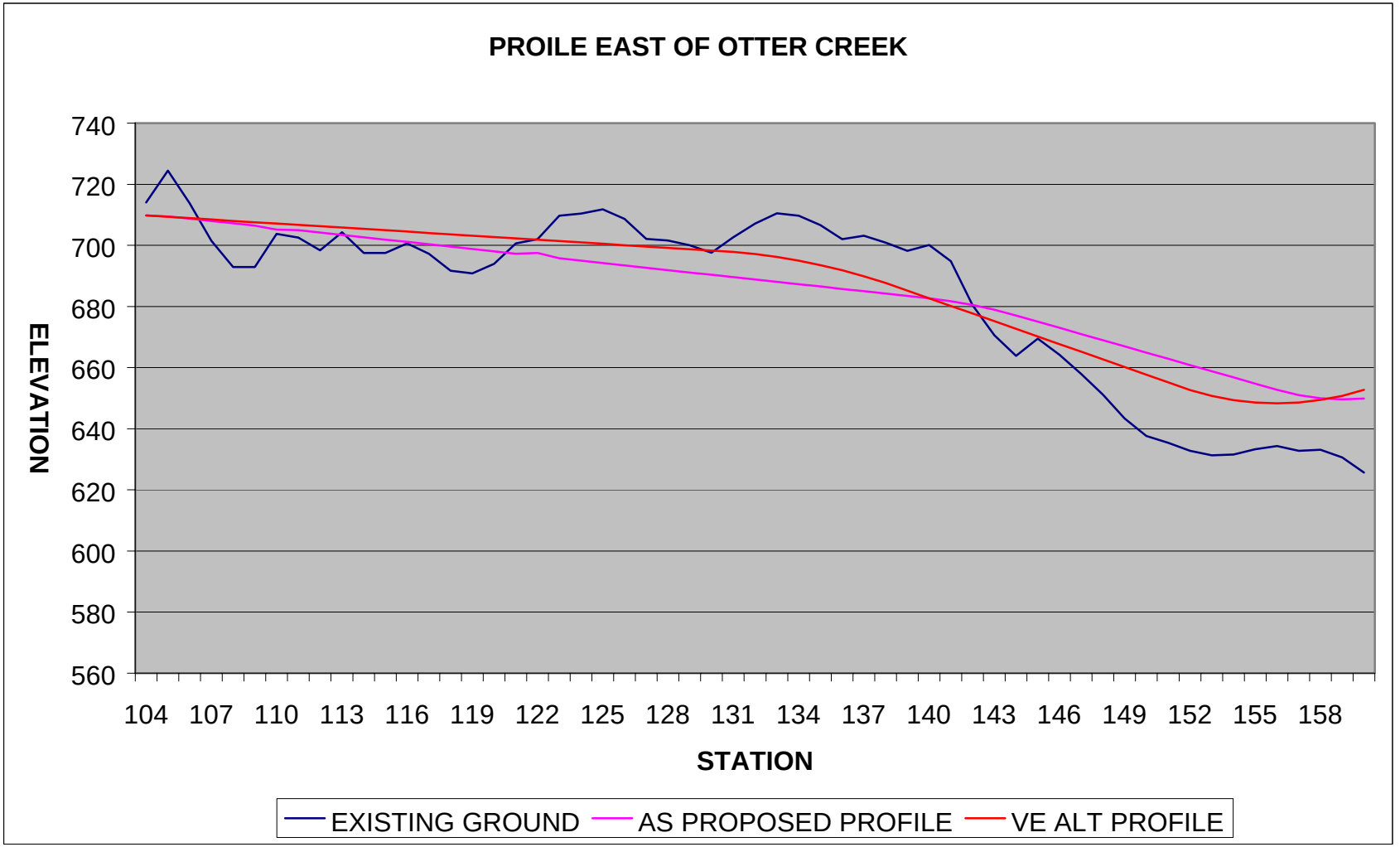
Recommendation

As shown in the comparative cost tabulation sheet on a following page, the Value Engineering profile adjustments will provide a possible cost savings of approximately $767,200 in earthwork costs. It is therefore recommended for inclusion in the final design.

VII. DEVELOPMENT PHASE

C. EARTHWORK

2. Value Engineering Alternative

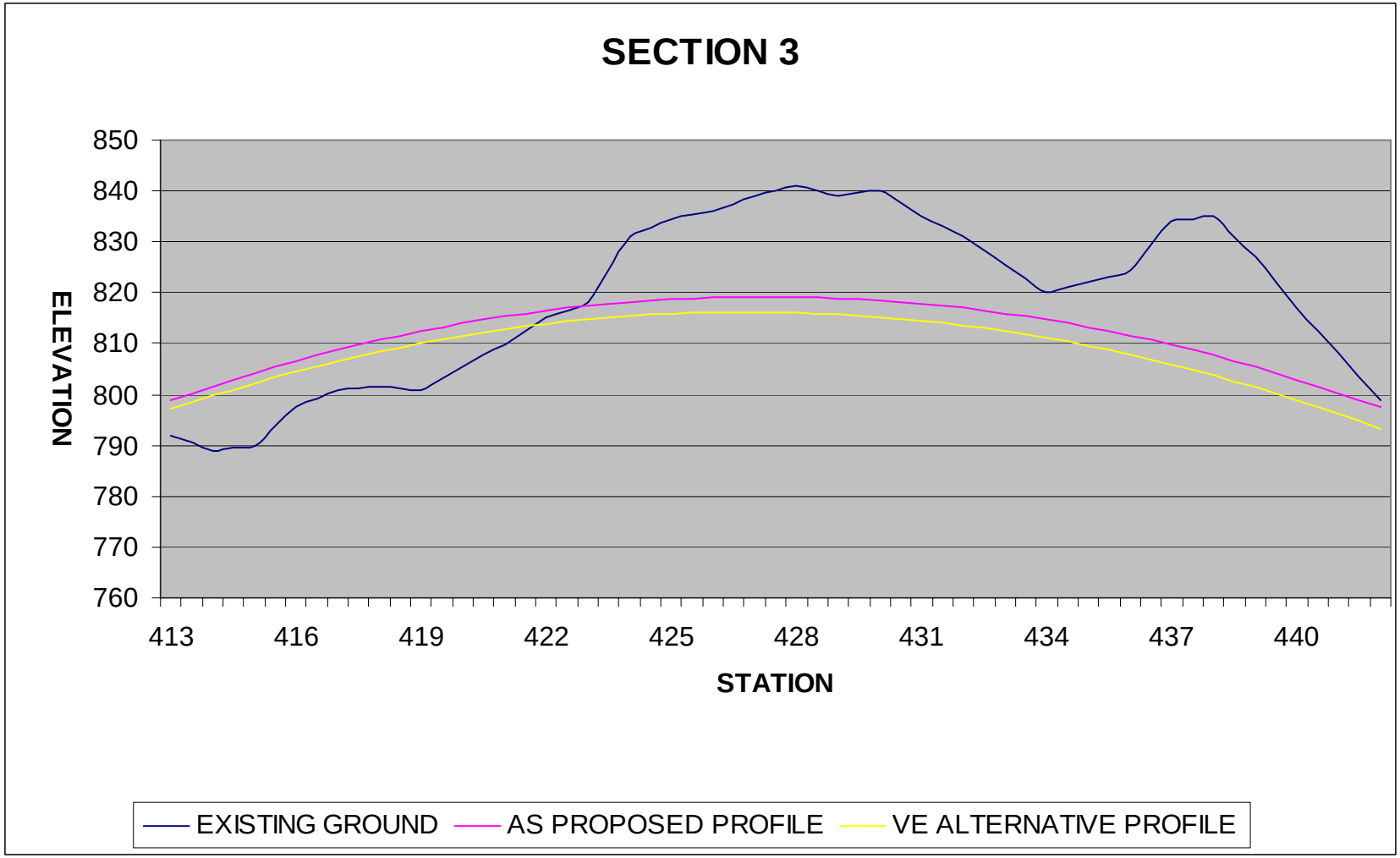


AS PROPOSED & VALUE ENGINEERING ALTERNATIVE PROFILE SECTION 1

VII. DEVELOPMENT PHASE

C. EARTHWORK

2. Value Engineering Alternative



AS PROPOSED AND VALUE ENGINEERING ALTERNATIVE PROFILES

KY 313 –EARTHWORK
VALUE ENGINEERING ALTERNATIVE
COST COMPARISON SHEET

DESCRIPTION	UNITS	UNIT COST	PROP'D QTY.	PROP'D COST	V.E. QTY.	V.E. COST
Embankment in Place	CY	$ 5.78	185,158	$ 1,070,213	164,155	$948,816
Roadway Excavation	CY	$ 3.55	414,023	$1,469,782	442,274	$ 1,570,073
SUBTOTAL				**$2,539,995**		**$2,518,889**
MOBILIZATION (THIS IS SUB+CONTIN. X % =)		4.5%		$ 125,730		$ 124,685
Miscellaneous		4.0%		$ 101,600		$ 100,756
CONTINGENCY		10.0%		$ 253,999		$ 251,889
GRAND TOTAL				**$ 3,021,324**		**$ 2,996,218**

POSSIBLE SAVINGS: $ 25,106

VII. DEVELOPMENT PHASE

C. EARTHWORK

COST COMPARISON SHEET BACK UP INFORMATION

Earthwork quantities were calculated base on the proposed typical section and did not include the excavation to bring the ground to subgrade elevations.

Profile Section 1 east of Otter Creek

		PGL		DEPTH		FRONT SLOPE		DIFF
STA	EXISTING	AS PROP	VE	AS PROP	VE			
104	714.1	709.80	709.80	-4.30	-4.30	4	4	0.00
105	724.5	709.49	709.36	-15.01	-15.14	2	2	-0.13
106	713.8	708.78	708.91	-5.02	-4.89	4	4	0.13
107	701.5	708.01	708.47	6.51	6.97	4	4	0.46
108	692.9	707.24	708.03	14.34	15.13	2	2	0.79
109	692.9	706.47	707.58	13.57	14.68	2	2	1.11
110	703.7	705.10	707.14	1.40	3.44	4	4	2.04
111	702.5	704.94	706.70	2.44	4.20	4	4	1.76
112	698.4	704.17	706.25	5.77	7.85	4	4	2.08
113	704.3	703.40	705.81	-0.90	1.51	4	4	2.41
114	697.5	702.63	705.37	5.13	7.87	4	4	2.74
115	697.5	701.86	704.92	4.36	7.42	4	4	3.06
116	700.6	701.10	704.48	0.50	3.88	4	4	3.38
117	697.2	700.33	704.04	3.13	6.84	4	4	3.71
118	691.7	699.56	703.60	7.86	11.90	4	2	4.04
119	690.8	698.79	703.15	7.99	12.35	4	2	4.36
120	693.9	698.02	702.71	4.12	8.81	4	4	4.69
121	700.6	697.25	702.27	-3.35	1.67	4	4	-5.02
122	702.0	697.49	701.82	-4.51	-0.18	4	4	4.33
123	709.7	695.72	701.38	-13.98	-8.32	2	4	5.66
124	710.4	694.95	700.94	-15.45	-9.46	2	4	5.99
125	711.8	694.18	700.49	-17.62	-11.31	2	2	6.31
126	708.7	693.41	700.05	-15.29	-8.65	2	4	6.64
127	702.1	692.64	699.61	-9.46	-2.49	4	4	6.97
128	701.6	691.88	699.16	-9.72	-2.44	4	4	7.28
129	700.0	691.11	698.72	-8.89	-1.28	4	4	7.61
130	697.6	690.34	698.28	-7.26	0.68	4	4	7.94
131	702.6	689.57	697.83	-13.03	-4.77	2	4	8.26
132	707.1	688.80	697.14	-18.30	-9.96	2	4	8.34
133	710.5	688.03	696.19	-22.47	-14.31	2	2	8.16
134	709.7	687.27	694.99	-22.43	-14.71	2	2	7.72
135	706.6	686.60	693.54	-20.00	-13.06	2	2	6.94
136	702.0	685.73	691.83	-16.27	-10.17	2	2	6.10
137	703.1	684.96	689.87	-18.14	-13.23	2	2	4.91
138	700.9	684.19	687.66	-16.71	-13.24	2	2	3.47
139	698.2	683.42	685.19	-14.78	-13.01	2	2	1.77
140	700.1	682.66	682.69	-17.44	-17.41	2	2	0.03
141	694.8	681.73	680.19	-13.07	-14.61	2	2	-1.54

VII. DEVELOPMENT PHASE

C. EARTHWORK

COST COMPARISON SHEET BACK UP INFORMATION

Profile Section 1 east of Otter Creek

142	680.4	680.49	677.69	0.09	-2.71	4	4	-2.80
143	670.6	678.93	675.19	8.33	4.59	4	4	-3.74
144	663.8	677.06	672.69	13.26	8.89	2	4	-4.37
145	669.5	675.04	670.19	5.54	0.69	4	4	-4.85
146	664.2	673.01	667.69	8.81	3.49	4	4	-5.32
147	657.9	670.98	665.19	13.08	7.29	2	4	-5.79
148	651.2	668.95	662.69	17.75	11.49	2	2	-6.26
149	643.4	666.92	660.19	23.52	16.79	2	2	-6.73
150	637.6	664.90	657.69	27.30	20.09	2	2	-7.21
151	635.4	662.87	655.19	27.47	19.79	2	2	-7.68
152	632.8	660.84	652.69	28.04	19.89	2	2	-8.15
153	631.3	658.81	650.76	27.51	19.46	2	2	-8.05
154	631.6	656.78	649.39	25.18	17.79	2	2	-7.39
155	633.3	654.76	648.57	21.46	15.27	2	2	-6.19
156	634.3	652.73	648.29	18.43	13.99	2	2	-4.44
157	632.8	651.03	648.57	18.23	15.77	2	2	-2.46
158	633.1	649.98	649.40	16.88	16.30	2	2	-0.58
159	630.6	649.59	650.78	18.99	20.18	2	2	1.19
160	625.7	649.86	652.71	24.16	27.01	2	2	2.85
161	625.7	649.86	655.19	24.16	29.49	2	2	5.33

Earthwork Quantities - Section 1 east of Otter Creek

STA	FILL DEPT	VOLUME	CUT	FILL
104	-4.3	-3769.71	-3770	0.0
105	-15.0	-9360.67	-9361	0.0
106	-5.0	-2646.52	-2647	0.0
107	6.5	2403.86	0	2403.9
108	14.3	5387.74	0	5387.7
109	13.6	4831.16	0	4831.2
110	1.4	149.77	0	149.8
111	2.4	656.77	0	656.8
112	5.8	1927.36	0	1927.4
113	-0.9	-772.67	-773	0.0
114	5.1	1677.01	0	1677.0
115	4.4	1363.45	0	1363.4
116	0.5	-224.80	-225	0.0
117	3.1	954.36	0	954.4
118	7.9	2995.89	0	2995.9
119	8.0	2974.97	0	2975.0
120	4.1	1241.18	0	1241.2
121	-4.5	-2512.28	2512	0.0

COST COMPARISON SHEET BACK UP INFORMATION

Earthwork Quantities - Section 1 east of Otter Creek

122	-15.4	-3833.85	3834	0.0
123	-15.3	-9652.85	9653	0.0
124	-9.7	-10788.78	10789	0.0
125	-7.3	-11982.70	11983	0.0
126	-18.3	-9936.29	9936	0.0
127	-22.4	-6748.23	6748	0.0
128	-16.3	-6836.69	6837	0.0
129	-16.7	-6106.91	6107	0.0
130	-17.4	-5575.15	5575	0.0
131	0.1	-9294.34	9294	0.0
132	13.3	-13170.17	13170	0.0
133	8.8	-16102.97	16103	0.0
134	17.8	-15786.99	15787	0.0
135	27.3	-13675.22	13675	0.0
136	28.0	-11373.81	11374	0.0
137	25.2	-12470.79	12471	0.0
138	18.4	-11338.09	11338	0.0
139	16.9	-10338.82	10339	0.0
140	24.2	-11643.15	11643	0.0
141	#REF!	-7783.83	7784	0.0
142	#REF!	-219.40	219	0.0
143	#REF!	3364.17	0	3364.2
144	#REF!	4754.48	0	4754.5
145	#REF!	1874.87	0	1874.9
146	#REF!	3623.74	0	3623.7
147	#REF!	4836.67	0	4836.7
148	#REF!	7393.72	0	7393.7
149	#REF!	10877.68	0	10877.7
150	27.5	13229.14	0	13229.1
151	28.0	13374.96	0	13375.0
152	27.5	13702.89	0	13702.9
153	25.2	13209.47	0	13209.5
154	21.5	11552.79	0	11552.8
155	18.4	9253.30	0	9253.3
156	18.2	7592.97	0	7593.0
157	16.9	7442.60	0	7442.6
158	19.0	6795.28	0	6795.3
159	24.2	8101.93	0	8101.9
160	#REF!	11095.75	0	11095.7
		TOTAL	**207171**	**153317.6**

VII. DEVELOPMENT PHASE

C. EARTHWORK

COST COMPARISON SHEET BACK UP INFORMATION

Profile – Section 3

STA	EXISTING	PGL AS PROP	VE	DEPTH AS PROP	VE	FRONT SLOPE		DIFF
413	792.00	798.88	797.06	6.88	5.06	4	4	1.82
	790.50	800.29	798.42					
414	789.00	801.65	799.73	12.65	10.73	2	2	1.91
	789.50	802.95	800.99					
415	790.00	804.21	802.20	14.21	12.20	2	2	2.00
	793.75	805.41	803.36					
416	797.50	806.56	804.47	9.06	6.97	4	4	2.09
	799.25	807.67	805.53					
417	801.00	808.72	806.54	7.72	5.54	4	4	2.18
	801.25	809.72	807.50					
418	801.50	810.68	808.41	9.18	6.91	4	4	2.27
	801.25	811.58	809.27					
419	801.00	812.43	810.08	11.43	9.08	2	4	2.35
	803.25	813.23	810.83					
420	805.50	813.98	811.54	8.48	6.04	4	4	2.44
	807.70	814.68	812.20					
421	809.90	815.32	812.81	5.42	2.91	4	4	2.52
	812.45	815.92	813.36					
422	815.00	816.47	813.87	1.47	-1.13	4	4	2.60
	816.50	816.97	814.33					
423	818.00	817.41	814.73	-0.59	-3.27	4	4	2.68
	824.50	817.81	815.09					
424	831.00	818.15	815.39	-12.85	-15.61	2	2	2.76
	832.75	818.45	815.65					
425	834.50	818.69	815.86	-15.81	-18.64	2	2	2.84
	835.25	818.89	816.01					
426	836.00	819.03	816.11	-16.97	-19.89	2	2	2.92
	837.50	819.12	816.17					
427	839.00	819.17	816.17	-19.83	-22.83	2	2	2.99
	840.00	819.16	816.13					
428	841.00	819.12	816.04	-21.88	-24.96	2	2	3.08
	840.00	819.02	815.90					
429	839.00	818.88	815.72	-20.12	-23.28	2	2	3.16
	839.55	818.69	815.48					
430	840.10	818.45	815.19	-21.65	-24.91	2	2	3.25
	837.55	818.15	814.86					
431	835.00	817.81	814.47	-17.19	-20.53	2	2	3.34
	833.00	817.41	814.03					
432	831.00	816.97	813.54	-14.03	-17.46	2	2	3.42
	828.25	816.47	813.00					

COST COMPARISON SHEET BACK UP INFORMATION

Profile – Section 3

433	825.50	815.92	812.41	-9.58	-13.09	4	2	3.51
	822.75	815.32	811.78					
434	820.00	814.68	811.09	-5.32	-8.91	4	4	3.59
	821.00	813.98	810.35					
435	822.00	813.23	809.56	-8.77	-12.44	4	2	3.67
	823.25	812.43	808.72					
436	824.50	811.58	807.83	-12.92	-16.67	2	2	3.75
	829.25	810.68	806.89					
437	834.00	809.73	805.89	-24.27	-28.11	2	2	3.83
	834.50	808.73	804.85					
438	835.00	807.67	803.76	-27.33	-31.24	2	2	3.91
	831.00	806.57	802.62					
439	827.00	805.42	801.43	-21.58	-25.57	2	2	3.99
	822.00	804.22	800.19					
440	817.00	802.96	798.89	-14.04	-18.11	2	2	4.07
	812.50	801.66	797.55					
441	808.00	800.30	796.16	-7.70	-11.84	4	2	4.14
	803.50	798.90	794.72					
442	799.00	797.44	793.22	-1.56	-5.78	4	4	4.22

VII. DEVELOPMENT PHASE

C. EARTHWORK

COST COMPARISON SHEET BACK UP INFORMATION

Earthwork Quantities – Section 3

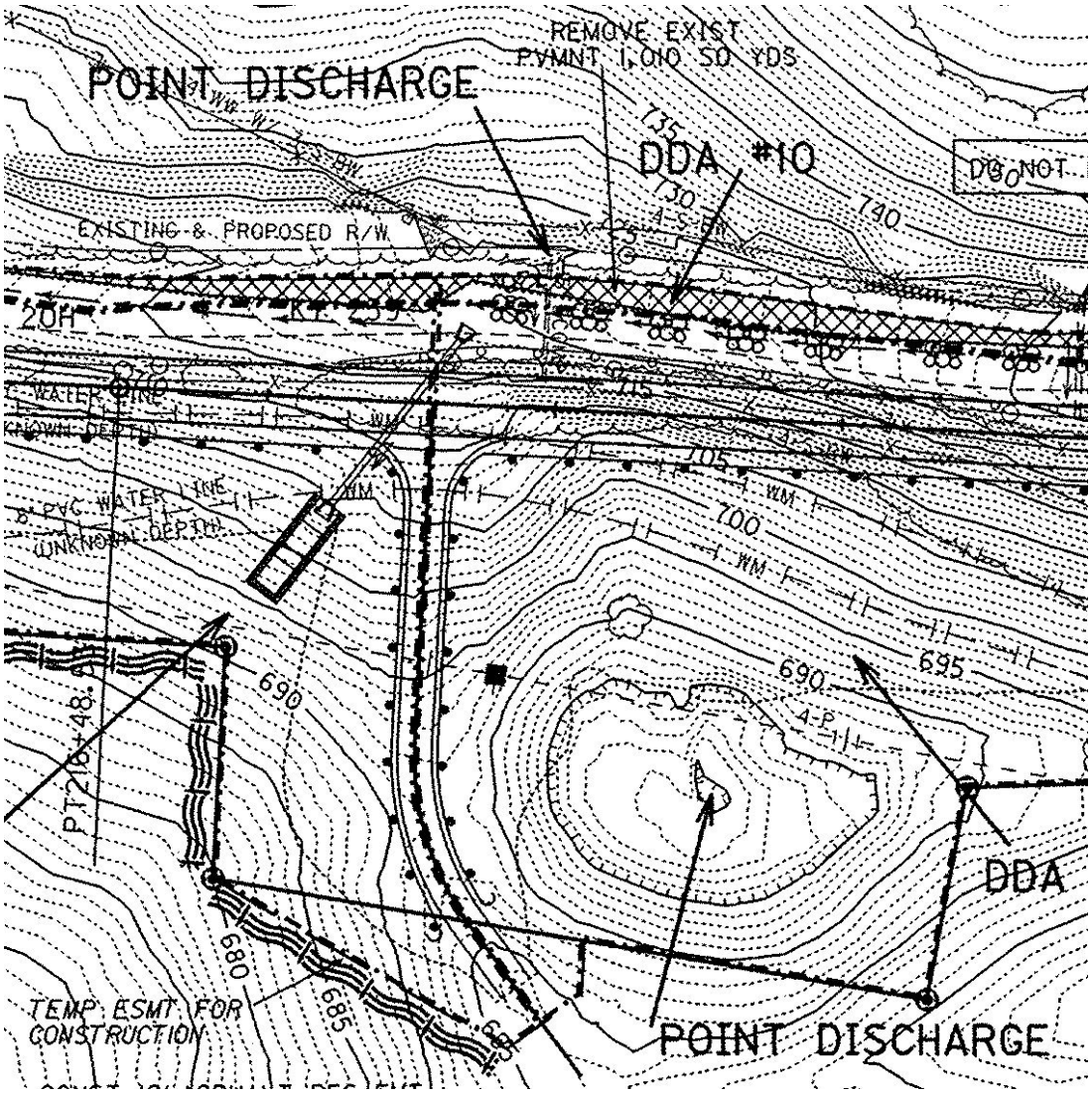
STA	DEPTH	VOLUME	CUT	FILL
413	5.1	1,644	-	1644
414	10.7	3,624	-	3624
415	12.2	4,256	-	4256
416	7.0	2,468	-	2468
417	5.5	1,841	-	1841
418	6.9	2,438	-	2438
419	9.1	2,949	-	2949
420	6.0	2,053	-	2053
421	2.9	719	-	719
422	-1.1	(1,385)	1,385	0
423	-3.3	(2,695)	2,695	0
424	-15.6	(11,584)	11,584	0
425	-18.6	(13,997)	13,997	0
426	-19.9	(15,021)	15,021	0
427	-22.8	(17,541)	17,541	0
428	-25.0	(19,449)	19,449	0
429	-23.3	(17,943)	17,943	0
430	-24.9	(19,401)	19,401	0
431	-20.5	(15,565)	15,565	0
432	-17.5	(13,039)	13,039	0
433	-13.1	(10,449)	10,449	0
434	-8.9	(6,806)	6,806	0
435	-12.4	(9,855)	9,855	0
436	-16.7	(12,416)	12,416	0
437	-28.1	(22,386)	22,386	0
438	-31.2	(25,456)	25,456	0
439	-25.6	(20,009)	20,009	0
440	-18.1	(13,559)	13,559	0
441	-11.8	(9,308)	9,308	0
442	-5.8	(4,405)	4,405	0
		TOTAL	282,269	21,992

VII. DEVELOPMENT PHASE

D. DESIGN COMMENTS

Sinkholes/Karsts are within the project limits of all three sections. The Contractor will have to seal sinkholes within the embankment footprint and protect the ones outside that footprint. The Transportation Cabinet has standards for sealing sinkholes/Karsts, but none for how to protect the sinkholes from unwanted sediment from the construction site or from future runoff. Danny Jasper and Shelby Jett used the following procedure to protect a sinkhole along KY 59 in Edmondson County:

1. Place silt fence around sinkhole.
2. Place rock on both sides of silt fence to approximately 6" above silt fence.



PLAN VIEW OF SINK HOLE

VII. DEVELOPMENT PHASE

D. DESIGN COMMENTS

SINKHOLE WITH PROTECTION

PLACING SILT FENCE AND COVERING WITH ROCK

This Best Management Practice (BMP) will protect the sinkhole from sediment during the construction as well as after.

VIII. SUMMARY OF RECOMMENDATIONS

It is the recommendation of the Value Engineering Team that the following Value Engineering Alternatives be carried into the Project Development process for further development.

Recommendation Number1:

The Value Engineering Team recommends that Value Engineering Alternative be implemented. This alternative proposes to construct 12' shoulder with 5' paved and 7' grassed

If this recommendation can be implemented, there is a possible savings of ***$ 530,509.***

Recommendation Number 2:

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative purposes to use "Geo-Grid" reinforcement in the pavement base.

If this recommendation can be implemented, there is a possible savings of ***$ 178,370.***

Recommendation Number 3:

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative proposes to construct a 4-span Type "7" PCI Beam bridge over Otter Creek (80', 120', 120', 80' spans) with vertical abutments.

If this recommendation can be implemented, there is a possible savings of ***$ 460,738.***

Recommendation Number 4:

The Value Engineering Team recommends that the Value Engineering Alternative be implemented. This alternative proposes to adjust the profile to reduce the amount of earthwork and balance each section.

If this recommendation can be implemented, there is a possible savings of ***$ 25.106.***

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