Appendix F:
Engineering Technical Memoranda

US 550 South Connection to US 160
SUPPLEMENT to the US Highway 160 from Durango to Bayfield EIS
APPENDIX F: ENGINEERING TECHNICAL MEMORANDA

INDEX

Date	Correspondence
September 20, 2010	Technical Memorandum to Joe Duran (FHWA) from Keith Powers (CDOT R5) re: cost estimates for Section 4(f) Alternatives
September 20, 2010	Technical Memorandum to Joe Duran (FHWA) from Keith Powers (CDOT R5) re: revised Preliminary Alternative A and Partial Interchange
September 20, 2010	Technical Memorandum to Joe Duran (FHWA) from Keith Powers (CDOT R5) re: US 550 Western Realignment Alternative
December 22, 2010	Technical Memorandum to Joe Duran (FHWA) from Keith Powers (CDOT R5) re: cost estimates for Section 4(f) Alternatives addendum
August 1, 2011	Technical Memorandum to William Hanson (FHWA) from Keith Powers (CDOT R5) re: US 550 On Grade Alignments
May 21, 2012	Technical Memorandum to Stephanie Gibson (FHWA) from Edward Archuleta (CDOT R5) re: US 550 at US 160 Supplemental Impact Statement—Alternative R

STATE OF COLORADO

DEPARTMENT OF TRANSPORTATION
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DEPARTMENT OF TRANSPORTATION

Date:	September 20, 2010
To:	Joe Duran FHWA Operational Engineer
From:	Keith Powers Program Engineer
Subject:	US 550 at US 160 Re-Evaluation, Cost Estimates for Section 4(f) Alternatives

Attached are the cost estimates completed for the five (5) alternatives being considered for the Section 4(f) analysis.

The estimates were completed for comparison purposes. These estimates should not be used for budgeting purposes due to minimum level of preliminary design completed. Thirteen common items were quantified in order to complete the estimates. The same thirteen items were priced utilizing the same unit prices. In a few cases, the alternative justified having an additional item quantified and priced for work unique to that alternative. For example in the estimates for Preliminary Alternative A and Existing US 550 with a Partial Interchange both include the cost of upgrading CR 220 as it will be needed as a detour for these alternatives. Please reference the attached cost estimate worksheets.

Contingency percentages were set at 30% for all alternatives. The same percentages were used on all alternatives to estimate costs for work not included in the thirteen common items. Right of Way (ROW) costs were broke down into three lines: ROW acreage, residences and businesses, and ROW costs/damages. The unit price for ROW acreage was adjusted to each alignment, the same unit price or percentage was used for residences, businesses and ROW costs/damages.

The alignments where gas wells were identified and required to be abandoned, a consistent cost of $1.5 million was used. This cost does not include new easements or loss of residual profits.

The cost estimates for the alternatives are based on the cost of the US 550 alignment and connection of US 550 to US 160. To meet the capacity need in 2030 and because of environmental constraints, all alternatives in the Grandview Section need to include three interchanges: one at Grandview, one at CR 233 (Three Springs Boulevard) and one at SH172/CR234. In addition, the traffic analysis indicates that all the alternatives need to extend the auxiliary lanes on US 160 from the west project limit to the CR 233 (Three Springs Boulevard) interchange in each direction between the Grandview Interchange and the Three Springs Interchange. Because these items are the same for all the alternatives, they are not included in the cost estimates.

For G Modified, Revised G Modified, F Modified and the Eastern Realignment, costs are included for additional ramps and lanes needed at the interchange of US 550 with US 160.

Below is a of cost estimate attachments:

1. Western Re-alignment Alternative
2. Revised Preliminary Alternative A
3. Partial Interchange at the Existing US 550/US 160 Intersection
4. County Road 220
5. Alternative G Modified (EIS)
6. Revised Alternative "G" Modified
7. Revised Alternative F Modified
8. Eastern Realignment Alternative
9. Unit cost summary

Below is a summary of each alternatives cost estimate and an explanation of any unique adjustments or large items associated with that alternative.

Western Realignment Alternative: $326,931,000

1. A local access road and bridge would be required to cross US 550 in two locations.

2. Four (4) additional ramps and bridges will be required to tie US 550 into US 160.

3. US 550 will cross the Animas River twice and will require bridges. This is the only alternative that crosses the Animas River.

4. There is a large amount of earth that will need to be moved in this alternative. It is estimated that 3.5 million cubic yards of embankment material will be needed. Some of it will come from the excavation required for the project and the remainder will come from an outside sores.

5. Estimated ROW acreage acquisition is 129 acres with the ramps.

6. Estimated residential acquisitions is 18 each.

7. Estimated Business acquisition is 2 each with the ramps.

8. The ROW acreage cost was estimated at $30,000/ acre and $100,000 per acre for ROW located adjacent to existing US 160. These unit value were based on a blended use of current and potential residential uses and current commercial uses. Many of these properties are smaller residential sites that enjoy expansive views or river frontage.

Revised Preliminary Alternative A: $232,874,000

1. The cost estimate accounts for the cost of upgrading CR 220 for its use as a detour for all of the US 550 traffic during construction of this alternative. The length of the CR 220 is 2.73 miles. To widen and pave this length of road the asphalt cost is estimated at $4,393,153. This cost does not include excavation to improve sight distance, relocate utilities, acquire ROW, driveways, intersection improvements, or environmental mitigation in order to complete widening. If this alternative is chosen substantial amount of design work would be required in order to complete a more accurate estimated cost.

2. Estimated ROW acreage acquisition is 73.4 acres with the ramps.

3. Estimated residential acquisitions is 1 each with the ramps.

4. Estimated Business acquisition is 2 each with the ramps.

5. The ROW acreage cost was estimated at $14,000/ acre for acreage associated with residences and $100,000 per acre for ROW located adjacent to existing US 160.

6. Due to the height of walls (plus 80 feet and three tiers) a complete geotechnical investigation would be required in order to complete a more accurate estimate. The cost of $400/SF is based on a recent Region 5 project where the foundation was micropiles with a structural concrete cap with wire faced MSE. The height of the wall and the widening of the roadway may require a significantly more costly foundation. In order to determine a more accurate estimate preliminary design and geotechnical drilling would be required. The height of fills walls required is substantial and a detriment for selection of this alternative.

<u>Partial Interchange at the Existing US 550 / US 160 Intersection:</u> $230,790,000

1. A cost estimate accounts for the cost of upgrading CR 220 for the use as a detour during construction of this alternative. The length of the CR 220 is 2.73 miles, to widen and pave this length of road the cost is estimated at $4,393,153. This cost does not include excavation to improve sight distance, relocate utilities or acquire ROW in order to complete widening. If this alternative is chosen substantial design work would be required in order to complete a more accurate estimated cost.

2. Estimated ROW acreage acquisition is 38.7 acres with the ramps.

3. Estimated residential acquisitions is 1 each with the ramps.

4. Estimated Business acquisition is 1 each with the ramps.

5. The ROW acreage cost was estimated at $14,000/ acre for acreage associated with residences and $100,000 per acre for ROW located adjacent to existing US 160. These unit values were based on current or potential commercial uses.

6. The estimated cost includes the cost of the ramps which would be required at the US 160 intersection at approximate M.P. 88.3.

7. Due to the height of walls (plus 80 feet and three tiers) a complete geotechnical investigation would be required in order to complete a more accurate estimate. The cost of $400/SF is based on a recent Region 5 project where the foundation was micropiles with a structural concrete cap with wirefaced MSE. The height of the wall and the widening of the roadway may require a significantly more costly foundation. In order to determine a more accurate estimate preliminary design and geotechnical drilling would be required. The height of fills walls required is substantial and a detriment for selection of this alternative.

<u>Eastern Realignment Alternative</u>: $93,106,000

1. Estimated ROW acreage acquisition is 175.7 acres with the ramps.

2. Estimated residential acquisitions is 16 each with the ramps.

3. Estimated Business acquisition is 7 each with the ramps.

4. The ROW acreage cost was estimated at $20,000/ acre. This unit value is based on higher density residential development and current residential uses. $100,000/acres. This unit value is based on current or potential commercial uses.

5. There is a large amount of earth that will need to be removed in this alternative. It is estimated that 2.7 million cubic yards of excavation will be removed.

Revised Alternative F Modified: $77,429,000

1. There are two (2) gas wells that will need to be relocated.

2. Estimated ROW acreage acquisition is 134.7 acres with the ramps.

3. Estimated residential acquisitions is 13 each with the ramps.

4. Estimated Business acquisition is 7 each with the ramps.

5. A cost was accounted for the large wildlife crossing and farm access, both bridges. The cost was estimated at $245/SF.

6. The ROW acreage cost was estimated at $14,000/ acre. This unit value is based on large agricultural tracts that may be suited for residential development or current residential uses.

7. There is a large amount of earth that will need to be removed in this alternative. It is estimated that 2.2 million cubic yards of excavation will be removed.

Alternative G Modified (EIS): $84,484,000

1. Estimated ROW acreage acquisition is 46 acres.

2. Estimated residential acquisitions is 0 each.

3. Estimated Business acquisition is 0 each.

4. The ROW acreage cost was estimated at $14,000/ acre. This unit value is based on large agricultural tracts that may be suited for residential development or current residential uses.

5. There is one gas well that will need to be relocated.

6. There is a large amount of earth that will need to be removed in this alternative. It is estimated that 2.1 million cubic yards of excavation will be removed.

Revised Alternative "G" Modified: $77,598,000

1. Estimated ROW acreage acquisition is 46 acres.

2. Estimated residential acquisitions is 0 each.

3. Estimated Business acquisition is 0 each.

4. The ROW acreage cost was estimated at $14,000/ acre. This unit value is based on large agricultural tracts that may be suited for residential development or current residential uses.

5. There is a large amount of earth that will need to be removed in this alternative. It is estimated that 1.6 million cubic yards of excavation will be removed.

Please review this letter and the attachments, if you have any questions please contact my office at 970-385-1436 or contact via email; Keith.powers@dot.state.co.us

cc: Neet
McVaugh
Archuleta
Cross
Project File

Alternative	Cost
Western Realignment	$326,930,917
Western Realignment Ramps	$75,935,110
Revised Preliminary Alternative A	$232,873,570
Revised Preliminary Alternative A Ramps	$94,582,195
CR 220	$4,393,153
Existing US 550 with Partial Interchange	$230,789,564
Partial interchange	$96,891,342
Alt G - Modified - EIS	$84,483,815
Revised G Modified	$77,598,325
Revised G Modified Ramps	$18,754,114
Revised F Modified	$77,429,104
Revised F Modified Ramps	$52,606,595
Eastern Realignment	$93,105,756
Eastern Realignment Ramps	$52,606,595

Project Number:	Project Name: US 550 at US 160 4F

Western Realignment Alternative Preliminary Engineers Estimate

Alternative:	West
Prepared By:	SPC, EJA, KEP
Date Prepared:	6/3/2009, 9/10/09, 12/7/09, 6/2/10

	Item		Unit	Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	105.0	$ 3,773.00	396,165.00	
2	203-00010	Unclassified Excavation (CIP)	CY	0	$ 6.00	0.00	
3	203-00060	Embankment Material (CIP)	CY	3,541,264	$ 8.00	28,330,112.00	
4	212-00006	Seeding (Native)	Acre	86.6	$ 509.00	44,075.94	
5	212-00006	Soil Conditioning	Acre	86.6	$ 2,049.00	177,429.48	
6	213-00003	Mulching (Weed Free)	Acre	86.6	$ 362.00	31,346.74	
7	304-00000	ABC	Ton	106,640	$ 17.00	1,812,880.00	
8	403-33851	HMA	Ton	40,291	$ 86.53	3,486,380.23	
9	504-00000	Retaining Walls (Cut)	SF	0	$ 85.00	0.00	
10	504-00000	Retaining Walls (Fill)	SF	29,625	$ 115.00	3,406,875.00	
11		Bridge	SF	288,750	$ 170.00	49,087,500.00	B1= 139400, B2 = 5850, B3=143500
12		Gas Well	Each	2	$ 1,500,000.00	3,000,000.00	new easements and residual profits unknown
13		Local access roads	LF	1,760	$ 95.00	167,200.00	1/2 mile at B2, class 6 roadway, based on $500k/mile
		Local access bridge south of River	SF	3,000	$ 170.00	510,000.00	Crossing US 550 at south of B1 @ Bardin Drive
						90,449,964.39	

		% Range	% Used	Cost
Project Construction Bid Items		Project Dependent	N / A	$90,449,964.39
Contingencies		(15 - 30%)	30.0%	$27,134,989.32
			Subtotal	$117,584,953.71
ITS		(6 - 10%) of subtotal	2.0%	$2,351,699.07
Drainage / Utilities		(3 - 10%) of subtotal	10.0%	$11,758,495.37
MS4 and environmental mitigations	RR Trestle	(1 - 3%) of subtotal Default = 6%	2.0%	$2,351,699.07
Signing and Striping		(1 - 5%) of subtotal Default = 5%	2.0%	$2,351,699.07
Construction Signing & Traffic Control		(5 - 25%) of subtotal	5.0%	$5,879,247.69
Mobilization		(4 - 7%) of subtotal Default = 7%	5.0%	$1,234,642.01
Total of Construction Bid Items			**Subtotal**	$143,512,436.00
Force Account - Misc.		(10 - 15%) Default = 12%	10.0%	$14,351,243.60
Subtotal of Construction Cost			**Subtotal**	$157,863,679.60
Total Construction Engineering		23.95%	23.95%	$37,808,351.26
Total Preliminary Engineering		10%	10.0%	$15,786,367.96
Subtotal of Construction Cost			**Subtotal**	$211,458,398.82
Right of Way acreage		113	$30,000	$3,390,000.00
Residences		18	$280,000	$5,040,000.00
Businesses		0	$1,000,000	$0.00
Right of Way costs/damages/relocation			50.0%	$4,215,000.00
			Subtotal ROW	$12,645,000.00
Subtotal of Construction Cost			**Subtotal**	$224,103,398.82
Inflation (4 years) (2009 $)		4	3.0%	$26,892,407.86
			Total Project Cost	$250,995,806.68

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West Alternative	
US 550	$250,995,806.68
Ramps	$75,935,110.14
Total	**$326,930,916.82**

	Preliminary Engineers Estimate Western Realignment Ramps				**Alternative:**	**West Alt Ramps**
					Prepared By:	**SPC, EJA, KEP**
					Date Prepared:	**6/3/2009, 9/10/09, 12/7/09, 6/2/10**

		Item		Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	14.0	$ 3,773.00	52,822.00	
2	203-00010	Unclassified Excavation (CIP)	CY	0	$ 6.00	0.00	
3	203-00060	Embankment Material (CIP)	CY	121,431	$ 8.00	971,448.00	
4	212-00006	Seeding (Native)	Acre	10.2	$ 509.00	5,191.80	
5	212-00006	Soil Conditioning	Acre	10.2	$ 2,049.00	20,899.80	
6	213-00003	Mulching (Weed Free)	Acre	10.2	$ 362.00	3,692.40	
7	304-00000	ABC	Ton	22,015	$ 17.00	374,255.00	
8	403-33851	HMA	Ton	8,318	$ 89.53	744,710.54	
9	504-00000	Retaining Walls (Cut)	SF	60,750	$ 85.00	5,163,750.00	
10	504-00000	Retaining Walls (Fill)	SF	12,800	$ 115.00	1,472,000.00	
11		Bridge	SF	84,304	$ 170.00	14,331,680.00	
12		Gas Well	Each	0	$ 1,500,000.00	0.00	new easements and residual profits unknown
13		Local access roads	LF	5,280	$ 473.48	2,500,000.00	Estimate at 2.5M per mile with walls
						25,640,449.54	

		% Range	% Used	Cost
Project Construction Bid Items		Project Dependent	N / A	$25,640,449.54
Contingencies		(15 - 30%)	30.0%	$7,692,134.86
			Subtotal	$33,332,584.40
ITS		(6 - 10%) of subtotal	2.0%	$666,651.69
Drainage / Utilities		(3 - 10%) of subtotal	10.0%	$3,333,258.44
MS4 and environmental mitigations		(1 - 3%) of subtotal Default = 6%	2.0%	$666,651.69
Signing and Striping		(1 - 5%) of subtotal Default = 5%	2.0%	$666,651.69
Construction Signing & Traffic Control		(5 - 25%) of subtotal	5.0%	$1,666,629.22
Mobilization		(4 - 7%) of subtotal Default = 7%	5.0%	$2,016,621.36
Total of Construction Bid Items			**Subtotal**	$42,349,048.48
Force Account - Misc.		(10 - 15%) Default = 12%	10.0%	$4,234,904.85
Subtotal of Construction Cost			**Subtotal**	$46,583,953.33
Total Construction Engineering		23.95%	23.95%	$11,156,856.82
Total Preliminary Engineering		10%	10.0%	$4,658,395.33
Subtotal of Construction Cost			**Subtotal**	$62,399,205.48
Right of Way acreage		16	$100,000	$1,600,000.00
Residences			$280,000	$0.00
Business		2	$ 1,000,000.00	$2,000,000.00
Right of Way costs/damages			50.0%	$1,800,000.00
			Subtotal ROW	$5,400,000.00
Subtotal of Construction Cost			**Subtotal**	$67,799,205.48
Inflation (4 years) (2009 $)		4	3.0%	$8,135,904.66
			Total Project Cost	**$75,935,110.14**

Project Number: | **Project Name: US 550 at US 160 4F**

Revised Preliminary Alternative A Preliminary Engineers Estimate

Alternative:	**A**
Prepared By:	**SPC, EJA, KEP**
Date Prepared:	**6/3/2009, 9/10/09, 12/7/09, 6/2/10**

#	Code	Item	Unit	Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	48.5	$ 3,773.00	182,990.50	
2	203-00010	Unclassified Excavation (CIP)	CY	1,632,000	$ 6.00	9,792,000.00	
3	203-00060	Embankment Material (CIP)	CY	0	$ 8.00	0.00	
4	212-00006	Seeding (Native)	Acre	33.4	$ 509.00	17,000.60	
5	212-00006	Soil Conditioning	Acre	33.4	$ 2,049.00	68,436.60	
6	213-00003	Mulching (Weed Free)	Acre	33.4	$ 362.00	12,090.80	
7	304-00000	ABC	Ton	87,369	$ 17.00	1,485,273.00	
8	403-33851	HMA	Ton	32,116	$ 89.53	2,875,345.48	
9	504-00000	Retaining Walls (Cut)	SF	0	$ 85.00	0.00	
10	504-00000	Retaining Walls (Fill)	SF	87,330	$ 382.00	33,360,060.00	From Keystone Hill plus panel facing to match corridor
11		Bridge	SF	0	$ 170.00	0.00	
12		Gas Well	Each	0	$ 1,500,000.00	0.00	new easements and residual profits unknown
13		Local access roads	LF	2,200	$ 95.00	209,000.00	West frontage road (1200LF) and CR 220 (1000LF)
					Subtotal	48,002,196.98	

Item		% Range	% Used	Cost
Project Construction Bid Items		Project Dependent	N / A	$48,002,196.98
Contingencies		(15 - 30%)	30.0%	$14,400,659.09
			Subtotal	$62,402,856.07
ITS		(6 - 10%) of subtotal Default = 6%	2.0%	$1,248,057.12
Drainage / Utilities		(3 - 10%) of subtotal Default = 6%	10.0%	$6,240,285.61
MS4 and environmental mitigations		(1 - 3%) of subtotal Default = 6%	2.0%	$1,248,057.12
Signing and Striping		(1 - 5%) of subtotal Default = 5%	2.0%	$1,248,057.12
Construction Signing & Traffic Control		(5 - 25%) of subtotal Default = 20%	5.0%	$3,120,142.80
Mobilization		(4 - 7%) of subtotal Default = 7%	5.0%	$3,775,372.79
Total of Construction Bid Items			Subtotal	$79,282,828.64
Force Account - Misc.		(10 - 15%) Default = 12%	10.0%	$7,928,282.86
Subtotal of Construction Cost			Subtotal	$87,211,111.50
Total Construction Engineering		23.95%	23.95%	$20,887,061.20
Total Preliminary Engineering		10%	10.0%	$8,721,111.15
Subtotal of Construction Cost			Subtotal	$116,819,283.85
Right of Way		38.7	$14,000	$541,800.00
Residences		1	$ 280,000.00	$280,000.00
Business		1	$ 1,000,000.00	$1,000,000.00
Right of Way costs/damages			50.0%	$910,900.00
			Subtotal ROW	$2,732,700.00
Subtotal of Construction Cost			Subtotal	$119,551,983.85
Inflation (4 years) (2009 $)		4	3.0%	$14,346,238.06
			Total Project Cost	$133,898,221.91

A Alternative	
US 550	$133,898,221.91
Ramps	$94,582,194.74
CR 220 Upgrade	$4,393,152.98
Total	**$232,873,569.63**

Project Number:		Project Name: US 550 at US 160 4F

US 160 plus Ramps A Alternative Preliminary Engineers Estimate

Alternative:	A Ramp
Prepared By:	SPC, EJA, KEP
Date Prepared:	6/3/2009, 9/10/09, 12/7/09, 6/2/10

		Item		Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	52.4	$ 3,773.00	197,705.20	
2	203-00010	Unclassified Excavation (CIP)	CY	1,768,000	$ 6.00	10,608,000.00	
3	203-00060	Embankment Material (CIP)	CY	0	$ 8.00	0.00	
4	212-00006	Seeding (Native)	Acre	35.5	$ 509.00	18,069.50	
5	212-00006	Soil Conditioning	Acre	35.5	$ 2,049.00	72,739.50	
6	213-00003	Mulching (Weed Free)	Acre	35.5	$ 362.00	12,851.00	
7	304-00000	ABC	Ton	97,606	$ 17.00	1,659,302.00	
8	403-33851	HMA	Ton	35,878	$ 89.53	3,212,157.34	
9	504-00000	Retaining Walls (Cut)	SF	8,500	$ 85.00	722,500.00	
10	504-00000	Retaining Walls (Fill)	SF	80,065	$ 115.00	9,207,475.00	
11		Bridge	SF	38,025	$ 170.00	6,464,250.00	
12		Gas Well	Each	0	$ 1,500,000.00	0.00	new easements and residual profits unknown
13		Local access roads	LF	3,400	$ 473.48	1,609,832.00	Access to County gravel pit. Includes walls, based on $2.5M/mile
						0.00	
						33,784,881.54	

	% Range	% Used	Cost
Project Construction Bid Items	Project Dependent	N / A	$33,784,881.54
Contingencies	(15 - 30%)	30.0%	$10,135,464.46
		Subtotal	$43,920,346.00
ITS	(6 - 10%) of subtotal	2.0%	$878,406.92
Drainage / Utilities	(3 - 10%) of subtotal	10.0%	$4,392,034.60
MS4 and environmental mitigations	(1 - 3%) of subtotal Default = 6%	2.0%	$878,406.92
Signing and Striping	(1 - 5%) of subtotal Default = 5%	2.0%	$878,406.92
Construction Signing & Traffic Control	(5 - 25%) of subtotal	5.0%	$2,196,017.30
Mobilization	(4 - 7%) of subtotal Default = 7%	5.0%	$2,657,180.93
Total of Construction Bid Items		Subtotal	$55,800,799.59
Force Account - Misc.	(10 - 15%) Default = 12%	10.0%	$5,580,079.96
Subtotal of Construction Cost		Subtotal	$61,380,879.55
Total Construction Engineering	23.95%	23.95%	$14,700,720.65
Total Preliminary Engineering	10%	10.0%	$6,138,087.96
Subtotal of Construction Cost		Subtotal	$82,219,688.16
Right of Way	34.7	$14,000	$485,800.00
Residences	0	$ 280,000.00	$0.00
Business	1	$ 1,000,000.00	$1,000,000.00
Right of Way costs/damages		50.0%	$742,900.00
		Subtotal ROW	$2,228,700.00
Subtotal of Construction Cost		Subtotal	$84,448,388.16
Inflation (4 years) (2009 $)	4	3.0%	$10,133,806.58
		Total Project Cost	$94,582,194.74

Project Number:		Project Name: US 550 at US 160 4F	
CR 220 Upgrade: This estimate is only for resurfacing. In order to complete a more detailed cost estimate additional design is required.		Alternative:	CR 220 upgrade
		Prepared By:	EJA
		Date Prepared:	11/10/2009, 12/8/09, 6/2/10

		Item		Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	2.7	$ 3,773.00	9,998.45	2.65
2	203-00010	Unclassified Excavation (CIP)	CY	0	$ 6.00	0.00	
3	203-00060	Embankment Material (CIP)	CY	4,270	$ 8.00	34,160.00	4270.93
4	212-00006	Seeding (Native)	Acre	13.2	$ 509.00	6,734.07	13.24
5	212-00006	Soil Conditioning	Acre	13.2	$ 2,049.00	27,046.80	
6	213-00003	Mulching (Weed Free)	Acre	13.2	$ 362.00	4,778.40	
7	304-00000	ABC special	Ton	2,595	$ 17.00	44,115.00	2594.59
8	403-33851	HMA	Ton	7,400	$ 89.53	662,522.00	7399.39
9		Milling	SY	11,211	$ 2.00	22,422.00	11211.20
10	504-00000	Retaining Walls (Fill)	SF	0	$ 115.00	0.00	
11		Bridge	SF	0	$ 170.00	0.00	
12		Gas Well	Each	0	$ 1,500,000.00	0.00	
13		Local access roads	LF			0.00	
		Traffic Signals at US 160/SH 172 and US 550/CR220	Each	2	$ 400,000.00	800,000.00	
					Subtotal	1,611,776.72	

	% Range	% Used	Cost
Project Construction Bid Items	Project Dependent	N / A	$1,611,776.72
Contingencies	(15 - 30%)	30.0%	$483,533.02
		Subtotal	$2,095,309.74
ITS	(6 - 10%) of subtotal	2.0%	$41,906.19
Drainage / Utilities	(3 - 10%) of subtotal	10.0%	$209,530.97
MS4 and environmental mitigations	(1 - 3%) of subtotal Default = 6%	2.0%	$41,906.19
Signing and Striping	(1 - 5%) of subtotal Default = 5%	2.0%	$41,906.19
Construction Signing & Traffic Control	(5 - 25%) of subtotal	5.0%	$104,765.49
Mobilization	(4 - 7%) of subtotal Default = 7%	5.0%	$126,766.24
Total of Construction Bid Items		**Subtotal**	$2,662,091.02
Force Account - Misc.	(10 - 15%) Default = 12%	10.0%	$266,209.10
Subtotal of Construction Cost		**Subtotal**	$2,928,300.12
Total Construction Engineering	23.95%	23.95%	$701,327.88
Total Preliminary Engineering	10%	10.0%	$292,830.01
Subtotal of Construction Cost		**Subtotal**	$3,922,458.01
Right of Way	0	$0	$0.00
Residences	0	$ 280,000.00	$0.00
Business	0	$ 1,000,000.00	$0.00
Right of Way costs/damages		50.0%	$0.00
		Subtotal ROW	$0.00
Subtotal of Construction Cost		**Subtotal**	$3,922,458.01
Inflation (4 years) (2009 $)	4	3.0%	$470,694.96
		Total Project Cost	$4,393,152.98

Project Number:		Project Name: US 550 at US 160 4F
	Alternative:	Existing US 550 w/Partial
Existing US 550 with Partial Interchange Preliminary Engineers Estimate	Prepared By:	SPC, EJA, KEP
	Date Prepared:	6/3/2009, 9/10/09, 12/7/09, 6/2/10

	Item			Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	48.5	$ 3,773.00	182,990.50	
2	203-00010	Unclassified Excavation (CIP)	CY	1,632,000	$ 6.00	9,792,000.00	
3	203-00060	Embankment Material (CIP)	CY	0	$ 8.00	0.00	
4	212-00006	Seeding (Native)	Acre	33.4	$ 509.00	17,000.60	
5	212-00006	Soil Conditioning	Acre	33.4	$ 2,049.00	68,436.60	
6	213-00003	Mulching (Weed Free)	Acre	33.4	$ 362.00	12,090.80	
7	304-00000	ABC	Ton	87,369	$ 17.00	1,485,273.00	
8	403-33851	HMA	Ton	32,116	$ 89.53	2,875,345.48	
9	504-00000	Retaining Walls (Cut)	SF	0	$ 85.00	0.00	
10	504-00000	Retaining Walls (Fill)	SF	87,330	$ 382.00	33,360,060.00	
11		Bridge	SF	0	$ 170.00	0.00	
12		Gas Well	Each	0	$ 1,500,000.00	0.00	new easements and residual profits unknown
13		Local access roads	LF	2,200	$ 95.00	209,000.00	West frontage road (1200LF) and CR 220 (1000LF)
						48,002,196.98	

		% Range	% Used	Cost
Project Construction Bid Items		Project Dependent	N / A	$48,002,196.98
Contingencies		(15 - 30%)	30.0%	$14,400,659.09
			Subtotal	$62,402,856.07
ITS		(6 - 10%) of subtotal	2.0%	$1,248,057.12
Drainage / Utilities		(3 - 10%) of subtotal	10.0%	$6,240,285.61
MS4 and environmental mitigations		(1 - 3%) of subtotal Default = 6%	2.0%	$1,248,057.12
Signing and Striping		(1 - 5%) of subtotal Default = 5%	2.0%	$1,248,057.12
Construction Signing & Traffic Control		(5 - 25%) of subtotal	5.0%	$3,120,142.80
Mobilization		(4 - 7%) of subtotal Default = 7%	5.0%	$3,775,372.79
Total of Construction Bid Items			**Subtotal**	$79,282,828.64
Force Account - Misc.		(10 - 15%) Default = 12%	10.0%	$7,928,282.86
Subtotal of Construction Cost			**Subtotal**	$87,211,111.50
Total Construction Engineering		23.95%	23.95%	$20,887,061.20
Total Preliminary Engineering		10%	10.0%	$8,721,111.15
Subtotal of Construction Cost			**Subtotal**	$116,819,283.85
Right of Way		38.7	$14,000	$541,800.00
Residences		1	$ 280,000.00	$280,000.00
Business		1	$ 1,000,000.00	$1,000,000.00
Right of Way costs/damages			50.0%	$910,900.00
			Subtotal ROW	$2,732,700.00
Subtotal of Construction Cost			**Subtotal**	$119,551,983.85
Inflation (4 years) (2009 $)		4	3.0%	$14,346,238.06
			Total Project Cost	$133,898,221.91

A Alternative	
US 550	$133,898,221.91
Partial interchange	$96,891,342.48
CR 220 Upgrade	$4,393,152.98
Total	**$230,789,564.39**

Project Number:		Project Name: US 550 at US 160 4F	
		Alternative:	US 550 Partial I
	US 550 Partial Interchange Preliminary Engineers Estimate	Prepared By:	SPC, EJA, KEP
		Date Prepared:	6/3/2009, 9/10/09, 12/7/09, 6/2/10

		Item		Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	43.5	$ 3,773.00	164,125.50	Estimated based on similar design of Ramp C
2	203-00010	Unclassified Excavation (CIP)	CY	1,768,000	$ 6.00	10,608,000.00	
3	203-00060	Embankment Material (CIP)	CY	0	$ 8.00	0.00	
4	212-00006	Seeding (Native)	Acre	23.7	$ 509.00	12,063.30	
5	212-00006	Soil Conditioning	Acre	23.7	$ 2,049.00	48,561.30	
6	213-00003	Mulching (Weed Free)	Acre	23.7	$ 362.00	8,579.40	
7	304-00000	ABC	Ton	98,943	$ 17.00	1,682,031.00	
8	403-33851	HMA	Ton	42,260	$ 89.53	3,783,537.80	
9	504-00000	Retaining Walls (Cut)	SF	41,059	$ 85.00	3,490,015.00	
10	504-00000	Retaining Walls (Fill)	SF	29,314	$ 115.00	3,371,110.00	
11		Bridge	SF	63,353	$ 170.00	10,770,010.00	
12		Gas Well	Each	0	$ 1,500,000.00	0.00	
13		Local access roads	LF	3,400	$ 473.48	1,609,832.00	Access to County gravel pit. Includes walls, based on $2.5M/mile
						0.00	
						35,547,865.30	

Item	% Range	% Used	Cost
Project Construction Bid Items	Project Dependent	N / A	$35,547,865.30
Contingencies	(15 - 30%)	30.0%	$10,664,359.59
		Subtotal	$46,212,224.89
ITS	(6 - 10%) of subtotal Default = 6%	2.0%	$924,244.50
Drainage / Utilities	(3 - 10%) of subtotal Default = 6%	10.0%	$4,621,222.49
MS4 and environmental mitigations	(1 - 3%) of subtotal Default = 6%	2.0%	$924,244.50
Signing and Striping	(1 - 5%) of subtotal Default = 5%	2.0%	$924,244.50
Construction Signing & Traffic Control	(5 - 25%) of subtotal Default = 20%	5.0%	$2,310,611.24
Mobilization	(4 - 7%) of subtotal Default = 7%	5.0%	$2,795,839.61
Total of Construction Bid Items		**Subtotal**	$58,712,631.72
Force Account - Misc.	(10 - 15%) Default = 12%	10.0%	$5,871,263.17
Subtotal of Construction Cost		**Subtotal**	$64,583,894.89
Total Construction Engineering	23.95%	23.95%	$15,467,842.83
Total Preliminary Engineering	10%	10.0%	$6,458,389.49
Subtotal of Construction Cost		**Subtotal**	$86,510,127.21
Right of Way	0	$14,000	$0.00
Residences	0	$ 280,000.00	$0.00
Business	0	$ 1,000,000.00	$0.00
Right of Way costs/damages		50.0%	$0.00
		Subtotal ROW	$0.00
Subtotal of Construction Cost		**Subtotal**	$86,510,127.21
Inflation (4 years) (2009 $)	4	3.0%	$10,381,215.27
		Total Project Cost	$96,891,342.48

Project Number:		Project Name: US 550 at US 160 4F

Alternative G - Modified - EIS Preliminary Engineers Estimate

Alternative:	G - Modified - EIS
Prepared By:	SPC, EJA, KEP
Date Prepared:	6/3/2009, 9/10/09, 12/7/09, 6/2/10

		Item		Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	57.1	$ 3,773.00	215,438.30	
2	203-00010	Unclassified Excavation (CIP)	CY	2,070,000	$ 6.00	12,420,000.00	
3	203-00060	Embankment Material (CIP)	CY	0	$ 8.00	0.00	
4	212-00006	Seeding (Native)	Acre	37.8	$ 509.00	19,240.20	
5	212-00006	Soil Conditioning	Acre	37.8	$ 2,049.00	77,452.20	
6	213-00003	Mulching (Weed Free)	Acre	37.8	$ 362.00	13,683.60	
7	304-00000	ABC	Ton	65,000	$ 17.00	1,105,000.00	Includes all lifts (2ft)
8	403-33851	HMA	Ton	31,000	$ 89.53	2,775,430.00	
9	504-00000	Retaining Walls (Cut)	SF		$ 85.00	0.00	
10	504-00000	Retaining Walls (Fill)	SF	0	$ 115.00	0.00	
11		Bridge	SF	30,844	$ 170.00	5,243,480.00	Bridge over draw
12		Gas Well	Each	1	$ 1,500,000.00	1,500,000.00	new easements and residual profits unknown
13		Local access roads	LF			0.00	West access road included in HMA for this estiamate
14		Large wildlife crossing/farm access (bridges)	SF	2,050	$ 170.00	348,500.00	25ft span bridges, with wing walls
						23,718,224.30	

		% Range	% Used	Cost
Project Construction Bid Items		Project Dependent		$23,718,224.30
Contingencies		(15 - 30%)	30.0%	$7,115,467.29
			Subtotal	$30,833,691.59
ITS		(6 - 10%) of subtotal	2.0%	$616,673.83
Drainage / Utilities		(3 - 10%) of subtotal	10.0%	$3,083,369.16
MS4 and environmental mitigations		(1 - 3%) of subtotal Default = 6%	2.0%	$616,673.83
Signing and Striping		(1 - 5%) of subtotal Default = 5%	2.0%	$616,673.83
Construction Signing & Traffic Control		(5 - 25%) of subtotal	5.0%	$1,541,684.58
Mobilization		(4 - 7%) of subtotal Default = 7%	5.0%	$1,865,438.34
Total of Construction Bid Items			Subtotal	$39,174,205.17
Force Account - Misc.		(10 - 15%) Default = 12%	10.0%	$3,917,420.52
Subtotal of Construction Cost			Subtotal	$43,091,625.69
Total Construction Engineering		23.95%	23.95%	$10,320,444.35
Total Preliminary Engineering		10%	10.0%	$4,309,162.57
Subtotal of Construction Cost			Subtotal	$57,721,232.61
Right of Way		46	$14,000	$644,000.00
Residences		0	$ 280,000.00	$0.00
Business		0	$ 1,000,000.00	$0.00
Right of Way costs/damages			50.0%	$322,000.00
			Subtotal ROW	$966,000.00
Subtotal of Construction Cost			Subtotal	$58,687,232.61
Inflation (4 years) (2009 $)		4	3.0%	$7,042,467.91
			Total Project Cost	$65,729,700.52

Alternative G	
US 550	$65,729,700.52
Alt G Ramps	$18,754,114.05
Total	$84,483,814.58

Project Number:		Project Name: US 550 at US 160 4F

Revised G Modified Preliminary Engineers Estimate

Alternative:	G Revised
Prepared By:	SPC, EJA, KEP
Date Prepared:	6/3/2009, 9/10/09, 12/7/09, 6/2/10

		Item		Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	57.1	$ 3,773.00	215,438.30	
2	203-00010	Unclassified Excavation (CIP)	CY	1,600,000	$ 6.00	9,600,000.00	
3	203-00060	Embankment Material (CIP)	CY	0	$ 8.00	0.00	
4	212-00006	Seeding (Native)	Acre	37.8	$ 509.00	19,240.20	
5	212-00006	Soil Conditioning	Acre	37.8	$ 2,049.00	77,452.20	
6	213-00003	Mulching (Weed Free)	Acre	37.8	$ 362.00	13,683.60	
7	304-00000	ABC	Ton	111,640	$ 17.00	1,897,880.00	Includes all lifts (2ft)
8	403-33851	HMA	Ton	42,180	$ 89.53	3,776,375.40	
9	504-00000	Retaining Walls (Cut)	SF		$ 85.00	0.00	
10	504-00000	Retaining Walls (Fill)	SF	0	$ 115.00	0.00	
11		Bridge	SF	30,844	$ 170.00	5,243,480.00	Bridge over draw
12		Gas Well	Each	0	$ 1,500,000.00	0.00	new easements and residual profits unknown
13		Local access roads	LF			0.00	West access road included in HMA for this estiamate
14		Large wildlife crossing/farm access (bridges)	SF	2,050	$ 170.00	348,500.00	25ft span bridges, with wing walls
						21,192,049.70	

	% Range	% Used	Cost
Project Construction Bid Items	Project Dependent		$21,192,049.70
Contingencies	(15 - 30%)	30.0%	$6,357,614.91
		Subtotal	$27,549,664.61
ITS	(6 - 10%) of subtotal	2.0%	$550,993.29
Drainage / Utilities	(3 - 10%) of subtotal	10.0%	$2,754,966.46
MS4 and environmental mitigations	(1 - 3%) of subtotal Default = 6%	2.0%	$550,993.29
Signing and Striping	(1 - 5%) of subtotal Default = 5%	2.0%	$550,993.29
Construction Signing & Traffic Control	(5 - 25%) of subtotal	5.0%	$1,377,483.23
Mobilization	(4 - 7%) of subtotal Default = 7%	5.0%	$1,666,754.71
Total of Construction Bid Items		Subtotal	$35,001,848.89
Force Account - Misc.	(10 - 15%) Default = 12%	10.0%	$3,500,184.89
Subtotal of Construction Cost		Subtotal	$38,502,033.78
Total Construction Engineering	23.95%	23.95%	$9,221,237.09
Total Preliminary Engineering	10%	10.0%	$3,850,203.38
Subtotal of Construction Cost		Subtotal	$51,573,474.25
Right of Way	46	$14,000	$644,000.00
Residences	0	$ 280,000.00	$0.00
Business	0	$ 1,000,000.00	$0.00
Right of Way costs/damages		50.0%	$322,000.00
		Subtotal ROW	$966,000.00
Subtotal of Construction Cost		Subtotal	$52,539,474.25
Inflation (4 years) (2009 $)	4	3.0%	$6,304,736.91
		Total Project Cost	$58,844,211.16

Alternative G	
US 550	$58,844,211.16
Alt G Ramps	$18,754,114.05
Total	$77,598,325.21

Project Number:	Project Name: US 550 at US 160 4F

Revised G Modified and Revised Connection Preliminary Engineers Estimate; quantities used from 10-2-08 Full Interchange estimate

Note:

Alternative:	G modified and revised connection
Prepared By:	EJA
Date Prepared:	6/3/2009, 9/10/09, 12/7/09, 6/2/10

		Item		Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	2.3	$ 3,773.00	8,677.90	
2	203-00010	Unclassified Excavation (CIP)	CY	0	$ 6.00	0.00	
3	203-00060	Embankment Material (CIP) - Ramp C	CY	20,000	$ 8.00	160,000.00	Estimated balance of fill after 16042 and 17269
4	212-00006	Seeding (Native)	Acre	2.3	$ 509.00	1,170.70	
5	212-00006	Soil Conditioning	Acre	2.3	$ 2,049.00	4,712.70	
6	213-00003	Mulching (Weed Free)	Acre	2.3	$ 362.00	832.60	
7	304-00000	ABC - Class 3	Ton	8,536	$ 20.00	170,710.00	Ramp C, 6953T Cl3, 1583T Cl6
8	403-33851	HMA	Ton	2,161	$ 57.00	123,177.00	Ramp C
9		Bridge - Ramp C	SF	13,725	$ 170.00	2,333,250.00	Ramp C widening
10	504-00000	Retaining Walls (Fill)	SF	1,380	$ 115.00	158,700.00	South abut, at US 160 for bridge widening
10		Bridge over US 160	SF	23,055	$ 170.00	3,919,350.00	Additional 2 lanes over US 160
11							
12							
13						0.00	
						6,880,580.90	

	% Range	% Used	Cost
Project Construction Bid Items	Project Dependent		$6,880,580.90
Contingencies	(15 - 30%)	30.0%	$2,064,174.27
		Subtotal	$8,944,755.17
ITS	(6 - 10%) of subtotal Default = 6%	2.0%	$178,895.10
Drainage / Utilities	(3 - 10%) of subtotal Default = 6%	10.0%	$894,475.52
MS4 and environmental mitigations	(1 - 3%) of subtotal Default = 6%	2.0%	$178,895.10
Signing and Striping	(1 - 5%) of subtotal Default = 5%	2.0%	$178,895.10
Construction Signing & Traffic Control	(5 - 25%) of subtotal Default = 20%	5.0%	$447,237.76
Mobilization	(4 - 7%) of subtotal Default = 7%	5.0%	$541,157.69
Total of Construction Bid Items		**Subtotal**	$11,364,311.44
Force Account - Misc.	(10 - 15%) Default = 12%	10.0%	$1,136,431.14
Subtotal of Construction Cost		**Subtotal**	$12,500,742.58
Total Construction Engineering	23.95%	23.95%	$2,993,927.85
Total Preliminary Engineering	10%	10.0%	$1,250,074.26
Subtotal of Construction Cost		**Subtotal**	$16,744,744.69
Right of Way	0	$14,000	$0.00
Residences	0	$ 280,000.00	$0.00
Business	0	$ 1,000,000.00	$0.00
Right of Way costs/damages		50.0%	$0.00
		Subtotal ROW	$0.00
Subtotal of Construction Cost		**Subtotal**	$16,744,744.69
Inflation (4 years) (2009 $)	4	3.0%	$2,009,369.36
		Total Project Cost	$18,754,114.05

Project Number:		Project Name: US 550 at US 160 4F
		Alternative: F
Revised F Modified Preliminary Engineers Estimate		Prepared By: SPC, EJA, KEP
		Date Prepared: 6/3/2009, 9/10/09, 6/2/10

		Item		Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	91.9	$ 3,773.00	346,738.70	
2	203-00010	Unclassified Excavation (CIP)	CY	2,247,493	$ 6.00	13,484,958.00	
3	203-00060	Embankment Material (CIP)	CY	0	$ 8.00	0.00	
4	212-00006	Seeding (Native)	Acre	67.7	$ 509.00	34,459.30	
5	212-00006	Soil Conditioning	Acre	67.7	$ 2,049.00	138,717.30	
6	213-00003	Mulching (Weed Free)	Acre	67.7	$ 362.00	24,507.40	
7	304-00000	ABC	Ton	189,935	$ 17.00	3,228,895.00	
8	403-33851	HMA	Ton	69,818	$ 89.53	6,250,805.54	
9	504-00000	Retaining Walls (Cut)	SF	0	$ 85.00	0.00	
10	504-00000	Retaining Walls (Fill)	SF	0	$ 115.00	0.00	
11		Bridge	SF	0	$ 170.00	0.00	
12		Gas Well	Each	2	$ 1,500,000.00	3,000,000.00	new easements and residual profits unknown
13		Local access roads	LF			0.00	
14		Additional Ramps at US 160 to connect US 550	LS			0.00	
						26,509,081.24	

	% Range	% Used	Cost
Project Construction Bid Items	Project Dependent	N / A	$26,509,081.24
Contingencies	(15 - 30%)	30.0%	$7,952,724.37
		Subtotal	$34,461,805.61
ITS	(6 - 10%) of subtotal Default = 6%	2.0%	$689,236.11
Drainage / Utilities	(3 - 10%) of subtotal Default = 6%	10.0%	$3,446,180.56
MS4 and environmental mitigations	(1 - 3%) of subtotal Default = 6%	2.0%	$689,236.11
Signing and Striping	(1 - 5%) of subtotal Default = 5%	2.0%	$689,236.11
Construction Signing & Traffic Control	(5 - 25%) of subtotal Default = 20%	5.0%	$1,723,090.28
Mobilization	(4 - 7%) of subtotal Default = 7%	5.0%	$2,084,939.24
Total of Construction Bid Items		Subtotal	$43,783,724.03
Force Account - Misc.	(10 - 15%) Default = 12%	10.0%	$4,378,372.40
Subtotal of Construction Cost		Subtotal	$48,162,096.43
Total Construction Engineering	23.95%	23.95%	$11,534,822.09
Total Preliminary Engineering	10%	10.0%	$4,816,209.64
Subtotal of Construction Cost		Subtotal	$64,513,128.16
Right of Way	100	$14,000	$1,400,000.00
Residences	6	$ 280,000.00	$1,680,000.00
Business	0	$ 1,000,000.00	$0.00
Right of Way costs/damages		50.0%	$1,540,000.00
		Subtotal ROW	$4,620,000.00
		Subtotal	$69,133,128.16
Inflation (4 years) (2009 $)	4	3.0%	$8,295,975.38
		Total Project Cost	$77,429,103.54
			F Alternative
		US 550	$77,429,103.54
		Total	**$77,429,103.54**

Project Number:	Project Name: US 550 at US 160 4F

Interchange (SPUI) Revised F Modified Preliminary Estimate (Common to all alternatives)

Alternative:	F Ramp
Prepared By:	SPC, EJA, KEP
Date Prepared:	6/3/2009, 9/10/09, 6/2/10

	Item		Unit	Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	41.1	$ 3,773.00	155,070.30	
2	203-00010	Unclassified Excavation (CIP)	CY	0	$ 6.00	0.00	
3	203-00060	Embankment Material (CIP)	CY	271,000	$ 8.00	2,168,000.00	
4	212-00006	Seeding (Native)	Acre	21.7	$ 509.00	11,045.30	
5	212-00006	Soil Conditioning	Acre	21.7	$ 2,049.00	44,463.30	
6	213-00003	Mulching (Weed Free)	Acre	21.7	$ 362.00	7,855.40	
7	304-00000	ABC	Ton	83,798	$ 17.00	1,424,566.00	
8	403-33851	HMA	Ton	41,382	$ 89.53	3,704,930.46	
9	504-00000	Retaining Walls (Cut)	SF	0	$ 85.00	0.00	
10	504-00000	Retaining Walls (Fill)	SF	42,035	$ 115.00	4,834,025.00	
11		Bridge	SF	18,054	$ 170.00	3,069,180.00	
12		Gas Well	Each	0	$ 1,500,000.00	0.00	new easements and residual profits unknown
13		Local access roads	LF			0.00	
						0.00	
						15,419,135.76	

Item	% Range	% Used	Cost
Project Construction Bid Items	Project Dependent	N / A	$15,419,135.76
Contingencies	(15 - 30%)	30.0%	$4,625,740.73
		Subtotal	$20,044,876.49
ITS	(6 - 10%) of subtotal	2.0%	$400,897.53
Drainage / Utilities	(3 - 10%) of subtotal	10.0%	$2,004,487.65
MS4 and environmental mitigations	(1 - 3%) of subtotal Default = 6%	2.0%	$400,897.53
Signing and Striping	(1 - 5%) of subtotal Default = 5%	2.0%	$400,897.53
Construction Signing & Traffic Control	(5 - 25%) of subtotal	5.0%	$1,002,243.82
Mobilization	(4 - 7%) of subtotal Default = 7%	5.0%	$1,212,715.03
Total of Construction Bid Items		Subtotal	$25,467,015.58
Force Account - Misc.	(10 - 15%) Default = 12%	10.0%	$2,546,701.56
Subtotal of Construction Cost		Subtotal	$28,013,717.14
Total Construction Engineering	23.95%	23.95%	$6,709,285.26
Total Preliminary Engineering	10%	10.0%	$2,801,371.71
Subtotal of Construction Cost		Subtotal	$37,524,374.11
Right of Way	34.7	$14,000	$485,800.00
Residences	7	$ 280,000.00	$1,960,000.00
Businesses	7	$ 1,000,000.00	$7,000,000.00
Right of Way costs/damages		25.0%	$2,361,450.00
		Subtotal ROW	$9,445,800.00
		Subtotal	$46,970,174.11
Inflation (4 years) (2009 $)	4	3.0%	$5,636,420.89
		Total Project Cost	$52,606,595.00

Project Number:			Project Name: US 550 at US 160 4F
		Alternative:	East
	Eastern Realignment Preliminary Engineers Estimate	Prepared By:	SPC, EJA, KEP
		Date Prepared:	6/3/2009, 9/10/09, 6/2/10

		Item		Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	117.0	$ 3,773.00	441,441.00	
2	203-00010	Unclassified Excavation (CIP)	CY	2,742,193	$ 6.00	16,453,158.00	
3	203-00060	Embankment Material (CIP)	CY	0	$ 8.00	0.00	
4	212-00006	Seeding (Native)	Acre	80.0	$ 509.00	40,720.00	
5	212-00006	Soil Conditioning	Acre	80.0	$ 2,049.00	163,920.00	
6	213-00003	Mulching (Weed Free)	Acre	80.0	$ 362.00	28,960.00	
7	304-00000	ABC	Ton	211,297	$ 17.00	3,592,049.00	
8	403-33851	HMA	Ton	79,832	$ 89.53	7,147,358.96	
9	504-00000	Retaining Walls (Cut)	SF	0	$ 85.00	0.00	
10	504-00000	Retaining Walls (Fill)	SF	0	$ 115.00	0.00	
11		Bridge	SF	0	$ 170.00	0.00	
12		Gas Well	Each	2	$ 1,500,000.00	3,000,000.00	new easements and residual profits unknown
13		Local access roads	LF			0.00	
14		Additional Ramps at US 160 to connect US 550	LS			0.00	
						30,867,606.96	

		% Range	% Used	Cost
Project Construction Bid Items		Project Dependent	N / A	$30,867,606.96
Contingencies		(15 - 30%)	30.0%	$9,260,282.09
			Subtotal	$40,127,889.05
ITS		(6 - 10%) of subtotal	2.0%	$802,557.78
Drainage / Utilities		(3 - 10%) of subtotal	10.0%	$4,012,788.91
MS4 and environmental mitigations		(1 - 3%) of subtotal Default = 6%	2.0%	$802,557.78
Signing and Striping		(1 - 5%) of subtotal Default = 5%	2.0%	$802,557.78
Construction Signing & Traffic Control		(5 - 25%) of subtotal	5.0%	$2,006,394.45
Mobilization		(4 - 7%) of subtotal Default = 7%	5.0%	$2,427,737.29
Total of Construction Bid Items			Subtotal	$50,982,483.04
Force Account - Misc.		(10 - 15%) Default = 12%	10.0%	$5,098,248.30
Subtotal of Construction Cost			Subtotal	$56,080,731.34
Total Construction Engineering		23.95%	23.95%	$13,431,335.16
Total Preliminary Engineering		10%	10.0%	$5,608,073.13
Subtotal of Construction Cost			Subtotal	$75,120,139.63
Right of Way		141	$20,000	$2,820,000.00
Residences		9	$ 280,000.00	$2,520,000.00
Business		0	$ 1,000,000.00	$0.00
Right of Way costs/damages			50.0%	$2,670,000.00
			Subtotal ROW	$8,010,000.00
			Subtotal	$83,130,139.63
Inflation (4 years) (2009 $)		4	3.0%	$9,975,616.76
		Total Project Cost		$93,105,756.38

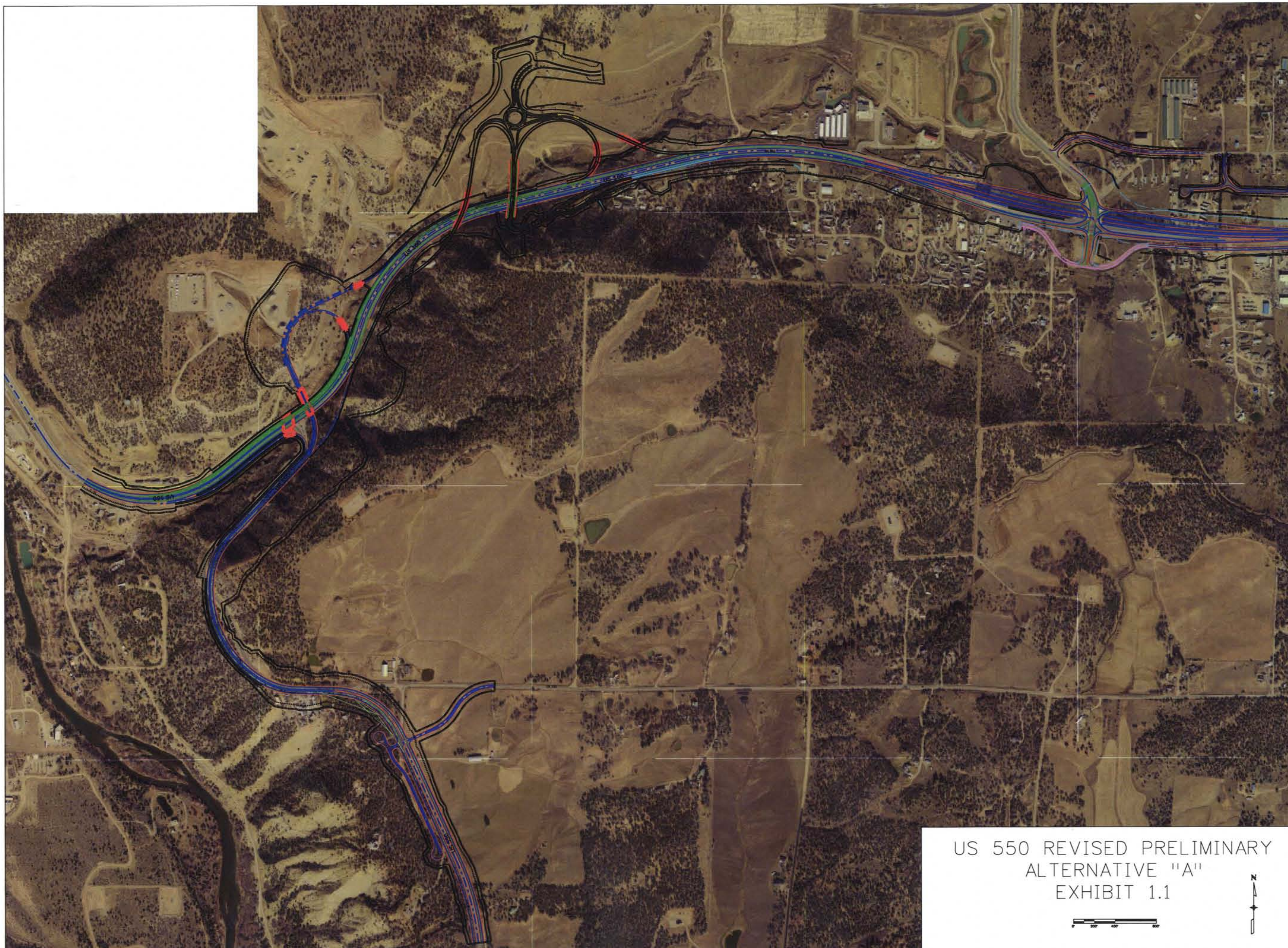
East Alternative	
US 550	$93,105,756.38
Total	**$93,105,756.38**

c

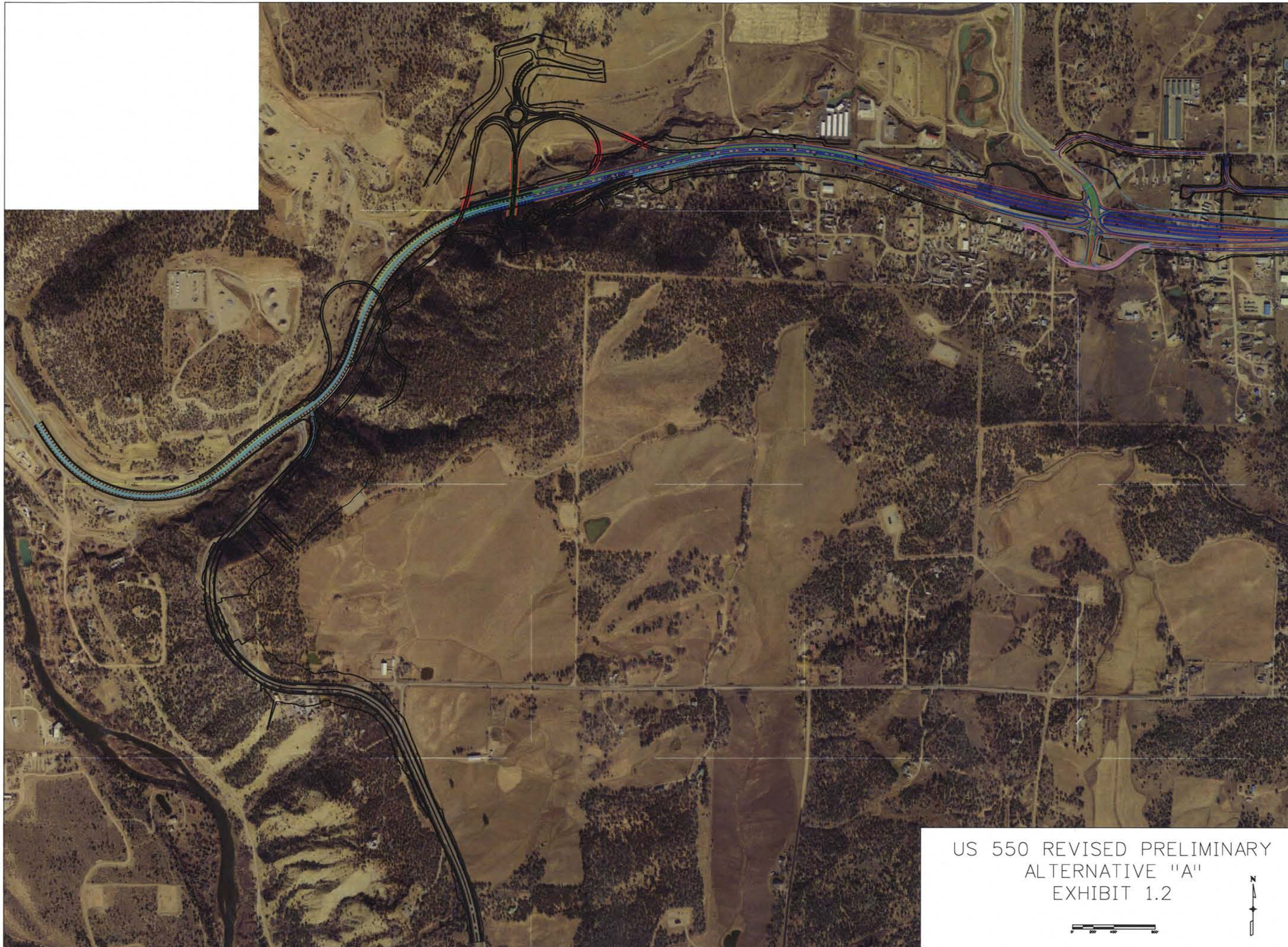
Project Number:			Project Name: US 550 at US 160 4F	
			Alternative:	East Alt
nterchange (SPUI) Eastern Realignment Preliminary Estimate (Common to all alternatives			Prepared By:	SPC, EJA, KEP
			Date Prepared:	6/3/2009, 9/10/09, 6/2/10

		Item		Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	41.1	$ 3,773.00	155,070.30	
2	203-00010	Unclassified Excavation (CIP)	CY	0	$ 6.00	0.00	
3	203-00060	Embankment Material (CIP)	CY	271,000	$ 8.00	2,168,000.00	
4	212-00006	Seeding (Native)	Acre	21.7	$ 509.00	11,045.30	
5	212-00006	Soil Conditioning	Acre	21.7	$ 2,049.00	44,463.30	
6	213-00003	Mulching (Weed Free)	Acre	21.7	$ 362.00	7,855.40	
7	304-00000	ABC	Ton	83,798	$ 17.00	1,424,566.00	
8	403-33851	HMA	Ton	41,382	$ 89.53	3,704,930.46	
9	504-00000	Retaining Walls (Cut)	SF	0	$ 85.00	0.00	
10	504-00000	Retaining Walls (Fill)	SF	42,035	$ 115.00	4,834,025.00	
11		Bridge	SF	18,054	$ 170.00	3,069,180.00	
12		Gas Well	Each	0	$ 1,500,000.00	0.00	new easements and residual profits unknown
13		Local access roads	LF			0.00	
						0.00	
						15,419,135.76	

	% Range	% Used	Cost
Project Construction Bid Items	Project Dependent	N / A	$15,419,135.76
Contingencies	(15 - 30%)	30.0%	$4,625,740.73
		Subtotal	$20,044,876.49
ITS	(6 - 10%) of subtotal	2.0%	$400,897.53
Drainage / Utilities	(3 - 10%) of subtotal	10.0%	$2,004,487.65
MS4 and environmental mitigations	(1 - 3%) of subtotal Default = 6%	2.0%	$400,897.53
Signing and Striping	(1 - 5%) of subtotal Default = 5%	2.0%	$400,897.53
Construction Signing & Traffic Control	(5 - 25%) of subtotal	5.0%	$1,002,243.82
Mobilization	(4 - 7%) of subtotal Default = 7%	5.0%	$1,212,715.03
Total of Construction Bid Items		Subtotal	$25,467,015.58
Force Account - Misc.	(10 - 15%) Default = 12%	10.0%	$2,546,701.56
Subtotal of Construction Cost		Subtotal	$28,013,717.14
Total Construction Engineering	23.95%	23.95%	$6,709,285.26
Total Preliminary Engineering	10%	10.0%	$2,801,371.71
Subtotal of Construction Cost		Subtotal	$37,524,374.11
Right of Way	34.7	$14,000	$485,800.00
Residences	7	$ 280,000.00	$1,960,000.00
Businesses	7	$ 1,000,000.00	$7,000,000.00
Right of Way costs/damages		25.0%	$2,361,450.00
		Subtotal ROW	$9,445,800.00
		Subtotal	$46,970,174.11
Inflation (4 years) (2009 $)	4	3.0%	$5,636,420.89
		Total Project Cost	$52,606,595.00



US 550 REVISED PRELIMINARY
ALTERNATIVE "A"
EXHIBIT 1.1



US 550 REVISED PRELIMINARY
ALTERNATIVE "A"
EXHIBIT 1.2

STATE OF COLORADO

DEPARTMENT OF TRANSPORTATION
PROGRAM ENGINEERING
REGION 5
3803 N. Main Avenue, Suite 300
Durango, CO 81301
(970) 385-1400
Fax (970) 385-1410

DOT
DEPARTMENT OF TRANSPORTATION

Date: September 20, 2010

To: Joe Duran
FHWA Operational Engineer

From: Keith Powers
Program Engineer

Subject: US 550 at US 160 Section 4(f) Evaluation - Revised Preliminary Alternative A and Partial Interchange

This technical memorandum describes engineering issues and costs associated with the Revised Preliminary Alternative A and the Partial Interchange at the Existing US 550/US 160 Intersection Alternative being considered in the US 550 at US 160 Section 4(f) Evaluation.

Description of Alternatives

The US 550 Revised Preliminary Alternative A and Partial Interchange Alternative at the Existing US 550/US 160 Intersection would both connect US 550 from the top of the Florida Mesa with US 160, at the current location at M.P. 88.3. These alignments would require an interchange or partial interchange at the current location of the intersection with US 160. Exhibits for both of these alternatives and cost estimates are attached.

Both of these alternatives follow a similar alignment as that of the existing US 550 Farmington Hill roadway. The roadway typical section used includes two through lanes in each direction with 10 foot shoulders and a 14 foot median with a concrete safety barrier.

Design and Construction Issues

Connecting US 550 to US 160 along the existing alignment has geographic and climatic challenges. The hillside has a steep grade, rising over 200 feet in approximately 0.66 mile. The north-facing slope of the hillside makes this area prone to winter icing. The steep embankment above the existing roadway is comprised of decomposed shale overlain by sandy cobbles and boulders, which are prone to sloughing onto the roadway surface, creating hazards for drivers. Widening to four lanes along this alignment will also require excavation in an area of known subsurface water problems, which may create drainage and possible slope instabilities.

Changes in the speed limit that is required for these alternatives will create safety issues. US 550, in the US 550 Environmental Assessment, was designed to a 70 mph design speed from the New Mexico State Line to just south of County Road 220. The section of US 550 north of County Road 220 was designed to a 60 mph design speed in the US 160 Environmental Impact Statement. When analyzing Revised Preliminary Alternative A and the Partial Interchange Alternative, the roadway design speed would need to be decreased from 70 mph to 35 mph as you descend the Farmington Hill section of US 550, please reference last column of table below.

The below table is a summary of roadway stations (locations) with corresponding geometry (radius of curve, superelevation) and corresponding design speeds which are dependent on the roadway geometry at the roadway station. The lowest design speed, whether it is based on superelevation or site distance governs the design because it is considered the speed a driver can drive the road safely. This “governing” design speed is listed below in the right hand column of the table. The design speed below are based on the AASHTO Geometric Design of Highways and Streets, 2004 criteria. The table shows that between stations 204+11.57 and 226+20.73 the allowable design speed is 70 (mph). At station 226+20.73 the geometry of the road changes (radius of curve decreases from 2546.99 ft to 710 ft), this large reduction in radius requires the design speed to decrease to 35 mph.

PI Station	Radius of Curve (ft)	*Superelevation (%) & Corresponding Design Speed	**Horizontal Stopping Sight Distance (ft) & Corresponding Design Speed	Governing Design Speed (mph)
204+11.57	2,546.99	7.2% @ 70 mph	769’ @ 70 mph	**70**
226+20.73	710	7.8% @ 45 mph	272’ @ 35 mph	**35**
235+03	680	8% @ 45 mph	266’ @ 35 mph	35
243+38	1020	8% @ 55 mph	326’ @ 40 mph	40
250+86	680	8% @ 45 mph	266’ @ 35 mph	35
266+07	391	7.8% @ 35 mph	202’ @ 30 mph	30

* 2006 M & S Standards (Miscellaneous and Safety Standards)
** AASHTO Geometric Design of Highways and Streets, 2004 (pages 112, 224-228)

The large reduction in design speed from 70 mph to 35 mph creates an unsafe condition and is not an acceptable reduction per the 2004 edition of AASHTO Geometric Design of Highways and Streets (AASHTO), see discussion on pages 67-72 and 503. CDOT uses these guidelines to provide for a safe and uniform traveling experience that the public has come to expect.

An additional factor that is not desirable is the 8% super elevation required for the tighter radius curves on Farmington Hill. The roadway is a northerly facing slope and combined with the 8% slope of the road as it traverses the hillside will be a safety concern. This steep cross slope can cause sliding of vehicles in icy conditions.

The vertical grade of the new alignment would be 4%. This alignment on a north facing slope presents a safety hazard in winter months when roads are snow-packed or icy. Currently the existing highway is often the scene of accidents due to the steep vertical grade and icy winter conditions. For the time period 1/1/2001 to 12/31/2005, a Detailed Accident Summary Report between M.P. 15.86 to 16.56 (The current US 550/US 160 intersection is at M.P. 16.56) shows that nine out of thirty (30%) accidents occurred during snowy, icy, slushy or wet road conditions.

The sharp curvature of the highway also creates an unsafe condition. Because of the sharp horizontal curves, driver visibility along the road will be short, as little as 202 feet at some locations. Assuming a 35 mph travel speed, drivers have only 4.5 seconds to react to roadway hazards. This short reaction time will create an unsafe condition, especially in winter with icy conditions on a north-facing slope.

Both the grade and curvature would affect the traffic flow of the highway. Truck traffic on a 4% uphill grade would be moving at approximately 30 mph and the downhill grade speeds will increase approximately 5%. These changes in speeds affect the traffic flows and are not addressed in the *Year 2030 Traffic Operations Analysis for the US 550 at US 160 Section 4(f) Alternatives Memorandum (SEH, 2010).*

The widened template would require significant retaining wall construction on the downhill side of the existing roadway. Retaining walls would contain fills with wall heights of up to 85 feet, utilizing a tiered wall design in order to minimize right of way impacts as well as wetland habitat. The cost of the retaining wall has been estimated utilizing bid costs form a MSE on a micropile foundation which was utilized on a project on SH 145 near Telluride completed in 2007.

The final design of the roadway is dependent on the geotechnical site conditions, which are unknown. Without a complete geotechnical foundation investigation, it is not known whether a MSE on micropile foundation would be adequate for the site. Bedrock may be deeper than 40 feet based on geotechnical information from the Grandview Interchange project and visual observation and the existing alignment is on a hillside cut/fill. The required widening would push the roadway alignment outside the existing fill approximately 35 feet. Bedrock depths may be beyond the depths suitable for a micropile foundation design and may require a drilled shaft, essentially larger piles. This requirement would increase the estimated construction cost.
During construction of US 550 from CR 220 to US 160, a detour on to CR 220 to SH 172 would be required in order to widen the highway and add retaining walls. The construction of the retaining walls would not allow traffic to remain on the existing US 550 alignment while under construction. CR 220 parallels US 160 approximately 1 mile to the south and is a narrow county road with poor sight distance, no shoulders, and numerous access points for residential driveways. It is estimated that in the year 2015 on US 550 there would be an approximate average annual daily traffic count of 9,887. In its current condition, CR 220 would have to be upgraded to handle the US 550 and CR 220 traffic. Under either Revised Preliminary Alternative A or the Partial Interchange Alternative, CR 220 would have to be reconstructed and new signals would have to be installed at the US 550/CR 220 and the CR 220/SH 172 intersections.

The county road has poor sight distance due to the vertical alignment of the road. The use of the road would require a low speed limit due to the poor sight distance, with minimal shoulders (less than 2 feet), and the numerous local accesses onto the county road. To improve the safety of the county road, the vertical curves would need to be improved and right of way would need to be purchased. In addition, signalized intersections would be necessary where US 550 intersects CR 220 to the west and SH 172 to the east.. Also, the intersection of SH 172 and US 160 would need to be improved to accommodate the increased left turning traffic (double left turn lanes) onto and off of SH 172 with the relocation of US 550. The duration of the detour would most likely be a 2-year period. Despite the geometric improvements, the safety of the road for detour purposes would still be an issue due to the number of accesses entering CR 220. For example, between SH 172 and Whitney Way, which are approximately 1 mile apart, there are 37 driveways, county roads and other accesses entering CR 220. There will be many conflicts between the vehicles coming out onto CR 220 and the estimated additional 9,887 daily vehicles from US 550 that would be detoured. Conflicts with through moving traffic and residential driveways on CR 220 would create unsafe conditions during the 2-year period of construction.

Traffic Safety and Operational Issues Where US 550 Connects to US 160

Revised Preliminary Alternative A and the Partial Interchange at the Existing US 550/US 160 Intersection Alternative both meet capacity requirements of the purpose and need (see *Year 2030 Traffic Operations Analysis for the US 550 at US 160 Section 4(f) Alternatives Memorandum, SEH 2010).* The beneficial safety improvement of the partial interchange, however, relative to a fully grade separated interchange is not as safe. In the case of the partial interchange, only the northbound US 550 left turning traffic is removed from crossing US 160 at the signalized intersection, the eastbound US 160 to southbound US 550 left turns must still cross oncoming traffic with a signal, and the traffic volumes in the year 2030 require the left turn movement to be a double left which reduces the safety of the intersection further. A grade-separated interchange eliminates any left turning conflicts making Revised Preliminary Alternative A safer than the Partial Interchange at the Existing US 550/US 160 Intersection.

Cost
The estimated cost for the different alternatives are included in the memorandum *US 550 at US 160 Re-Evaluation, Cost estimates for Section 4(f) Alternatives* (September 2010). The costs for the alternatives are estimated as follows:

- Western Realignment Alternative: $326,931,000
- Revised Preliminary Alternative A: $232,874,000
- Partial Interchange at the Existing US 550/US 160 Intersection: $230,790,000
- Alternative G Modified - EIS: $84,484,000
- Revised Alternative G Modified: $77,598,000
- Revised Alternative F Modified: $77,429,000
- Eastern Realignment Alternative: $93,106,000

The Revised Preliminary Alternative A is almost 3 times the cost of the least expensive alternative, Revised Alternative G Modified, but is less than the cost of the Western Alignment Alternative. The cost for Revised Preliminary Alternative A may be significantly higher if a larger foundation or roadway typical section is needed.

Summary
These on alignment alternatives have a combination of a low design speeds, sharp curves, 8% superelevation, 4% vertical grades, north facing slopes, and unknown geotechnical conditions. Other contributing facts such as the radius of curves would negatively impact the traffic flow. Detouring traffic on to CR 220 for a 2-year period would have safety issues due to the number of accesses onto the county road. For these reasons, Revised Preliminary Alternative A and the Partial Interchange at the Existing US 550/US 160 Intersection are considered to have extraordinary safety problems.

cc: Archuleta
Neet
McVaugh
Cross
Project File

Project Number:	Project Name: US 550 at US 160 4F

	Alternative:	A
Revised Preliminary Alternative A Preliminary Engineers Estimate	Prepared By:	SPC, EJA, KEP
	Date Prepared:	6/3/2009, 9/10/09, 12/7/09, 6/2/10

	Item			Quantity	Unit Cost	Extended Cost	Comments
1	201-00000	Clearing and Grubbing	Acre	48.5	$ 3,773.00	182,990.50	
2	203-00010	Unclassified Excavation (CIP)	CY	1,632,000	$ 6.00	9,792,000.00	
3	203-00060	Embankment Material (CIP)	CY	0	$ 8.00	0.00	
4	212-00006	Seeding (Native)	Acre	33.4	$ 509.00	17,000.60	
5	212-00006	Soil Conditioning	Acre	33.4	$ 2,049.00	68,436.60	
6	213-00003	Mulching (Weed Free)	Acre	33.4	$ 362.00	12,090.80	
7	304-00000	ABC	Ton	87,369	$ 17.00	1,485,273.00	
8	403-33851	HMA	Ton	32,116	$ 89.53	2,875,345.48	
9	504-00000	Retaining Walls (Cut)	SF	0	$ 85.00	0.00	
10	504-00000	Retaining Walls (Fill)	SF	87,330	$ 382.00	33,360,060.00	From Keystone Hill plus panel facing to match corridor
11		Bridge	SF	0	$ 170.00	0.00	
12		Gas Well	Each	0	$ 1,500,000.00	0.00	new easements and residual profits unknown
13		Local access roads	LF	2,200	$ 95.00	209,000.00	West frontage road (1200LF) and CR 220 (1000LF)
					Subtotal	48,002,196.98	

		% Range	% Used	Cost
Project Construction Bid Items		Project Dependent	N / A	$48,002,196.98
Contingencies		(15 - 30%)	30.0%	$14,400,659.09
			Subtotal	$62,402,856.07
ITS		(6 - 10%) of subtotal Default = 6%	2.0%	$1,248,057.12
Drainage / Utilities		(3 - 10%) of subtotal Default = 6%	10.0%	$6,240,285.61
MS4 and environmental mitigations		(1 - 3%) of subtotal Default = 6%	2.0%	$1,248,057.12
Signing and Striping		(1 - 5%) of subtotal Default = 5%	2.0%	$1,248,057.12
Construction Signing & Traffic Control		(5 - 25%) of subtotal Default = 20%	5.0%	$3,120,142.80
Mobilization		(4 - 7%) of subtotal Default = 7%	5.0%	$3,775,372.79
Total of Construction Bid Items			Subtotal	$79,282,828.64
Force Account - Misc.		(10 - 15%) Default = 12%	10.0%	$7,928,282.86
Subtotal of Construction Cost			Subtotal	$87,211,111.50
Total Construction Engineering		23.95%	23.95%	$20,887,061.20
Total Preliminary Engineering		10%	10.0%	$8,721,111.15
Subtotal of Construction Cost			Subtotal	$116,819,283.85
Right of Way		38.7	$14,000	$541,800.00
Residences		1	$ 280,000.00	$280,000.00
Business		1	$ 1,000,000.00	$1,000,000.00
Right of Way costs/damages			50.0%	$910,900.00
			Subtotal ROW	$2,732,700.00
Subtotal of Construction Cost			Subtotal	$119,551,983.85
Inflation (4 years) (2009 $)		4	3.0%	$14,346,238.06
			Total Project Cost	$133,898,221.91

A Alternative	
US 550	$133,898,221.91
Ramps	$94,582,194.74
CR 220 Upgrade	$4,393,152.98
Total	**$232,873,569.63**

US 550 WESTERN REALIGNMENT
EXHIBIT 1.1

STATE OF COLORADO
DEPARTMENT OF TRANSPORTATION

Region 5 - Engineering
3803 N. Main Ave., Suite 300
Durango, Colorado 81301
(970) 385-1440
FAX (970) 385-1410

DEPARTMENT OF TRANSPORTATION

Date: September 20, 2010

To: Joe Duran
FHWA Operational Engineer

From: Keith Powers
Program Engineer

Subject: US 550 at US 160 Section 4(f) Evaluation, US 550 Western Realignment Alternative

This technical memorandum describes engineering issues and costs associated with the US 550 Western Realignment Alternative being considered in the US 550 at US 160 Section 4(f) Evaluation. This alternative is one of five alternatives being evaluated in the US 550 at US 160 Section 4(f) evaluation. This memo describes issues related to construction of this alternative, safety and operations, and cost.

Description of Alternative

The US 550 Western Realignment Alternative would connect to US 550 at approximately M.P. 13.17 on the top of Florida Mesa. After coming down off Florida Mesa, the alignment generally follows the Animas River north to its connection with US 160 at approximately M.P. 88.0. This alignment crosses the Animas River twice and would require an intersection or an interchange where it intersects existing US 550, and would require an interchange at its intersection with US 160. An exhibit of this alternative is attached.

The US 550 Western Realignment Alternative was aligned to avoid and minimize environmental impacts where possible. The alignment minimizes impacts to wetlands and riparian habitat by utilizing longer bridge crossings and reducing the use of fills for placement of bridge structures. Longer bridge crossings reduce impacts, because piers are placed away from the river and outside of riparian habitat and wetlands, instead of in the river or in riparian/wetland habitat. In a similar way, retaining walls are used to contain fills in order to minimize impacts to riparian and wetland habitat. Retaining walls minimize impacts by keeping fill contained behind a wall instead of sloping it out and disturbing a larger area.

Details of the US 550 Western Realignment Alternative are described below. An exhibit of this alternative is attached.

1. The typical section of the roadway as illustrated in Figure 1 is:
   - 4 – twelve foot lanes, two in each direction
   - 2 – ten foot shoulders
   - 46 foot wide median
   - 12 foot "Z" slope –The Z slope is a slope that starts from the edge of pavement and slopes gently away from the roadway. Its serves multiple purposes, such as giving an errant vehicle a little more recovery area, helping with drainage, allowing for snow storage and sign placement, and providing for rockfall containment.

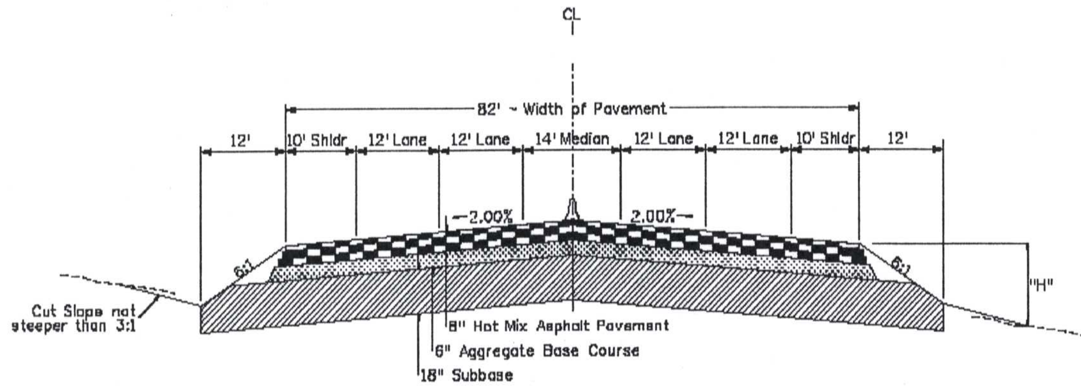


Figure 1: Typical Section of roadway used for this analysis

2. The alignment goes through the Animas River valley and crosses the Animas River twice. This area contains natural river habitation. The alignment avoids the river's habitat as much as possible by utilizing longer bridge crossing and not using fills.

3. This alignment cuts through a cliff that has an upper elevation of 6631 feet and a bottom elevation of 6,330. This alternative drops 301 feet in less than ½ mile. To achieve a grade of 5% there has to be a significant amount of excavation and fill.

4. The excavation would begin approximately 1,800 feet south of the Florida Mesa rim. Several gas transmission lines would need to be relocated, because of the excavation required for construction of the road. The cost of the transmission line relocation is not addressed in detail in the cost estimate, but is covered by a contingency percentage.

5. Located adjacent to the gas line easement is a private property that would have to be acquired in whole in order to complete the required excavation. The estimated cost of this property is identified in Right of Way costs.

6. The roadway north of the excavated section would cross a fill section and the river basin. In the fill section to the north of Florida Mesa, two existing residences would need to be acquired.

7. Just prior to the new bridge, south of the Animas River, the existing railroad bed would be removed for highway construction. This railroad is abandoned and is part of the Denver & Rio Grande Railroad which is eligible for listing on the National Register of Historic Places.

8. The fill section continues to the first bridge crossing. A large retaining wall would be required in order to contain the bridge abutment fill and to avoid impacts to the Animas River.

9. Bridge No. 1 would be the first river crossing. The structure would be a 4 lane bridge, 1,700 feet in length and having a total bridge deck area of 139,400 square feet. The bridge crossing would affect the riparian and wetland resources both in temporary construction and permanent impacts. It is likely permanent mitigation would be required for both resources. The structure's abutments would also require extensive wing walls in order to contain the fills.

10. Proceeding north off of Bridge No. 1, the roadway would be constructed on a fill section. In order to contain the fill and avoid impacts to the riparian habitat a MSE wall would be constructed to contain the fill within the roadway prism. The wall would be approximately 750 feet in length, wall heights wouldvary from a 5 foot height to an approximate maximum height of 74 feet (3 tiers), and have an estimated wall area of 29,625 square feet.

11. Bridge No. 2 would be constructed north of the wall where the fill section would intersect a residential and gas well roadway (Jack Rabbit Lane). The bridge is required to maintain local access below the proposed US 550 roadway. In the cost estimate, Bridge No. 2 is identified as a 50 - foot span bridge.

12. The roadway would continue north of Bridge No. 2 on a fill section. The fill section would intersect an existing gas well (identified as permit 07237 on the La Plata County GIS site). Design modifications were studied that would avoid the gas well. Moving the alignment to the west would still affect a gas well as there are two gas wells in this location. Moving the alignment to the east is not desirable as it is closer to the Animas River and would cause greater environmental impacts than the current alignment. Costs for the gas well relocation are included in the cost estimate.

13. At the north end of the fill section the roadway will travel on Bridge No. 3. which is the second river crossing. The structure would be a 4 - Lane Bridge, 1,750 feet in length and having a total bridge deck area of 143,500 square feet. The bridge crossing would affect the riparian and wetland resources both in temporary construction and permanent impacts. It is likely permanent mitigation would be required for both resources. The structure's abutments would require extensive wing walls in order to contain the fills. This bridge would also need to accommodate local traffic east and west under the highway.

14. Upon leaving the north abutment of Bridge 3, the connection with US 160 would be made using a fully directional three level "T" interchange. Four additional ramp bridges would be required along with extensive retaining wall systems running along Wilson Gulch and on the cut slopes to the north.

Construction Issues

The US 550 Western Alignment Alternative will require a large amount of excavation and fill. This alignment cuts through the Florida Mesa where it has an upper elevation of 6631 feet and a bottom elevation of 6330 feet. This elevation difference of 301 feet occurs within less than a half of a mile.

In referring to the 2004 AASHTO Policy on Design, Chapter 8, page 505 discusses maximum grades for freeways. Exhibit 8.1 states that for a design speed of 65 mph, rolling terrain, the maximum grade is 4%. A sub note allows a 1% steeper grade than the 4% value shown in Exhibit 8.1. This steeper grade may be provided in mountainous or urban areas with crucial right of way controls.

To achieve a grade of 5%, approximately 3,541,264 cubic yards would need to be removed from the hillside. This equates to 236,084 truck equivalents at 15 cubic yards per truck. If we assume that the material is removed and placed in the fill section, and that the material could be moved at a rate of 10 truck loads per hour, at 8 hours per day for a 5 day work week, it would take 197 work days or 9.5 months to move all this material. This compares to approximately 1,600,000 cubic yards of material that would need to be removed for Revised G Modified Alternative and 2,742,000 cubic yard for the Revised Eastern Realignment Alternative.

In addition to the large amount of excavation and fill required for this alternative, it requires more bridge structures than any of the other alternatives being considered. This alternative requires three bridges with a total bridge deck area of 287,000 square feet. In comparison, Revised G Modified Alternative has a total bridge deck area of 85,990 square feet and the Revised Eastern Realignment Alternative has no bridges. The longest bridge structure required for the US 550 Western Realignment Alternative is 1,750 feet which is 3.3 times longer than the bridge recently constructed across US 160 as part of the Grandview Interchange. The three structures do not include those structures needed for the interchange connection at US 160.

Safety and Operational Issues

The location of where US 550 connects to US 160 in this alternative creates safety, operational, and congestion problems as described in the *Year 2030 Traffic Operations Analysis for the US 550 at US 160 Section 4(f), SEH, 2010.*The interchange will experience congestion and capacity problems due to the close proximity of the River Road signalized intersection to the northbound on ramp to US 160. Intersection queues, northbound at River Road, during the evening peak period will extend beyond the merge for the US 550 to US 160 on ramp. This will cause vehicles to stop on the ramp during evening peak periods. Approaching vehicles on US 550 would not anticipate a stopped vehicle on the northbound US 550 to westbound US 160 ramp. The speed difference between approaching vehicles and stopped vehicles on the ramp will create an unsafe condition that could cause sideswipe and rear-end accidents.

Cost

The estimated cost for the different alternatives are included in the memorandum *US 550 at US 160 Re-Evaluation, Cost Estimates for Section 4(f) Alternatives* (Powers, 2010). The costs for the alternatives are estimated as follows:

- Western Realignment Alternative: $326,931,000
- Revised Preliminary Alternative A: $232,874,000
- Partial Interchange at the Existing US 550/US 160 Intersection: $230,790,000
- Alternative G Modified - EIS: $84,484,000
- Revised Alternative G Modified: $77,598,000
- Revised Alternative F Modified: $77,429,104
- Eastern Realignment Alternative: $93,106,000

Summary

The US 550 Western Realignment requires 3 bridge structures with two of them crossing the Animas River. It has construction challenges, such as, removal of greater than 3.0 million cubic yards of material. It has safety and operational issues due to its proximity to River Road. It also costs almost 4.2 times the amount of the least costly alternative.

cc: Archuleta
Neet
McVaugh
Cross
Project File

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Date: December 22, 2010

To: Joe Duran
FHWA Operational Engineer

From: Keith Powers [signature] FOR K.P.
Program Engineer

Subject: US 550 at US 160 Re-Evaluation, Cost Estimates for Section 4(f) Alternatives Addendum

The alternatives considered in the least harm analysis, Revised G Modified, Revised F Modified, and the Eastern Realignment, were updated to begin at a common southern point for the following reason. All three alternatives needed to include the same point or origin on US 550 south of CR 220 to allow a relative comparison of impacts between alternatives. The common point of origin is near the location where the Eastern Realignment diverges from US 550. Because US 550 will be constructed as a four lane divided highway regardless of where the US 550/160 connection alternative diverges from the existing highway, the common point of origin normalizes the relative comparison of alternatives. The purpose of this memo is to update the cost estimates for these alternatives. The table below shows the original cost estimates and the revised cost estimates for each alternative.

ALTERNATIVE	ORIGINAL CONSTRUCTION COST ESTIMATE	REVISED CONSTRUCTION COST ESTIMATE	DIFFERENCE
Eastern Realignment Alternative	$93,106,000	$92,753,000	($353,000)
Revised Alternative F Modified	$77,429,000	$78,394,000	$965,000
Revised Alternative G Modified	$77,598,000	$79,680,000	$2,082,000

cc: Neet
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Date: August 1, 2011

To: William Hanson
FHWA Operational Engineer

From: Keith E. Powers P.E.
CDOT Region 5 Program Engineer

Subject: US 550 on Grade Alignments

This technical memorandum describes engineering issues related to "on-grade alignments" that closely follow the existing roadway along the current US 550 south alignment with its connection to US 160. The "on-grade alignments" include the US 550 at US 160 At-Grade Intersection Alternative, the Partial Interchange at the Existing US 550/US 160 (South) Intersection Alternative, and Revised Preliminary A Alternative. Several design variations that have different curvatures and grades along the existing US 550 alignments are included in these alternatives. Design variations T.1.4, T.1.6, and T.4.4 are variations of the US 550 at US 160 At-Grade Intersection Alternative. Design variations T.2.4, T.2.6, T.3.4 and T.3.6 are variations of the Partial Interchange at the Existing US 550/US 160 (South) Intersection Alternative. These alternatives are collectively referred to in this memo as "on-grade alignments". The design variations are collectively referred to as the "T design variations". The memo addresses only horizontal and vertical alignments and does not include any analysis of proposed connections.

Description of Alternatives

The "on-grade alignments" all connect US 550 from the top of the Florida Mesa with US 160, at or near the current location on US 160 at M.P. 88.3. These alignments would require various types of connection to US 160 that are not a part of this memorandum discussion. The connections and their analysis are discussed elsewhere in the SDEIS.

The roadway geometry is relatively the same for the "on-grade alignments". The differences occur in the percent grade and radius for 2 curves: one approximately 500 feet away from the US 550/US 160 (south) intersection where the horizontal curvature and grade varies (the lower curve) and the other at the top of the mesa where the highway first starts descending the hillside (the upper curve). The design variations are described as follows:

- **Design Variation T.1.4** includes a 1050-foot radius and a four percent grade for the lower curve and a 700-foot radius and four percent grade for the upper curve. Connection at US 160 utilizes the existing at grade signalized intersection.

- **Design Variation T.1.6** includes a 925-foot radius and a six percent grade for the lower curve and a 700-foot radius and six percent for the upper curve. Connection at US 160 utilizes the existing at grade signalized intersection.

- **Design Variation T.2.4** includes a 1050-foot radius and a four percent grade for the lower curve and a 700-foot radius and a four percent grade for the upper curve. The location of the flyover has half of the loop on each the north and south side of US 160 and traffic flow is in a counterclockwise direction with the flyover crossing US 160 approximately 1,300 feet (1/4 mile) east of the US 550/US 160 intersection.

- **Design Variation T.2.6** includes a 925-foot radius curve and six percent grade for the lower curve and 700-foot radius and six percent grade for the upper curve. The location of the flyover has half of the loop on each the north and south side of US 160 and traffic flow is in a counterclockwise direction with the flyover crossing US 160 approximately 1,300 feet (1/4 mile) east of the US 550/US 160 intersection.

- **Design Variation T.3.4** includes a 1050-foot radius curve and a four percent grade for the lower curve and a 700-foot radius and 4 percent grade for the upper curve. The location of the flyover loop is entirely on the north side of US 160 and traffic flow is in a clockwise direction with the flyover crossing US 160 approximately 500 feet east of the US 550/US 160 intersection.

- **Design Variation T.3.6** includes a 925-foot radius curve and a six percent grade for the lower curve and a 700-foot radius and six percent grade for the upper curve. The location of the flyover loop is entirely on the north side of US 160 and traffic flow is in a clockwise direction with the flyover crossing US 160 approximately 500 feet east of the US 550/US 160 intersection.

- **Design Variation T.4.4** includes a 1250-foot radius and a four percent grade for the lower curve and a 1000-foot radius and four percent grade for the upper curve.

- **Revised Preliminary Alternative A**. Includes a series of compound curves beginning with a 1020 foot radius lower curve, a 680 foot radius intermediate curve and a 710 foot radius top curve. It includes a grade-separated trumpet interchange at the existing US 550/US 160 connection. Revised Preliminary Alternative A is the same as in the 2006 US 160 EIS for the US 550 alignment and the connection to US 160. “Revised” has been added to title of this alternative to reflect inclusion of the Grandview Interchange and auxiliary lanes in each direction from the west limit of the Grandview Section to the CR 233 (Three Springs) Interchange.

All of these alternatives follow a similar alignment as that of the existing US 550 Farmington Hill roadway. The roadway typical section for Revised Preliminary Alternative A includes two 12-foot wide through lanes in each direction with 10-foot outside shoulders and a 14-foot median consisting of two 6-foot shoulders with a 2-foot wide concrete safety barrier. The T design variations are similar in alignment, but differ in cross section. They also included two 12-foot wide through lanes but instead of a 14-foot median with safety barrier, they include a 8-foot median consisting of two 3-foot shoulders with a 2-foot wide concrete safety barrier. The T design variations do not include the needed auxiliary lanes at the CR 220 intersection location nor the connection for the local residences to safely access the highway. Another issue with the typical section of the T design variations is the lack of provision for roadside drainage and outside guardrail. Including these required design elements will result in a wider section and much greater fill slope disturbances than represented in the plans and cross sections for the T design variations provided by attorney Mr. Tom McNeill on behalf of the Webb Family.

<u>**Design and Construction Issues**</u>

As discussed in the memo *US 550 at US 160 Section 4(f) Evaluation – Revised Preliminary Alternative A and Partial Interchange* dated September 20, 2010 to Joe Duran with FHWA, connecting US 550 to US 160 along the existing alignment has geographic and climatic challenges. The hillside has a steep grade, rising over 200 feet in approximately 0.66 mile. The north-facing slope of the hillside makes this area prone to winter icing. The steep embankment above the existing roadway is comprised of decomposed shale overlain by sandy cobbles and boulders, which are prone to sloughing onto the roadway surface, creating hazards for drivers, especially in freeze thaw cycles or adverse weather conditions such as heavy rain or snow. Widening to four lanes along this alignment will also require excavation in an area of known subsurface water problems, which may create drainage and possible slope instability. Changes in the speed limit that are required for these alternatives will create safety issues. US 550, in the US 550 Environmental Assessment, was designed to a 70 mph design speed from the New Mexico State Line to just south of the County Road 220 intersection. The section of US 550 north of County Road 220 was designed to a 60 mph design speed in the US 160 Environmental Impact Statement. When analyzing

Revised Preliminary Alternative A and the proposed T design variations, the roadway design speed would need to be decreased from 70 mph to 30 or 35 mph as you descend into the Farmington Hill section of US 550 (See Table 1).

The below table is a summary of roadway stations (locations) with corresponding geometry (radius of curve, super-elevation) and corresponding design speeds which are dependent on the roadway geometry at the roadway station for Revised Alignment A and the T design variations. The lowest design speed, whether it is based on super-elevation or sight distance governs the design because it is considered the speed a driver can drive the road safely. The design speeds below are based on the AASHTO Geometric Design of Highways and Streets, 2004 criteria. At or near the connection with County Road 220 all of the alignments begin with a geometry change of the road (radius of curve decreases to 700 Ft minimum, this large reduction in radius requires the design speed to decrease to 30 to 35 mph.

Table 1. Summary of Design Variations with Geometry & Design Specifications

Alignment*	% Grade	Restricting Curve Radius**	Horizontal Sightline Offset***	Stopping Site Distance****	Design Speed MPH	Eagle Block Impact	CR 220 Connection (see notes)	Met All EIS Alignment Criteria#
T 1.4	4%	709	9	226.2	30	Yes	Not shown	No
		1059	9	275.9	35			
T 1.6	6%	709	9	226.2	30	Yes	Not Shown	No
		934	9	259.5	35			
T 2.4	4%	709	9	226.2	30	Yes	Not Shown	No
		1059	9	276.3	35			
T 2.6	6%	709	9	226.2	30	Yes	Not Shown	No
		934	9	259.5	35			
T 3.4	4%	709	9	226.2	30	Yes	Not Shown	No
		1059	9	276.3	35			
T 3.6	6%	709	9	326.3	30	Yes	Not Shown	No
		934	9	259.5	35			
T 4.4	4%	1009	9	269.7	35	Yes	Not Shown	No
		1259	9	301.2	40			
Revised Preliminary Alignment A	4%	709	12	361.2	35	Yes	Shown	No
		679	12	255.7	35			
		1019	12	313.1	40			

*T design variations provided by Thomas T McNeill letter dated October 28, 2008.
** Curve radius taken at centerline of driving lane nearest median barrier.
*** HSO is measured from center line of lane nearest to center line of median barrier - AASHTO Geometric Design of Highways and Streets, 2004 (pages 112, 224-228).
**** Stopping sight distance taken from Exhibit 3-2 AASHTO Geometric Design of Highways and Streets, 2004 (page 115).

An additional factor that is not desirable is the eight percent super-elevation required for the tighter radius curves on Farmington Hill. The following radius of curvature table represents the increase in curvature needed with each reduction in super-elevation. (reference AASHTO 2004 exhibit 3-15 page 147).

% SUPER	4%	6%	8%
MPH			
30	250	231	214
35	371	340	314
40	533	485	444
45	711	643	587
50	926	833	758
55	1190	1060	960
60	1500	1330	1200

Minimum Radius of Curve (feet)

The large reduction in design speed from 70 mph to 30 or 35 mph creates an unsafe condition and is not an acceptable reduction per the 2004 edition of AASHTO Geometric Design of Highways and Streets (AASHTO); see discussion on pages 67-72 and 503. CDOT uses these guidelines to provide for a safe and uniform traveling experience that the public has come to expect.

For all the on-grade alignments, the roadway for the most part is northerly facing. The north-facing slope combined with the eight percent slope of the road as it traverses the hillside creates an unsafe condition. This steep cross slope can cause sliding of vehicles in icy conditions. The vertical grade of the on-grade alignments varies between four percent and six percent depending on the alternative and design variation. These alignments on a north facing slope presents a safety hazard when roads are wet, snow-packed, or icy, especially in winter months. Currently the existing highway is often the scene of accidents due to the steep vertical grade and icy winter conditions. See the *US 550 Connection to SH 160 in Grandview SEIS Safety Review of Alternative Connection Options* (CDOT, 2011) for more information.

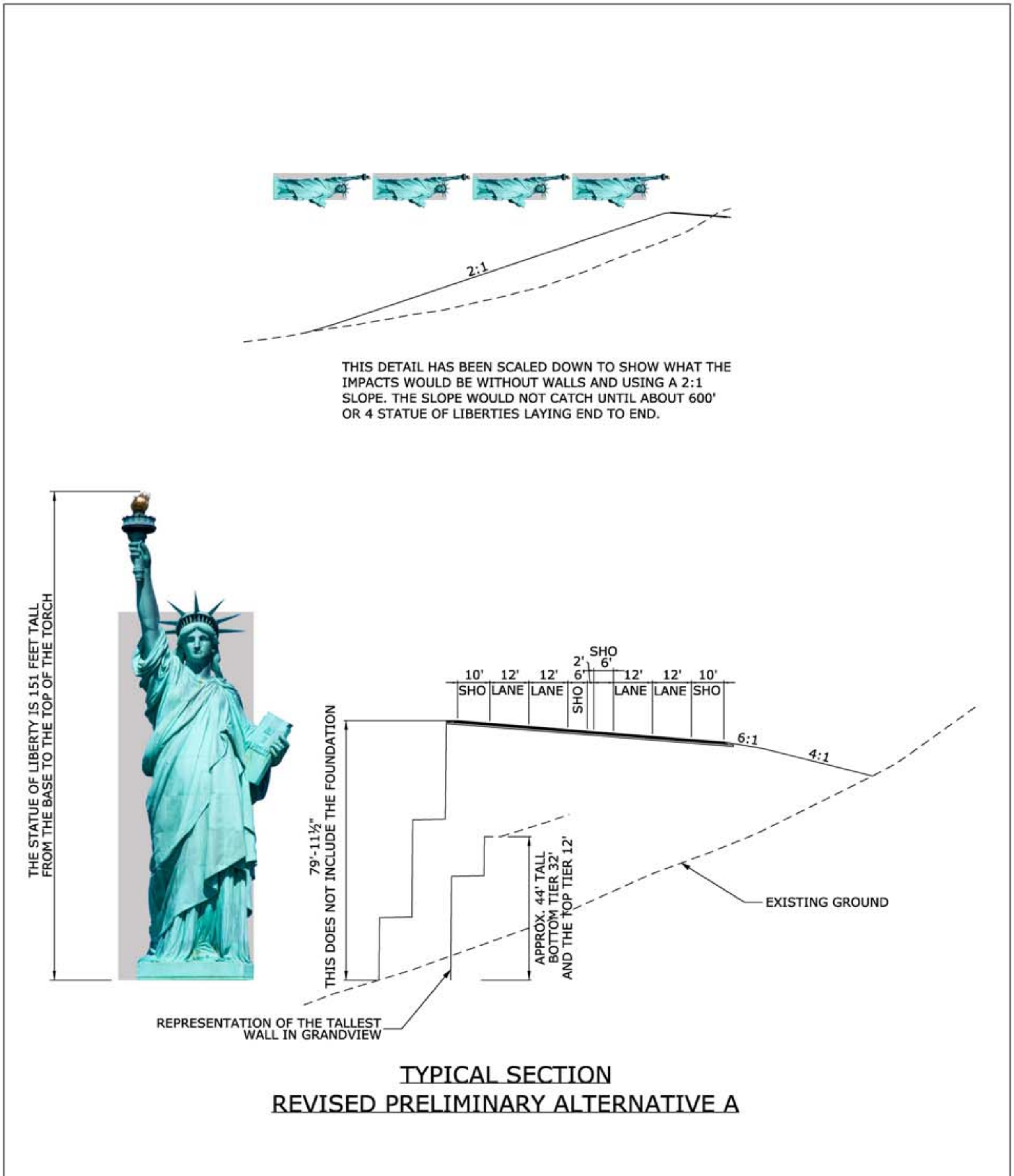
The sharp curvature of the highways proposed in the reviewed alignments also can create unsafe conditions. Because of the sharp horizontal curves, driver visibility along the road will be short, as little as 202 feet at some locations. Assuming a 35 mph travel speed, drivers have only 4.5 seconds to react to roadway hazards. This short reaction time will create an unsafe condition, especially in winter with icy conditions and reduced visibility in adverse conditions on a north-facing slope.

Both the grades and curvatures of the proposed alignments would affect the traffic flow of the highway. Truck traffic on a four percent uphill grade would be moving at approximately 30 mph and the downhill grade speeds will increase approximately five percent. The proposed six percent grades are even worse with uphill running speeds of approximately 25 MPH.

The widened template for Revised Alternative A and other on-grade alignments requires significant retaining wall construction on the downhill side of the existing roadway to stay out of homes above the Animas River located below the alignment to the west, wetlands along Wilson Gulch, and possibly the uphill side to avoid cultural sites located along the ridge to the east. Some T design variations, as proposed in the Thomas T. McNeill letter dated October 28, 2008, extend further out on the existing side slope than Revised Alternative A and with the proposed 2:1 cut and fill slopes probably will extend further than indicated. In addition the on-grade alignments show impact to the cultural sites lying along the ridge to the east and potential impact to wetlands along Wilson Gulch.

Please see the typical section below modeled for Revised Preliminary Alternative A. Retaining walls would contain fills with wall heights of up to approximately 80 feet, utilizing a tiered wall design in order to minimize right of way impacts as well as wetland impacts. Walls of this height are very difficult to construct, maintain and would have an adverse visual impact to the area. Cut and fill slopes as proposed would have a similar adverse visual impact and be difficult to reseed and maintain. Currently the maximum height wall on the US 160 corridor in the immediate area is a two tiered wall 44 feet in total height.

The final design of the roadway is dependent on the geotechnical site conditions, which are unknown. Without a complete geotechnical foundation investigation, it is not known whether a Mechanically Stabilized Earth Retaining Wall on micro pile foundation would be adequate for the site. Bedrock may be deeper than 40 feet based on geotechnical information from the Grandview Interchange project and visual observation and the existing alignment is on a hillside cut/fill. The required widening would push the roadway alignment outside the existing fill approximately 35 feet. Bedrock depths may be beyond the depths suitable for a micro pile foundation design and may require a drilled shaft, essentially larger piles. This requirement would increase the estimated construction cost dramatically.



TYPICAL SECTION
REVISED PRELIMINARY ALTERNATIVE A

Summary

These on-alignment alternatives have a combination of a low design speeds, sharp curves, eight percent superelevation, four percent to six percent vertical grades, north facing slopes, and unknown geotechnical conditions. Other contributing facts such as the radius of curves would negatively impact the traffic flow. Many of the T design variations do not show a required connection to CR 220. None of the on-grade alignments meet the design speeds and criteria established in the AASHTO Geometric Design of Highways and Streets, 2004 criteria as discussed above. For these reasons, all of the on-grade alignments are considered to have extraordinary safety problems and are not suitable from an engineering perspective.

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Date: May 21, 2012

To: Stephanie Gibson
FHWA Environmental Program Manager

From: Edward Archuleta, PE
Program Engineer

Subject: US 550 at US 160 Supplemental Environmental Impact Statement – Alternative R

This technical memorandum describes engineering issues, and logistical, cost and right-of-way factors associated with the Alternative R proposal. This alternative was submitted to FHWA on behalf of the Webb Ranch during the public comment period for the US 550 South Connection to US 160 Supplemental Draft Environmental Impact Statement (SDEIS).

All of the alternatives in the SEIS were first evaluated for whether they meet the purpose and need for the project and whether they have other issues such as logistical problems or substantially greater costs. Alternative R was analyzed according these same criteria to determine if it was a reasonable alternative that should be carried forward for analysis in the SEIS. These criteria are described in Table 1 below:

Table 1. SEIS Criteria for Purpose and Need, Logistics and Cost

Criterion	Description
	Purpose and Need
Capacity	Provide a 2030 peak hour LOS D.
Safety	Improve existing design and safety deficiencies to current standards and not create an unsafe condition by increasing conflict opportunities between vehicles, vehicles and wildlife, or between vehicles and other objects.
Access control	Meet or exceed the minimum CDOT, FHWA, and AASHTO spacing, access, and operational requirements.
	Other Criteria
Logistics	Maintain access and provide mobility during construction and not have challenging technical issues for construction. Challenging technical issues include slope instability, or the need to remove large amounts of material compared to other alternatives.
Cost	Cost should not be substantially greater than other alternatives. Substantially greater costs are considered to be at least 200 percent higher or at least twice the cost compared to the lowest cost alternative

Description of Alternative

Alternative R connects US 550 from the top of Florida Mesa with US 160 at the existing US 550/US 160 Intersection. The proposed alternative includes modification of the existing signalized intersection at US 160 and US 550 with a hybrid diamond interchange. The proposed interchange would utilize a single bridge over US 160 to carry US 160 westbound to US 550 southbound (Bayfield to Farmington) and US 550 northbound to US 160 westbound (Farmington to Durango) traffic. These traffic movements onto and off of US 550 would be handled at a signalized intersection. This interchange is considered a hybrid diamond due to the fact that it incorporates the traditional diamond design on the northern portion, but limits movements on the south side. On the south, the movements include the through movement to the Grandview Area and the left turns to Durango. The interchange would include a tie-in to Ramp A of the existing Grandview Interchange.

This alternative (illustrated on Figure 1a and b) includes four design variations: R1, R2, R3, and R4. All of these alternatives follow a similar, but slightly modified alignment as that of the existing US 550 Farmington Hill roadway. Each design variation illustrates US 550 intersecting US 160 with the signal controlled hybrid diamond interchange described above. The differences among the Alternative R design variations occur at the radius of the upper curve on Farmington Hill near the CR 220 intersection, the proposed design speed, the number of lanes, and slight variations in the alignment that alter the required cut walls/slopes and fill walls/slopes. The design variations are described as follows:

- Design Variation R1 has a 35 mph design speed, includes a 715-foot upper radius curve, a 715-foot lower radius curve and a six percent grade. This variation includes two northbound lanes and three southbound lanes which includes a climbing lane for trucks, 10-foot paved shoulders (4-foot adjacent to climbing lane), and a 14-foot median with concrete barrier down the center. The location of the alignment roughly follows the existing US 550 alignment allowing for 3:1 cut slopes and fill walls, and incorporates a signal controlled hybrid diamond interchange at the US 550 and US 160 connection.
- Design Variation R2 has a 45 mph design speed, includes a 1250-foot upper radius curve, a 1,250-foot lower radius curve and a five percent grade. This variation includes two northbound lanes and two southbound lanes with 10-foot paved shoulders, and a 14-foot median with concrete barrier down the center. The location of the alignment roughly follows the existing US 550 alignment allowing for 3:1 cut slopes and fill walls, and incorporates a signal controlled hybrid diamond interchange at the US 550 and US 160 connection.
- Design Variation R3 has a 35 mph design speed, includes a 715-foot upper radius curve, a 715-foot lower radius curve and a six percent grade. This variation includes two northbound lanes and three southbound lanes which includes a climbing lane for trucks, 10-foot paved shoulders (four-foot adjacent to climbing lane), and a 14-foot median with concrete barrier down the center. The location of the alignment closely follows the existing US 550 alignment, requires 3:1 cut slopes and fill walls with 30-foot vertical soil nail walls, and incorporates a signal controlled hybrid diamond interchange at the US 550 and US 160 connection.
- Design Variation R4 has a 35 mph design speed, includes a 1250-foot upper radius curve, a 1,250-foot lower radius curve and a five percent grade. This variation includes two northbound lanes and two southbound lanes with 10-foot paved shoulders, and a 14-foot

median with concrete barrier down the center. The location of the alignment roughly follows the existing US 550 alignment, requires 3:1 cut slopes and fill walls with 30-foot vertical soil nail walls, and incorporates a signal controlled hybrid diamond interchange at the US 550 and US 160 connection.

Capacity and Safety Issues

This alternative was evaluated to determine if it meets the capacity and safety requirements of the purpose and need identified in the SEIS.

Capacity

CDOT conducted a traffic analysis of Alternative R, which indicates that this alternative meets the capacity requirements for the project purpose and need as defined in the SEIS. This interchange with a signal is expected to meet the stated requirement of a LOS D or better. However, the proposed design would impact the only existing access to the La Plata County Gravel Pit situated to the north of the intersection. While an alternate access through several privately owned parcels situated to the north and east may be possible for the gravel pit, CDOT would likely have to consolidate access by bringing a fourth leg into the proposed hybrid diamond interchange to be consistent with the purpose and need of the SEIS for access control. Adding this fourth leg to this interchange would operate at a LOS of E and it would not meet the capacity requirements of the project's purpose and need (see Appendix A for a copy of the traffic analysis).

Safety

This on-alignment alternative varies the radius of the upper-most curve to achieve either a stated 35 mph or stated 45 mph design speed. These stated design speeds do not account for a center median barrier, which have been included in the design to reduce the overall width of the roadway and therefore the amount of earthwork that is required by the alternative. The barrier reduces driver sight-distance and would likely lower the actual design speed of the roadway by approximately 5 mph per the horizontal site distance calculation requirement found on page 227 of the 2004 edition of AASHTO Design of Highways and Streets (AASHTO). US 550, in the US 550 Environmental Assessment, was designed to a 70 mph design speed from the New Mexico State Line to just south of County Road 220 due to minimal curvature and flat terrain. The section north of County Road 220 was designed to a 60 mph design speed in the US 160 Environmental Impact Statement. When analyzing the variations presented by Alternative R, the roadway design speed would need to be decreased from 70 mph to either 30 mph or 40 mph, depending on the alternative variant. In an attempt to avoid the serious safety issues with lowering the speed at the upper curve on Farmington Hill, the design lowers the operating (posted) speed on US 550 several miles south of the US 550/US 160 intersection. However, lowering speeds on the mainline also creates significant safety issues. Speeds cannot be reduced by simply changing the posted speed. The curvature and width of the roadway, along with visual cues in the surrounding landscape are what establish a driving environment where drivers choose speeds that feel reasonable and comfortable (FHWA, 2007). The design on US 550 would have to be modified to add speed limiting roadway characteristics to the mainline to reduce the speeds drivers are likely to feel comfortable driving. This is contradictory to the purpose of updating the facility. Also, adding additional curvature to the roadway would increase the impacts to adjacent properties, increase costs associated with right of way acquisition, and likely increase the amount of environmental impact associated with the proposal. Although warning signs could be used to alert drives to the sharp curves and lowered speed, it is not acceptable to design a new mainline facility that requires warnings to drivers that an unsafe condition is ahead unless there is no other alternative.

This large reduction in design speed from 70 mph to approximately 30 mph or 40 mph on the mainline creates an unsafe condition and is not an acceptable reduction per the 2004 edition of AASHTO Design of Highways and Streets (AASHTO), see discussion on pages 67-72 and 503. CDOT uses these guidelines to provide a safe and uniform traveling experience that the public has come to expect. It should be noted that a roadway's posted speed is generally less than the design speed to provide an additional safety buffer. This principle has been followed on the design and posted speeds of both US 550 and US 160, and would be followed on the US 550 connection to US 160. This brings the posted speed along any Alternative R design variation to 25 mph or 35 mph. Research suggests that reductions in the design or posted speed of a roadway of more than 15 mph creates a high crash risk (FHWA, 2007). Under this direction, dropping the design speed to anything below 55 mph would be an unacceptable safety risk. While the other alternatives carried forward in the SEIS have speed reductions, these occur at the interchange where it is safe and acceptable to do so. Alternative R reduces speeds on the mainline, 1.2 miles south of the interchange, beyond where a driver can see the interchange and anticipate the need to slow down.

The vertical grade of the Alternative R alignments is between 5% and 6%. While it is acceptable and common to design roadways with grades up to 6% in mountainous areas, it is not desirable to have these large vertical curves combined with sharp horizontal curves. Per page 281 of the 2004 edition of AASHTO Design of Highways and Streets, "Sharp horizontal curves should not be introduced at the top of a pronounced crest vertical curve. This condition is undesirable because drivers may not perceive the horizontal change in alignment, especially at night." Page 282 goes on to state, "…sharp horizontal curvature should not be introduced near the bottom of a steep grade approaching or near the low point of a pronounced sag vertical curve." Both of these conditions are present in the Alternative R designs.

The Alternative R variations do not improve the existing design and safety deficiencies to current standards, which CDOT uses to provide for a safe and uniform traveling experience. Instead, Alternative R perpetuates the existing situation in which sharp curves and steep grades are introduced into the mainline of the roadway after many miles with minimal curvature in flat terrain. The proposed Alternative R creates unacceptable safety problems, so this alternative does not meet the safety requirement for purpose and need.

Logistics, Cost and Right of Way Issues

Alternative R was presented to CDOT as means of reducing the required amounts of excavation, cost, and property impacts relative to the alternatives carried forward in the SEIS for detailed analysis. Therefore, CDOT also evaluated this alternative for logistical, cost and right of way issues.

Logistics

This alternative has significant constructability issues due to elevation differences between the proposed and existing grades. Along most of the alignment, the elevational difference between the existing and proposed highway is 10 feet. This elevational difference becomes more pronounced as the roadway nears the interchange where it exceeds 24.5 feet. While the Alternative R proposal is to construct the roadway without detouring traffic off the US 550 alignment, this would require temporary retaining walls extending from near CR 220 all the way to US 160. In rough numbers, there would be approximately 28,000 square feet of temporary walls required to keep traffic on US 550 while building a new roadway. This would exceed $2,000,000 in throw-away costs. Additional costs associated with a proposal of this nature include barriers, traffic control, temporary widening, temporary signals, and bridge construction phasing, among others. Improvements made to CR 220 so it could be used as a detour would include its own costs, but these would be permanent features that would be beneficial to the County and the residences along CR 220. Additionally, a detour would be far safer to the traveling public, more efficient for the contractor, and would allow construction to proceed more quickly. Given these challenges, and with the reduced construction time made possible by allowing construction to occur in this difficult area without the need to maintain traffic immediately adjacent to the construction site, and the fact that the detour will be safer for the traveling public, the detour is logistically a better option.

Design variation R1 requires 1.8 million cubic yards of excavation, design variation R2 requires 3.1 million cubic yards of excavation, design variation R3 requires 810,000 cubic yards of excavation, and design variation R4 requires 1.6 million cubic yards of excavation. This compares to approximately 1.6 million cubic yards of excavation for Revised G Modified, 2.2 million cubic yards of excavation for the F Modified Alternative, and 2.7 million cubic yards of excavation required for the Eastern Realignment Alternative. This alternative was presented as a means to reduce the required amount of excavation under the Preferred Alternative (Revised G Modified). Only one variation (R3) has less excavation requirements than the Preferred Alternative, and this is accomplished through the incorporation of uphill terraced walls. It is important to note that this same design with uphill terraced walls could be used on any of the alternatives discussed in the SEIS to reduce excavation quantities.

While these logistical concerns are an issue, they do not cause the alternative to fail the logistical criteria established in the SEIS.

<u>Cost</u>
Cost is a relevant factor in determining whether an alternative is reasonable or practicable. Although estimates for Alternative R were provided to CDOT, they do not consider and include costs associated with the purchase of right of way and also do not include costs for a number of required design elements. For a more direct comparison of relative costs, CDOT analyzed the conceptual right of way needs for this alternative. To do so, several issues had to be addressed. The interchange design at the US 160 connection presented to CDOT was incomplete. The alignments did not tie to US 160, but were drawn without joining to the existing mainline. There was no consideration in the interchange design for spanning, bridging, or filling Wilson Gulch and its associated high quality wetlands and wildlife habitat, which would be required. The designs did not incorporate the inclusion of the wildlife underpass at Wilson Gulch which is required under the 2006 US 160 EIS. Additionally, while the Alternative R design identifies that a tie-in to Ramp A of the Grandview Interchange is anticipated, there is no right-of-way consideration for this tie-in. Alternative A presents a fully designed and functional interchange at approximately the same location as that proposed in Alternative R, and includes the right of way needs for the features absent in the Alternative R design. Therefore the right of way needs for Alternative A were merged with Alternative R for a rough determination of conceptual right-of way needs for the sake of this comparison.

The submittal did not include any design for a CR 220 intersection with US 550, which will be required. The Revised Preliminary Alternative A intersection at CR 220 would likely work for Alternative R design variations R1 and R3, but not for R2 and R4. Since R2 and R4 both have a significant curve near CR 220, the intersection would have to be moved further to the south to provide adequate sight-distance. This would require the acquisition of additional right of way to tie in CR 220, and would increase impacts to historic and Section 4(f) resources.

Additionally, CDOT did not attempt to determine if the alignment presented in the submitted design would create un-economic remnant parcels that would require total property acquisitions and increase costs. Based on the conceptual right of way required for each design variant, it is very likely that total property acquisitions would be required for the Piccoli and Hillmeyer residences. CDOT assumed the conceptual right of way required for the CR 220 intersection for Alternative R would be the same as required by that shown in Alternative A. CDOT estimates that right-of way required to construct design variations R1 and R3 would be approximately 87.1 acres, and 96.5 acres for design variations R2 and R4, however these estimates do not include the likely total property takes at the Piccoli and Hillmeyer residences described above.

Assuming the same cost for right of way as with all other alternatives presented in this document ($14,000/acre), the expected costs of the Alternative R design variations would be $73,736,985 for Alternative R1, $92,926,876 for Alternative R2, $83,855,653 for Alternative R3, and $102,440,558 for Alternative R4. This compares to $77,598,000 for the Revised G Modified Alternative, $77,429,000 for the Revised F Modified Alternative, and $93,106,000 for the Eastern Realignment Alternative. The relative difference in cost is not a deciding factor between alternatives.

Right of Way

Information on property impacts is relevant to the discussion of Alternative R as this alternative was presented to CDOT as a means of reducing impacts to the Webb Ranch property and the Section 4(f) resource associated with that property. The information present herein was either taken directly from or calculated from the Webb Ranch submittal. Unfortunately, CDOT is uncertain of the extent of all property impacts associated with the differing design variations of Alternative R as these were not calculated for all parcels. Therefore, CDOT had to estimate impacts to these properties based off of the provided drawings illustrating these properties and the extent of the disturbance created by the roadway. Alternative R impacts the Webb property and the historic Webb Ranch to varying degrees depending on the design variation. It also impacts archeological site 5LP2223. The design states that Alternative R will provide a revised access to the Piccoli properties which include the Eagle Block commercial venture and three single-family residences, and the Hillmeyer residence. A review of the plans presented within the Webb submittal shows that all of the design variations directly impact the Eagle Block commercial building and two of the three single-family residential structures located on the Piccoli property. These impacts would require complete purchase of the property and relocations of the business and residents, and are impacts and costs which have not been disclosed or analyzed by the submittal. In addition, two of the design variations (R2 and R4) would require complete acquisition and relocation of the Hillmeyer residence as well. Property impacts associated with Alternative R variations as compared with the Eastern Realignment Alternative, Revised F Modified Alternative, and Revised G Modified (Preferred) Alternative are presented in Table 2 below:

Table 2. Comparison of Property Impacts by Alternative

Alternatives	Webb Property [Historically Designated Webb Ranch]	Hillmeyer Property	Piccolli Property (three residences and one commercial building)	Total Right of Way Needs
Alternative R (R1)	26.9 acres [9.3 acres]	Access Revision	Complete Acquisition and Relocation	87.1 acres*
Alternative R (R2)	31.4 acres [13.2 acres]	Complete Acquisition and Relocation	Complete Acquisition and Relocation	96.5 acres*
Alternative R (R3)	18.5 acres [3.9 acres]	Access Revision	Complete Acquisition and Relocation	87.1 acres*
Alternative R (R4)	24.8 acres [5.4 acres]	Complete Acquisition and Relocation	Complete Acquisition and Relocation	96.5 acres*
Eastern Realignment Alternative	0.0 acres [0.0 acres]	None	None	133.0 acres
Revised F Modified Alternative	32.6 acres [32.6 acres]	Access Revision	Access Revision	106.2 acres
Revised G Modified (Preferred) Alternative	41.5 acres [41.5 acres]	Access Revision	Access Revision	71.6 acres

* Acreages do not account for the likely remnant property acquisitions that would be required at the Hillmeyer and Piccoli residences.

Conclusion

In summary, Alternative R meets the project purpose and need for capacity however, it would create unacceptable safety problems, so this alternative does not meet the safety requirement for purpose and need. The Alternative R variations do not improve the existing design and safety deficiencies to current standards, which CDOT uses to provide for a safe and uniform traveling experience. These alignments have a combination of low design speeds, sharp curves, five to six percent vertical grades, and north facing slopes. The large reduction in design speed from 70 mph to 30 to 40 mph on the mainline, along with the introduction of sharp horizontal curves at the top of a pronounced vertical curve are substantial safety concerns. Based on the constrained nature of the existing alignment on the steep slopes of Florida Mesa, achievement of acceptable design speeds cannot be met at this location. For these reasons, it is not reasonable and is not carried forward for detailed analysis in the SFEIS.

In addition, this alternative results in additional problems for other residential properties on the west side of US 550, and does not result in the advantages of reducing cost and reducing earthwork compared to the other alternatives.   It does not reduce the costs associated with connecting US 550 to US 160 relative to other alternatives and does not reduce the required amounts of earthwork relative to other alternatives. While it does accomplish a reduction in the extent of the impact to the Webb Ranch property, it does so by shifting the alignment thereby creating additional impacts to adjacent properties on the west side of US 550.

Other issues associated with this alternative include substantial logistical problems with attempting to construct a grade separated roadway while keeping traffic on the existing alignment, and capacity problems if a fourth leg is required to be added to the interchange to accommodate access to the properties located north of the interchange that would be directly affected by the implementation of this design, and likely substantial impacts to Wilson Gulch and its associated high quality wetlands and wildlife habitat.

This is not a reasonable alternative, and therefore is eliminated from the SEIS analysis, and not carried forward for additional consideration.

Figure 1a. Alternative R: Design Variations 1 and 3

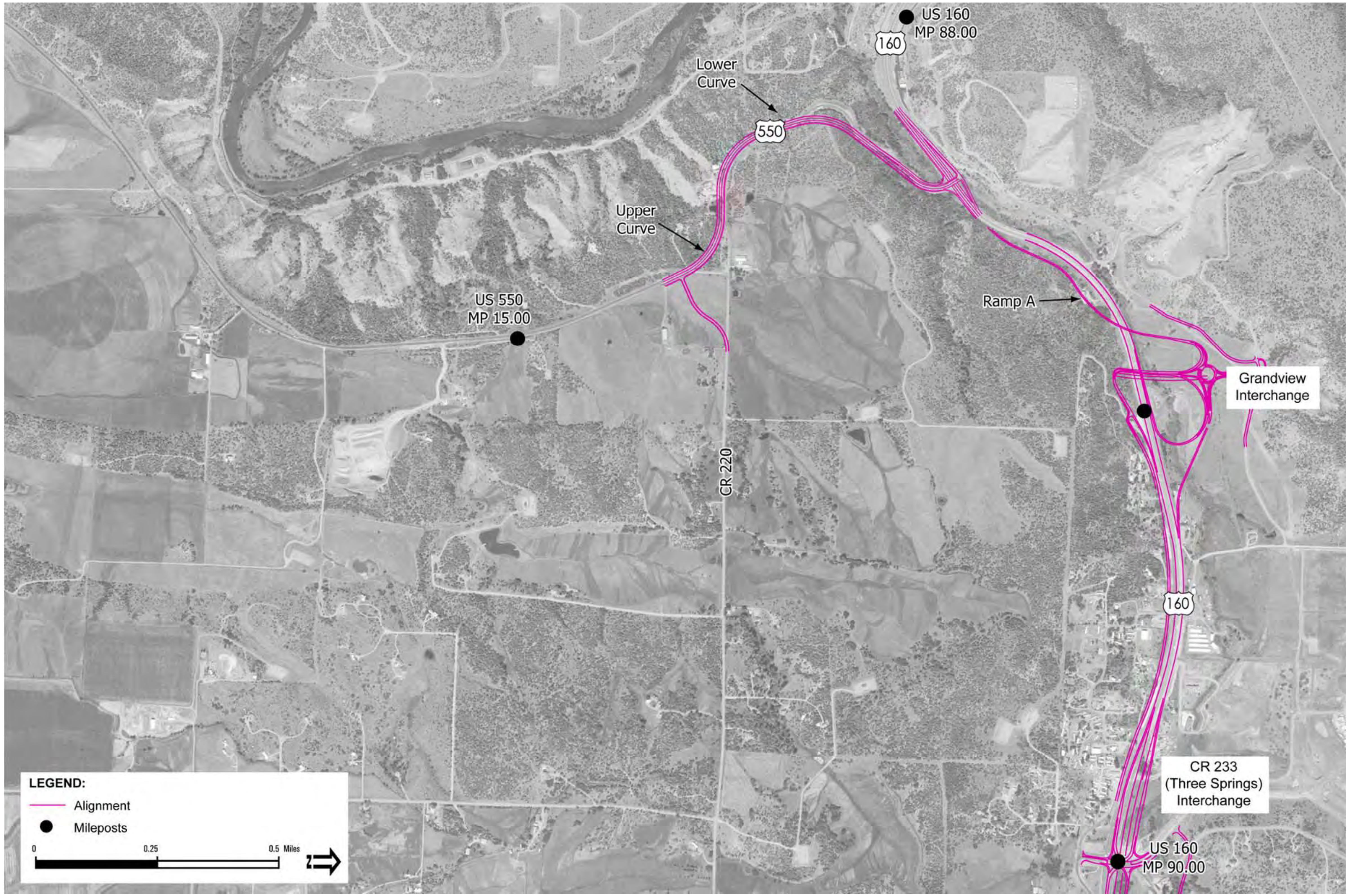

Figure 1b. **Alternative R: Design Variations 2 and 4**