# Appendix E:
# Engineering Technical Memoranda

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

## INDEX


| Date | Correspondence |
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| 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 |

# STATE OF COLORADO

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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.

**Partial Interchange at the Existing US 550 / US 160 Intersection: $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.

**Eastern Realignment Alternative: $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 | | |
|---|---|---|---|---|---|---|---|
| | | | | | Alternative: | West | |
| **Western Realignment Alternative 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 | 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 | | |
|---|---|---|---|---|---|---|---|
| | | | | | 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** |

**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 | |

| | | % 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 | |
| | | Alternative G - Modified - EIS 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 | 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 | | |
|---|---|---|---|---|---|---|---|
| | | | | | Alternative: | G Revised | |
| | | **Revised G Modified 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 | 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 | |
|---|---|---|---|---|---|---|---|
| | | | | | | Alternative: | F Ramp |
| Interchange (SPUI) Revised F Modified 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 |

| 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 | |

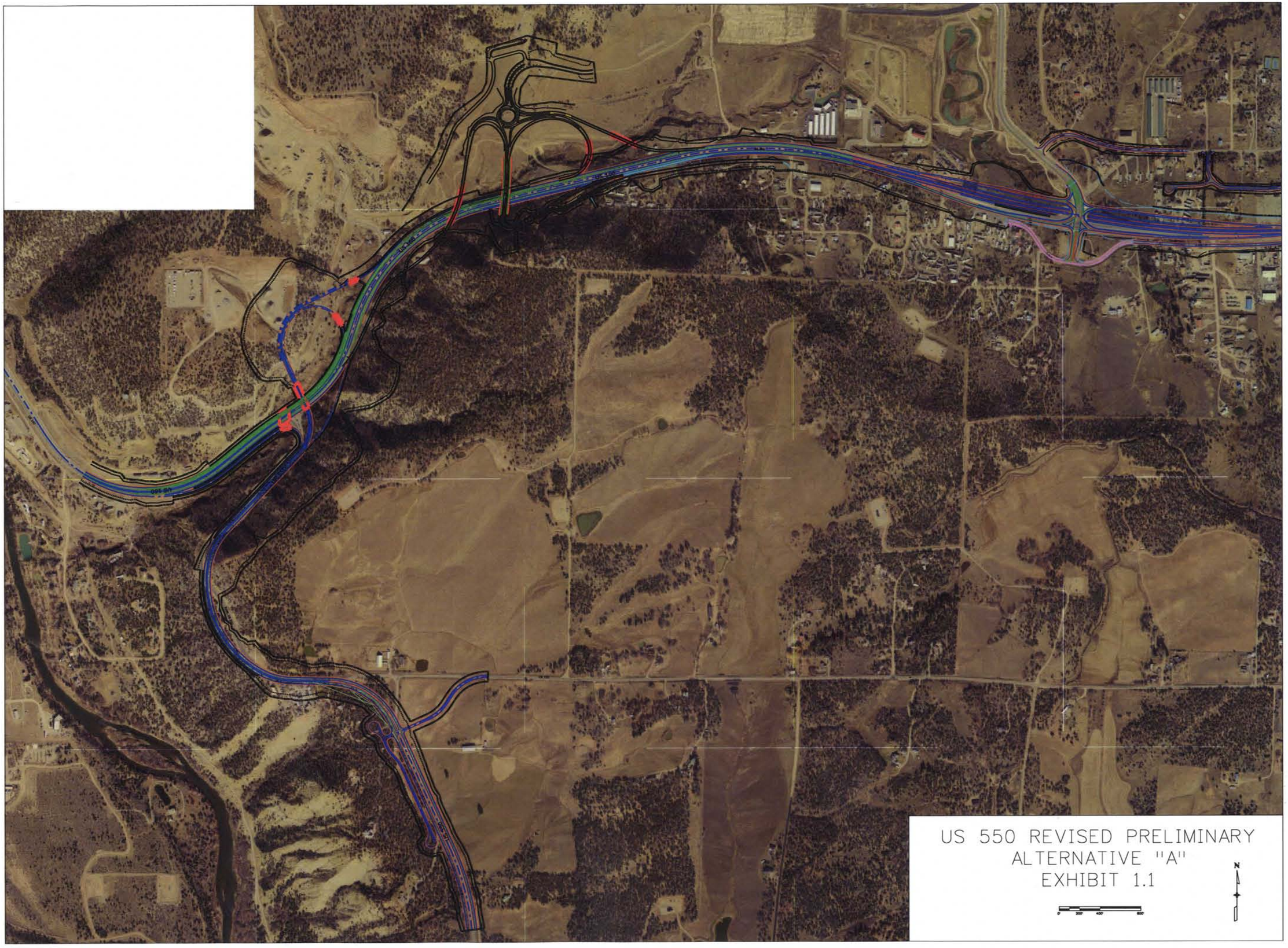
| | | % Range | % Used | Cost |
|---|---|---|---|---|
| | Project Construction Bid Items | Project Dependent | N / A | $30,867,606.96 |
| | Contingencies | (15 - 30%) | 30.0% | $9,260,282.09 |
| | | | **Subtotal** | $40,127,889.05 |
| | ITS | (6 - 10%) of subtotal | 2.0% | $802,557.78 |
| | Drainage / 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** |

| 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
N

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

**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

**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.

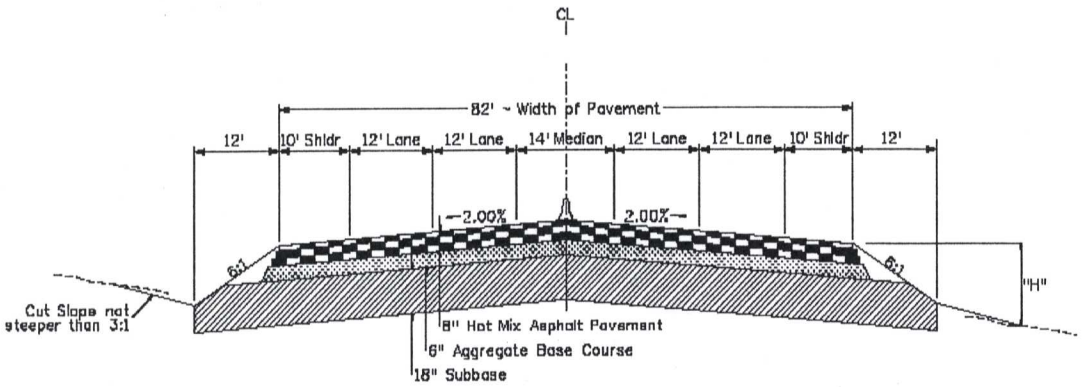



**Figure 1: Typical Section of roadway used for this analysis**

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

# STATE OF COLORADO

DEPARTMENT OF TRANSPORTATION
PROGRAM ENGINEERING
REGION 5
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Durango, CO 81301
(970) 385-1400
Fax (970) 385-1410

Date: December 22, 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 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
McVaugh
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# STATE OF COLORADO

**DEPARTMENT OF TRANSPORTATION**
**PROGRAM ENGINEERING**
**REGION 5**
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Durango, CO 81301
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Fax (970) 385-1410

**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.

**Design and Construction Issues**

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.

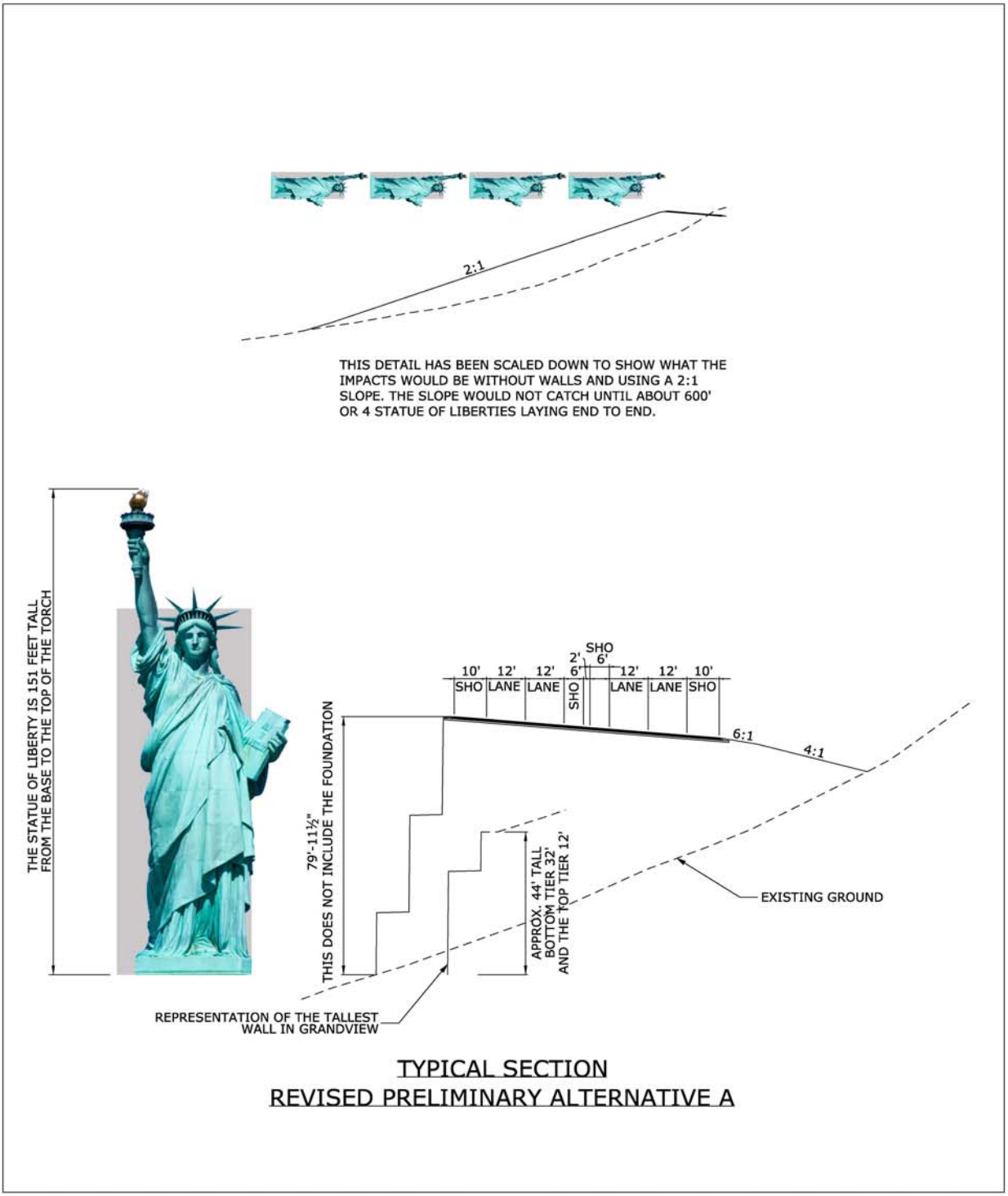
Both the grades and curvatures of the proposed alignments would affect the traffic flow of the highway. Truck traffic on a four percent uphill grade would be moving at approximately 30 mph and the downhill grade speeds will increase approximately five percent. The proposed six percent grades are even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


2:1
THIS DETAIL HAS BEEN SCALED DOWN TO SHOW WHAT THE IMPACTS WOULD BE WITHOUT WALLS AND USING A 2:1 SLOPE. THE SLOPE WOULD NOT CATCH UNTIL ABOUT 600' OR 4 STATUE OF LIBERTIES LAYING END TO END.
THE STATUE OF LIBERTY IS 151 FEET TALL FROM THE BASE TO THE TOP OF THE TORCH
SHO
2'
6'
10' SHO
12' LANE
12' LANE
SHO
12' LANE
12' LANE
10' SHO
6:1
4:1
79'-11½" THIS DOES NOT INCLUDE THE FOUNDATION
APPROX. 44' TALL BOTTOM TIER 32' AND THE TOP TIER 12'
EXISTING GROUND
REPRESENTATION OF THE TALLEST WALL IN GRANDVIEW
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.