STATE OF ALASKA DEPARTMENT OF TRANSPORTATION & PUBLIC FACILITIES (DOT & PF)
DALTON HIGHWAY MP 0-9 RECONSTRUCTION
VALUE ENGINEERING STUDY
FINAL REPORT
JULY 25, 2017

VE TEAM

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EXECUTIVE SUMMARY

Purpose and Goals of the Study

This Value Engineering (VE) report is presented to the Alaska Department of Transportation and Public Facilities (DOT & PF) to assist in decision making at the 40% design level. The goals for this VE study were to identify component and planning alternatives that may offer first cost or life cycle cost benefits and/or improve project quality. During the kick-off meeting, the design team defined the following criteria as most important to the project:

- Safety – reduce accidents
- Increase traffic mobility – truck
- Support tourism
- Maintainability
- Constructability
- Highway standards
- Budget

Project Risk

The VE team assessed project risks and identified the following as warranting the most attention during planning and design. These were also used to guide the VE team's choice of alternatives developed in this study:

- Drainage – culvert requirements
- Permitting – schedule
- ROW claims process
- Unsuitable sub grade – differing site conditions
- ACE embankment – amount required
- Pipeline impacts resolution
- Public safety

Value Engineering Team

The multi-disciplined VE team included the following disciplines: Structural, Civil, Hydraulics, Construction, Geotechnical, Maintenance, and the Certified Value Specialist (CVS) team leader. At the initial kick-off meeting the study goals, objectives and criteria were presented by Alaska DOT & PF design team representatives. The VE team worked together for five days, using the formal Value Methodology and VE job plan. The essential and secondary functions from the project components were identified with their associated costs; alternative ideas were generated and the most viable VE alternatives were developed and analyzed against project criteria. Recommended proposals were presented in an oral presentation at the conclusion of the study and documented herein.

Value Engineering Proposals

Key VE proposals include:

- Alternative culvert and drainage materials for improved life span
- Bridge structural design refinement
- Reduced bridge size to meet design criteria for reduced cost
- Structural plate configuration for bridge in lieu of precast concrete bridge to reduce cost and construction impacts
- Alternatives for roadway materials (including excavation and sourcing) in order to achieve more balanced earthwork throughout the project
- Alternative methods and materials to manage permafrost thawing and settlement, both during initial construction as well as long term
- Construction schedule and phasing considerations to accommodate cold weather and to reduce overall construction schedule impacts

Substantiate Current Design

In the process of comparing alternative concepts against the current design, the VE team noted a number of major design components that merit strong, continued support:

- The basic horizontal and vertical alignment and profile of the project through this corridor with a combination of reconstructed and new sections
- Proactive management of settlement issues

PROJECT DESCRIPTION AND PLANS

Construction Cost:	$39,470,000
Right of Way Costs:	$500,000
TOTAL COST:	$39,970,000
Total length:	10.66 miles
Cost per mile:	$3,416,538

Location: Livengood, Alaska

Project Description (excerpted from the DOT & PF Design Study Report):

Background

The Alaska Department of Transportation and Public Facilities (DOT & PF), in cooperation with the Federal Highway Administration (FHWA) proposes to reconstruct the first nine miles of the James W. Dalton Highway (known simply as the Dalton Highway).

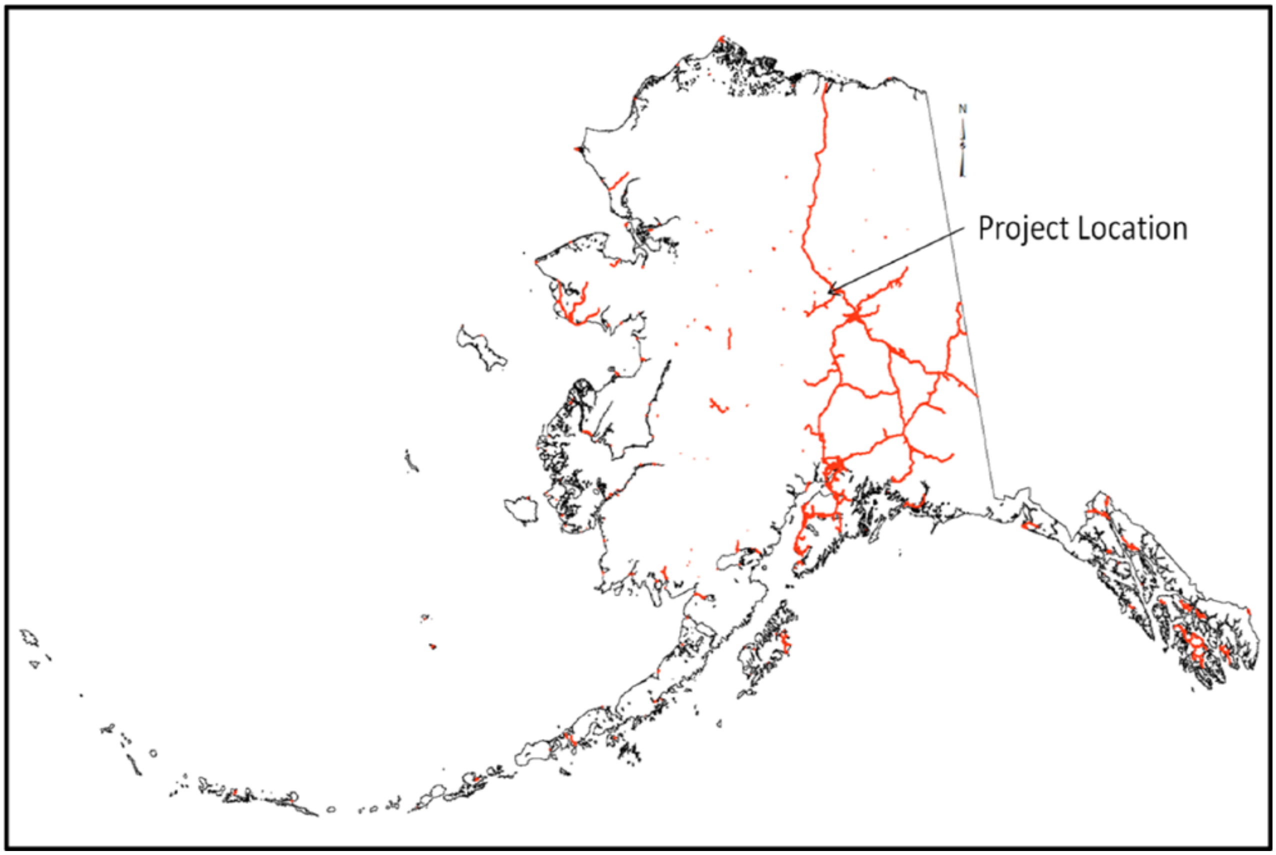
The Dalton Highway is classified as a rural principal arterial and is part of the National Highway System (NHS), extending from north of Fairbanks to Deadhorse. The Dalton Highway provides the only vehicle access route across Northern Alaska and serves as a critical supply route between commercial and industrial centers. The original roadway was built between 1971 and 1974 as a private haul route to support the Trans-Alaska Pipeline System (TAPS) and was constructed to the former State of Alaska Department of Highways secondary road standards. It was opened to the public in 1994 and currently supports heavy truck and tourism traffic.

This reconstruction project will upgrade this existing TAPS access route to arterial standards, improving safety and service. Approximately two thirds of the roadway will be realigned to meet standards, and a third will closely follow the existing alignment.

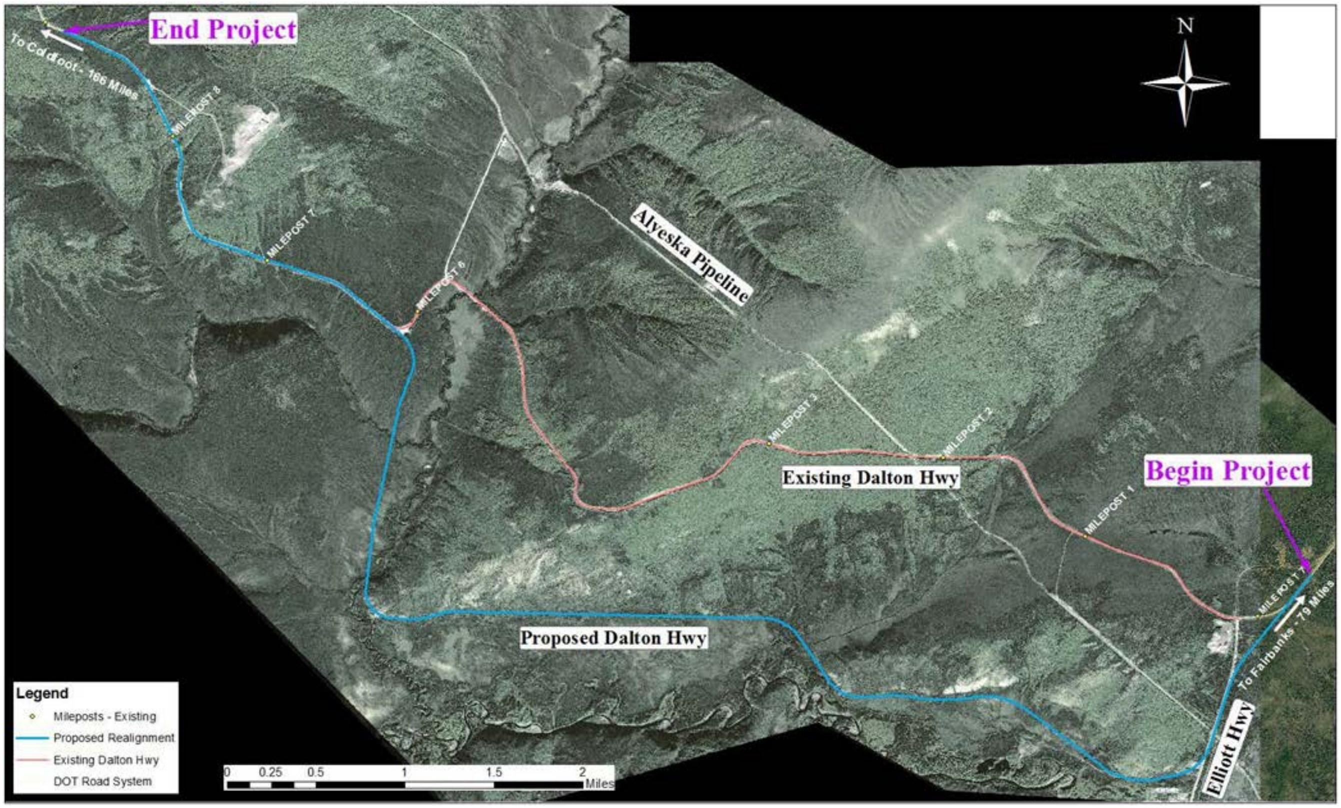
The proposed realignment portion of the project departs from the Elliott highway and travels down the West Fork Tolovana River Valley and Lost Creek Valley, staying near the valley bottom until rising again to tie back into MP6.5 of the existing Dalton Highway, in which the road continues to climb until reaching the end of the project, near the summit of 9 Mile Hill. The proposed road varies in elevation from 450’ to 1450’.

Proposed improvements include corrections to horizontal and vertical geometry, road widening, installation of a new bridge at the Lost Creek crossing, new culverts, new signage, constructing vehicle pullouts, removal of the existing culverts at Lost Creek, and existing highway abandonment (including retaining portions to provide access to adjacent land facilities).

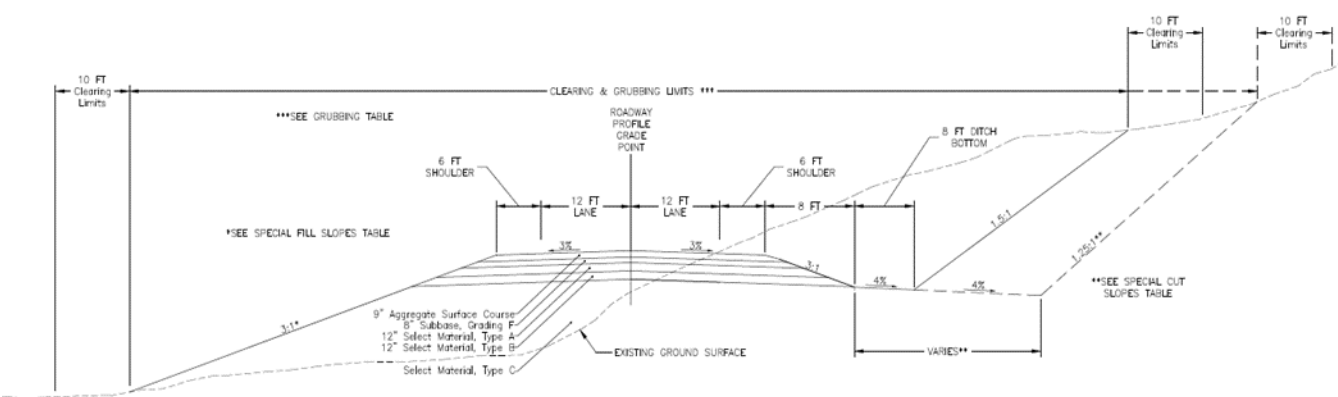
Project Location



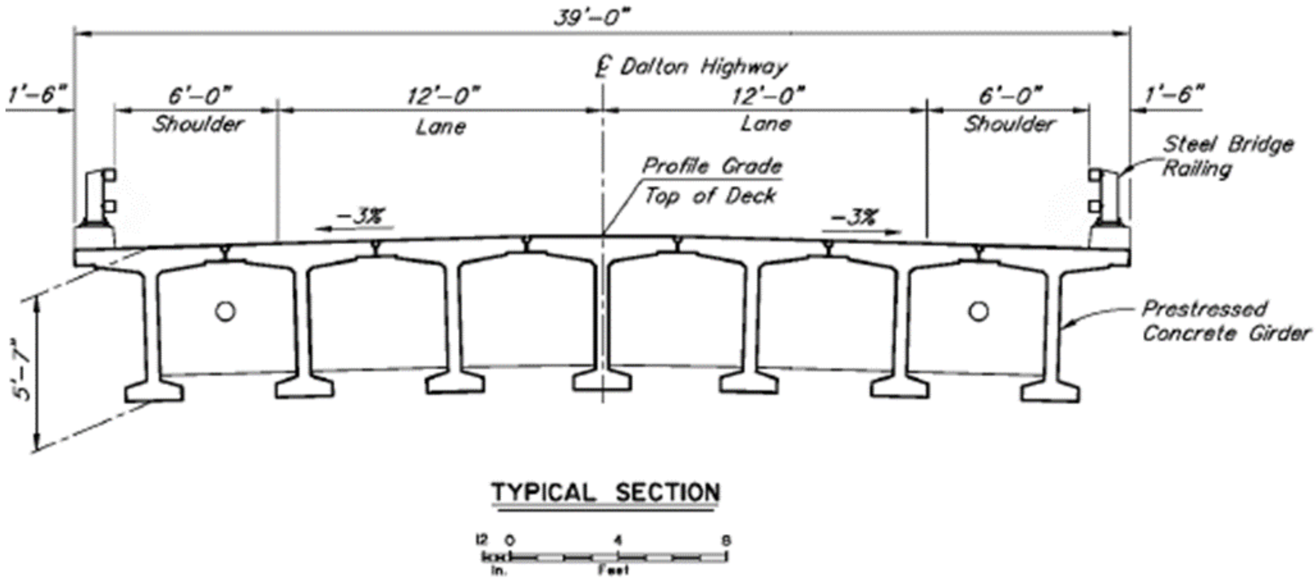
Project Plan – Image



Typical Rodway Cross Section



Typical Bridge Cross Section



PROPOSAL SUMMARY

Prop. #	VALUE ENGINEERING ALTERNATIVES	Current Concept	VE Proposal	Difference	LCCA 30 Year Difference
D1a	Drainage - Pipe Culvert - Culvert Gauge	$ 801,000	$ 1,341,000	$ (540,000)	$ 267,000
D1b	Drainage - Pipe Culvert Material Upgrade	$ 790,000	$ 1,396,000	$ (606,000)	$ 100,000
D2	Drainage - Pipe Installation Method	$ 493,000	$ 251,000	$ 242,000	
D3	Drainage - Pipe Bedding - Insulated	$ 790,000	$ 1,233,000	$ (443,000)	$ 264,000
B1	Bridge - Structural Design Refinement	$ 2,334,000	$ 1,915,000	$ 419,000	
B2	Bridge - Width Criteria	$ 2,334,000	$ 2,051,000	$ 283,000	
B3	Bridge - Span	$ 2,334,000	$ 2,057,000	$ 277,000	
B4	Bridge - Structural Plate	$ 2,334,000	$ 1,265,000	$ 1,069,000	
R1	Roadway Construction - Materials Sourcing	$ 20,436,000	$ 17,082,000	$ 3,354,000	
R2	Roadway - Surface	$ 2,904,000	$ 2,684,000	$ 220,000	$ 6,702,000
R3	Roadway - Surface Section	$ 4,320,000	$ 3,210,000	$ 1,110,000	
G1	Geotechnical - Permafrost Provisions - Thermal Berms	$ 9,185,000	$ 10,527,000	$ (1,342,000)	
G2	Geotechnical - Permafrost Provisions - Tundra Excavation	$ 198,000	$ 124,000	$ 74,000	
G3	Geotechnical - Permafrost Provisions - Deep Excavation / Oversized Embankments	$ 11,500,000	$ 7,351,000	$ 4,149,000	
G4	Geotechnical - Permafrost Provisions - ACE Embankment Height	$ 10,768,000	$ 12,723,000	$ (1,955,000)	
C1	Construction - Schedule	$ 8,155,000	$ 5,659,000	$ 2,496,000	
	Technical Comments				
T1	Material Criteria - Degradation Values				
T2	Construction Delivery				
T3	Construction Considerations				
T4	Utilities - Pipeline Casing				
T5	Planning - Alignment				
	LCCA indicates life cycle cost analysis				

VE PROPOSALS

	PROPOSAL	D1A
COMPONENT : Drainage – Pipe Culvert – Culvert Gauge	**AUTHOR**	RDP

CURRENT CONCEPT:

Existing culverts will be replaced with new corrugated steel pipe (CSP) culverts; diameters include 18", 24", 36", 48", and 72".

VE CONCEPT:

Increase pipe thickness (gage) of CSP culverts in areas of poor soils with high probability of settlement to increase structural strength and extend functional life. Install deadman end anchors on W Fork Tolovona Tributary and Rosebud Creek culverts.

FUNCTIONS		
Convey water	Support Loads	Resist deformation

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 801,000	$ 1,341,000	$ (540,000)
$ 1,607,982 (LCCA)	$ 1,341,000 (LCCA)	$ 266,982 (LCCA)

ADVANTAGES:

- Improved culvert performance
- Reduced pipe deformation
- Reduced maintenance
- Life cycle cost savings

DISADVANTAGES:

- Increased initial construction costs

	PROPOSAL	D1A
COMPONENT : Drainage – Pipe Culvert – Culvert Gauge	**AUTHOR**	RDP

DISCUSSION:

Consider installing heavy-gage (10- or 12-gage) CSP culverts in areas of known poor soils (ice-rich soils). Heavy gage pipes have greater structural strength to resist deformation from settlement, frost-jacking, and aufeis formation. Heavy gage pipes also increase design life in areas of high abrasion and/or corrosion.

Installation of deadman end anchors on large pipes (48” and 72”) may also reduce effects of settlement on culverts.

Unit costs of heavy-gage (10/12-gage) pipe are roughly twice those of standard 16-gage pipe. Higher initial construction costs are offset by 30-year life cycle maintenance costs, assuming eventual need to replace standard 16-gage culverts (50% of 36” and smaller pipes, and the 48” and 72” pipes assumed) due to settlement- or abrasion-related failure.

		PROPOSAL	D1A
COMPONENT : Drainage – Pipe Culvert – Culvert Gauge		**AUTHOR**	RDP

D1 Drainage - Pipe Costs by Gage

Unit cost calculations for standard and heavy gage pipe

Estimate Costs			Contech 16GA WS	Markup
CSP 18 Inch	$ 90	LF	$ 25	3.60
CSP 24 Inch	$ 150	LF	$ 30	5.00
CSP 36 Inch	$ 200	LF	$ 45	4.44
CSP 48 Inch	$ 300	LF	$ 60	5.00
CSP 72 Inch	$ 400	LF	$ 100	4.00
			Ave:	4.41

Contech Unit Costs 6/8/2017

Assumes welded seams and wide bands for joints; 20-foot stick lengths

	16 GA WS	12 GA WS	10 GA WS	12/16 Markup	10/16 Markup
CSP 18 Inch	$ 25	$ 37	N/A	1.48	
CSP 24 Inch	$ 30	$ 50	N/A	1.67	
CSP 36 Inch	$ 45	$ 74	$ 93	1.64	2.07
CSP 48 Inch	$ 60	$ 98	$ 123	1.63	2.05
CSP 72 Inch	$ 100	$ 165	$ 210	1.65	2.10
			Ave:	1.61	2.07

Unit Costs*	12 GA WS	10 GA WS
CSP 18 Inch	$ 163	
CSP 24 Inch	$ 220	
CSP 36 Inch	$ 326	$ 410
CSP 48 Inch	$ 432	$ 542
CSP 72 Inch	$ 727	$ 926

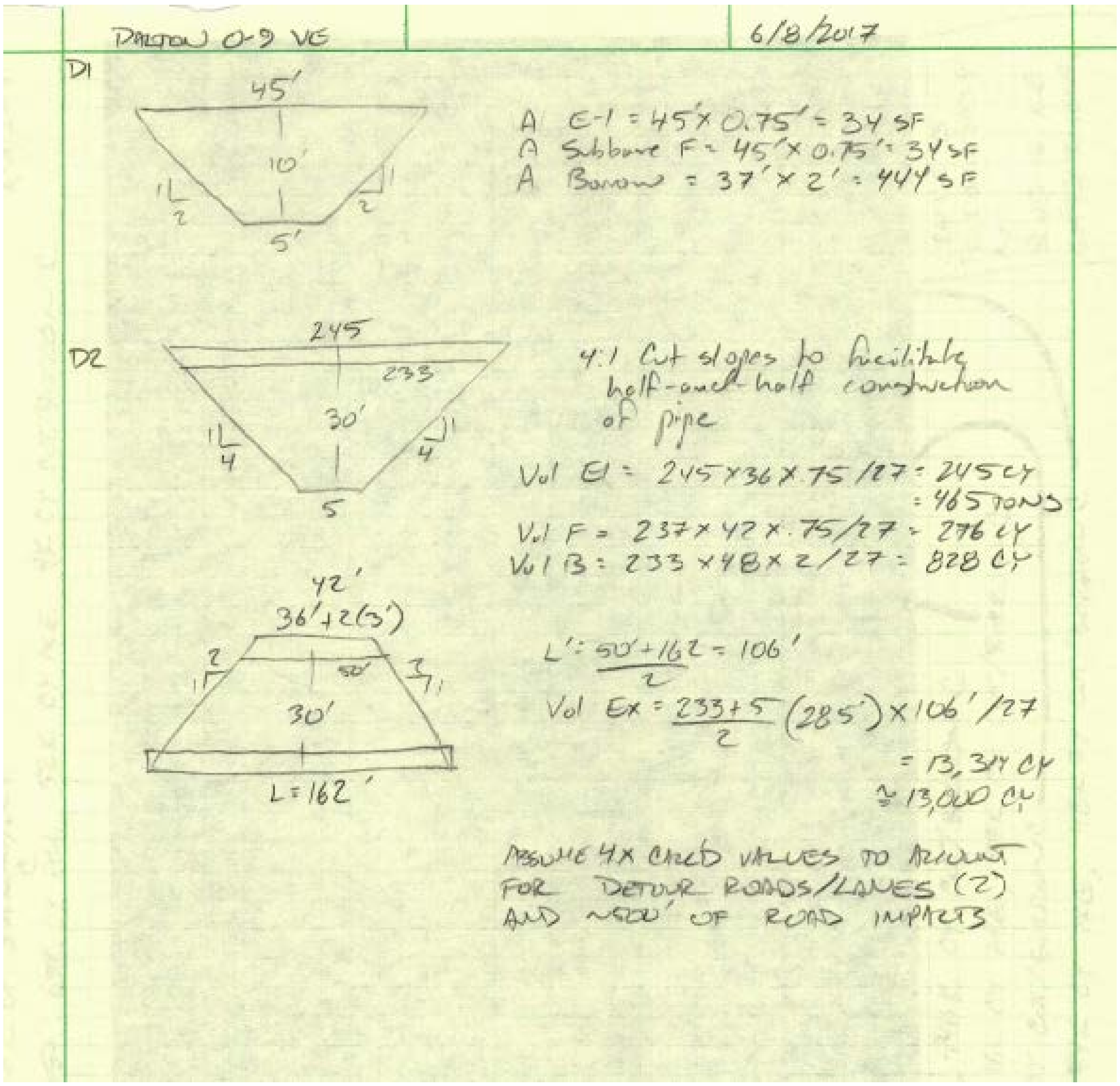
*Using 4.41 scale up on estimate costs

Unit Costs*	12 GA WS	10 GA WS
CSP 18 Inch	$ 145	
CSP 24 Inch	$ 242	
CSP 36 Inch	$ 323	$ 414
CSP 48 Inch	$ 484	$ 622
CSP 72 Inch	$ 646	$ 829

*Using 1.61 and 2.07 base scale up

Unit Costs	12 GA WS	10 GA WS
CSP 18 Inch	$ 160	$ -
CSP 24 Inch	$ 240	$ -
CSP 36 Inch	$ 330	$ 420
CSP 48 Inch	$ 460	$ 590
CSP 72 Inch	$ 690	$ 880

	PROPOSAL	D1A
COMPONENT : Drainage – Pipe Culvert – Culvert Gauge	**AUTHOR**	RDP



DALTON 0-9 VE

6/8/2017

D1

45'

10'

1
2

1
2

5'

A E-1 = 45' × 0.75' = 34 SF
A Subbase F = 45' × 0.75' = 34 SF
A Borrow = 37' × 2' = 44 SF

D2

245

233

30'

1
4

1
4

5

4:1 Cut slopes to facilitate half-and-half construction of pipe

Vol E1 = 245 × 36 × .75 / 27 = 245 CY
= 465 TONS
Vol F = 237 × 42 × .75 / 27 = 276 CY
Vol B = 233 × 48 × 2 / 27 = 828 CY

42'
36' + 2(3')

2
1

50'

3
1

30'

L = 162'

L' = (50' + 162) / 2 = 106'

Vol Ex = (233 + 5) / 2 (285) × 106' / 27
= 13,314 CY
≈ 13,000 CY

ASSUME 4X CALC'D VALUES TO ACCOUNT FOR DETOUR ROADS/LANES (2) AND ~500' OF ROAD IMPACTS

COMPONENT LIFE CYCLE COST ANALYSIS (LCCA) **D1a**

Project:	**Dalton Highway MP 0 - 9 Reconstruction**
Client:	**Alaska Department of Transportation and Public Facilities**
Date:	**6/9/2017**
By:	
COMPONENT	**Drainage -Pipe Culvert - Culvert Gauge**
COMPONENT #	**D1a**
Escalation rate	**0.03**
Discount rate	**0.015**
Study Period	**30** Yrs.

Instructions: Enter escalation, discount, and study period above.
Enter annual costs, replacement costs (and appropriate replacement year), and salvage value.
Enter these costs in the shaded cells using today's (current) dollars. For annual costs, escalation rates will be automatically entered,
but can be individually overwritten below for differential escalation.
All costs will automatically be escalated and discounted.

ALTERNATIVE A : Current design			**Std CSP Culverts**	**ALTERNATIVE B:**			**Heavy gage CSP Culverts**	**DIFFERENCE**
INITIAL COSTS			INITIAL COST				INITIAL COST	DIFFERENCE
			$ 801,000				**$ 1,341,000**	**$ (540,000)**
O & M ANNUAL COSTS								
STAFFING OPERATIONS		**ENERGY**						
STAFFING MAINTENANCE								
SUPPLIES OPERATIONS								
SUPPLIES MAINTENANCE								
Subcomponents	**Cost in current $**	**Esc.**	**Pres. Worth $**	**Subcomponents**	**Cost in current $**	**Esc.**	**Pres. Worth $**	
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
SUBT. O & M OVER LIFE CYCL	**$ -**		**$ -**		**-**		**$ -**	**$ -**
REPLACEMENT and CYCLICAL COSTS								
Subcomponents	**Cost in current $**	**Yr.**	**Pres. Worth $**	**Subcomponents**	**Cost in current $**	**Yr.**	**Pres. Worth $**	
CSP 18 Inch	$ 5,400	15	$ 6,729				$ -	**$ 6,729**
CSP 24 Inch	$ 75,000	15	$ 93,461				$ -	**$ 93,461**
CSP 36 Inch	$ 250,000	15	$ 311,536				$ -	**$ 311,536**
CSP 48 Inch	$ 36,000	15	$ 44,861				$ -	**$ 44,861**
CSP 72 Inch	$ 104,000	15	$ 129,599				$ -	**$ 129,599**
Borrow	$ 90,033	15	$ 112,194				$ -	**$ 112,194**
Aggregate Surface Course, E1	$ 62,877	15	$ 78,354				$ -	**$ 78,354**
Subbase, Grading F	$ 8,273	15	$ 10,310				$ -	**$ 10,310**
Thaw Pipe 1/2 Inch Diameter	$ 16,000	15	$ 19,938				$ -	**$ 19,938**
SUBT. REPLACEMENT			**$ 806,982**				**$ -**	**$ 806,982**
TOT. O & M & REPL. (Pres. Worth)			**$ 806,982**				**$ -**	**$ 806,982**
TOT. INITIAL, O&M, & REPL. (Pres. Worth)			**$ 1,607,982**				**$ 1,341,000**	**$ 266,982**
	Cost in current $				**Cost in current $**			
SALVAGE VALUE		30	$ -			30	$ -	**$ -**
TOT. INITIAL, O&M, REPL. MINUS SALVAGE			**$ 1,607,982**				**$ 1,341,000**	**$ 266,982**

State of Alaska Department of Transportation & Public Facilities
Dalton Highway MP 0-9 Reconstruction

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Drainage - Pipe Culvert - Culvert Gauge

D1a

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
CSP 18 Inch	120	LF	$ 90	10,800	CSP 18 Inch, 12 Gage	60	LF	$ 160	9,600
CSP 24 Inch	1,000	LF	$ 150	150,000	CSP 24 Inch, 12 Gage	500	LF	$ 240	120,000
CSP 36 Inch	2,500	LF	$ 200	500,000	CSP 36 Inch, 10 Gage	1,250	LF	$ 420	525,000
CSP 48 Inch	120	LF	$ 300	36,000	CSP 48 Inch, 10 Gage	120	LF	$ 590	70,800
CSP 72 Inch	260	LF	$ 400	104,000	CSP 72 Inch, 10 Gage	260	LF	$ 880	228,800
					Deadman	4	EA	$14,000	56,000
					CSP 18 Inch	60	LF	$ 90	5,400
					CSP 24 Inch	500	LF	$ 150	75,000
					CSP 36 Inch	1,250	LF	$ 200	250,000
Assumes estimate unit costs are for standard 16 gage pipe					Assumes 50% of pipes (<48") upgraded to heavy gage pipe				
30-year life cycle assumes 50% of pipes (<48") replaced due to settlement					Assumes 48" and 72" upgraded to heavy gage pipe				
Assumes 48" (WFT Trib #1) and 72" (Rosebud) replaced due to settlment					Geotech prelim suggest ~42% of alignment is on ice-rich soils				
Subtotal				800,800	Subtotal				1,340,600
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				801,000	Total to nearest $1000				1,341,000
					Difference				(540,000)

MENG Analysis
DOWL

Proposal **D1a**

	PROPOSAL	D1B
COMPONENT: Drainage – Pipe Culvert Material Upgrade	**AUTHOR**	RDP

CURRENT CONCEPT:

Existing culverts will be replaced with new corrugated steel pipe (CSP) culverts; diameters include 18”, 24”, 36”, 48”, and 72”.

VE CONCEPT:

Use straight-walled steel pipe (pile pipe) in lieu of CSP culverts in areas of poor soils with high probability of settlement to increase structural strength and extend functional life.

FUNCTIONS

Convey Water	Support Loads	Resist Deformation

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 790,000	$ 1,396,000	$ (606,000)
$ 1,496,458 (LCCA)	$ 1,396,000 (LCCA)	$ 100,458 (LCCA)

ADVANTAGES:

- Improved culvert performance
- Welded joints
- Reduced pipe deformation
- Reduced maintenance
- Life cycle cost savings

DISADVANTAGES:

- Increased initial construction costs
- Higher handling weights

	PROPOSAL	D1B
COMPONENT: Drainage – Pipe Culvert Material Upgrade	**AUTHOR**	RDP

DISCUSSION:

Consider installing straight-walled heavy steel culverts (steel pile) in areas of known poor soils (ice-rich soils). Steel pile pipes have greater structural strength to resist deformation from settlement, frost-jacking, and aufeis formation. Because sticks of pipe are welded together, there is very low risk of pipe separation due to differential settlement or heaving. Steel pile pipes also increase design life in areas of high abrasion and/or corrosion.

Steel pile pipe segments must be welded together during installation and may be more difficult to furnish relative to CSP. Steel pile pipe is substantially heavier per linear foot than CSP so may require larger equipment to install.

Unit costs of steel pile pipe are roughly 2.5 times those of standard CSP. Higher initial construction costs are offset by 30-year life cycle maintenance costs, assuming eventual need to replace CSP culverts (50% of 24” and 36” pipes, and the 48” and 72” pipes assumed) due to settlement- or abrasion-related failure.

COMPONENT LIFE CYCLE COST ANALYSIS (LCCA)

D1b

Project: Dalton Highway MP 0 - 9 Reconstruction
Client: Alaska Department of Transportation and Public Facilities
Date: 6/9/2017
By:
COMPONENT Drainage - Pipe Culvert Material Upgrade
COMPONENT # D1b
Escalation rate 0.03
Discount rate 0.023
Study Period 30 Yrs.

Instructions: Enter escalation, discount, and study period above.
Enter annual costs, replacement costs (and appropriate replacement year), and salvage value.
Enter these costs in the shaded cells using today's (current) dollars. For annual costs, escalation rates will be automatically entered,
but can be individually overwritten below for differential escalation.
All costs will automatically be escalated and discounted.

ALTERNATIVE A : Current design			Std CSP Culverts	ALTERNATIVE B:			Steel Pile Culverts	DIFFERENCE
INITIAL COSTS			INITIAL COST				INITIAL COST	DIFFERENCE
			$ 790,000				$ 1,396,000	$ (606,000)
O & M ANNUAL COSTS								
STAFFING OPERATIONS		ENERGY						
STAFFING MAINTENANCE								
SUPPLIES OPERATIONS								
SUPPLIES MAINTENANCE								
Subcomponents	Cost in current $	Esc.	Pres. Worth $	Subcomponents	Cost in current $	Esc.	Pres. Worth $	
		0.03	$ -			0.030	$ -	$ -
		0.03	$ -			0.030	$ -	$ -
		0.03	$ -			0.030	$ -	$ -
		0.03	$ -			0.030	$ -	$ -
		0.03	$ -			0.030	$ -	$ -
		0.03	$ -			0.030	$ -	$ -
		0.03	$ -			0.030	$ -	$ -
SUBT. O & M OVER LIFE CYCL	$ -		$ -		-		$ -	$ -
REPLACEMENT and CYCLICAL COSTS								
Subcomponents	Cost in current $	Yr.	Pres. Worth $	Subcomponents	Cost in current $	Yr.	Pres. Worth $	
CSP 24 Inch	$ 75,000	15	$ 83,078				$ -	$ 83,078
CSP 36 Inch	$ 250,000	15	$ 276,926				$ -	$ 276,926
CSP 48 Inch	$ 36,000	15	$ 39,877				$ -	$ 39,877
CSP 72 Inch	$ 104,000	15	$ 115,201				$ -	$ 115,201
Borrow	$ 87,567	15	$ 96,998				$ -	$ 96,998
Aggregate Surface Course, E1	$ 61,155	15	$ 67,741				$ -	$ 67,741
Subbase, Grading F	$ 8,047	15	$ 8,913				$ -	$ 8,913
Thaw Pipe 1/2 Inch Diameter	$ 16,000	15	$ 17,723				$ -	$ 17,723
SUBT. REPLACEMENT			$ 706,458				$ -	$ 706,458
TOT. O & M & REPL. (Pres. Worth)			$ 706,458				$ -	$ 706,458
TOT. INITIAL, O&M, & REPL. (Pres. Worth)			$ 1,496,458				$ 1,396,000	$ 100,458
	Cost in current $				Cost in current $			
SALVAGE VALUE		30	$ -			30	$ -	$ -
TOT. INITIAL, O&M, REPL. MINUS SALVAGE			$ 1,496,458				$ 1,396,000	$ 100,458

State of Alaska Department of Transportation & Public Facilities
Dalton Highway MP 0-9 Reconstruction

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Drainage - Pipe Culvert Material Upgrade

D1b

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
CSP 24 Inch	1,000	LF	$ 150	150,000	Steel Pile, 24 Inch	500	LF	$ 290	145,000
CSP 36 Inch	2,500	LF	$ 200	500,000	Steel Pile, 36 Inch	1,250	LF	$ 460	575,000
CSP 48 Inch	120	LF	$ 300	36,000	Steel Pile, 48 Inch	120	LF	$ 540	64,800
CSP 72 Inch	260	LF	$ 400	104,000	Stele Pile, 72 Inch	260	LF	$ 1,100	286,000
					CSP 24 Inch	500	LF	$ 150	75,000
30-year life cycle assumes 50% of 24" and 36" pipes replaced					CSP 36 Inch	1,250	LF	$ 200	250,000
Assumes 48" (WFT Trib #1) and 72" (Rosebud) replaced due to settlment									
					Assumes 50% of 24" and 36" culverts upgraded to steel pile				
					Assumes 48" and 72" culverts upgraded to steel pile				
					Geotech prelim suggest ~42% of alignment is on ice-rich soils				
					Assumes bid cost is 2x material cost from supplier				
Subtotal				790,000	Subtotal				1,395,800
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				790,000	Total to nearest $1000				1,396,000
					Difference				(606,000)

MENG Analysis
DOWL

Proposal **D1b**

	PROPOSAL	D2
COMPONENT: Drainage – Pipe Installation Method	**AUTHOR**	RDP

CURRENT CONCEPT:

Replacement of existing culverts along existing highway segments of project (MP 6.5 to 9 and Elliott Highway) will be completed through traditional open-cut excavation.

VE CONCEPT:

Replace deep-fill culverts (e.g., MP 8 culvert) via pipe ramming trenchless technologies. Decommission and abandon existing pipes in place.

FUNCTIONS		
Convey Water	Support Loads	Protect Embankment

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 493,000	$ 251,000	$ 242,000

ADVANTAGES:

- Overall reduced installation cost
- Reduced impacts to traffic operations
- Reduced traffic maintenance/control costs
- Reduced maintenance
- Reduced differential settlement

DISADVANTAGES:

- Requires specialized contractor experience
- Lower tolerances on grade/alignment
- Risk of pipe refusal
- Frozen soils may limit feasibility

	PROPOSAL	D2
COMPONENT: Drainage – Pipe Installation Method	**AUTHOR**	RDP

DISCUSSION:

Consider installing replacement culverts in deep-fill locations along existing highway alignment (e.g., MP 8 culvert, station ~520+00) using pipe ramming trenchless technologies instead of traditional open-cut excavation. Pipe ramming will allow highway to stay open to traffic with minimal impacts during culvert installation, with subsequent reductions in traffic maintenance and traffic control costs. Open-cut excavation for culvert replacement will likely require detour roads/lanes to keep the highway open to traffic during culvert replacement work; a short road closure may also be required, which would impact traffic operations along the highway.

Pipe ramming also allows the existing embankment material to stay in place; excavation and backfill for open-cut installation increases the risk of differential settlement and long-term maintenance issues as embankment reconsolidates. M&O staff will not have to address differential settlement from reconstructed portion of road.

Pipe ramming requires the contractor/subcontractor to be experienced with technology to complete work. Trenchless installation includes the risk of the rammed pipe striking an obstruction, requiring a contingency plan being in place with potential excavation to resolve. Ramming a pipe through frozen soils may not be feasible, though it is existing embankment is likely not frozen. Rammed pipe typically has a lower tolerance for the finished pipe grade and alignment; aiming the pipe is only realistic within the first 10 to 20 feet of installation.

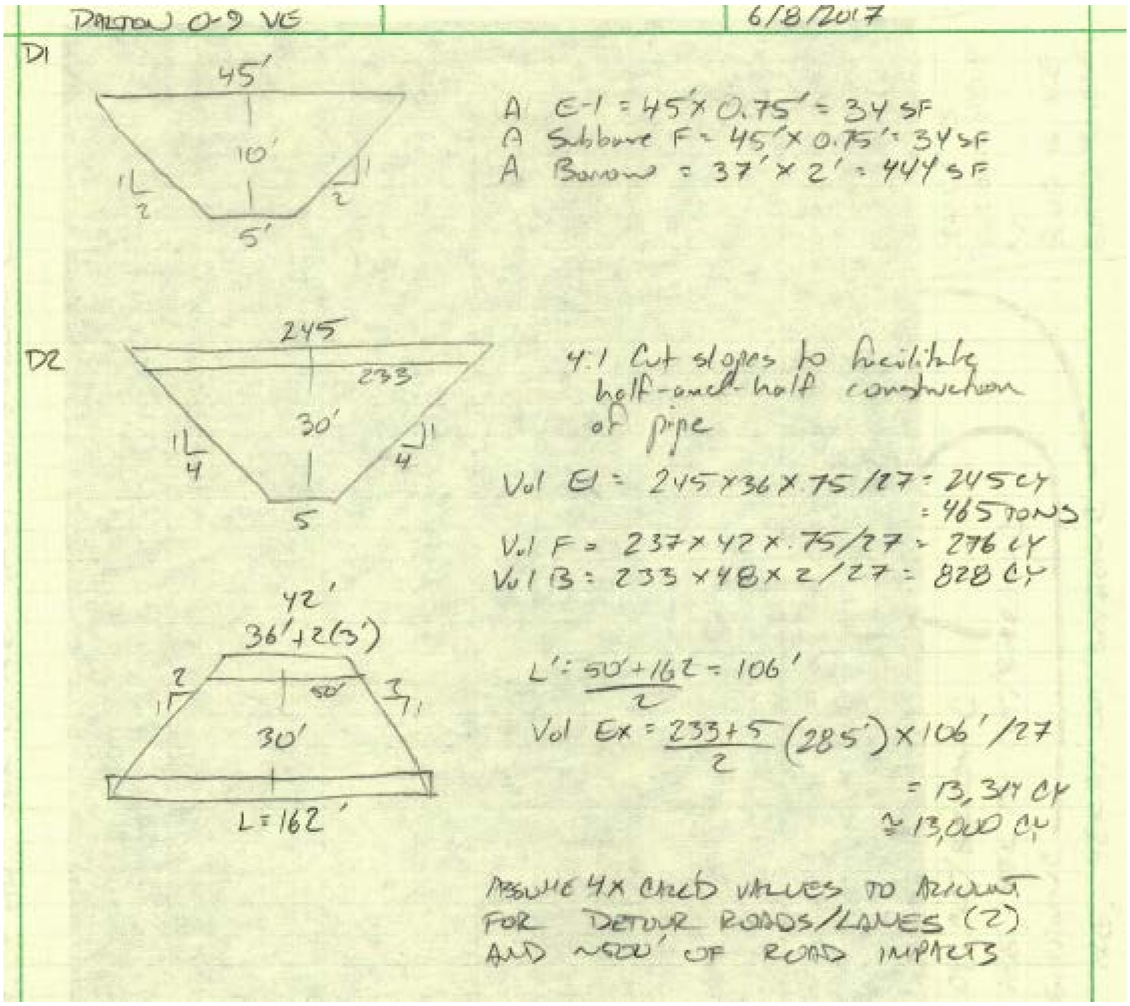
PROPOSAL	D2

COMPONENT: Drainage – Pipe Installation Method	**AUTHOR**	RDP

D1b - Drainage Steel Pile Unit Costs

Year	Project	Item	Quantity	Eng Est % of Bid	Min Bid Low Bidder	Avg Bid 2nd Low Bidder	Max Bid 3rd Low Bidder		
2009 12	Dalton Hwy Culverts MP 260-321	505(5) Furnish Structural Steel Piles – HP 12x53	702 LF	55	52	100.67	300	$ 151	
				0.18%	52	100	56		
2016 01	Denali Hwy Seattle Ck	505(5) Furnish... Pile (1'-6" dia pipe)	480 LF	200	88	117.6	141.41	$ 116	
				2.78%	121	133	88		
2013 06	Elliott Hwy Livengood Ck Bridge	505(5) Furnish... Pile (1'-6" dia)	580 LF	140	112	167.57	250	$ 177	$ 148
				3.45%	210	112	250		
2016 11	Richardson MP 235 Ruby Ck Bridge #0594	505(5) Furnish Structural Steel Piles (2'-0" dia)	1524.8 LF	150	125	152.31	182	$ 153	
				3.45%	170	125	130		
2016 01	Tok Cutoff MP 17 Tulsona Ck	505(5) Furnish... Pile (2'0" dia ½" Pipe Pile)	896 LF	150	155.55	151.79	200	$ 169	
				3.40%	170	160	160		
2014 08	Parks Hwy MP 237 Riley Ck	505(5) Furnish... Piles (2'-0" Pipe)	1213.6 LF	185	184	190.38	196.75	$ 190	$ 171
				1.92%	196.75	-	-		
2015 11	Tok Cutoff MP 75.6 Slana River Bridge	505(5B) Furnish... Piles (3'-0" PIPE)	441.3 LF	400	275	425.14	750	$ 483	
				2.40%	275	320	525		
2015 05	Edgerton Hwy Lakina River Bridge	505(5B) Furnish... Piles (3'-0" Dia. Pipe)	459 LF	500	327.67	368.46	440	$ 379	
				3.90%	356.17	327.67	440		
2015 04	Richardson Hwy MP 295 Banner Ck Bridge	505(5B) Furnish... Piles (3'-0" Dia. Pipe)	366 LF	500	181.5	370.63	495	$ 349	
				2.65%	181.5	400	360		
2014 11	Tok Cutoff MP 104 Tok River Bridge	505(5B) Furnish... Plies (3'-0" pipe)	1200.9 LF	350	350	421.57	480	$ 417	
				4.10%	480	350	375		
2014 08	Parks Hwy MP 237 Riley Ck	505(5B) Furnish... Piles (3'-0" Pipe)	634.8	320	621	655.22	693.43	$ 657	$ 457
				1.73%	689.43	-	-		

	PROPOSAL	D2
COMPONENT: Drainage – Pipe Installation Method	**AUTHOR**	RDP



Dalton Highway MP 0-9 Reconstruction
State of Alaska Department of Transportation & Public Facilities

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Drainage - Pipe Installation Method

D2

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
CSP 36 Inch	162	LF	$ 200	32,400	36 Inch Steel Pipe, Rammed	162	LF	$ 1,500	243,000
Removal of Culvert Pipe	1	EA	$ 2,500	2,500	Decommision of Culvert Pipe	162	LF	$ 50	8,100
Unclassified Excavation	52,000	CY	$ 6.5	338,000					
Borrow	3,320	CY	$ 5	16,600	Assumes failed pipe at MP 8 under 30' fill replaced by pipe ramming.				
Aggregate Surface Course, E1	1,860	Ton	$ 24	44,640	Assumes existing pipe decommissioned and abandoned in place.				
Subbase, Grading F	1,110	CY	$ 6	6,660					
Traffic Maintenance	1	LS	$ 12,000	12,000					
Traffic Control	1	CSUM	$ 40,000	40,000					
Earthwork quantities assume two detour roads/lanes necessary for									
half-and-half culvert construction; detours ~500' long.									
Traffic Maintenance and Traffic Control assumed as 10% of									
project totals; MP 8 culvert is the primary deep-fill culvert to									
be replaced within existing highway reconstruction segment.									
Subtotal				492,800	Subtotal				251,100
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				493,000	Total to nearest $1000				251,000
					Difference				242,000

MENG Analysis
DOWL

Proposal **D2**

	PROPOSAL	D3
COMPONENT: Drainage – Pipe Bedding - Insulated	**AUTHOR**	RDP

CURRENT CONCEPT:

Existing culverts will be replaced with new corrugated steel pipe (CSP) culverts.

VE CONCEPT:

Add insulation board in bottom of culvert trench (below bedding, up to Selected Material, Type A/B) in areas of ice-rich soils to reduce risk of permafrost degradation and subsequent embankment settlement and pipe deformation.

FUNCTIONS

Convey Water	Protect Embankment	Protect Permafrost

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 790,000	$ 1,233,000	$ (443,000)
$ 1,496,458 (LCCA)	$ 1,233,000 (LCCA)	$ 263,458 (LCCA)

ADVANTAGES:

- Reduced settlement
- Improved culvert performance
- Reduced maintenance
- Life cycle cost savings

DISADVANTAGES:

- Increased initial construction costs

	PROPOSAL	D3
COMPONENT: Drainage – Pipe Bedding - Insulated	**AUTHOR**	RDP

DISCUSSION:

Consider installing insulation board in the bottom of the trench for CSP culvert installation in areas of known ice-rich soils. Insulation board reduces heat transfer from new embankment to underlying permafrost, reducing subsequent settlement and pipe deformation from permafrost thaw.

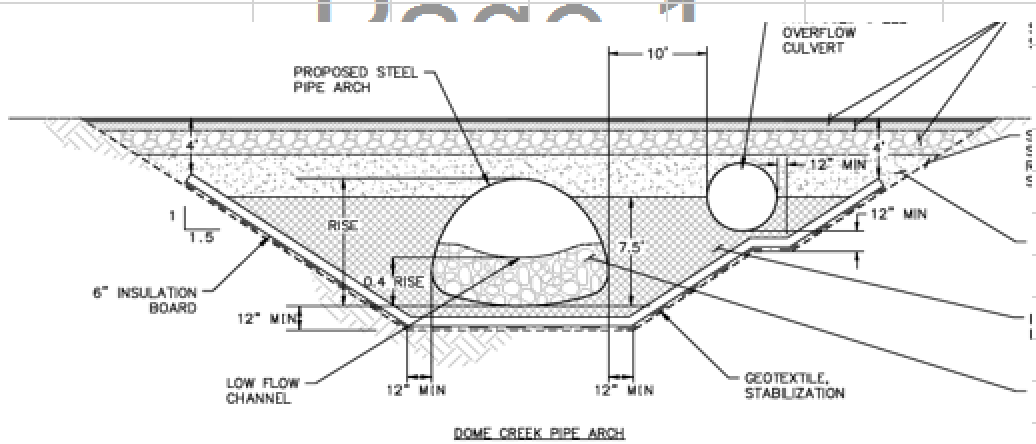
Higher initial construction costs are offset by 30-year life cycle maintenance costs, assuming eventual need to replace culverts (50% of 36” and smaller pipes and the 48” and 72” pipes) due permafrost thaw, settlement, and pipe deformation.

		PROPOSAL	D3
COMPONENT: Drainage – Pipe Bedding - Insulated		**AUTHOR**	RDP

D3 Drainage - Insulation Board Calculations

	Dome	72"	48"	36"
Trench Width	15.25	8	6	5
Height of Crown	10.33	7	5	4
Side Length	18.6	12.6	9.0	7.2
Trench Perimeter at Crown	52.5	33.2	24.0	19.4
MBM/LF	0.31	0.20	0.14	0.12
$1000/MBM				
Dome Actual MBM/LF	0.70			
Scale BY:	220.86%	0.44	0.32	0.26
Dalton MBM/LF	**AVG**	**0.32**	**0.23**	**0.19**
$/LF	**$ 315**	**$ 320**	**$ 231**	**$ 187**

1MBM = 1000 SF x 1" Thick



Dome Creek crossing used from Elliott Highway MP 0-12 project; designed 2017.

COMPONENT LIFE CYCLE COST ANALYSIS (LCCA) **D3**

Project:	**Dalton Highway MP 0 - 9 Reconstruction**
Client:	**Alaska Department of Transportation and Public Facilities**
Date:	**6/9/2017**
By:	
COMPONENT	**Drainage - Pipe Bedding - Insulated**
COMPONENT #	**D3**
Escalation rate	**0.03**
Discount rate	**0.023**
Study Period	**30** Yrs.

Instructions: Enter escalation, discount, and study period above.
Enter annual costs, replacement costs (and appropriate replacement year), and salvage value.
Enter these costs in the shaded cells using today's (current) dollars. For annual costs, escalation rates will be automatically entered,
but can be individually overwritten below for differential escalation.
All costs will automatically be escalated and discounted.

ALTERNATIVE A : Current design			**Std CSP Culverts**	**ALTERNATIVE B:**			**Std CSP Culverts with Insulation**	**DIFFERENCE**
INITIAL COSTS			**INITIAL COST**				**INITIAL COST**	**DIFFERENCE**
			$ 790,000				**$ 1,233,000**	**$ (443,000)**
O & M ANNUAL COSTS								
STAFFING OPERATIONS		**ENERGY**						
STAFFING MAINTENANCE								
SUPPLIES OPERATIONS								
SUPPLIES MAINTENANCE								
Subcomponents	**Cost in current $**	**Esc.**	**Pres. Worth $**	**Subcomponents**	**Cost in current $**	**Esc.**	**Pres. Worth $**	
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
SUBT. O & M OVER LIFE CYCL	**$ -**		**$ -**		**-**		**$ -**	**$ -**
REPLACEMENT and CYCLICAL COSTS								
Subcomponents	**Cost in current $**	**Yr.**	**Pres. Worth $**	**Subcomponents**	**Cost in current $**	**Yr.**	**Pres. Worth $**	
CSP 24 Inch	$ 75,000	15	$ 83,078				$ -	**$ 83,078**
CSP 36 Inch	$ 250,000	15	$ 276,926				$ -	**$ 276,926**
CSP 48 Inch	$ 36,000	15	$ 39,877				$ -	**$ 39,877**
CSP 72 Inch	$ 104,000	15	$ 115,201				$ -	**$ 115,201**
Borrow	$ 87,567	15	$ 96,998				$ -	**$ 96,998**
Aggregate Surface Course, E1	$ 61,155	15	$ 67,741				$ -	**$ 67,741**
Subbase, Grading F	$ 8,047	15	$ 8,913				$ -	**$ 8,913**
Thaw Pipe 1/2 Inch Diameter	$ 16,000	15	$ 17,723				$ -	**$ 17,723**
SUBT. REPLACEMENT			**$ 706,458**				**$ -**	**$ 706,458**
TOT. O & M & REPL. (Pres. Worth)			**$ 706,458**				**$ -**	**$ 706,458**
TOT. INITIAL, O&M, & REPL. (Pres. Worth)			**$ 1,496,458**				**$ 1,233,000**	**$ 263,458**
	Cost in current $				**Cost in current $**			
SALVAGE VALUE		30	$ -			30	$ -	**$ -**
TOT. INITIAL, O&M, REPL. MINUS SALVAGE			**$ 1,496,458**				**$ 1,233,000**	**$ 263,458**

COST ESTIMATE FORM

COMPONENT: Drainage - Pipe Bedding - Insulated

D3

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
CSP 24 Inch	1,000	LF	$ 150	150,000	CSP 24 Inch	1,000	LF	$ 150	150,000
CSP 36 Inch	2,500	LF	$ 200	500,000	CSP 36 Inch	2,500	LF	$ 200	500,000
CSP 48 Inch	120	LF	$ 300	36,000	CSP 48 Inch	120	LF	$ 300	36,000
CSP 72 Inch	260	LF	$ 400	104,000	CSP 72 Inch	260	LF	$ 400	104,000
30-year life cycle assumes 50% of 24" & 36" pipes replaced due to settlement					Insulation Board, 24" CSP	95	MBM	$ 1,000	95,000
Assumes 48" (WFT Trib #1) and 72" (Rosebud) replaced due to settlment					Insulation Board, 36" CSP	238	MBM	$ 1,000	237,500
					Insulation Board, 48" CSP	28	MBM	$ 1,000	27,600
					Insulation Board, 72" CSP	83	MBM	$ 1,000	83,200
					Assumes insulation used with 50% of 24" and 36" pipes				
					Assumes insulation used with 48" and 72" pipes				
					Geotech prelim suggest ~42% of alignment is on ice-rich soils				
Subtotal				790,000	Subtotal				1,233,300
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				790,000	Total to nearest $1000				1,233,000
					Difference				(443,000)

MENG Analysis
DOWL

Proposal **D3**

	PROPOSAL	B1
COMPONENT: Bridge – Structural Design Refinement	**AUTHOR**	MJM

CURRENT CONCEPT:

Lost Creek Bridge Crossing consisting of a single span pre-cast concrete bridge (39'x142.5' bulb-tee) on driven steel HP14x117 piles. Design also includes over 2,000 cubic yards of riprap (Classes I and III) for scour protection.

VE CONCEPT:

Refine the proposed design by adjusting the quantities and unit prices for the driven steel H-pile design and Class I and III riprap quantities.

FUNCTIONS		
Span Creek	Support Vehicles	Pass Fish

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 2,334,000	$ 1,915,000	$ 419,000

ADVANTAGES:

- Less cost
- Pile supply and driving requirements greatly reduced.
- Less riprap material to source.

DISADVANTAGES:

- Reduced riprap section may not provide adequate embankment protection based on the final hydraulic analysis

	PROPOSAL	B1
COMPONENT: Bridge – Structural Design Refinement	**AUTHOR**	MJM

DISCUSSION:

This VE proposal is based on reducing foundation and riprap material quantities. It is understood the proposed bridge design is based on a similar single span bridge crossing recently built at MP 265 which reportedly did not have shallow bedrock. As such, the pile quantities in the current concept may very well be placeholders. The VE proposal assumes the piles on the north abutment will extend through native soils and be driven to practical refusal at about 5 feet into the chert formation. On the south abutment, the piles will be much shorter on the order of 15 feet of length per pile and will be placed in core drilled holes and grouted in.

As for the reduction in riprap quantity, a reduction of 50% is based on a visual review of a cad drawing illustrating the extent of riprap in the vicinity of the bridge abutments and in both directions (North and South) along the road embankment.

State of Alaska Department of Transportation & Public Facilities
Dalton Highway MP 0-9 Reconstruction

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Bridge - Structural Design Refinement

B1

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
205(3) Structural Fill	1400	CY	35	49,000	205(3) Structural Fill	1400	CY	35	49,000
501(1) Class A Concrete	125	CY	2500	312,500	501(1) Class A Concrete	125	CY	2500	312,500
501(7) Precast Concrete Member	7	EA	110000	770,000	501(7) Precast Concrete Member	7	EA	110000	770,000
503(1) Reinforcing Steel	20000	LBS	2.5	50,000	503(1) Reinforcing Steel	20000	LBS	2.5	50,000
503(2) Epoxy Coated Rein Steel	10000	LBS	2.75	27,500	503(2) Epoxy Coated Rein Steel	10000	LBS	2.75	27,500
505(5) Furnish Steel H-Piles HP14x117	1400	LF	125	175,000	505(5) Furnish Steel H-Piles HP14x117	415	LF	125	51,875
505(6) Drive Steel H-Piles HP14x117	14	EA	20000	280,000	505(6) Drive Steel H-Piles HP14x117	14	EA	6500	91,000
507(1) Steel Bridge Railing	368	LF	275	101,200	507(1) Steel Bridge Railing	368	LF	275	101,200
512(X) Temporary Work Structure	2720	SF	125	340,000	512(X) Temporary Work Structure	2720	SF	125	340,000
606(16) Transition Rail	4	EA	4000	16,000	606(16) Transition Rail	4	EA	4000	16,000
611(A) Riprap, Class I	500	CY	75	37,500	611(A) Riprap, Class I	250	CY	75	18,750
611(B) Riprap, Class III	1750	CY	100	175,000	611(B) Riprap, Class III	875	CY	100	87,500
Subtotal				2,333,700	Subtotal				1,915,325
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				2,334,000	Total to nearest $1000				1,915,000
					Difference				419,000

MENG Analysis
DOWL

Proposal **B1**

	PROPOSAL	B2
COMPONENT: Bridge – Width Criteria	**AUTHOR**	MJM

CURRENT CONCEPT:

Lost Creek Bridge Crossing consisting of a single span pre-cast concrete bridge (39’x142.5’ bulb-tee) on driven steel HP14x117 piles. The 39’ bridge width accommodates the lane/shoulder width criteria of 12’ lanes and 6’ shoulders with 1.5’ barriers. Design also includes over 2,000 cubic yards of riprap (Classes I and III) for scour protection.

VE CONCEPT:

Reduce the bridge deck overall width to the minimum required for a rural bridge having an ADT of 400 or less (39 feet down to 31 feet).

FUNCTIONS		
Span Creek	Support Vehicles	Pass Fish

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 2,334,000	$ 2,051,000	$ 283,000

ADVANTAGES:

- Less cost
- Fewer foundation and substructure elements to construct
- Fewer precast concrete girders to fabricate, ship and erect

DISADVANTAGES:

- Has a narrower width than adjacent roadway sections

	PROPOSAL	B2
COMPONENT: Bridge – Width Criteria	**AUTHOR**	MJM

DISCUSSION:

This VE proposal is based on reducing the overall deck width from 39 feet to 31 feet.

Design Designations assume a 2% growth rate over a 30-year design life with:

- Current year AADT (2010) = 330
- Mid-Year AADT (2020) = 490
- Design Year AADT (2040) = 600

A review of recent historical actual ADT data shows it is not growing as predicted:

- 2013 = 363
- 2014 = 310
- 2015 = 227

These volumes fit within the AASHTO section 7.2.3 (AASHTO 2011).

If this proposal is combined with proposal B1, costs would be reduced further due to shallower pile installation.

State of Alaska Department of Transportation & Public Facilities
Dalton Highway MP 0-9 Reconstruction

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Bridge - Width Criteria

B2

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
205(3) Structural Fill	1400	CY	35	49,000	205(3) Structural Fill	1120	CY	35	39,200
501(1) Class A Concrete	125	CY	2500	312,500	501(1) Class A Concrete	100	CY	2500	250,000
501(7) Precast Concrete Member	7	EA	110000	770,000	501(7) Precast Concrete Member	6	EA	110000	660,000
503(1) Reinforcing Steel	20000	LBS	2.5	50,000	503(1) Reinforcing Steel	16000	LBS	2.5	40,000
503(2) Epoxy Coated Rein Steel	10000	LBS	2.75	27,500	503(2) Epoxy Coated Rein Steel	800	LBS	2.75	2,200
505(5) Furnish Steel H-Piles HP14x117	1400	LF	125	175,000	505(5) Furnish Steel H-Piles HP14x117	1200	LF	125	150,000
505(6) Drive Steel H-Piles HP14x117	14	EA	20000	280,000	505(6) Drive Steel H-Piles HP14x117	12	EA	20000	240,000
507(1) Steel Bridge Railing	368	LF	275	101,200	507(1) Steel Bridge Railing	368	LF	275	101,200
512(X) Temporary Work Structure	2720	SF	125	340,000	512(X) Temporary Work Structure	2720	SF	125	340,000
606(16) Transition Rail	4	EA	4000	16,000	606(16) Transition Rail	4	EA	4000	16,000
611(A) Riprap, Class I	500	CY	75	37,500	611(A) Riprap, Class I	500	CY	75	37,500
611(B) Riprap, Class III	1750	CY	100	175,000	611(B) Riprap, Class III	1750	CY	100	175,000
Subtotal				2,333,700	Subtotal				2,051,100
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				2,334,000	Total to nearest $1000				2,051,000
					Difference				283,000

MENG Analysis
DOWL

Proposal **B2**

	PROPOSAL	B3
COMPONENT: Bridge - Span	**AUTHOR**	MJM

CURRENT CONCEPT:

Lost Creek Bridge Crossing consisting of a single span pre-cast concrete bridge (39’x142.5’ bulb-tee) on driven steel HP14x117 piles. Design also includes over 2000 cubic yards of riprap (Classes I and III) for scour protection.

VE CONCEPT:

Refine the proposed design reducing the proposed bridge span from 142.5 feet to 110 feet.

FUNCTIONS		
Span Creek	Support Vehicles	Pass Fish

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 2,334,000	$ 2,057,00	$ 277,000

ADVANTAGES:

- Less Cost
- Smaller girders to transport & erect.
- Appears to be hydraulically adequate.

DISADVANTAGES:

- Rip rap slope angle under the bridge is decreased from 2:1 to 1.5 to 1.
- May increase scour due to increase flow velocity at higher flows.

	PROPOSAL	B3
COMPONENT: Bridge - Span	**AUTHOR**	MJM

DISCUSSION:

This VE proposal is based on reducing the overall bridge span by over 30 feet. The success of this proposal will be dependent on the final hydraulic analysis including estimates of scour.

The shorter span will allow for a shallower girder which results in a significant weight reduction. By inspection, shorter and lighter girders should be easier to ship and erect. Further savings could be realized if this proposal is combined with material reductions discussed in proposals B1 and B2.

DOWL
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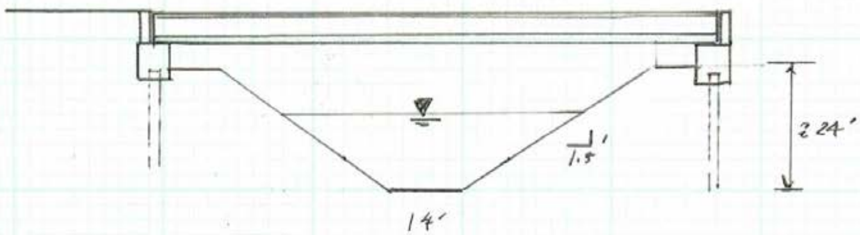
COMPUTATIONS

Project #: 1129.62473.01
Client Name: ADOT+PF
Sheet 1 of
Project Name: DALTON HWY MP 0 TO 9
Prepared by: MM Date 6/18/17
Checked by: Date

LOST CREEK BRIDGE

PROPOSAL B3



SPAN LENGTH (THEORETICAL)

$L = 14' + 2(36') + 2(5') + 2(4')$

$L = 104' \Rightarrow$ SAY 110'

CONCRETE TECHNOLOGIES 53" (4'-5") BULB TEE WILL SUPPORT HL-93 LOADING AT THIS SPAN

GIRDER WEIGHT ≈ 963 lb/ft

TOTAL WEIGHT = 963 (110) = 105,930 lbs

COST = \$0.72/lb × 105,930 ≈ \$76,270

ASSUME ALL OTHER QUANTITIES REMAIN THE SAME

HYDRAULIC CHECK

WATER DEPTH = 15'

$A = 15'\left(\frac{14' + (2)(15)(1.5)}{2}\right) = 442.5\ ft^2$

$P = 15' + 2\sqrt{15^2 + 22.5^2} = 69.1\ ft$

$R = A/P = 442.5/69.1 = 6.4$

$Q = (1.49/0.04)(442.5\ ft^2)(6.4)^{2/3}\sqrt{0.01} = \underline{5720\ CFS}$ O.K.

$Q_{50} = 1940$ CFS
$Q_{100} = 2300$ CFS
$Q_{500} = 3090$ CFS

State of Alaska Department of Transportation & Public Facilities
Dalton Highway MP 0-9 Reconstruction

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Bridge - Span

B3

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
205(3) Structural Fill	1400	CY	35	49,000	205(3) Structural Fill	1400	CY	35	49,000
501(1) Class A Concrete	125	CY	2500	312,500	501(1) Class A Concrete	125	CY	2500	312,500
501(7) Precast Concrete Member	7	EA	110000	770,000	501(7) Precast Concrete Member	7	EA	76270	533,890
503(1) Reinforcing Steel	20000	LBS	2.5	50,000	503(1) Reinforcing Steel	20000	LBS	2.5	50,000
503(2) Epoxy Coated Rein Steel	10000	LBS	2.75	27,500	503(2) Epoxy Coated Rein Steel	10000	LBS	2.75	27,500
505(5) Furnish Steel H-Piles HP14x117	1400	LF	125	175,000	505(5) Furnish Steel H-Piles HP14x117	1400	LF	125	175,000
505(6) Drive Steel H-Piles HP14x117	14	EA	20000	280,000	505(6) Drive Steel H-Piles HP14x117	14	EA	20000	280,000
507(1) Steel Bridge Railing	368	LF	275	101,200	507(1) Steel Bridge Railing	220	LF	275	60,500
512(X) Temporary Work Structure	2720	SF	125	340,000	512(X) Temporary Work Structure	2720	SF	125	340,000
606(16) Transition Rail	4	EA	4000	16,000	606(16) Transition Rail	4	EA	4000	16,000
611(A) Riprap, Class I	500	CY	75	37,500	611(A) Riprap, Class I	500	CY	75	37,500
611(B) Riprap, Class III	1750	CY	100	175,000	611(B) Riprap, Class III	1750	CY	100	175,000
Subtotal				2,333,700	Subtotal				2,056,890
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				2,334,000	Total to nearest $1000				2,057,000
					Difference				277,000

MENG Analysis
DOWL

Proposal **B3**

	PROPOSAL	B4
COMPONENT: Bridge – Structural Plate	**AUTHOR**	MJM

CURRENT CONCEPT:

Lost Creek Bridge Crossing consisting of a single span pre-cast concrete bridge (39'x142.5' bulb-tee) on driven steel HP14x117 piles. Design also includes over 2000 cubic yards of riprap (Classes I and III) for scour protection.

VE CONCEPT:

Corrugated, low-rise structural plate-arch structure having a span of 45' and a rise of approximately 19'. Culvert will be supported on concrete grade beams that can be site cast or pre-cast off-site and transported to the field. The culvert will be buried using earth materials depicted on the current typical sections (E1 surfacing, grade F sub base and Select C).

FUNCTIONS		
Span Creek	Support Vehicles	Pass Fish

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 2,334,000	**$** 1,265,000	**$** 1,069,000

	PROPOSAL	B4
COMPONENT: Bridge – Structural Plate	**AUTHOR**	MJM

ADVANTAGES:	**DISADVANTAGES:**
• Less cost • Less transportation cost to mobilize construction materials to the site. • Provides adequate hydraulic opening for the design flows. • Will use materials already planned for road construction	• Hydraulic opening is not as large as proposed bridge.

DISCUSSION:

This VE proposal is based on material unit costs listed in the DSR estimate and costs obtained from a known manufacturer/supplier of plate arch structures. Cost for the plate arch structure includes panels, fasteners and labor required to erect the structure. Grade beams and thrust beams are included as separate line items.

We verified the hydraulic capacity based on calculated flows provided by ADOT&PF. Assumptions included a channel slope of 1% and a manning's coefficient of 0.04. Based on these assumptions the proposed alternative can pass the 100 and 500 year flows satisfactorily.

DOWL
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COMPUTATIONS	Project #: 1124.62437.01
Client Name: ADOT+PF	Sheet 1 of
Prepared by: MM Date 6/7/17 Checked by:	Date

Project Name: DALTON HWY MP 0 TO 9

PLATE ARCH STRUCTURE ALTERNATIVE – B4

PROPOSED PLATE ARCH STRUCTURE

SPAN 45'

RISE 18.67'

602(1) $A = \pi/2\,(22.5)(18.67') = 659.8\ ft^2$

BRIDGE CONCEPT HYD OPENING

$A = (14' \times 23.75') + (64.25 \times 23.75')$

$A = 1858.44\ ft^2$

DESIGN FLOWS FOR THE CONCEPT BRIDGE — HDR H+H REPORT 4/22/16

$Q_{50} = 1940$ CFS

$Q_{100} = 2270$ CFS

$Q_{500} = 3090$ CFS

STREAM GRADIENT IS ASSUMED TO BE AT LEAST 1%

QUICK HYDRAULIC CHECK USING MANNINGS EQUATION

$$Q = VA = \left(\frac{1.49}{n}\right) A R^{2/3} \sqrt{S}$$

KNOWNS:

$Q \rightarrow$ VARIES FROM 1940 TO 3090 CFS

$A \rightarrow 1858.44\ ft^2$

$S \rightarrow 1\%$

$n \rightarrow 0.04$

FOR Q, USE 100YR FLOW = 2270 CFS

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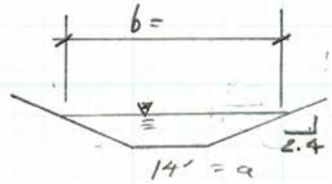
COMPUTATIONS	Project #: 1124.62437.01
Client Name: ADOT+PF	Sheet 2 of

Project Name: DALTON HWY MP 0 TO 9	Prepared by: MM	Date 6/7/19	Checked by:	Date

B-4 CONTINUED

FOR A FLOW DEPTH OF 7.5'



$P = 14 + 2(7.5^2 + 18^2)^{1/2}$

$P = 53$ ft

$A = (50 + 14)\,1/2\,(7.5) = 240\ ft^2$

$R = A/P = 4.53'$

$\therefore\ Q = 2460$ CFS $> Q_{100} = 2270$ CFS

FOR A FLOW DEPTH OF 12 ft

$b = 14' + 12(2.4)(2) = 71.6'$

$A = (71.6 + 14)/2\,(12) = 513.6\ ft^2$

$P = 14 + 2(12^2 + 28.8^2)^{1/2} = 76.4$ ft

$R = A/P = 6.723$

$\therefore\ Q = 6{,}858$ CFS $\gg Q_{500} = 3090$ CFS

THEREFORE, IT WOULD APPEAR THAT PLATE ARCH STRUCTURE WITH AN EFFECTIVE AREA OF $>$ 600 Ft^2 WOULD HAVE ADEQUATE HYDRAULIC CAPACITY AND PERHAPS THE CONCEPT BRIDGE COULD BE SHORTENED.

DOWL
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COMPUTATIONS	Project #: 1124.62437.01
Client Name: ADOT + PF	Sheet 3 of
Prepared by: MM Date 6/7/17	Checked by: Date

Project Name: DALTON HWY MP 0 TO 9

PLATE ARCH CONT. B4

GRADE BEAM ESTIMATE

$L = (2)\,162' = 324'$

$W = (2)\,4' = 8'$

$T = 2'$

$V = \dfrac{324'(8')(2')}{27} = 192\text{ cy}$

THRUST BEAM

$V = 2\left(\dfrac{2' \times 3'}{2} \times 162'\right) \cdot \dfrac{1}{27} = 36\text{ cy}$

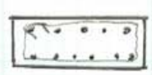
HEAD WALLS

$V = (2)(20' \times 48' \times 1')\,\dfrac{1}{27} = 72\text{ cy}$

501 (4) TOTAL CLASS A CONC. = 300 cy

REBAR - GRADE BEAMS

(6) #6's T+B
162 #4 HOOPS
$\ell = 11'$


2'
4'

$24(162')(1.502) = 5840\text{ lbs}$

$324(11')(0.668) = 2381\text{ lbs}$

$300\,ft^2\left(8' \times \dfrac{1.502\,lb}{ft^2}\right)2 = 7210\text{ lbs}$

503(1) REBAR = 15,430.6 lbs ⇒ 16K

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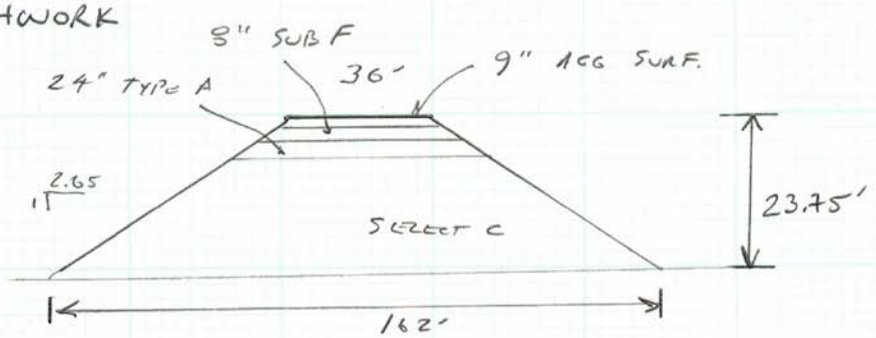
COMPUTATIONS	Project #: 1124.62437.01
Client Name: ADOT+PF	Sheet 4 of
Project Name: DALTON HWY MP 0 TO 9	Prepared by: MM Date 6/7/17 Checked by: Date

EARTHWORK



L = 170'

GROSS AREA

$A = \frac{(162+36)}{2}(23.75) \approx 2352\ ft^2$

ACG SURFACING $A = 28.5\ ft^2$

SUB F $A = 56\ ft^2$

TYPE A $A = 98\ ft^2$

SELECT C $A = 2352 - \Sigma(28.5+56+98)$

$A = 2169.5\ ft^2$

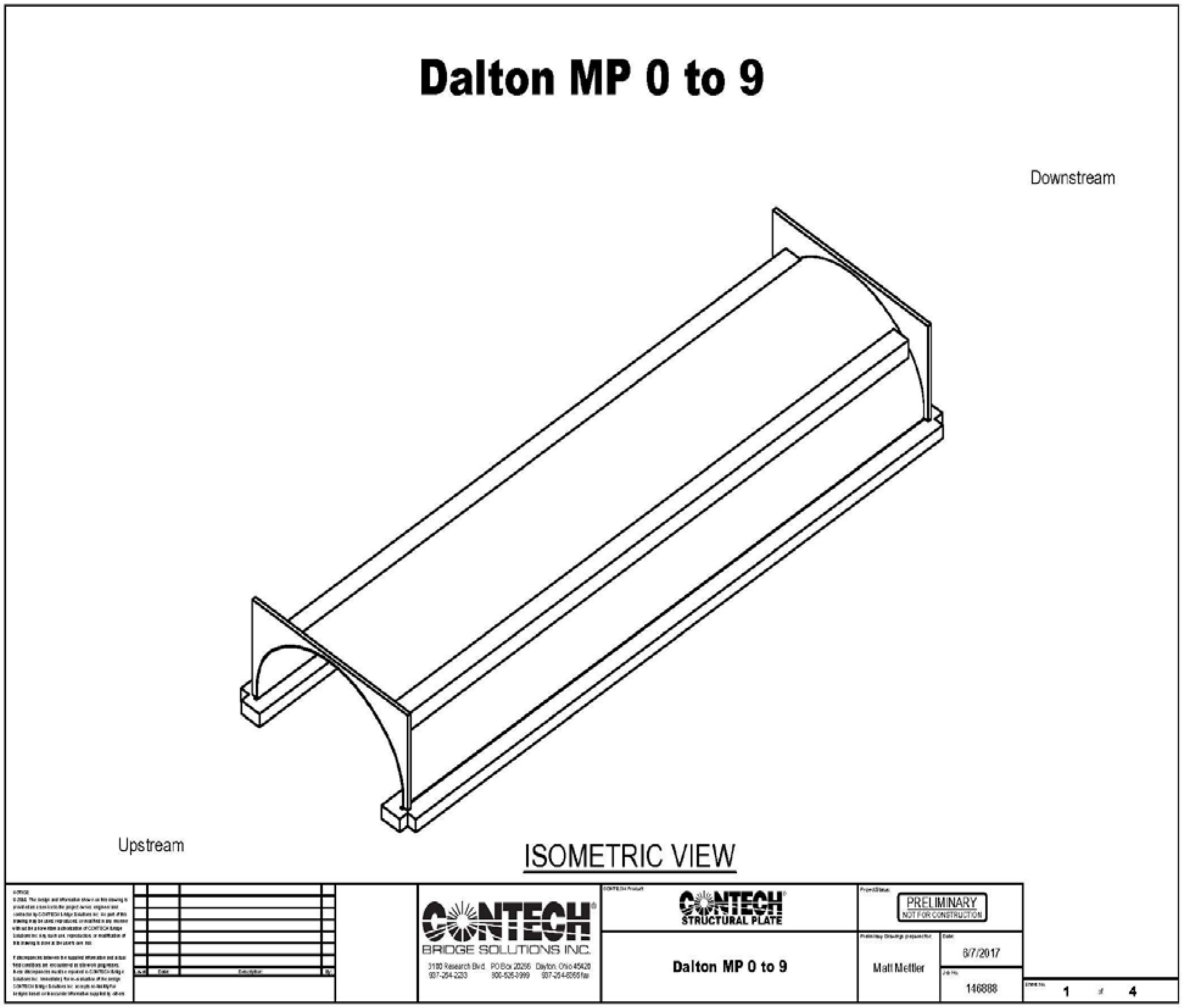
301(3) ✓ ACG. SURF = 180 cy = 305 TONS

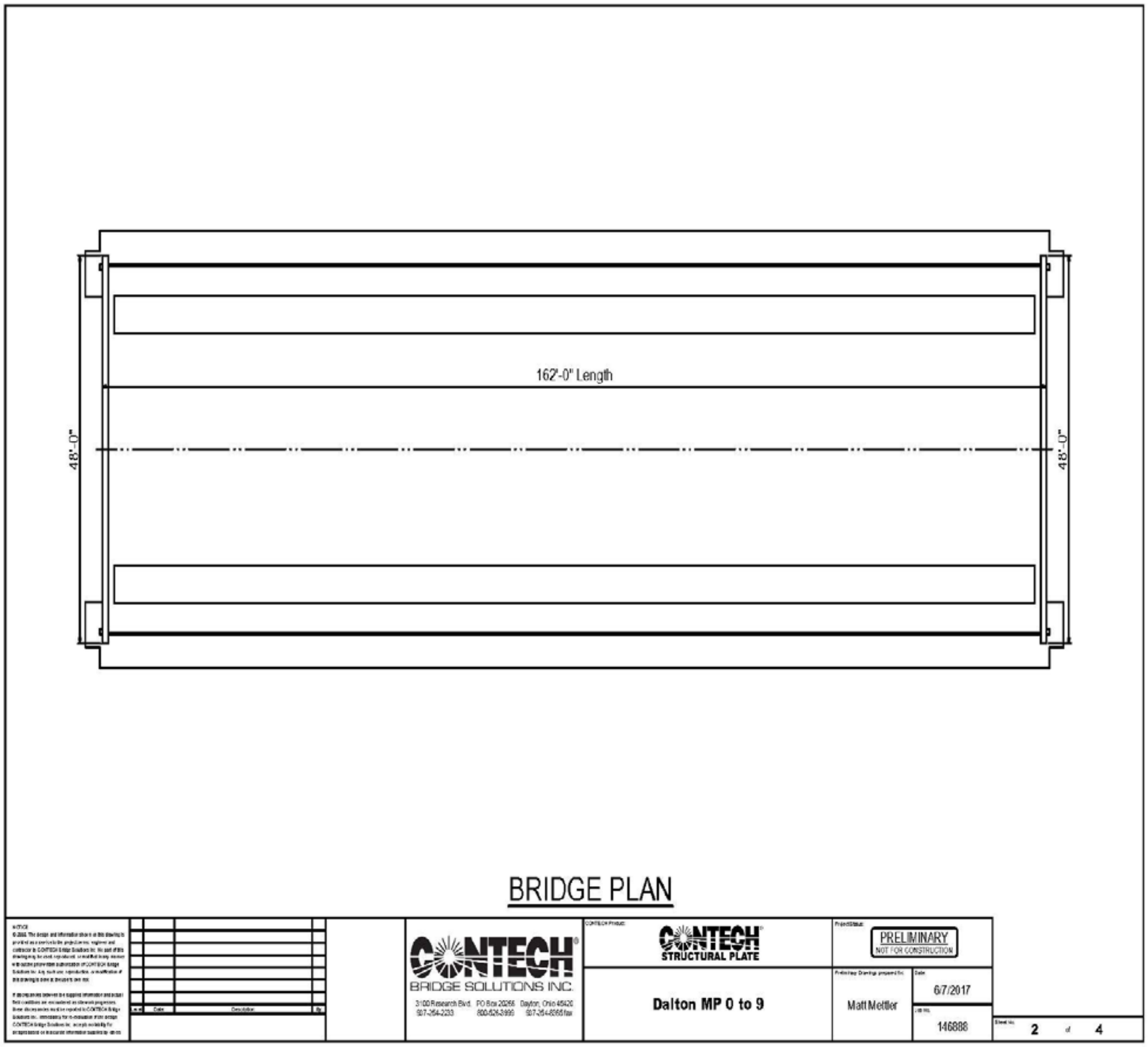
304(2) ✓ SUB F = 353 cy ⟩ ⇒ 957

203(5) ✓ TYPE A = 604 cy

203(5) ✓ SELECT C = 13,660 cy $- \frac{1}{27}(36+63)(659.8)$

$\approx$ 11,241 cy


Dalton MP 0 to 9
Downstream
Upstream
ISOMETRIC VIEW
CONTECH
BRIDGE SOLUTIONS INC.
CONTECH
STRUCTURAL PLATE
PRELIMINARY
NOT FOR CONSTRUCTION
Dalton MP 0 to 9
Matt Mettler
6/7/2017
146888
1
4


162'-0" Length
48'-0"
48'-0"
BRIDGE PLAN
CONTECH
BRIDGE SOLUTIONS INC.
3100 Research Blvd. PO Box 20266 Dayton, Ohio 45420
937-264-2233 800-526-3999 937-264-8265 fax
CONTECH
STRUCTURAL PLATE
PRELIMINARY
NOT FOR CONSTRUCTION
Dalton MP 0 to 9
Matt Mettler
6/7/2017
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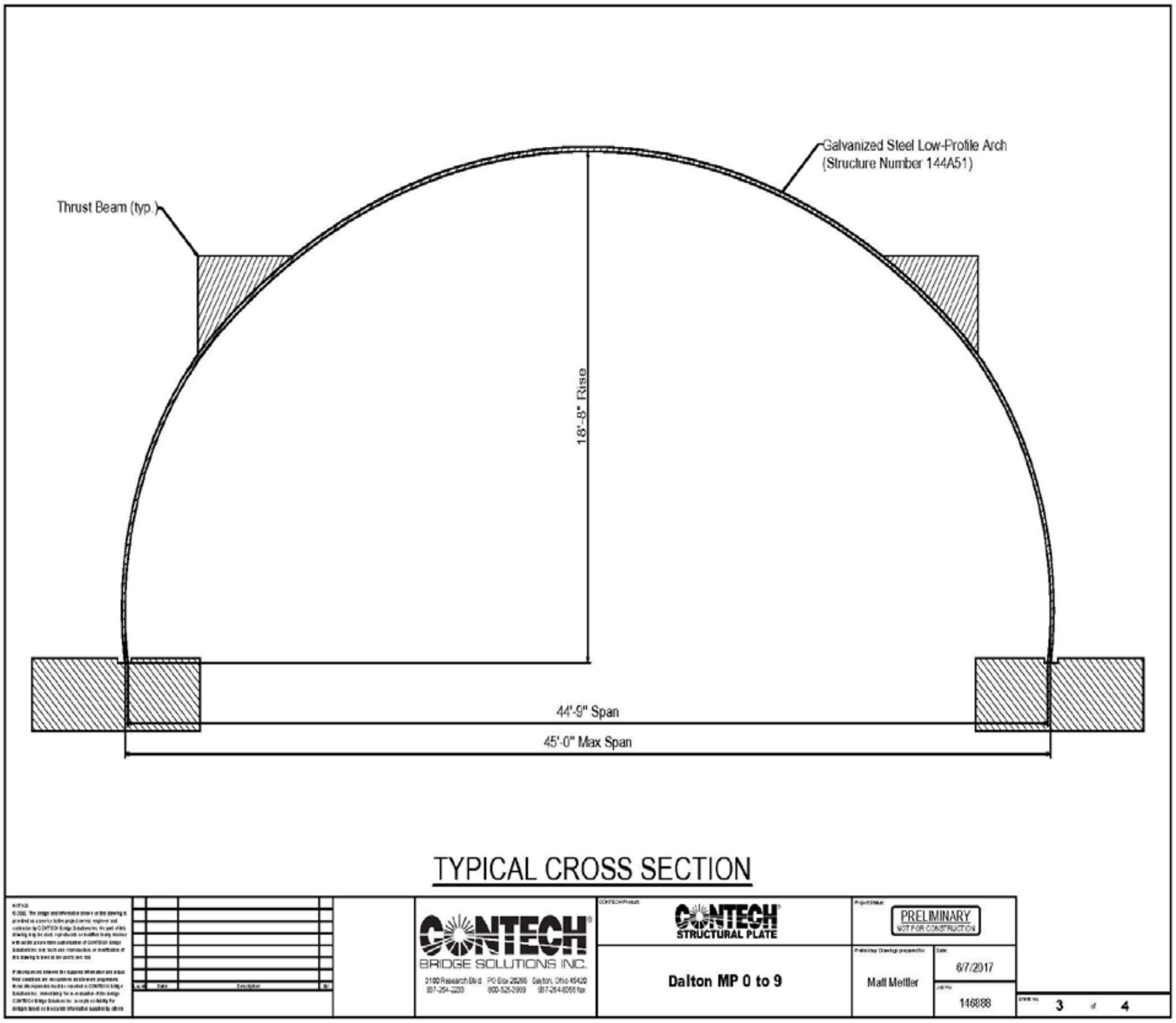
Galvanized Steel Low-Profile Arch
(Structure Number 144A51)
Thrust Beam (typ.)
18'-8" Rise
44'-9" Span
45'-0" Max Span
TYPICAL CROSS SECTION
CONTECH
BRIDGE SOLUTIONS INC.
CONTECH
STRUCTURAL PLATE
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NOT FOR CONSTRUCTION
Dalton MP 0 to 9
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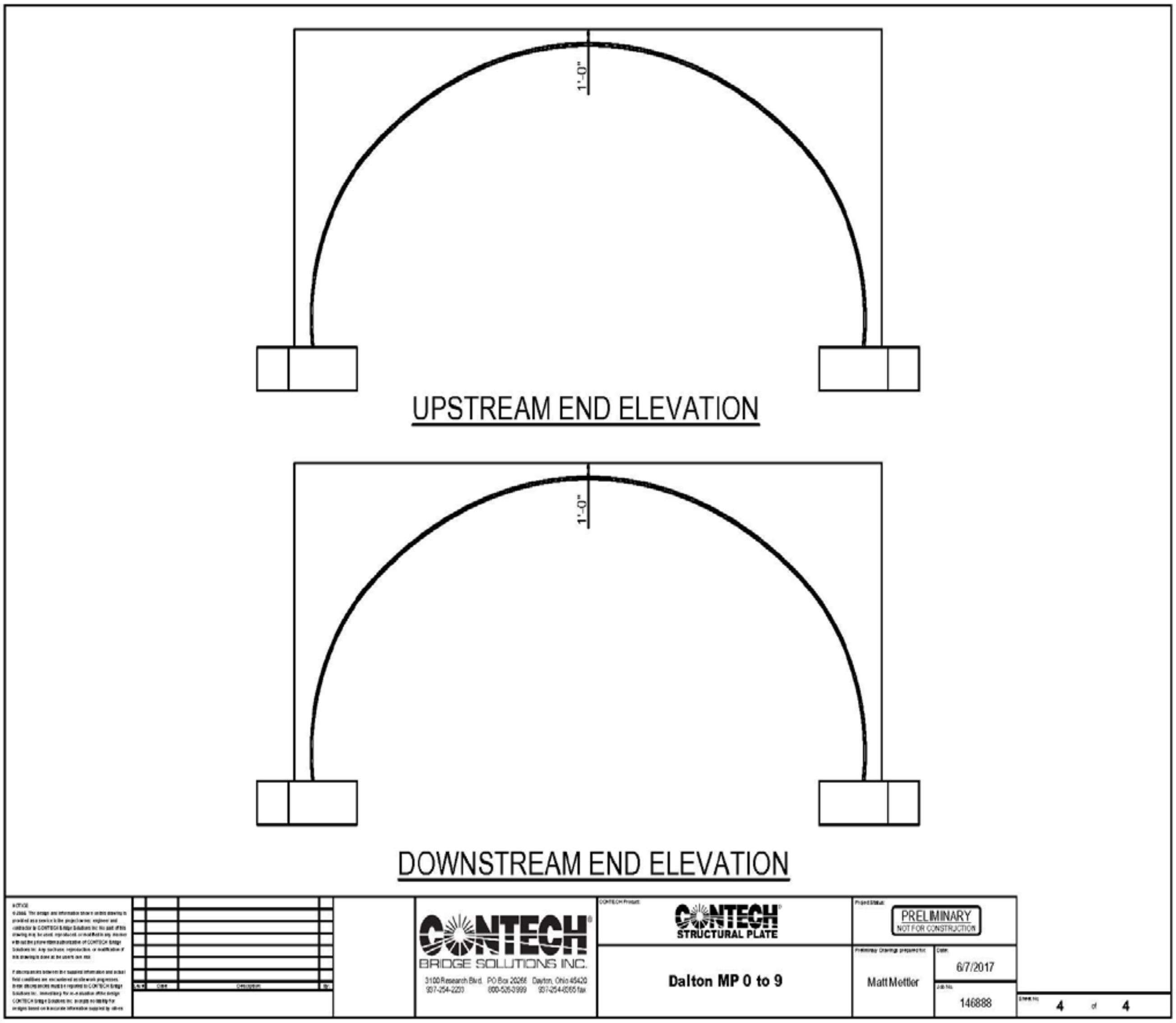
3 of 4


1'-0"
UPSTREAM END ELEVATION
1'-0"
DOWNSTREAM END ELEVATION
CONTECH
BRIDGE SOLUTIONS INC.
CONTECH
STRUCTURAL PLATE
PRELIMINARY
NOT FOR CONSTRUCTION
Dalton MP 0 to 9
6/7/2017
Matt Mettler
146888
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State of Alaska Department of Transportation & Public Facilities
Dalton Highway MP 0-9 Reconstruction

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Bridge - Structural Plate

B4

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
205(3) Structural Fill	1400	CY	35	49,000	203(5) Borrow (Select C)	11241	CY	5	56,205
501(1) Class A Concrete	125	CY	2500	312,500	301(3) Aggregate Surface Course E1	395	Ton	24	9,480
501(7) Precast Concrete Member	7	EA	110000	770,000	304(2) Subbase Grading F	957	CY	6	5,742
503(1) Reinforcing Steel	20000	LBS	2.5	50,000	501(4) Class A Concrete	300	CY	2500	750,000
503(2) Epoxy Coated Rein Steel	10000	LBS	2.75	27,500	503(1) Reinforcing Steel	15435	LB	2.5	38,588
505(5) Furnish Steel H-Piles HP14x117	1400	LF	125	175,000	602(1) Low Rise Structural Plate Pipe	162	LF	2500	405,000
505(6) Drive Steel H-Piles HP14x117	14	EA	20000	280,000					
507(1) Steel Bridge Railing	368	LF	275	101,200					
512(X) Temporary Work Structure	2720	SF	125	340,000					
606(16) Transition Rail	4	EA	4000	16,000					
611(A) Riprap, Class I	500	CY	75	37,500					
611(B) Riprap, Class III	1750	CY	100	175,000					
Subtotal				2,333,700	Subtotal				1,265,015
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				2,334,000	Total to nearest $1000				1,265,000
					Difference				1,069,000

MENG Analysis
DOWL

Proposal **B4**

	PROPOSAL	R1
COMPONENT: Roadway Construction – Material Sourcing	**AUTHOR**	RDP/DS

CURRENT CONCEPT:

Provide ACE material from 19-mile pit for entire project. Provide borrow A/B predominately from Lost Creek material site near MP 6.5.

VE CONCEPT:

Evaluate rock cut at 300+00 to 308+00 for producing ACE embankment rock. If rock is suitable for ACE, increase ROW similar to or exceeding the expansion at 245+00 to 260+00 (alluvial fan material source).

Evaluate and identify useable cut materials from 10+00 to 350+00 for borrow A, B, & C to reduce haul costs, and allow for substantial embankment completion without hauling over Lost Creek. Provide any additional required borrow A/B from alluvial fan material source.

FUNCTIONS		
Support Loads	Improve Safety	Stabilize Embankment

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 20,436,000	$ 17,082,000	$ 3,354,000

ADVANTAGES:

- Reduced haul and material costs
- Improved efficiency for material production
- Minimal hauling across Lost Creek
- Reduced construction cost

DISADVANTAGES:

- May require further permitting/ROW
- Potentially reduced material quality
- Reduces availability of other materials

	PROPOSAL	R1
COMPONENT: Roadway Construction – Material Sourcing	**AUTHOR**	RDP/DS

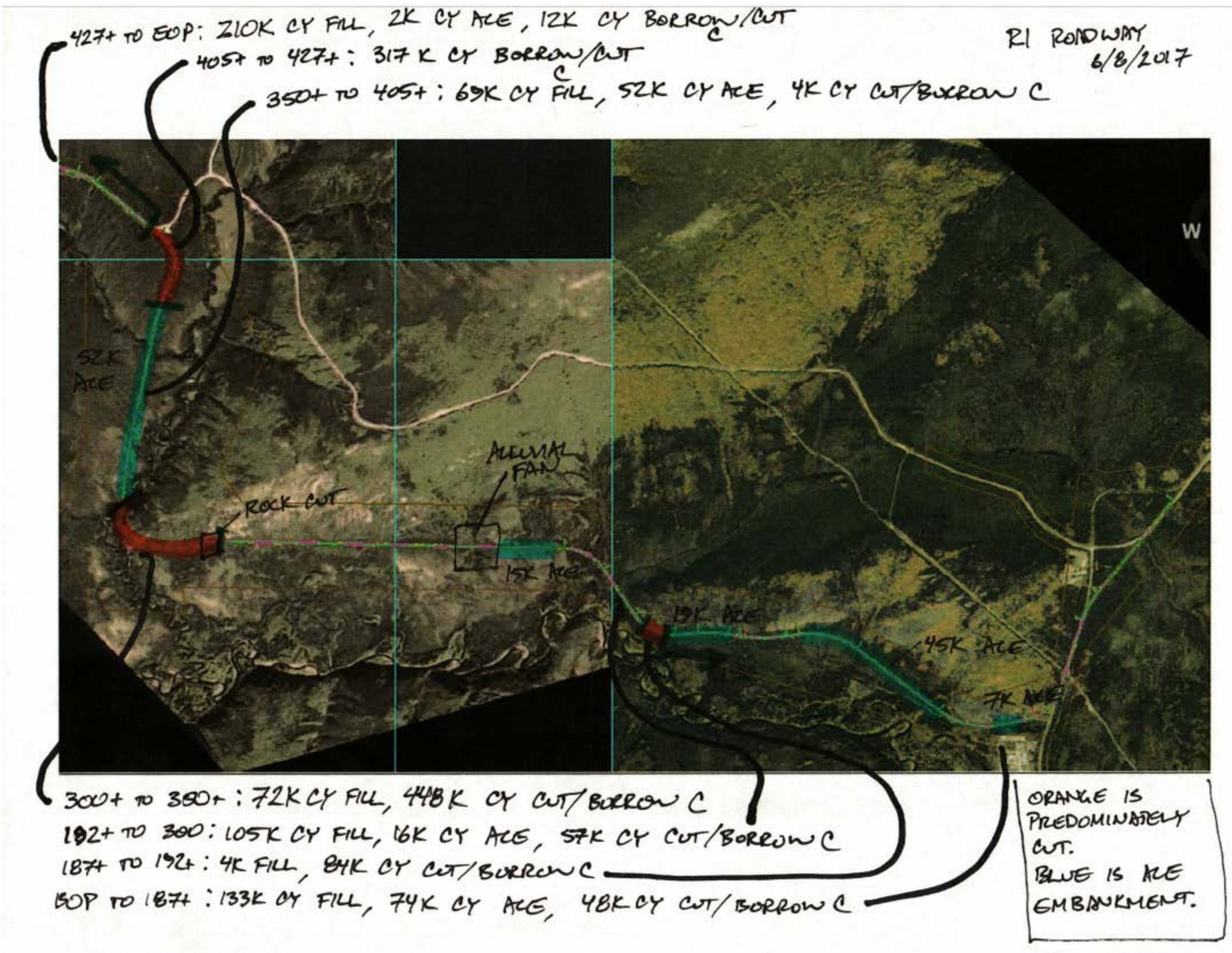
DISCUSSION:

There are several advantages of acquiring the materials as close as possible to the fill and embankment areas. Haul costs are always a large driver in overall project costs and reducing these costs is certainly a significant advantage. Sporadic areas of ACE as identified in the geotechnical recommendations will also require a staged type of embankment construction. ACE is unique as it is recommended for winter placement and may not be driven on after placement without the driving surface being placed.

Dividing the project into two sections at Lost Creek will be the most effective and efficient method to complete the ACE embankment, and to be efficient requires identifying an ACE source south of Lost Creek. Hauling the entire project ACE embankment from the north end (19-mile pit) may require winter haul/stockpiling on the south side of Lost Creek, or hauling on the existing Dalton/Elliott to the southern part of the project. Sourcing ACE material south of Lost Creek would reduce material costs and the quantity of material that would need to be hauled from the 19-mile pit.

Mining a sufficient quantity of ACE material south of Lost Creek (~74K CY) may require additional ROW acquisition and permitting; specifically, between 300+00 and 308+00 or 187+00 to 192+50. Using material for ACE may reduce material available to process for select A or B; mining of the alluvial fan at 250+00 may provide adequate material.

	PROPOSAL	R1
COMPONENT: Roadway Construction – Material Sourcing	**AUTHOR**	RDP/DS



		PROPOSAL	R1
COMPONENT: Roadway Construction – Material Sourcing		**AUTHOR**	RDP/DS

ACE	5' embankment height							
To	From	Length	Embank Height	Full ACE	Shoulder ACE			
ft	ft	ft	ft	CY	CY			
2000	2200	200	5		741			
2200	2900	700	5		2593			
8600	9350	750	5	7222				
10550	15200	4650	5	44778				
16850	18850	2000	5	19259				
20100	20300	200	5		741			
22550	24150	1600	5	15407				
35150	35750	600	5	5778				
35750	37250	1500	5	14444				
37250	38250	1000	5	9630				
38250	39450	1200	5	11556				
39450	40500	1050	5	10111				
48300	49400	1100	5		2037		Total	
Total:		14350		138185	6111		144296	CY
					Assumes 1.4 tons/CY		202015	TON
			Total west of Lost Creek:	51519		$	10,100,741	

ACE	7' embankment height							
To	From	Length	Embank Height	Full ACE	Shoulder ACE			
ft	ft	ft	ft	CY	CY			
2000	2200	200	7		1037			
2200	2900	700	7		3630			
8600	9350	750	7	10889				
10550	15200	4650	7	67511				
16850	18850	2000	7	29037				
20100	20300	200	7		1037			
22550	24150	1600	7	23230				
35150	35750	600	7	8711				
35750	37250	1500	7	21778				
37250	38250	1000	7	14519				
38250	39450	1200	7	17422				
39450	40500	1050	7	15244				
48300	49400	1100	7		2852		Total	
Total:		14350		208341	8556		216896	CY
					Assumes 1.4 tons/CY		303655	TON
			Total west of Lost Creek:	77674		$	15,182,741	

(R1 ACE Quantities)

State of Alaska Department of Transportation & Public Facilities
Dalton Highway MP 0-9 Reconstruction

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Roadway Construction - Materials Sourcing

R1

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
Unclassified Excavation	1,347,000	CY	$ 6.50	8,755,500	Unclassified Ex, W of Lost Creek	392,000	CY	$ 6.00	2,352,000
Borrow	320,000	CY	$ 5.00	1,600,000	Unclassified Ex, E of Lost Creek	955,000	CY	$ 6.00	5,730,000
ACE Fill	201,600	Ton	$ 50.00	10,080,000	Borrow, west of Lost Creek	128,000	CY	$ 4.50	576,000
					Borrow, east of Lost Creek	192,000	CY	$ 4.50	864,000
Assume all ACE material provided from 19-mile Pit. Assume majority of Select A/B processed from Lost Crk mtl site with some material coming from East Rock cut site near 190+.					ACE Fill	75,600	Ton	$ 50.00	3,780,000
					ACE Fill, on-site source	126,000	Ton	$ 30.00	3,780,000
					Assume material is managed for two segments: north of Lost Creek and south of Lost Creek. Efficiencies in balancing cut fill are assumed to provide $0.5/CY savings on excavation and borrow.				
					North End: Assume useable cut from Lost Crk mtl site used for fill north of bridge; 317K CY available and 263k CY needed; remainder can be processed to Select A/B. ACE material is assumed to come from 19-mile Pit for north segment.				
					South End: Useable excavation from cut area at 190+ is sufficient for needed fill to south (BOP to 187+). Useable excavation from 300+ to bridge is more than sufficient to cover required fill (~49K CY) between 192+ and 300+; profile could be modified to reduce excavation. Assume ACE material can be mined from rock cut area at 300+ or from alluvial fan area at 250+, resulting in lower unit cost. Assume needed Select A/B required south of bridge can be mined from alluvial fan; quantities indicate 1.5' depth provides 90K CY Select A/B, so mining 3-4' deep to provide 192K CY required is reasonable.				
Subtotal				20,435,500	Subtotal				17,082,000
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				20,436,000	Total to nearest $1000				17,082,000
					Difference				3,354,000

MENG Analysis
DOWL

Proposal **R1**

	PROPOSAL	R2
COMPONENT: Roadway – Surface	**AUTHOR**	KLK

CURRENT CONCEPT:

Place 9” of Surface Course E-1.

VE CONCEPT:

Place 6” of Surface Course E-1 and emulsified asphalt.

FUNCTIONS		
Support Loads	Reduce Dust	

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 2,904,000	$ 2,684,000	$ 220,000
$ 15,296,418 (LCCA)	$ 8,594,270 (LCCA)	$ 6,702,149 (LCCA)

ADVANTAGES:

- Increases long term success of ACE embankment.
- Lower initial cost
- Less annual M&O efforts and cost over a 30-yr life cycle cost
- Uses project excess Select C Material to replace 2” Surface Course material

DISADVANTAGES:

- Creates larger M&O effort for resurfacing every 5 years.
- Increased risk of major settling on new alignment creating larger resurfacing efforts in the initial year(s)

	PROPOSAL	R2
COMPONENT: Roadway – Surface	**AUTHOR**	KLK

DISCUSSION:

The Dalton 0-9 project currently has approximately 16,500 feet of Air Cooled Embankment (ACE) or modified ACE embankment. This realignment does traverse considerable ice rich soils and there is a high probability for embankment movement even with ACE and other mitigation measures.

Typically, on new alignment areas with questionable subsurface conditions, a gravel surface wearing course is recommended for the first several years for maintenance considerations.

This realignment has the benefit of considerable soils and foundation investigations as well as significant areas with ACE enhanced embankments. This geotechnical information, embankment insulation and ACE embankments make the application of a “sealed” surface a viable option during the initial construction project. A sealed surface will also provide a significant advantage to the success of the ACE embankment areas by limiting gravel, dust and other roadway debris from contaminating the ACE embankment and reducing the effectiveness of the embankment airflow.

High float surfacing will reduce future summer maintenance costs by not requiring re-grading efforts as well as the depletion of the surface course through traffic and natural degradation.

In the event of unanticipated large-scale embankment failures, the high float could be “blended” back into the surface course and the section maintained as a gravel surface.

COMPONENT LIFE CYCLE COST ANALYSIS (LCCA) **R2**

Project:	**Dalton Highway MP 0 - 9 Reconstruction**
Client:	**Alaska Department of Transportation and Public Facilities**
Date:	**6/9/2017**
By:	
COMPONENT	**Roadway - Surface**
COMPONENT #	**R2**
Escalation rate	**0.03**
Discount rate	**0.023**
Study Period	**30** Yrs.

Instructions: Enter escalation, discount, and study period above.
Enter annual costs, replacement costs (and appropriate replacement year), and salvage value.
Enter these costs in the shaded cells using today's (current) dollars. For annual costs, escalation rates will be automatically entered, but can be individually overwritten below for differential escalation.
All costs will automatically be escalated and discounted.

ALTERNATIVE A : Current design			**Gravel Surface**	**ALTERNATIVE B:**			**High Float Surface**	**DIFFERENCE**
INITIAL COSTS			**INITIAL COST**				**INITIAL COST**	**DIFFERENCE**
			$ 2,904,000				**$ 2,684,000**	**$ 220,000**
O & M ANNUAL COSTS								
STAFFING OPERATIONS		**ENERGY**						
STAFFING MAINTENANCE								
SUPPLIES OPERATIONS								
SUPPLIES MAINTENANCE								
Subcomponents	**Cost in current $**	**Esc.**	**Pres. Worth $**	**Subcomponents**	**Cost in current $**	**Esc.**	**Pres. Worth $**	
Regrading every 2 weeks	371,000	0.03	$ 12,392,418	25% Length Resurface	106,333	0.030	$ 3,551,814	**$ 8,840,604**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
		0.03	$ -			0.030	$ -	**$ -**
SUBT. O & M OVER LIFE CYCL	**$ 371,000**		**$ 12,392,418**		**106,333**		**$ 3,551,814**	**$ 8,840,604**
REPLACEMENT and CYCLICAL COSTS								
Subcomponents	**Cost in current $**	**Yr.**	**Pres. Worth $**	**Subcomponents**	**Cost in current $**	**Yr.**	**Pres. Worth $**	
				Whole Length Resurface	425,333	5	$ 440,085	**$ (440,085)**
				Whole Length Resurface	425,333	10	$ 455,350	**$ (455,350)**
				Whole Length Resurface	425,333	15	$ 471,143	**$ (471,143)**
				Whole Length Resurface	425,333	20	$ 487,485	**$ (487,485)**
				Whole Length Resurface	425,333	25	$ 504,393	**$ (504,393)**
							$ -	**$ -**
							$ -	**$ -**
							$ -	**$ -**
SUBT. REPLACEMENT			**$ -**				**$ 2,358,456**	**$ (2,358,456)**
TOT. O & M & REPL. (Pres. Worth)			**$ 12,392,418**				**$ 5,910,270**	**$ 6,482,149**
TOT. INITIAL, O&M, & REPL. (Pres. Worth)			**$ 15,296,418**				**$ 8,594,270**	**$ 6,702,149**
	Cost in current $				**Cost in current $**			
SALVAGE VALUE		30	$ -			30	$ -	**$ -**
TOT. INITIAL, O&M, REPL. MINUS SALVAGE			**$ 15,296,418**				**$ 8,594,270**	**$ 6,702,149**

State of Alaska Department of Transportation & Public Facilities
Dalton Highway MP 0-9 Reconstruction

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Roadway - Surface

R2

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
9" Aggregate Surface Course, Grading _E1	121,000	ton	24	2,904,000	6" Aggregate Surface Course, Grading _E1	94,111	ton	24	2,258,667
					Add 2" Select C -use excess (no cost)	12,437	cy		
					High Float (oil/material)	260	ton	550	143,000
					Add 3/4" layer Aggregate Surface Course, Grading _E1	11,764	ton	24	282,333
					Unit weight assumptions				
					140 lb/ft3				
					0.27 gal/yd2				
					233 gal/ton				
Subtotal				2,904,000	Subtotal				2,684,000
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				2,904,000	Total to nearest $1000				2,684,000
					Difference				220,000

MENG Analysis
DOWL

Proposal **R2**

	PROPOSAL	R3
COMPONENT: Roadway – Surface Section	**AUTHOR**	MJM/LK

CURRENT CONCEPT:

The typical roadway embankment sections are requiring 9” of Select E-1, 8” of Subbase Gradation F and up to 24” of Select Material, Type A.

VE CONCEPT:

Reduce the concept pavement sections to 6” of Select D-1 in lieu of the E-1 material, increasing Subbase Gradation F to 18” and eliminating Select Material Type A.

FUNCTIONS		
Support Loads	Reduce Dust	Drain Stormwater

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 4,320,000	$ 3,210,000	$ 1,110,000

ADVANTAGES:

- Fewer material types to track
- Less on-site processing and stockpiling

DISADVANTAGES:

- May require expansion of proposed material mining sites

	PROPOSAL	R3
COMPONENT: Roadway – Surface Section	**AUTHOR**	MJM/LK

DISCUSSION:

The typical sections illustrate multiple material types to construct the complete embankment. Minimizing the quantity of material types appears to simplify the contractor's effort in processing, stockpiling, hauling and compacting numerous material types. Simply put, fewer is better. This proposal assumes the calculated waste quantity will make up 2/3 of the required quantity of subbase A with the balance being made up by expanding the proposed mining sites along the proposed alignment.

It is worth noting the proposed section is consistent with the section used for the 9 Mile North and MP 118 projects.

State of Alaska Department of Transportation & Public Facilities
Dalton Highway MP 0-9 Reconstruction

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Roadway - Surface Section

R3

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
301(3) Agg Surface Grading E-1	121000	Ton	24	2,904,000	301(1) Agg Surface Grading D-1	80667	Ton	24	1,936,008
304(2) Subbase Grading F	61000	CY	6	366,000	203(5) Subbase Grading A	137250	CY	6	823,500
203(5)Subbase Grading A	210000	CY	5	1,050,000	Type C Select	90000	CY	5	450,000
Subtotal				4,320,000	Subtotal				3,209,508
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				4,320,000	Total to nearest $1000				3,210,000
					Difference				1,110,000

MENG Analysis
DOWL

Proposal **R3**

	PROPOSAL	G1
COMPONENT: Geotechnical – Permafrost Provisions – Thermal Berms	**AUTHOR**	DJ

CURRENT CONCEPT:

For areas with non-ice-rich foundation soils: clear and grub, construct a conventional embankment with select material Type C borrow.

VE CONCEPT:

For areas with non-ice-rich foundation soils: clear and grub, construct a conventional embankment, add thermal berms using waste material from unclassified excavation.

FUNCTIONS		
Reduce Maintenance	Embankment Stability	Control Thawing/Settlement

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 9,184,500	$ 10,527,000	$ (1,342,000)

ADVANTAGES:

- Potential to improve embankment stability.
- Reduced rotational failure at shoulders.
- Additional roadway clear-zone.
- Provides location for placement of excess and waste material.

DISADVANTAGES:

- Cost increase (~15%)

	PROPOSAL	G1
COMPONENT: Geotechnical – Permafrost Provisions – Thermal Berms	**AUTHOR**	DJ

DISCUSSION:

In areas with non-ice-rich permafrost, excess and waste material from unclassified excavation can be used as thermal berms. This allows for a location to place excess and waste material on-site and provides additional roadway clear-zone. The additional embankment material has the potential to add support to the core embankment via a “buttress” affect, and keeps embankment toe settlement and water farther from the structural embankment.

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Thermal Berms vs offsite disposal of excess and waste

Assumptions:
- Designer's 203(3) unit cost accounts for 54.8% of material being placed as embankment fill and 45.2% being hauled and dumped as waste or excess.
- Hauling and dumping excess and waste costs 50% of placement cost.
- Placing material for thermal berm costs 75% of embankment placement cost.

Known: Total 203(3) = 1,413,000 cy
Unit cost of 203(3) = \$6.5 / cy
54.8% of 203(3) is re-used as embankment fill
45.2% of 203(3) is excess or waste

Placement of all excess or waste material as thermal berms will increase unit cost of 203(3).

$$\$6.50/cy = x(0.548)(1{,}413{,}000\ cy) + x(0.5)(0.452)(1{,}413{,}000\ cy)$$

$$x = \frac{13}{2187324}$$

$$\text{New unit cost} = \frac{13}{2187324}(0.548)(1{,}413{,}000) + \frac{13}{2187324}(0.75)(0.452)(1{,}413{,}000)$$

New unit cost = \$7.45/cy

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COST ESTIMATE FORM

COMPONENT: Geotechnical - Permafrost Provisions - Thermal Berms

G1

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
203(3) Unclassified Excavation	1413000	CY	6.5	9,184,500	203(3) Unclassified Excavation	1413000	CY	7.45	10,526,850
Subtotal				9,184,500	Subtotal				10,526,850
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				9,185,000	Total to nearest $1000				10,527,000
					Difference				(1,342,000)

MENG Analysis
DOWL

Proposal **G1**

	PROPOSAL	G2
COMPONENT: Geotechnical – Permafrost Provisions – Tundra Excavation	**AUTHOR**	DJ

CURRENT CONCEPT:

During winter, clear and grub prior to placing ACE fill (assuming minimum ACE fill height of 5'). Replace grubbed material with select material Type C.

VE CONCEPT:

Replace clearing and grubbing with clearing only and place select material Type C over existing ground.

FUNCTIONS		
Extend Life of Roadway	Reduce Maintenance	Control Thawing/Settlement

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 198,000	$ 124,000	$ 74,000

ADVANTAGES:	**DISADVANTAGES:**
• Lower cost (~37%) • Simplified construction (no grubbing or additional Type C)	• Potentially longer freeze-back time beneath embankment.

	PROPOSAL	G2
COMPONENT: Geotechnical – Permafrost Provisions – Tundra Excavation	**AUTHOR**	DJ

DISCUSSION:

Clearing and grubbing may not be necessary beneath the recommended 5' ACE. The tundra is likely to be highly compressed after placement of the ACE fill and will have a much lower thermal conductivity, thus reducing its insulating properties. Therefore, it is not likely to have a significant impact on the ACE performance. Clearing and placement of select material Type C and ACE over existing ground is believed to be sufficient for embankment performance, and has a lower cost compared to clearing and grubbing and replacing the grubbed material with additional select material Type C.

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G2

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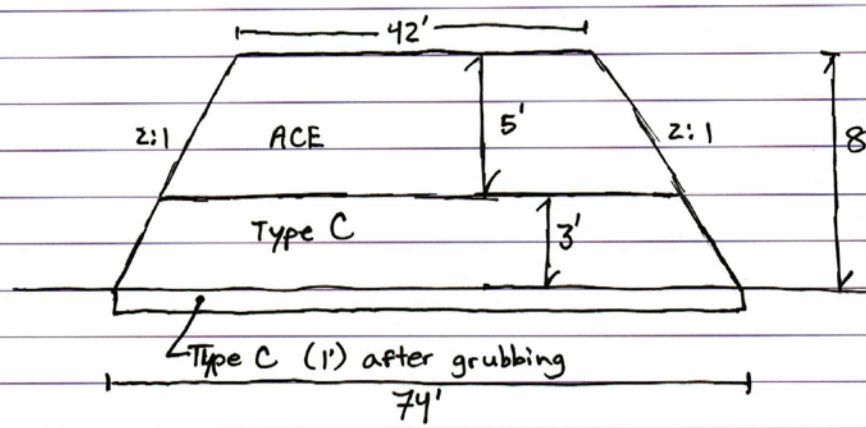
Replace Clearing and Grubbing 201(3A) w/ Clearing 201(1A) Beneath Minimum 5' High ACE

Assumptions:
- Embankment height to top of ACE is typically 8'
- Approximately 1' of material is removed and replaced w/ Type C borrow to EG.
- Typical Section is as shown below.



Known: 201 (3A) = $8,000/ACRE
201 (1A) = $5,000/ACRE
Total Length of full ACE = 14,550 LF
203 (3) for Type C after grubbing = $6.50/cy

Current Design Cost
Area = (74')(14,550 LF)/43560 sf = 24.72 Acres ⇒ $197,760
Type C Vol = (74')(1')(14550')/27 = 39,878 cy ⇒ $0, assuming placement of 1' of Type C does not add to cost due to excess Type C being generated by required cuts.

Proposed Design Cost
Area = (74')(14,550 LF)/43560 sf = 24.72 Acres ⇒ $123,600

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Dalton Highway MP 0-9 Reconstruction

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Geotechnical - Permafrost Provisions - Tundra Excavation

G2

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
201(3A) Clearing and Grubbing	24.72	ACRE	8000	197,760	201(1A) Clearing	24.72	ACRE	5000	123,600
Subtotal				197,760	Subtotal				123,600
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				198,000	Total to nearest $1000				124,000
					Difference				74,000

MENG Analysis
DOWL

Proposal **G2**

	PROPOSAL	G3
COMPONENT: Geotechnical – Permafrost Provisions – Deep Excavation/ Oversized Embankments	**AUTHOR**	MEK

CURRENT CONCEPT:

Per the geotechnical recommendations, ACE Embankment is planned for 14,550 lf of the alignment where ice rich soils were encountered. ACE embankment requires well graded rock of a specific size range that can be costly.

VE CONCEPT:

In areas where ACE embankment is proposed, there is significant ice within the near surface subgrade soils.

Where ACE embankment is proposed, the proposed road alignment is 8 to 13 feet above original ground (OG).

This concept proposes the removal of ACE embankment from the alignment, over-excavation of the near surface high ice soils, replacement with Type C, and the construction of the road embankment above OG with Type C.

FUNCTIONS		
Embankment Stability	Reduce Settlement	Ease of Maintenance

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 11,500,000	**$** 7,351,000	**$** 4,149,000

	PROPOSAL	G3
COMPONENT: Geotechnical – Permafrost Provisions – Deep Excavation/ Oversized Embankments	**AUTHOR**	MEK

ADVANTAGES:	**DISADVANTAGES:**
• Removal of subgrade. (near surface, ice rich areas) will reduce subsequent settlement • Thickness of Type C embankment above grade will help to reduce settlement • Able to drive on during construction • Eliminates the need to use insulation • Eliminates the need for ACE fill	• Winter construction recommended • Summer construction will be more difficult and time consuming – possible dewatering • Large waste material quantities

DISCUSSION:

The depth of near surface excess ice varies from 3 – 12 feet with the majority of the ice present at less than 8 feet below OG. By excavating the near surface ice and replacing with Type C, a large amount of future settlement will be avoided.

The elevation of the road profile is significantly higher than OG. The height varies from 8 to 11 feet. Multiple cross sections were developed to evaluate incorporating additional embankment height above the ACE Recommended minimum of 5 feet. These sections include:

1) All Type C (With and without insulation)
2) All ACE Embankment
3) Type C core with ACE shoulders and 5' ACE Embankment on top
4) Type C with ACE shoulders

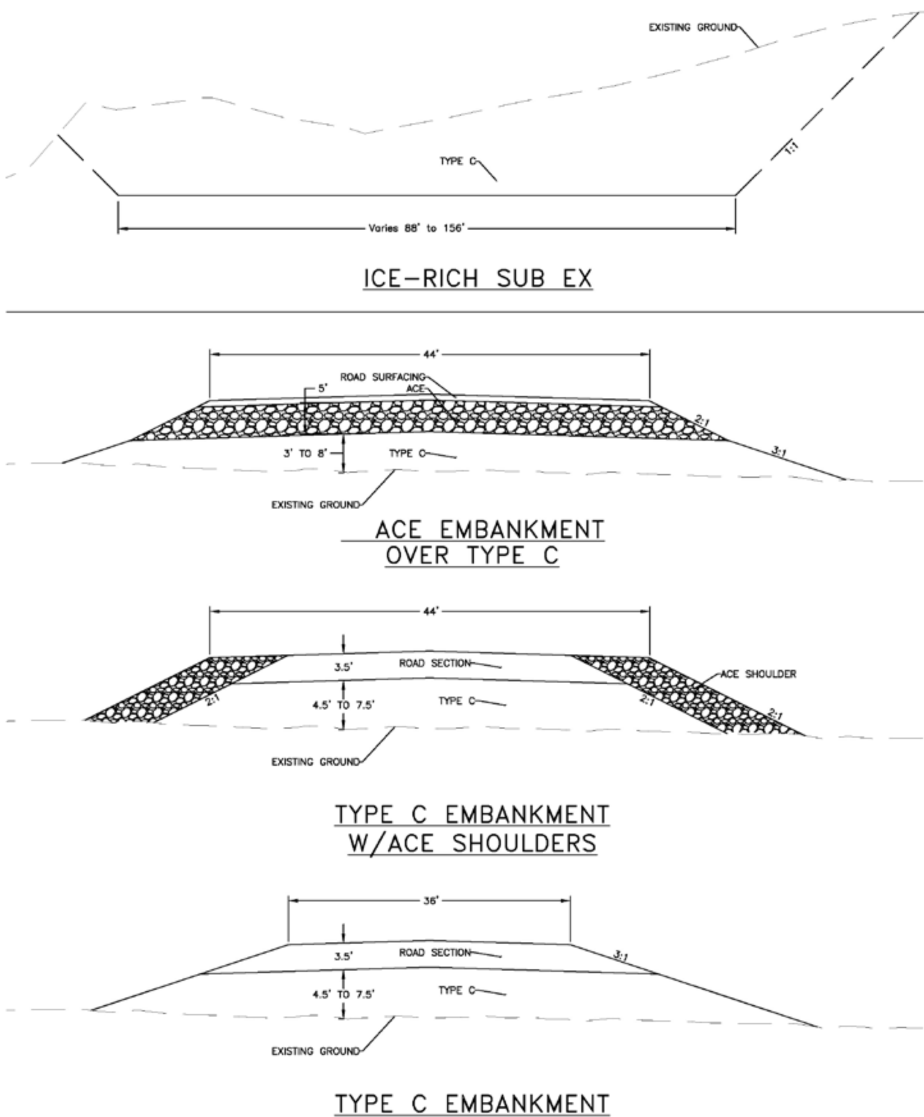
An all Type C embankment is a more appropriate section given the road profile.

	PROPOSAL	G3
COMPONENT: Geotechnical – Permafrost Provisions – Deep Excavation/ Oversized Embankments	**AUTHOR**	MEK

The combination of a Type C embankment with the subex of ice rich soils / backfill with Type C would further reduce the potential for settlement while still being considerably more cost effective than ACE.

Insulation could be placed on embankments less than 10 feet in height (an estimated 25% of the alignment).

	PROPOSAL	G3
COMPONENT: Geotechnical – Permafrost Provisions – Deep Excavation/ Oversized Embankments	**AUTHOR**	MEK



State of Alaska Department of Transportation & Public Facilities
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VALUE ENGINEERING STUDY

COST ESTIMATE FORM

G3

COMPONENT: Geotechnical - Permafrost Provisions - Deep Excavation/ Oversized Embankments

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
Grubbing of ACE Embankment Areas	5.3	Acres	3000	15,900	Grubbing of ACE Embankment Areas	22.95	Acre	3000	68,850
Unclassified Excavation	38889	cy	6.5	252,779	Unclassified Excavation	333987	cy	6.5	2,170,916
ACE Fill	196155	ton	50	9,807,770	Type C	669082	cy	6.5	4,349,033
Type C	218954	cy	6.5	1,423,201	Insulation	761.775	MBM	1000	761,775
Subtotal				11,499,650	Subtotal				7,350,574
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				11,500,000	Total to nearest $1000				7,351,000
					Difference				4,149,000

MENG Analysis
DOWL

Proposal **G3**

	PROPOSAL	G4
COMPONENT: Geotechnical – Permafrost Provisions – ACE Embankment Height	**AUTHOR**	DJ

CURRENT CONCEPT:

Winter construction: clear and grub, Type C, and 5’ Min. ACE. Spring construction: clear, Type C, and 7’ Min. ACE. (Assume design will use 5’ Min. ACE fill).

VE CONCEPT:

Winter or spring construction: clear, Type C, 6’ Min. ACE.

FUNCTIONS		
Control Thawing/Settlement	Extend Life of Roadway	Reduce Maintenance

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 10,768,000	$ 12,723,000	$ (1,955,000)

ADVANTAGES:

- Winter or spring construction
- Clearing only (no grubbing)
- Improved ACE performance over minimum 5’ height.
- Potentially less settlement and reduced maintenance costs.

DISADVANTAGES:

- Increased cost (~18%)

	PROPOSAL	G4
COMPONENT: Geotechnical – Permafrost Provisions – ACE Embankment Height	**AUTHOR**	DJ

DISCUSSION:

By replacing clearing and grubbing with clearing only and using a minimum ACE fill thickness of 6’, instead of 5’, the overall embankment stability and ACE performance may be improved for a minor cost increase of approximately 18% for the embankment materials and construction. This design simplifies construction and allows for winter or spring construction. Improved ACE performance and embankment stability would result in reduced long term maintenance costs, as well as an improved factor of safety against unusually warm summers or future climate change.

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G4

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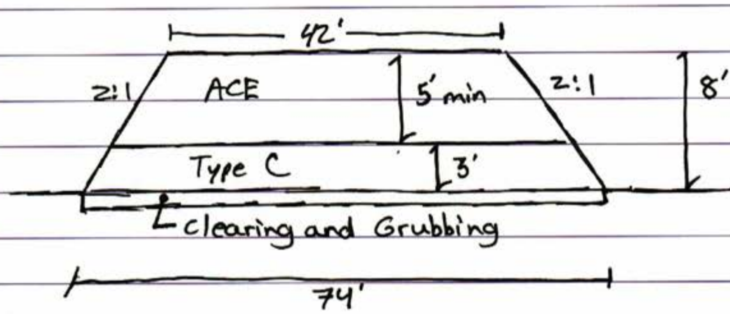
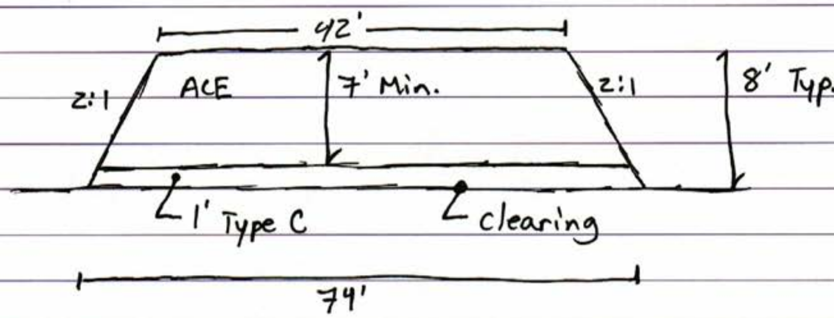
Increase ACE Height

Assumptions:
- Unit weight of ACE fill = 104.1 lb/cf = 1.4 Ton/cy (Taken from D. Goering paper)
- Typical sections are as shown below

5' Min. ACE Fill (Winter)



7' Min. ACE Fill (spring)



Known: Total length of full ACE = 14,550 LF
ACE = $50/Ton
Borrow = $5/cy
Clearing and grubbing = $8,000/Acre
Clearing = $5,000/Acre

1 of 3

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NR Design

Increased ACE Height

Current Design Cost

Winter (5' ACE)

ACE Area = 260 sf
ACE Vol/LF = 260 cf = 9.63 cy/LF
ACE W/LF = (1.4 Ton/cy)(9.63 cy/LF)
= 13.5 Ton/LF
Total W = 13.5 Ton/LF (14,550 LF)
= 196,425 Ton
ACE Cost = $50/Ton (196,425 Ton)
= $9,821,250
Clear/Grub Area = (74')(14550')
= 1,076,700 sf = 24.72 Acre
Clear/Grub Cost = $197,760
Type C = (62')(3') + (6')(3') + (74')(1')
= 278 sf
Vol Type C = (278 sf)(14550')/27
= 149,811 cy
Cost Type C = $749,055

Total Cost = $10,768,065

Spring (7' ACE)

ACE Area = 392 sf
ACE Vol/LF = 392 cf = 14.52 cy/LF
ACE W/LF = (1.4 Ton/cy)(14.52 cy/LF)
= 20.3 Ton/LF
Total W = 20.3 Ton/LF (14,550 LF)
= 295,365 Ton
ACE Cost = $50/Ton (295,365 Ton)
= $14,768,250
Clear ~~Grub~~ Area = (74')(14550)
= 1,076,700 sf = 24.72 Acre
Clear cost = $123,600
Type C = (70')(1') + (2')(1')
= 72 sf
Vol Type C = (72 sf)(14550')/27
= 38,800 cy
cost Type C = $194,000

Total Cost = $15,085,850

≈ 40% more expensive

Assume designers will opt for 5' ACE for cost savings.

2 of 3

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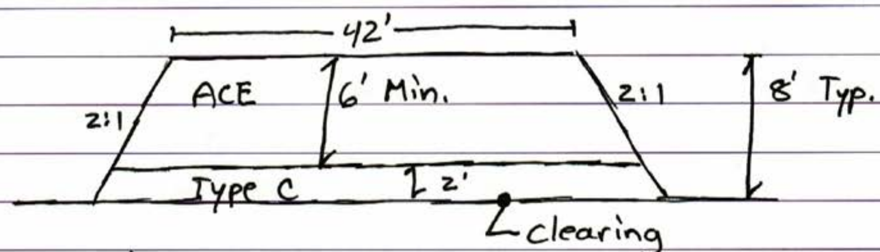
NR Design

Increased ACE Height

Proposed Design Cost

Use a minimum ACE height of 6' and only clear (no grubbing) beneath embankment.

6' Min. ACE Fill (Winter or Spring)



Winter or Spring (6' ACE)

ACE Area = 324 sf
ACE Vol/LF = 12.00 cy/LF
ACE W/LF = (1.4 Ton/cy)(12.00 cy/LF) = 16.8 Ton/LF
Total W = 16.8 Ton/LF (14,550 LF) = 244,440 Ton
ACE Cost = \$50/Ton (244,440 Ton) = \$12,222,000
Clearing Cost = \$123,600
Type C = (66)(2') + (4')(2') = 140 sf ~~LF~~
Vol Type C = (140 sf)(14550 LF)/27 = 75,449 cy
Cost Type C = \$377,225

Total Cost = \$12,722,825 (≈ 18% more expensive)

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State of Alaska Department of Transportation & Public Facilities
Dalton Highway MP 0-9 Reconstruction

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Geotechnical - Permafrost Provisions - ACE Embankment Height

G4

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
201(3A) Clearing and Grubbing	24.72	ACRE	8000	197,760	201(1A) Clearing	24.72	ACRE	5000	123,600
203(5) Borrow	149811	CY	5	749,055	203(5) Borrow	75445	CY	5	377,225
203(106) ACE Fill	196425	TON	50	9,821,250	203(106) ACE Fill	244440	TON	50	12,222,000
Subtotal				10,768,065	Subtotal				12,722,825
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				10,768,000	Total to nearest $1000				12,723,000
					Difference				(1,955,000)

MENG Analysis
DOWL

Proposal **G4**

	PROPOSAL	C1
COMPONENT: Construction - Schedule	**AUTHOR**	LK

CURRENT CONCEPT:

Contract time will be based on a project completion date which will allow 2 seasons of physical work. Current schedule shows field work beginning in May.

VE CONCEPT:

Contract time will be based on a project completion date which will allow 1 season of physical work. Physical Work will begin in March.

FUNCTIONS		
Roadway Base-Permafrost Protection	Roadway Grading	Construction Support

CURRENT CONCEPT	**PROPOSED CHANGE**	**DIFFERENCE**
$ 8,155,000	$ 5,659,000	$ 2,496,000

ADVANTAGES:

- Claim avoidance
- User cost decrease

DISADVANTAGES:

- Settlement repair is M&O cost

	PROPOSAL	C1
COMPONENT: Construction - Schedule	**AUTHOR**	LK

DISCUSSION:

One physical construction season contract time (March thru October) will decrease risks to the Contractor for the requirement to repair settled areas. The amount of settlement would be difficult to estimate. The estimate of settlement would not be sufficient for the contractor to provide fair and reasonable costs.

Repair of settlement areas may require the contractor to remain mobilized with the majority of crew and equipment for another season. Settlement repair would not be of a linear nature and decease the production experienced by original bid prices. Original bid prices would no longer be applicable and could be a “Material Change Order” (the Method and Means has changed from original bid items).

Determining the actual value of this proposal will require a detailed analysis of quantities and associated costs.

The cost value of this proposal is based on the following assumptions:

- DSR quantities include a volume for settlement
- DSR estimate includes an increased cost for out of sequence mainline placement of material

A decrease in costs for one season construction comes from the following factors:

- Decrease of material quantity supplied by contractor
- Risk burden is shifted from Contractor to State. Risk involves unknown settlement quantities and production rates for settlement spot repairs
- Reduced traffic maintenance and control
- Reduced construction engineering cost

	PROPOSAL	C1
COMPONENT: Construction - Schedule	**AUTHOR**	LK

Standard Specifications and Special Provisions Cost Estimate Influences

The costs estimated are based on utilizing the Standard Specifications without project specific Special Provisions. Special Provisions could be authored to attempt to define risk allocation for subgrade settlement. The project specific Special Provisions effectiveness and impact on getting a fair and reasonable bid may be questionable. The latitude in which the Department allows for project specific Special Provision authoring needs to be considered.

NTP to Letter of Project Completion

A two-season construction period could have a NTP in March of the first year with Substantial Completion issued in November of the second year. There would be approximately 8 months of full production, 10 months of less than full production and 3 months of winter shutdown. Also, an additional 4 months (December to March) while the Contractor may need to wait to demobilize depending on weather conditions will be required after Substantial Completion. A Letter of Project Completion could be issued the following year after demobilization.

A one season construction period could have a NTP in March of year 1 and Substantial Completion issued in November of the same year. There would be approximately 4 months of full production and 5 months of less than full production. An additional 4 months (December to March) while the Contractor may need to wait to demobilize depending on weather conditions will be required after Substantial Completion. A Letter of Project Completion could be issued the following year after demobilization.

Borrow, Subbase F, Aggregate Surface Course Costs

Cost savings were generated using the following reductions: 20 %for Borrow, 20% for Subbase F and 33% for Aggregate Surface Course. These percentages are based on a premise that an estimated rough calculation of 4” of settlement across the project would require around 30K CY of material. An assumption was made that the amount of settlement was included in the DSR Estimate. This assumption allows a quantity in which to base the calculations on what additional costs may occur when settlement is encountered on a two-season construction project. Doubling the cost of the allocated material will yield the estimated savings shown.

	PROPOSAL	C1
COMPONENT: Construction - Schedule	**AUTHOR**	LK

Since there is no detailed settlement prediction analysis numerous assumptions had to be made. What stage of the fill are the repairs to be made, inefficiencies of being out of the mainline spread operation, time of the year weather influences, availability of men and equipment and the accuracy of the contract documents on the ability to designate settlement locations and the control of the contractor's sequence of operations.

ACE

The cost of the ACE was reduced by 25%. Any settlement repair on the ACE will be extremely equipment specific and difficult. The probability of contamination and degradation of the ACE is high if settlement repair is required.

Mobilization

The cost savings number utilized for the mobilization and demobilization item is an extremely subjective number. The costs saving number does not directly fall into the 600 bid item definition however the contract cost implications need to be allocated.

If a contract is awarded that uses the Standard Specifications and allows for a two-season construction period and the contractor intends to complete the work in one season and undefined settlements occur a contract dispute would likely occur. A contract dispute due to a mixture of performance and prescriptive specifications is fraught with "what if's".

A cost was used based on: 8 months of full production vs 4 months, 10 months of less than full production vs 5 months, and 3 months of shutdown vs 0 months of shutdown. Using 12 months of standby time for 50 pieces of equipment yields around $560,000 in standby costs. The costs generated in the MOB item are extremely subjective and are open to scrutiny. Without devoting time to analyzing numerous scenario permutations the cost number can only be used as an indicative value.

Traffic Maintenance

A reduced time period of active construction from 18 months to 9 months will reduce the number of days of traffic maintenance required by 50%. There will be some fixed costs associated with performing this item.

	PROPOSAL	C1
COMPONENT: Construction - Schedule	**AUTHOR**	LK

Traffic Control

A reduced time period of active construction from 18 months to 9 months will reduce the number of days of traffic control required by 50%.

CEng Items

Minimal CEng Field staff could be required during periods of less than full production, however, the amount of overall documentation of field work will remain the same. There will be a savings generated with a larger field staff during a shorter period of time due to job assignment sharing.

State of Alaska Department of Transportation & Public Facilities
Dalton Highway MP 0-9 Reconstruction

VALUE ENGINEERING STUDY

COST ESTIMATE FORM

COMPONENT: Construction - Schedule

C1

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
BORROW	210K	CY	5	1,000,000	Borrow				800,000
ACE	30K	T	50	1,500,000	ACE				1,200,000
Agg Surface	121K	T	24	3,000,000	Agg Surface				2,000,000
Sub F	61K	CY	6	365,000	Sub f				290,000
MOB	LS	LS	LS	1,400,000	MOB				840,000
Traffic Maintenance	LS	LS	LS	140,000	Traffic Maint				84,000
Traffic Control	LS	LS	LS	400,000	Traffic Control				200,000
Ceng Items	LS	LS	LS	350,000	Ceng Items				245,000
Subtotal				8,155,000	Subtotal				5,659,000
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				8,155,000	Total to nearest $1000				5,659,000
					Difference				2,496,000

MENG Analysis
DOWL

Proposal **C1**

TECHNICAL COMMENTS

In the Value Engineering process, the team may explore issues that could be useful to the design team and the owner as the project progresses. These are typically not alternative design systems resulting in cost adjustments to the project, but they may improve constructability and avoid potential change orders. They are mentioned here as a courtesy to the design team.

TECHNICAL REPORT	PROPOSAL	T1
COMPONENT: Material Criteria – Degradation Values	**AUTHOR**	RDP, LK

CURRENT CONCEPT:

Use Standard Specification for Deg. values on Processed Materials

CONSIDERATIONS:

Based on the knowledge of the area within the project boundaries readily available Material Sources probably will not meet the Standard Specification Quality requirements

Quality specifications need to match the material quality that is readily available or include increased haul costs for the items.

Contract needs to address the possible location of material meeting the specifications. The Statewide Material Site Inventory –Material Site Inspection Report MS 65-3-013-2 19Mile Quarry shows evidence that acceptable material may be available.

TECHNICAL REPORT	PROPOSAL	T2
COMPONENT: Construction Delivery	**AUTHOR**	LK

CURRENT CONCEPT:

Design-Bid-Build Contracting Method.

CONSIDERATIONS:

Utilize CMGC Contracting Method.

The phasing of embankment construction required by the several types of typical sections is critical to short and long-term roadway profile stability.

The new alignment will encounter several areas of ice rich soils. The typical sections have sound engineering principals employed to ensure long term viability. The risk involved is knowing the exact location a type of typical section should be utilized, the rate and amount of settlement that can be expected, and a construction method and phasing plan to meet the design intent. Determining accurate biddable settlement amount locations and rates would require a preconstruction materials investigation that would be cost prohibitive. A contracting methodology is required that will more evenly proportion the liability of risk.

The ACE and other suggested typical section require construction phasing that will be impacted by weather. Some typical sections will require the placement of thawed Select material, compaction and refreezing of the material. ACE typical sections will require the ACE material to be placed and not damaged by construction methods of hauling and placement.

Highway Standard Specifications are a mix of performance and prescriptive specifications. When using a mix of performance and prescriptive specifications a distinction between method and performance is critical in assessing liability. DDB during a competitive bidding climate will award to the lowest responsive and responsible contractor.

CMGC is well suited for this project because it can be considered to be:

- Technically complex: ACE embankment’s thermodynamic theory has specific requirements that must be met it order for it to function

TECHNICAL REPORT	**PROPOSAL**	**T2**
COMPONENT: Construction Delivery	**AUTHOR**	LK

- Difficult to define: developing performance and prescriptive specifications that are not mixed

- Subject to change: changing of typical section locations during construction will be required once the actual subsurface conditions are discovered

- Having several design options: the success of the typical sections with respect to cost and function is dependent on the contractor's method and means. CMGC will allow detailed discussions over key constructability issues including phasing of the work

- In the appropriate design stage: 30% design completion stage

GMGC – GCCM Considerations:

These contracting methods are viable and useful for complex projects that warrant advance contractor coordination.

Price competition

These methods are not necessarily less expensive methods; a factor that depends on the way the contract is written as well as the availability of competitive GCCM contractors for the specific project. These contracts can vary in price competition, depending on how many work items are self-performed and how many are required to attain competitive bids within the GCCM / GMGC contract. For the Dalton project, most of the work items are material mining and handling. They account for most of the project cost. It will be important to provide a method for attaining competition on this work.

GMGC – GCCM contracts can benefit also from contractor pre-construction services in the planning and design stages. For this to be useful in the Dalton project, which is currently at the 40% design stage, and scheduled for construction in Spring of 2018; it will be necessary to engage the contractor soon. Typically, it takes 6 months to engage a GCCM contract, so if this project stays on the currently defined schedule, it would be a late engagement if initiated now.

TECHNICAL REPORT	**PROPOSAL**	**T2**
COMPONENT: Construction Delivery	**AUTHOR**	LK

GCCM – GMGC Third party review:

Although the GMGC – GCCM contractors do participate during planning and design, they are not a substitute for third party review and value-added services often used for projects of this size. Valuable services such as constructability, risk assessment, and value management are still recommended by independent third-party providers employed directly by the “owner” rather than the “contractor”. Typically, the contractor can contribute greatly to discussions of means and methods, and even material substitutions, but seldom have the design or engineering background still needed by the owner during preconstruction. (Nor are they typically given the responsibility for project scope or basis of design analysis)

TECHNICAL REPORT	PROPOSAL	T3
COMPONENT: Construction Considerations	**AUTHOR**	LK, DS

CURRENT CONCEPT:

Contract time will be based on a project completion date which will allow 2 seasons of physical work.

CONSIDERATIONS:

Schedule, construction cost and public safety can be controlled by the use of standard and special provisions.

The costs associated with embankment settlements which will occur after the first season of settlement can either be borne by the construction contract or DOT maintenance.

The costs associated with traffic control and roadway maintenance during contract time for each portion of the project can either be borne by construction contract or DOT maintenance.

The allocation of risks associated with traffic maintenance and partial completion dates for each portion of the project needs to be clearly defined in the contract.

Designate 5 geographically separate portions of project:

- Elliot Tie In #1: BOP 10+00 to 25+00
- New Elliot Alignment: 25+00 to 45+00
- Elliot Tie in #2: 45+00 to 80+00
- New Alignment: 80+00 to 425+00
- Dalton Tie in: 425+00 to 573+06 (EOP)
- Existing Alignment

Each Geographically Separate Portion of Project will have a partial completion date

TECHNICAL REPORT	PROPOSAL	T3
COMPONENT: Construction Considerations	AUTHOR	LK, DS

nested into the Project Completion Date.

Applicable Specifications:

- 105-1.13 MAINTENANCE DURING CONSTRUCTION
- 107-1.14 OPENENING SECTIONS OF THE PROJECT TO TRAFFIC
- 107-1.15 CONTRACTORS RESPONSIBILITY FOR THE WORK
- 108-1.04 Limitations OF OPERATIONS
- 108-1.07 FAILURE TO COMPLETE ON TIME

Delete the second paragraph and substitute the following:

Maintain the entire highway and related highway facilities located within the project (between the beginning of the project and end of the project shown on thePlans) from the date construction begins until you have received a letter of Substantial completion. Maintain these areas continually and effectively on a daily basis, with adequate resources to keep them in a satisfactory condition at all times.

Elliott tie in #1. BOP 10+00 – 25+00 Contractor will not begin tie in work at this station prior to fill completion between 25+00 - 45+00. This will allow for uninterrupted traffic and limit traffic control costs at this location until the majority of the new alignment embankment is constructed.

Elliott Tie in #2 Station 45+00 – 80+00 Contractor will provide and maintain signage for the duration of the project. Flaggers or other project engineer approved traffic control methods will be provided during all material hauling through this section. This will allow for uninterrupted traffic during times when hauling operations are not active. It will also reduce traffic control costs.

Station 80+00 – 425+00 Contractor will assume responsibility to prevent access to re alignment areas at both stations by non-project personnel / vehicles throughout the duration of the project. Contractor will provide security to prevent access to this area as

TECHNICAL REPORT	PROPOSAL	T3
COMPONENT: Construction Considerations	AUTHOR	LK, DS

approved by the project engineer.

Station 425+00 – 573+06 EOP. Contractor will not begin work on this section prior to completion of embankment throughout re-alignment sections. This does not include pipe ramming efforts. This will allow for uninterrupted traffic flows throughout this area until the majority of the new alignment embankment is constructed.

Existing Alignment: Contractor shall not begin work on existing alignment and will not be responsible for Traffic Maintenance until all other portion of project are partially complete as identified in the special provisions. Prior to contractor performing work as outlined within the contract on existing Dalton/ Elliott highways, all maintenance for these sections will be provided by the state.

TECHNICAL REPORT	PROPOSAL	T4
COMPONENT: Utilities – Pipeline Casing	**AUTHOR**	DS

CURRENT CONCEPT:

Compensate Alyeska Pipeline Service Company (APSC) for the removal of the highway crossing sleeve at the Elliott Highway crossing.

CONSIDERATIONS:

APSC Elliott Highway Crossing:

Dalton Highway project MP 0-9 realignment will require an expansion of the existing Elliott highway embankment over the APSC /TAPS oil line crossing at Elliott Highway MP 74.

APSC provided an estimated cost for modifications to the pipeline to accommodate the roadway expansion over the pipeline to be approximately $2 million.

As this is a significant cost to the project, and the assertion by the department that the costs for this should be borne by APSC the following information should be requested:

1. What are the impacts to the pipeline from widening the roadway?
2. Does the expansion of the road foot print require the pipeline sleeve to be replaced?
3. Is there a requirement or regulation requiring the sleeve to be full width under the entire highway or just the driving lanes?
4. If the sleeve is removed will it be replaced?
5. Has APSC replaced similar sleeves at highway crossings for improved cathodic protection or other reasons?
6. Has APSC previously determined that the sleeve at this crossing should be replaced or removed at this location?
7. Are there other areas where buried pipeline crossings have not been modified during highway improvement /widening projects?

TECHNICAL REPORT	PROPOSAL	T4
COMPONENT: Utilities – Pipeline Casing	**AUTHOR**	DS

8. Would there be fewer impacts to APSC to widen the road 4 feet on each side? Or any other combination?

9. The new road will have the same drive lanes 2 @ 12 feet each. The additional width is for shoulders only. Would there be fewer impacts to APSC if this area was signed for emergency stopping only or no stopping/parking?

TECHNICAL REPORT	PROPOSAL	T5
COMPONENT: Planning - Alignment	**AUTHOR**	KLK

CURRENT CONCEPT:

Establish realignment of the first six miles of existing Dalton Highway to an adjacent valley bottom. The new alignment ties into the existing alignment at approximate MP 6.5.

CONSIDERATIONS:

This VE Team explored an alternative alignment on the existing alignment that increases grades to match the waivered design criteria. After this review, this VE Team does not recommend this as a proposal but wanted to show the thoughts and why it wasn't developed further.

The existing stretch of road has numerous substandard horizontal and vertical curves with grades up to 12%.

An alignment study was conducted to compare costs associated with bringing the existing alignment up to current geometric standards. Two options included: 1) reducing excavation to the greatest extent possible, and 2) balancing cut/fill (borrow material needed) to the greatest extent possible.

Summary of cut/borrow costs differences between alignments:

"Exist_Dalt_O"	Cut Cost (per CY)	Borrow Cost (per CY)	Total Cost
Profile 1 – Limited Excavation	$8	$6	$70,800,000
Profile 2 – Balanced Cut and Fill	$7	$7	$36,000,000
"O5"	$8	$8	$20,100,000

Table 4 – Prelim Construction Costs

The VE Team looked at the potential to decrease Profile 2 costs to match or lower costs compared to the proposed alignment by applying the relaxed design criteria as used for Sta 492+54 to 545+27. Relaxed criteria being, ~2,400' at 8-9% grade with ~1,000' bench at 3.5%.

TECHNICAL REPORT	PROPOSAL	T5
COMPONENT: Planning - Alignment	**AUTHOR**	KLK

This discussion is based on the standpoint that widening the roadway on an established alignment is typically much easier and less risk in already settled areas.

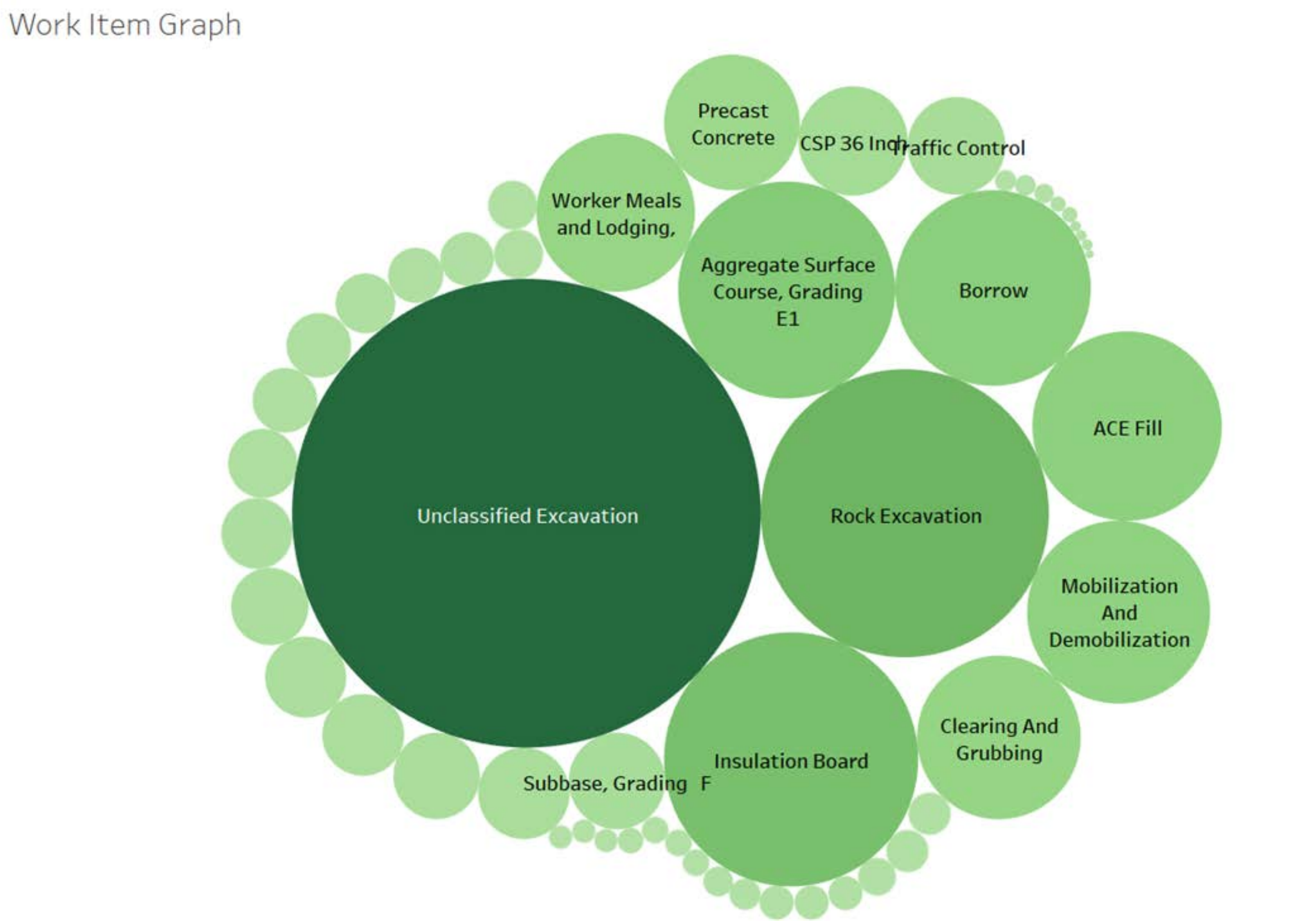
We applied these criteria at the valley and hill climb from 215+00 to 305+00 and determined excavation would have to occur in areas that have high probability of ice rich soils. The only option to avoid this would be to apply a long 9% grade for 1.2 miles which adds another long climb/downgrade near the previously approved design exception at 9-Mile of 9.4%.

Compared to the proposed realignment the benefit does not appear to be high enough to please users and adds to the potential high risk of encountering ice rich soils when excavating into the hillside.

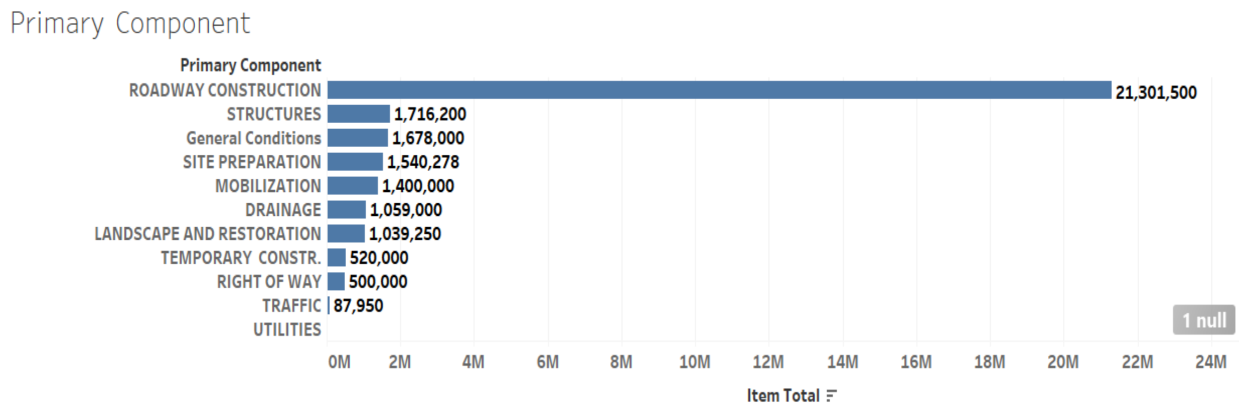
COST / BUDGET ANALYSIS

The VE team was not tasked to complete a detailed cost estimate review; but does use the estimate to better understand the most impacting systems and components and to compare the current design to VE alternatives. Therefore, the VE team prepares cost models and a summary of items that may warrant cost estimate adjustments.

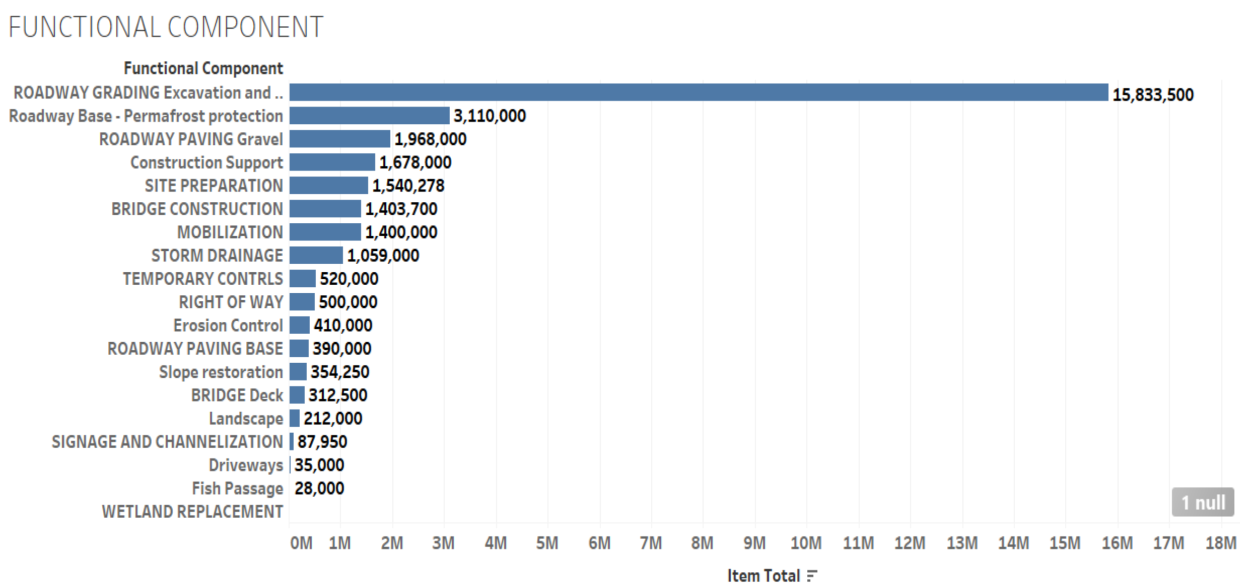
Project Cost Models – Work Items



Cost Model – Primary Components



Cost Model – Functional Components



Cost Estimate Comments

CE#	ROADWAY COMPONENT	CURRENT TOTAL	VE TOTAL	DIFF TOTAL	COMMENT
1	ACE Fill	$1,500,000	$9,821,000	-$8,321,000	The current project quantities reflect 30,000 tons of ACE fill. Recent Geotech recommendations increase the need to ~ 196,425 tons.

NOTE: This is not a comment on the bottom overall estimate. The VE team highlighted these items for further study based on differing cost opinion discussions.

COST ESTIMATE FORM

COMPONENT: ACE Fill

CE1

CURRENT DESIGN					VE PROPOSAL				
ITEM	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**	**ITEM**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL COST**
ACE Fill	30000	ton	50	1,500,000	ACE Fill	196425	ton	50	9,821,250
Subtotal				1,500,000	Subtotal				9,821,250
General Contractor Markup		%			General Contractor Markup		%		
Total to nearest $1000				1,500,000	Total to nearest $1000				9,821,000
					Difference				(8,321,000)

MENG Analysis
DOWL

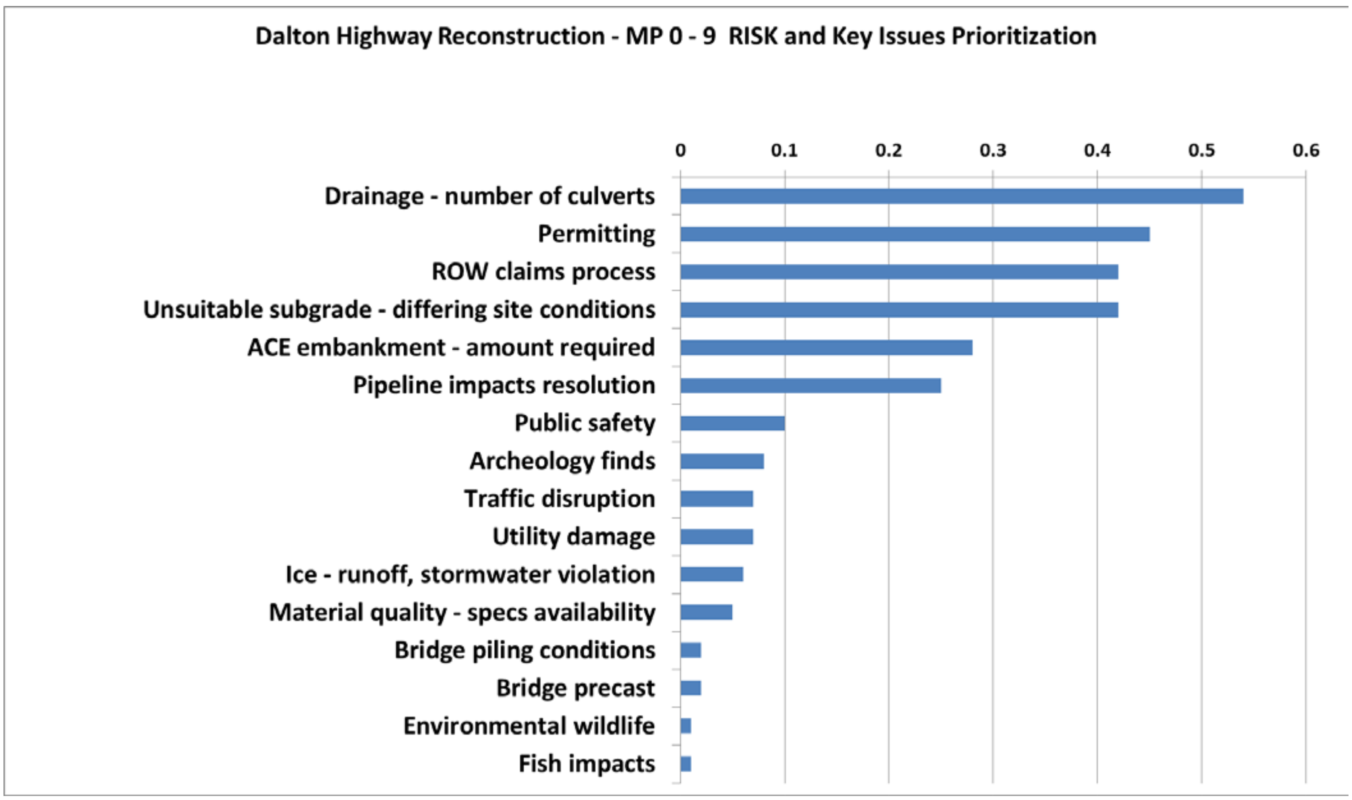
Proposal **CE1**

RISK ANALYSIS

The VE team discussed the potential project risks and assessed their probability as well as potential impacts. Risks were identified as very low (10%), low (30%), medium (50%), high (70%) or very high (90%) probability, as well as very low, low, medium, high or very high impact for both cost and schedule. Importance scores were calculated as the product of probability and impact.

This analysis was used to identify focus areas for the study, as well as to look for ways to balance the relationship between cost and risk with specific VE proposals. It is often possible to reduce risk with additional expenditures; but it is important to keep a good value ratio between those costs and the value of the reduced risk.

Prioritized Project Risks - Graph



VE PURPOSE AND METHODOLOGY

Value Engineering provides an independent, impartial project review by a team assembled specifically for this study. Value Engineering itself is an organized creative process, which examines the proposed project and identifies alternatives to optimize cost and performance and assure compliance with project requirements. Through a structured system of investigation, idea generation, and analysis, the independent multi-disciplined team is able to consider and identify alternatives for design, budget, schedule and construction methods, concurrently in a concentrated study.

After the initial presentation by the design team, the VE team analyzed the budget and cost estimate, and defined the basic functions of each project component. The VE team looked for ways to eliminate or modify design elements that add either first cost or life cycle cost without contributing to its required function. Specific proposals and reports were prepared and analyzed by the group for conformance to the project goals and VE study goals, prior to final prioritization. The design team, DOT & PF, specialists, and other suppliers were contacted regarding design questions, material options and pricing.

Prioritization and brainstorming were conducted in group sessions alternating with additional small group and individual study sessions. All members supported an "open minded" attitude to new suggestions, and all alternatives were considered valid until rejected by the entire team.

At the conclusion of the VE workshop all reports and information were assembled into an oral presentation to the stakeholders; and a written report was distributed to further study the proposals and findings. Key items for study are contained in the Executive Summary, the Technical Reports, and in the VE Proposals.

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FUNCTIONAL ANALYSIS

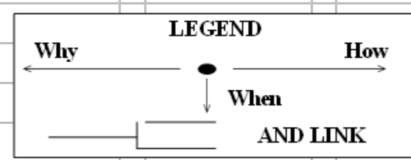
The VE team completed a function analysis of the Dalton Reconstruction project. The function analysis diagram arranges the functions with the higher order (Why) functions to the left of the diagram and supporting functions (How) to the right of the diagram. This identification and understanding of basic functions, support functions, and criteria were used to better understand the project; and during the speculative phase, as a basis for seeking alternative concepts.

Alaska Department of Transpotation - Public Facilities (DOT - PF)

Dalton Highway MP 0-9 Reconstruction

FUNCTIONAL ANALYSIS DIAGRAM | Working DRAFT

6/5/2017 | egm



CRITERIA			*PROGRAM SUPPORT FUNCTIONS*				
Safety	Cost	Highway Standards	Control Traffic	Construction	Maintain Traffic	Maintain road / structures	Manage project
Mobility	Maintainability	AASHTO / DOT Criteria	Inform Drivers	Stage equipment	Separate traffic - construction	Maintain surfacing	Permit project
Support Commerce	Constructabiity	Traffic Loads	Control speeds	Deliver materials	Manage traffic	Manage snow / ice	Design Project
Support Tourism				Support workers	Detour traffic	Repair setttlement	Manage construction
				House / feed workers	Transport workers		
HIGHER ORDER FUNCTIONS		*CRITICAL PATH FUNCTIONS*					
PROGRAM FUNCTIONS							
Support Commerce - trucking	Reduce slopes	Realign Roadway					
Access Deadhorse / Prudo Bay	Widen roadway	Reconstruct Existing roadway					
Protect people	Increase run out						
Respond emergencies	Flatten curves						
Reduce accidents	Widen shoulders						
Extend Life of highway	Control melting / settlement	Reconstruct surfacing	Foam embankments				
	Support highway loads	Reconstruct road base	Air cooled embankment				
	Manage snow / ice	Reconstruct embankments		0			
	Control stormwater / runoff						

Dalton Highway MP 0-9 Reconstruction

FUNCTIONAL ANALYSIS DIAGRAM

CONSTRUCTION FUNCTIONS

Construct Road	Seal surface	Construct road surface aggregate	Build road base	Mine material	Clear site	Acess site
				Haul material	Demolish rock	Temporary roads
			Rip rap	Import material	Excavate earthwork	
			Export Dispose excess			

SYSTEM FUNCTIONS

Site	Stormwater	Utilities	Structure - Bridge	Restoration
Procure site (ROW)	Drain stormwater	Reroute communications	Retain earth	Restore vegetation
Clear site	Prevent hydroplaning	Reroute fiber	Span creek	Plant grass
Remove soil	Reduce icing		Support bridge	Reduce dust
	Reduce erosion		Support paving	Reduce erosion
	Convey stormwater		Access bridge construction	
	Culvert stormwater		Railing	
	Reconfigure culverts		Stop vehicles (impact)	

VE IMPLEMENTATION FORM

The VE Implementation form is used to track the acceptance of the Value Engineering proposals.

We request a copy of the completed VE Implementation form be returned to MENG Analysis.

Receipt of the completed implementation form also helps track and analyze studies in order to improve future Value Engineering services.

	VALUE ENGINEERING PROPOSAL	PROPOSED COST AVOIDANCE	ACCEPT	REJECT	MODIFY	ACCEPTED VALUE OF PROPOSAL	COMMENTS / DISCUSSION
D1a	Drainage - Pipe Culvert - Culvert Gauge	(540,000)					
D1b	Drainage - Pipe Culvert Material Upgrade	(606,000)					
D2	Drainage - Pipe Installation Method	242,000					
D3	Drainage - Pipe Bedding - Insulated	(443,000)					
B1	Bridge - Structural Design Refinement	419,000					
B2	Bridge - Width Criteria	283,000					
B3	Bridge - Span	277,000					
B4	Bridge - Structural Plate	1,069,000					
R1	Roadway Construction - Materials Sourcing	3,354,000					
R2	Roadway - Surface	220,000					
R3	Roadway - Surface Section	1,110,000					
G1	Geotechnical - Permafrost Provisions - Thermal Berms	(1,342,000)					
G2	Geotechnical - Permafrost Provisions - Tundra Excavation	74,000					

	VALUE ENGINEERING PROPOSAL	PROPOSED COST AVOIDANCE	ACCEPT	REJECT	MODIFY	ACCEPTED VALUE OF PROPOSAL	COMMENTS / DISCUSSION
G3	Geotechnical - Permafrost Provisions - Deep Excavation / Oversized Embankments	4,149,000					
G4	Geotechnical - Permafrost Provisions - ACE Embankment Height	(1,955,000)					
C1	Construction - Schedule	2,496,000					
	TOTAL ACCEPTED and PENDING						

DOT & PF has reviewed each of the Value Engineering proposals and recommends the responses contained herein.

by

title

date

COMPLETED VE IMPLEMENTATION FORM

	VALUE ENGINEERING PROPOSAL	PROPOSED COST AVOIDANCE	ACCEPT	REJECT	MODIFY	ACCEPTED VALUE OF PROPOSAL	COMMENTS / DISCUSSION
D1a	Drainage - Pipe Culvert - Culvert Gauge	(540,000)	X			($540,000)	This is a normal NR design approach for thaw-unstable or areas with high expected settlement; for conveyances in these areas, thicker gauge culverts will be used except where smooth steel culverts (from proposal D1b) are determined to be a more desirable choice. The decision to accept this proposal is contingent on affordability in STIP.
D1b	Drainage - Pipe Culvert Material Upgrade	(606,000)	X			($606,000)	Similar to proposal D1b, this is a normal NR design approach for areas with expected differential settlement - which is anticipated. Smooth wall steel pipes have "held up" well to excessive settlement per M&O's experience in this region.
D2	Drainage - Pipe Installation Method	242,000		X			The culvert to be replaced at this location is not planned to be replaced at the depth of the original - rather the replacement culvert will be at a more appropriate grade and include the design of a long outfall protection from outlet to beyond the new embankment toe; this anticipated replacement does not lead to the savings shown here from employing trenchless culvert installation techniques. Furthermore, the availability of contractors to perform this type of work is very limited and the cost to mobilize this specialized equipment and crew would further lead to no net savings from this alternative installation method.
D3	Drainage - Pipe Bedding - Insulated	(443,000)	X			($443,000)	Similar to proposal D1a and D1b, this is a normal NR design approach and will be used where conditions are appropriate.
B1	Bridge - Structural Design Refinement	419,000	X			$419,000	As discussed during the VE proposal presentation, these savings would have likely been realized through the normal and expected design refinement process; The preliminary bridge plans were prepared with no geotechnical, hydraulic or refined site survey. The final bridge design will utilize the SFER, H&H Report and site survey thereby addressing the uncertainty in the preliminary design but may or may not result in a cost savings.
B2	Bridge - Width Criteria	283,000		X			For consistency with all new bridges on this highway and at the NR's decision this proposal was rejected. Furthermore, the proposed shoulder width would not safely accommodate bicycle use on this roadway.

	VALUE ENGINEERING PROPOSAL	PROPOSED COST AVOIDANCE	ACCEPT	REJECT	MODIFY	ACCEPTED VALUE OF PROPOSAL	COMMENTS / DISCUSSION
B3	Bridge - Span	277,000		X			The bridge length for water crossing is established by the hydraulic engineer. The proposed 1.5:1 side slopes are steeper than that commonly used for bridge projects. The proposed steep slopes may result in hydraulic, slope stability (static and/or seismic), and constructability problems. Furthermore, the savings from a reduction in length would likely not be as significant a proposed due to the economies of scale (i.e., the same foundations, abutments, wingwalls, bridge rails, etc. would still be required).
B4	Bridge - Structural Plate	1,069,000		X			Culverts are not as well suited for areas where differential settlement could be expected such as this location. If a SPPA was used at this location, a deep-pile foundation would likely be required rather than the spread footing shown for this proposal; the proposed cost savings would be significantly reduced with this type of foundation. Aufeis and overtopping has been an ongoing maintenance issue for the existing Lost Creek crossing of the Dalton Highway, with the roadway having washed out 3 times in the last 10 years. While Aufeis is unpredictable, it should be expected given the history and site conditions and, as such, a bridge is much more capable of preventing problems to the roadway due to aufeising. Large trees in this region that may become waterborne could cause issues with a SPPA whereas this is less likely with a bridge. Finally, NR has limited experience with these types of culverts and, coupled with this being a completely new alignment, there is an uncomfortable amount of uncertainty in using this type of SPPA.
R1	Roadway Construction - Materials Sourcing	3,354,000		X			This proposal is not applicable as the material at the noted locations is not expected to be capable of producing ACE material, even with a reduction in the proposed degradation values. The amount of waste generated to meet the gradations needed for effective ACE performance would be highly cost-prohibitive.
R2	Roadway - Surface	220,000			X		While Hi-Float surfacing would prevent embankment from being bladed or pushed onto the ACE shoulders over time, the installation process is very messy and would result in a lot of material entering the ACE shoulders immediately upon installation. Hi-Float was also not determined to be a good idea for areas with expected settlement and, with the little depth of material above the ACE and below the surfacing, Hi-Float would not provide sufficient strength to resist deformations, even minor ones, that might be expected due to the surface characteristics of the finished ACE layer. The Department has determined it would be best to install some type of impervious, wearing driving surface in the ACE sections at a minimum, however; this will be investigated further with locations and types to be determined during the detailed design process.

	VALUE ENGINEERING PROPOSAL	PROPOSED COST AVOIDANCE	ACCEPT	REJECT	MODIFY	ACCEPTED VALUE OF PROPOSAL	COMMENTS / DISCUSSION
R3	Roadway - Surface Section	1,110,000			X	($1,000,000)	The Department has modified this proposal to maintain a moderately thick section of Non-Frost Susceptible soil but reduce the number of layers, however the surface course was also increased upon further discussion. The final section will be a 12" E-1 layer underlain by a 30" Select A Layer, eliminating the subbase F layer as the likely source for the majority of the Select A layer is expected to contain primarily 3"-minus material which will result in an overall reduced unit cost as there will be no screening required.
G1	Geotechnical - Permafrost Provisions - Thermal Berms	(1,342,000)	X			($1,342,000)	Thermal Berms - or more appropriately - Embankment Stabilization Buttresses (ESB's, AKA "Steve's Buttress"), will be formed from suitable excess (waste) excavation in locations to be determined during detailed design.
G2	Geotechnical - Permafrost Provisions - Tundra Excavation	74,000	X			$74,000	This will be added along with the requirement that clearing is to occur during the winter (or frozen conditions).
G3	Geotechnical - Permafrost Provisions - Deep Excavation / Oversized Embankments	4,149,000			X		This proposal will/may be utilized at very limited/select locations and only during winter and only as scheduling would practically accommodate. Overall, NR is uncomfortable subexcavating to remove frozen material as the risk is uncertain yet potentially high, not only due to the uncertainty of the limits of excavation or the conditions encountered but also due to the negative scheduling impacts these ambiguous "dig outs" could have, primarily as they would all take place along the new road and likely sole haul route. There is also some moderate risk in efforts necessary to maintain CGP compliance. There are insolated locations, however, where the limits of are either better known or will have a more manageable amount of potential risk.
G4	Geotechnical - Permafrost Provisions - ACE Embankment Height	(1,955,000)		X			This proposal was rejected as the basis for ACE height was determined from thermal modeling based on the expected conditions. Simply averaging the heights could result in excessive heights in some areas and insufficient heights in others. The final thicknesses may change, however, due to other project design changes resulting from other accepted proposals in this VES (such as not-grubbing - G2).
C1	Construction - Schedule	2,496,000			X		This proposal restricted the field season to begin in May, however a substantial amount of work (pit development, clearing, access development, etc.) could be completed in winter conditions while still allowing the advantages of this proposal; this proposal was modified to restrict the physical work to one summer season, beginning in the fall after advertisement and a contract completion of the spring following the summer field season (approximately 18 months in total).

	VALUE ENGINEERING PROPOSAL	PROPOSED COST AVOIDANCE	ACCEPT	REJECT	MODIFY	ACCEPTED VALUE OF PROPOSAL	COMMENTS / DISCUSSION
	TOTAL ACCEPTED and PENDING					($3,438,000)	

DOT & PF has reviewed each of the Value Engineering proposals and recommends the responses contained herein.

Andrew Wells, P.E.
by

Engineer I, Project Designer
title

7/17/2017
date

GENERAL COMMENTS REGARDING THIS VALUE ENGINEERING STUDY: DOT Proposal Review Team Meetings held June 29, 2017. Attendees:
Jeff Russell, Dalton District M&O Superintendent
Elmer Marx, P.E.; Bridge Design
David Hemstreet, P.E., Statewide Foundations
Michael Knapp, P.E., Statewide Drainage/Hydro
Jeff Stutzke, P.E., Reggional Drainage/Hydro
Lauren Little, P.E., Northern Region Design Manager
Mike Lund, P.E., Northern Region Construction Manager
Jake Allen, P.E., Norther Region Group Chief/Project Delivery Team Leader
Steve McGroarty, P.E, Regional Geotechnical Engineer
Jeff Currey, P.E., Regional Materials Engineer
Matt Billings, P.E., Assistant Regional Geotechnical Engineer Andrew Wells, P.E., Engineer I

CREATIVITY ALTERNATIVES SHEETS

The following creativity worksheets are used by the VE team to record options discussed during the workshop. They are included herein to illustrate the range of options considered during the study for key project elements.

Note that the first column titled "#" indicates the VE team prioritization when the proposals were initially analyzed after the speculative phase.

CREATIVITY

COMPONENT: Drainage

FUNCTIONS:

1	Convey Runoff	**7**	Control Settlement
2	Reduce Icing	**8**	Pass Fish
3	Protect Permafrost	**9**	
4	Reduce Erosion	**10**	
5	Control Runoff	**11**	
6	Control Runoff	**12**	

CURRENT CONCEPT

36" CSP = $500,000; 24" CSP = $150,000; 72" CSP = $104,000; 48" CSP = $78,000. End sections, thaw pipe, marker posts, riprap = $65,000. 108" SSP = $192,000 (fish pass).

#	ALTERNATIVES
	Remove existing culverts $ look
8	Pile pre/straight wall steel pipe
5	Increased pipe gauge (CSP)
	Plastic corrugated pipe
	Extend piles in lieu of full replacement
1	Reline existing culverts in lieu of full replacement
2	Don't remove all existing culverts
4	Pipe ramming - new install
	Alternative fish structures (pipe arch, buried bridge, bottomless)
	Alternate bedding - cold weather insulation
	Impacts to ACE
	Insulation in bedding/below pipe
	Concrete box/bridge
1	Ponds/flow-thru embankment
	Ford - Armored crossing
	Realignment of streams/flows
	Offset roadside ditch

CREATIVITY

COMPONENT: Bridge

FUNCTIONS:

1	Span Creek	**7**	
2	Support Vehicles	**8**	
3	Release Fish	**9**	
4	Contain Flow	**10**	
5		**11**	
6		**12**	

CURRENT CONCEPT

142.5' x 39' Bridge Structures = $2,021k; Furnish and Drive H-Pieces = $455k; Site Cast Abutments = $390k; Erect Pre-Cast Bulb-Tee Girders = $770k; Riprap = $216.25k; Bridge and Approach Rail = $189k

#	ALTERNATIVES
5	Bottomless arch culvert (a = bebo; b = structural plate)
5	Refine (E) (a = foundation; b = scour countermeasures)
8	Reduce span
	Alignment change/move crossing
	Alternative abutments
	Steel girders with site cast or precast flanks
3	Alternative scour countermeasure - articurative mat
8	Narrow bridge deck to 21'

CREATIVITY

COMPONENT: Roadway Construction

FUNCTIONS:

1	Improve Alignment	**7**	
2	Obtain Material	**8**	
3	Stable Structure	**9**	
4	Wearing Surface	**10**	
5		**11**	
6		**12**	

CURRENT CONCEPT

Clearing 201 = $1,400,000; Excavation/Earthwork 203 = $16,000,000; Roadway Construction 300 = $2,500,000; E-1 120k Ton = $3,000,000; F 60k CV = $400,000; 1.3 Million CY Cut Material (970 total) with less than or equal to 80k CY Waste (>40) (230 total useable fill needed).

#	ALTERNATIVES
	Change alignment
7	Mining in ROW (220-320)
4	Alternate material sources (EOP Materials Source)
	Quality specs on materials
	Revise section for ACE
6	Revise ACE deg. Values
	Tunneling
	Fill only embankment
	Expand ROW - use more material from lower area vs. Lost Creek

CREATIVITY

COMPONENT: Roadway Paving

FUNCTIONS:

1	Support Loads	**7**	
2	Reduce Dust	**8**	
3	Reduce Erosion	**9**	
4	Drain Stormwater	**10**	
5		**11**	
6		**12**	

CURRENT CONCEPT

36' Wide Surface, 121k Tons = $29 million; E-1 AG. Surface Course, 9", 82k Tons = $1.97 million; Subbase f (320 k CY borrow a/b), 8", 65k CY = $390,000; Ref: 9 miles north y MP 11-18, 6" d-1 MOD/ 18" Subbase A.

#	ALTERNATIVES
	Asphalt pavement
8	High float (asphalt emulsion)
4	Different grave: 6" D-1 & 18" sub A (reduce borrow/optimize use of available material)
	Calcium chloride
	Chip seal
7	Revise material quality requirements E-1

CREATIVITY

COMPONENT: Geotech/Permafrost

FUNCTIONS:

1	Extend Life of Roadway	**7**	
2	Overall Embankment Stability	**8**	
3	Control Thawing/Settlement	**9**	
4	Reduce Maintenance	**10**	
5		**11**	
6		**12**	

CURRENT CONCEPT

ACE Fill (3,000 @ 5' height) = $1,500,000 (30,000 Ton); Insulation Board = $2,700,000 (2,700 MBM); Geotextile, Reinforcement = $350,000 (100,000 SY); Geotextile, Erosion Control = $60,000 (30,000 SY)

#	ALTERNATIVES
1	Revisit existing alignment
7	Thermal berms (in lieu of offsite disposal)
1	Geotextile "burrito wrap"
7	Don't excavate tundra under ACE
4	Use large conventional embankment, plan for maintenance (delete insulation board)
5	Deep subex of ice-rich material
	Thermosyphons
	Lightweight aggregates
	Bridge over permafrost
	Shoulder only insulation
4	More investigation into alternative ACE source
	Lighter colored aggregate
2	Pre-thawing and surcharging
4	Increase ACE embankment height (maintenance - life cycle)

CREATIVITY

COMPONENT: Utilities

FUNCTIONS:

1	Relocate Utility	**7**	
2	Determine Responsibility	**8**	
3	Maintain Access	**9**	
4		**10**	
5		**11**	
6		**12**	

CURRENT CONCEPT

Dalton Highway utilities owner responsibility; Elliott Highway utilities project responsibility = $300,000; Alyeska Pipeline crossing casing = $2,000,000

#	ALTERNATIVES
7	Determine need for casing removal
1	Do not remove casing
	Widen roadway to impact only one utility FOC line
	Approval for road contractor to do earthwork

CREATIVITY

COMPONENT: Landscape/Restoration

FUNCTIONS:

1 Reduce Erosion
2 Reduce Dust
3 Restore Vegetation
4 Restore Habitat
5 Convey Runoff
6
7
8
9
10
11
12

CURRENT CONCEPT

Seeding 5,300# = $212,000; Removal of Lost Creek Culverts (removal of culverts along existing highway) = $100,000

#	ALTERNATIVES
	Rolled erosion control product
	Mulch/compost
	Cover in gravel
	Cover in tires
8	Revise typical to accommodate sloughing/slope failure

CREATIVITY

COMPONENT: ROW

FUNCTIONS:

1	Prepare Site	**7**	
2	Contain Roadway	**8**	
3		**9**	
4		**10**	
5		**11**	
6		**12**	

CURRENT CONCEPT

New Alignment = 300ft; Existing Alignment = 200ft (some area of indears); New - passes through DNR, Permanent Estimate, Mineral Closing Order. Approximately $500k.

#	ALTERNATIVES
	Keep existing alignment
	Realign to avoid mining claims
7	Expand ROW acquisitions for material

CREATIVITY

COMPONENT: Planning Alignment -Horizontal

FUNCTIONS:
1 Meet Criteria
2 Increase Safety
3 Reduce M&O
4
5
6
7
8
9
10
11
12

CURRENT CONCEPT

Horizontal - Reduce Curves/Flatten = 30 to 21 (9 didn't meet criteria); Upgrade alignment to current principal rural arterial standard. Proposed = $10.6 M. Existing = $9.4 M

#	ALTERNATIVES
1	Keep existing
	Keep existing and build new (one-way roads)
	Realign at IMP.A (approximately 30+00 CY; approximately 215+00 Pinp)
	Narrower traveled way
	Realign at IMP.A (approximately 30+00 CY; approximately 215+00 Pinp)
	Reconstruct existing - relax grade criteria

CREATIVITY

COMPONENT: Planning Alignment Vertical

FUNCTIONS:

1	Meet Criteria	**7**	
2	Increase Safety	**8**	
3	Reduce Grades	**9**	
4		**10**	
5		**11**	
6		**12**	

CURRENT CONCEPT

Reduce curves by 50% (66 to 33), 41 did not meet criteria. Reduce grades - segments (67 to 34), 27 exceeded maximum. Design waiver approved for max grade (3% of corridor; reduces cost by $7M, compared to 9% criteria). Hill 1 = 9.7% for 1,00ft; Bench = 3.3% with pullout; Hill 2 = 9.7% (2,400ft).

#	ALTERNATIVES
	Evaluate other locations for design exception

CREATIVITY

COMPONENT: Planning - Lane Configuration & Design Criteria

FUNCTIONS:
1 Meet Criteria
2 Widen Roadway
3
4
5
6
7
8
9
10
11
12

CURRENT CONCEPT
Widen Roadway (12' lanes; 6' shoulders). DC - upgrade to principal rural arterial standards (AASHTO 2001). Adhere to Dalton Highway Memo-Directive.

#	ALTERNATIVES

CREATIVITY

COMPONENT: Construction General Conditions

FUNCTIONS:

1	Contract Admin Method	**7**	Inform Drivers
2	Social Engineering	**8**	Stage Equipment/Materials
3	Field Engineering	**9**	Transport/House Workers
4	Contract Compliance	**10**	Control Traffic
5	Worker Wellness	**11**	Environmental During Construction
6	Access Site	**12**	

CURRENT CONCEPT

Clearing 2011; Construction May 2018 - 2 Seasons; Mob/Demob = 4, $1.4 M; Pavement = 3, $1.05 M; Traffic = $400k; Traffic Maintenance = $120k; Temporary Erosion = $400k; Survey = $250k; Vehicles = $200k

#	ALTERNATIVES
2	Don't build Pioneer Road - build bridge after highway
8	Winter construction mandate - 1 season project
	Utility bedding
3	1 season project
8	2 season project (wait for 2nd season to complete wearing course)
	Design/build with contractor responsibility
	Separate mining contract
	Separate clearing contract
	ACE material mined in advance
7	Manage/specify traffic control - stage tie-ins
	Manage/specify traffic control - new alignment
	Manage/specify traffic control - reconstruction
	Full contractor responsible for maintenance
4	Be specific where/when contractor takes over maintenance vs. DOT maintenance