Final Report

Value Engineering Study

Grand Avenue Bridge
CDOT Project No. FBR 0821-094(18158)

Prepared for
CDOT – Region 3

Dates of Study: November 4-8, 2013

Submittal Date: December 18, 2013

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Section 1 - Summary

The Value Engineering Team (VET) generated 58 ideas with the following results:

- 22 ideas are proposals that reduce the cost of the project that the VE Team would like to see and are titled "**Recommended Action: Incorporate"**
- 18 ideas are Proposed as **Design Considerations** that are good design practice and compliment the proposals but may increase costs or not generate significant savings to the project directly
- The remaining items were **combined** with another idea, or **not evaluated** due to time constraints and the unlikelihood that the idea would result in a benefit.

Cautions using the proposals:

- The costs that are shown with each proposal reflect an order of magnitude cost savings relative to the original design concept it is compared to.
- The cost savings shown must carefully be evaluated by the design team. Additional savings or costs may be realized as the proposal is advanced to a final design.
- Life cycle costs are not provided in these proposals, however, some of the proposals would have life cycle costs that can alter the proposal either positively or negatively. The design team is encouraged to assess the life cycle costs as appropriate in accepting or rejecting a proposal.
- For the most part, the VET used the unit costs provided by the design team. In some cases, the VET used their own unit costs where new materials were introduced that are not currently a part of the project.
- Many of the VE proposals are mutually exclusive. Thus, the sum of all of the proposals cannot be added together. For this reason, the VET provide four proposal packages to demonstrate how the proposals could be combined.

This document is the final report and includes the dispositions of proposals and design considerations from the Review Board.

Section 2 - Project Description

The Colorado Department of Transportation (CDOT) and the Federal Highway Administration (FHWA) are conducting an Environmental Assessment (EA) process to address functional, structural and safety deficiencies of the SH 82 Grand Avenue Bridge in Glenwood Springs and to bring it up to current standards for a four-lane bridge.

HISTORY - The Grand Avenue Bridge EA began in April 2011 when CDOT worked with community representatives to form a Project Leadership Team (PLT) to guide the EA process and ensure that the project followed the principals of context sensitive solutions (CSS) and federal EA requirements. A consulting team was hired in August 2011 to support CDOT in identifying the project purpose and need and goals, and in developing and evaluating alternative solutions through the EA process. A Project Working Group (PWG) was formed to review and approve key technical evaluations and decisions. In keeping with CDOT's commitment to a context sensitive approach to projects statewide, community stakeholders were actively involved in defining the context statement and critical success factors for the project in a two-day visioning workshop. They continued to play an integral role as the Stakeholder Working Group (SWG).

PUBLIC INVOLVEMENT - Over the last two years, the project team has evaluated the possibility of refurbishing the existing bridge, replacing the bridge in its current location, and replacing the bridge on different alignments. These options were considered in light of the criteria developed with the PLT, the PWG, the SWG and the public. Numerous public involvement and outreach activities have generated ideas, alternatives, alignments and other design elements that might never have been considered. To date, five public open houses and seven SWG meetings, including the initial visioning workshop, have been held. Participants helped shape the alternatives and recommendations to align more closely with community values. The result is a project that reflects the unique character, history and setting of the Grand Avenue Bridge over the Colorado River and I-70 in Glenwood Springs.

RECOMMENDED ALIGNMENT - The recommended bridge alignment takes vehicles from I-70 Exit 116 directly across the river into downtown Glenwood Springs and to destinations south on SH 82. 6th Street no longer carries SH 82 traffic, and a reconfigured intersection at 6th and Laurel maintains connections to the hotel areas and neighborhoods on the north side of the river. Coordination with the City of Glenwood Springs and the Downtown Development Authority has focused on opportunities to redevelop 6th Street and the area under the Grand Avenue Bridge south of 7th Street to a more pedestrian scale. The recommended alignment and how to best build it led to discussions about replacing the pedestrian bridge. The project team, in collaboration with the PLT, PWG, SWG, and the public, determined that a new pedestrian bridge improves the pedestrian and bicyclist connection across the river and provides opportunities for aesthetic treatments that reflect the historic character of Glenwood Springs. It also reduces overall project costs and improves construction phasing to minimize the duration of a full closure of SH 82 while reconstructing the highway bridge.

NEXT STEPS - The Environmental Assessment is currently being written, a process that takes several months to address the range of federal requirements and complete a multiagency review. At the same time, the project team continues to work with the PWG, SWG and the public to identify and explore design considerations for bridge types, aesthetics and multimodal connections in a preliminary design phase. CDOT hired a construction consultant that will work with the project team to refine alternatives to minimize construction impacts and develop a cost-effective design that meets the project objectives. The public will have the opportunity to comment on the recommended alternative in the EA at a public hearing. Final design on the project will not occur until a Decision Document on the EA is issued by FHWA.

Project Purpose and Need:

The purpose of the project is to provide a safe, secure, and effective multimodal connection from downtown Glenwood Springs across the Colorado River and I-70 to the historic Glenwood Hot Springs area.

The Grand Avenue Bridge serves as a vital link of SH 82 across the Colorado River, I-70, and the Union Pacific Railroad, connecting downtown Glenwood Springs with the historic Hot Springs, Hotel Colorado, and I-70. The importance of the bridge to local and regional transportation underscores the following transportation needs:

1. Improve multimodal connectivity between downtown Glenwood Springs, and the Roaring Fork Valley, with the historic Hot Springs pool area and I-70.

The Grand Avenue Bridge connects the Hot Springs pool and Hotel Colorado area to the core commercial corridor located south of the bridge along Grand Avenue. However, the bridge's condition impairs this connection for a variety of transportation users. For example, very substandard lane widths (9 feet, 4 inches) and the absence of shoulders across the bridge pose an issue for RFTA's existing bus service, emergency service vehicles, and other large vehicles, forcing these vehicles to use both lanes. In addition, the absence of shoulders on the bridge makes for unsafe bicycling and precludes pedestrian use that was originally carried on the bridge. The lack of nearby alternate routes compounds these problems. Future traffic increases will worsen the bridge's ability to provide connectivity.

2. Address the functional and structural deficiencies of the bridge to improve public safety, including emergency service response, and reliability as a critical transportation route.

The aging and poor condition of the bridge increases the risk of bridge closure. The location of some existing bridge piers adjacent to I-70 increases this risk, since these piers are vulnerable to large vehicle collisions. Any closure would have major consequences to the travelling public. Users of the bridge, which include local and through traffic, commuters, and emergency service vehicles, would be required to use lengthier alternative routes during bridge closure. Alternate routes range from approximately five miles for detours through West Glenwood, to 141 miles for an I-70 closure.

Project Opinion of Probable Costs:

The total project cost, not including right-of-way, is estimated at $56,300,000. At this time, the right-of-way costs have not been provided.

Section 3 - Organization

Value Engineering Team

The following individuals were members of the VE team:

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Review Board

The Review Board is comprised of the following representatives.

Review Board	**Company**	**Phone/email**
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The Review Board will provide responses to Proposals and Design Considerations developed by the VET. The reviewers will decide the disposition of each VE Proposal in one of four ways:

1. Accept the proposed alternative. An accepted proposal means that the design team will implement the alternative. Agencies on the Review Board are expected to have the authority to implement the proposal.

2. Accept the proposed alternative with conditions. This disposition is similar to the first item but may include modifications or conditions that need to be satisfied in order to accept the Proposal.

3. Decline the proposed alternative. This disposition should include a brief explanation for declining the proposal.

4. Reclassify Proposal as a Design Consideration. In some cases, a proposal may need more information and design to determine if it is worthy of implementation. The Review Board may elect to perform additional analysis during final design before deciding to implement.

Other attendees	**Company**	**Phone/email**
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Section 4 – Proposals

The following table identifies proposals that the VE Team recommends to the Design Team to incorporate into the design. The right hand column in the table identifies the responses to the proposals from the Review Board.

Proposal No.	VE Proposal Summary Recommended Action: Incorporate into Design	***<u>Review Board Response</u>***
1	SH82 Bridge structure depth is shallower over UPRR **Savings potential: $200,000**	<u>Accept with conditions</u> – Evaluate how lowered vertical profile would work for design standards and accommodating clearance at alley downtown. If that is acceptable then: Evaluate vertical webs for easier fabrication. If both are favorable then accept. • Opportunity to make the transition work better (visual) • Challenge for fabrication • Staff bridge policy requires a minimum of a 5 foot girder depth over the RR to provide for inspection access and the design will meet the requirement. Staff Bridge would allow inspection access form the top for a short distance of girder depth of 4'-6" and the team concluded this will be impractical for safety and durability concerns. • The boxes will have vertical webs and not utilize a trapezoidal shape for ease of fabrication and reduction costs. • The profile grade still needs to be at a certain height over the alley, minimizing how much profile grade could be lowered. • The aesthetics of introduction one varying depth span between two constant depth units of different structure to be further considered.
2	Mix steel box girders with precast prestressed concrete box girders **Savings potential: $1,000,000**	<u>Decline</u> – Concrete was looked at previously, and screened out. Accelerated bridge risk. Poor aesthetics. Longer overall duration. There are significant advantages to using steel tubs over the parking lot and I-70. The speed of erection of steel saves 3-4 months of construction time over concrete, minimizing parking lot impacts and related mitigation with the HSP. The overall schedule benefit of steel allows more flexibility to meet seasonal access time frames considering HSP peak periods. The aesthetics of switching girder materials within the main unit is debatable for a high profile project under a lot of scrutiny. The connection at the interface pier is more difficult, as well as the design cost increase of two separate structural; systems which may be tied together.
3 and 8	Reconfigure 6th/Laurel intersection/Use 2 roundabouts instead of 3 closely spaced **Savings potential: $500,000**	<u>Decline</u> – Results in LOS F operations for several approaches. Similar large roundabout has been fully vetted through the alternatives process and screened out. VE proposal does not add new information that would change previous recommendation.
4 and 23	Re-evaluate Alternate 1/Construct SH 82 bridge on existing alignment **Savings potential: $13,500,000**	<u>Decline</u> – Proposal has been thoroughly evaluated and vetted through the Alternatives process and was screened out. VE Proposal does not add new information that would change previous recommendation.
13 and 42	Pedestrian bridge considered Truss structure type/Put a top on pedestrian bridge **Savings potential: $390,000**	<u>Decline</u> – Pigeon Nightmare. Would work structurally. Proposal has been evaluated and vetted through the Alternatives process and was screened out. VE proposal does not add new information that would change previous recommendation. For the truss type to be economical, a standard Continental or Big R truss would be utilized. It is unlikely the standard is available for the bridge width requirements and the cost savings most likely will be lost in design.

Proposal No.	VE Proposal Summary Recommended Action: Incorporate into Design	***Review Board Response***
14 and 54	SH 82 Bridge downtown unit use precast pretensioned components **Savings potential: $200,000**	Decline – Aesthetics vs. construction duration tradeoff. Side by side boxes were considered for the advantages it has over reinforced concrete as stated in the VE proposal. However, the design team had aesthetic concerns over variable girder cambers, not just the gaps between girders. This will be a high profile area where a smooth CIP soffit is preferred. Drop caps required for the precast boxes will also create more visual mass and possibly cut into minimum head room at pier 8. Reinforced concrete, if designed and detailed correctly will meet the 75 year service life required by AASHTO. Efflorescence seems more of a concern for a bare concrete riding surface, but this bridge will have a high quality polyester concrete wearing course.
15	Land south end of pedestrian bridge on the north side of the railroad lines **Savings potential: $0 to $1,000,000**	Decline – High likelihood the RR would not approve the underpass and very high likelihood the RR would not approve the at-grade crossing. Underpass would create long barrier and encroach into RR property. There are significant safety concerns with an at-grade crossing at the RR. Also, consider the impact to users, who will have to stop and wait for trains in the middle of winter.
16	Utilize spread footings for all bridge foundations **Savings potential: $400,000**	Accept with conditions – Approval for all except two next to river due to scour concerns. Consider spread footing for pier between railroad and 7th Street. Spread footing would have much larger footprint. Slide piers are better to have something in the ground rather than shallow. 75 to 80 feet deep caissons assumed. Caissons better for scour. Stiffness will be a little more comparable because we are not going into bedrock. To address stiffness, consider leaving blockouts in spread footing and grout if needed. (Stiffen the reaction under the spread footings). At the pier north of 7th a spread footing was evaluated but the size based on preliminary numbers precluded fitting its footprint adjacent to the existing pier without an undesirable column shift to the south into the sidewalk.
18	Shorten bridge span over HSP parking lot **Savings potential: $177,600**	Decline – Need to replace HSP parking spaces if at all possible. Current short on replacement parking and this proposal would remove additional spaces. Structured parking spaces would be very difficult to provide in this location.
19	Use portion of existing Grand Avenue Bridge for new pedestrian bridge **Savings potential: $1,339,000**	Decline – More challenging to relocate utilities. Aesthetics would be poor. Construction phasing would be more difficult. Maintenance costs would be higher for existing bridge. Funding impacts as CBE would still have poor rated bridge. The piers of the existing highway bridge are too close to I-70 on both sides and contribute to the structure being classified as functionally obsolete. Using the existing highway bridge for the pedestrian bridge as shown prevents removal of the pier on the north side of I-70.
20	Eliminate trail tunnel (contingent upon proposal No. 3/8) **Savings potential: $250,000**	Decline – Proposal No. 3/8 was declined
24	Optimize skews **Savings potential: $0 to 100,000**	Accept with conditions – Consider adjustment of pier 2 skew to balance adjacent girder lengths. Multiple columns is the architectural direction at this point, which is more efficient than single columns with large cantilever caps. The skews are set at the river based on hydraulics and to facilitate simpler slide. Skew at Pier 3 to minimize the River Road shift and maximize space for parking.
27 and 58	Change N. River Street to a one-way (with on-street parking)/add in bike trail adjacent to N. River Street **Savings potential: $215,000**	Reclassify as Design Consideration - Could provide additional parking spaces needed for mitigation. HSP had indicated desire for 2-way street. Perhaps convert as Interstate ROW to CDOT ROW for more flexibility in parking options.

Proposal No.	VE Proposal Summary Recommended Action: Incorporate into Design	***Review Board Response***
30	Use "top-down" abutment construction at south end of Grand Avenue Bridge **Savings potential: $40,000**	Reclassify as Design Consideration – Defer for additional evaluation as the proposal may have some merit once final caisson and spread footing design parameters are better understood. A CIP facing is desired, and the proposed wall system may not easily accommodate that.
31	Move the south abutment of the Grand Avenue Bridge to the location of Pier 7 **Savings potential: $790,000**	Decline – Location of the abutment was heavily influenced by the CSS process and has been the subject of much discussion. Wrapping wall downtown not compatible. Proposed abutment would be a big wall, aesthetically unfavorable. Additional historic property impacts possible. Removes open area under bridge.
33	One lane roundabout **Savings potential: $750,000**	Decline – Fore same reason as #3 and #8. LOS F
34	SH 82 Bridge width reduction at north flare **Savings potential: $180,000 to $350,000**	Reclassify as Design Consideration – Would reduce costs by simplifying the bridge construction. Consider if taper could occur quick from US 6 intersection east. May tie to one-way N. River Street proposal above.
36	Use single column piers at pedestrian bridge **Savings potential: $240,000**	Accept with conditions – Consider only if this design is acceptable based on architectural elements. Not a hammer head type design. Obtain input from Bridge architect and designers if this would work.
40	Pedestrian bridge width reduction **Savings potential: $600,000**	Decline – LOS calculations in proposal used wrong mode splits. With lower bike use and higher pedestrian use, LOS barely avoids LOS F at 16 feet. Utilities need all the space under the pedestrian bridge (primary reason for declining).
41	SH82 Bridge curb width reduction **Savings potential: $100,000**	Decline – Added 6" of deck for aesthetic edge. Not same cost as structural deck. Might be more like $20,000 savings. Thin edge important for aesthetics.
46	Do not remove existing retaining walls **Savings potential: $25,000 to $60,000**	Accept – This makes sense although there may be some conflicts to work out.
52	Switch proposed walls to slopes **Savings potential: $200,000**	Reclassify as Design Consideration – Aesthetics will need further evaluation.

Section 5 – Design Considerations

The following table identifies proposals that the VE Team recommends to the Design Team to consider as the design team progresses but they may or may not improve the Value. The right hand column in the table identifies the responses to the design considerations from the Review Board.

Proposal No.	VE Proposal Summary Recommended Action: Design Considerations	***Review Board Response***
5	Construction staging area	Accept – Staging areas in these locations have merit
6	Use new pedestrian bridge to assist with maintenance of traffic ("MOT")	Decline – Seen as fatal flaw on south end as no way to connect traffic during the bridge closure without major costs. Higher cost for truck design loading.
7	Launch pedestrian bridge from the North	Accept – Worth further consideration and evaluation
10 and 28	Regional Traffic Connection to 116 Interchange	Decline – A direct connection has already been evaluated and screened out.
17	Provide structured parking to reduce bridge height and span	Accept with conditions – Accept if best way to mitigate parking spaces. Not cost effective, but worth of consideration to address parking.
11	Tighten Grand Avenue Bridge horizontal curve	Decline – Not cost effective. Value as stated, questionable. Complicates bridge slide.
25	Improve WB off ramp and EB ramp merge and termini	Accept – Needed improvements that are made possible by GAB replacement
26	Use geothermal for snow melt on both bridges	Accept with conditions – Accept if cost effective low maintenance system. Systems don't work very well. Assumes 5,000 LF of 1-1/2" pipe within alluvial groundwater. The maintenance costs are unknown. Will look at further along with other snow melt options.
32	SH 82 Bridge slide interface location	Accept – As design consideration.
35	Vibrational monitoring before, during and after construction	Accept – Evaluate further during design
37	SH 82 Bridge and pedestrian bridge consistent girder shape	Decline – Due to the higher costs
38	Use Rapid Placed Fill to reduce construction time	Accept – Very expensive. Anticipate using existing fill to extent feasible. Design consideration where it makes sense to reduce construction time or add value.
47	Cantilever downtown roadway section past retaining walls	Decline – Expensive for limited benefit. Poor aesthetics. Largely low value space provided.
50	Separate permitting of pedestrian bridge from Grand Avenue Bridge in order to allow early action project	Accept – Consider if this helps construction schedule.
51	Adjust signal timing during construction	Accept – Can help traffic flow
53	Alternative stormwater configuration	Accept – Looking at closely. Issues with cost if not pond. Opportunities to landscape pond.
55	Monitor pre- and post- construction groundwater conditions	Accept – Good idea if we can do it.
57	Roundabout at Pine Street/6th Street Intersection	Decline – Only works with alignment 1 which was screened out.

Section 6 – Recommended Proposal Packages

Proposal No.	Option 1 – Alternative 3 Package
1	SH82 Bridge structure depth is shallower over UPRR **Savings potential: $200,000**
2	Mix steel box girders with precast prestressed concrete box girders **Savings potential: $1,000,000**
13 and 42	Pedestrian bridge considered Truss structure type/Put a top on pedestrian bridge **Savings potential: $390,000**
14 and 54	SH 82 Bridge downtown unit use precast pretensioned components **Savings potential: $200,000**
16	Utilize spread footings for all bridge foundations **Savings potential: $400,000**
18	Shorten bridge span over HSP parking lot **Savings potential: $177,600**
30	Use "top-down" abutment construction at south end of Grand Avenue Bridge **Savings potential: $40,000**
31	Move the south abutment of the Grand Avenue Bridge to the location of Pier 7 **Savings potential: $790,000**
36	Use single column piers at pedestrian bridge **Savings potential: $240,000**
40	Pedestrian bridge width reduction **Savings potential: $600,000**
41	SH82 Bridge curb width reduction **Savings potential: $100,000**
46	Do not remove existing retaining walls **Savings potential: $25,000 to $60,000**
	Total Savings potential = $4,162,600 to 4,197,600
Review Board Response to Option 1: No Comments	

Proposal No.	Option 2 – Alternative 3 Package
1	SH82 Bridge structure depth is shallower over UPRR **Savings potential: $200,000**
2	Mix steel box girders with precast prestressed concrete box girders **Savings potential: $1,000,000**
3 and 8 (or 33)	Reconfigure 6th/Laurel intersection/Use 2 roundabouts instead of 3 closely spaced **Savings potential: $500,000**
13 and 42	Pedestrian bridge considered Truss structure type/Put a top on pedestrian bridge **Savings potential: $390,000**
14 and 54	SH 82 Bridge downtown unit use precast pretensioned components **Savings potential: $200,000**
15	Land south end of pedestrian bridge on the north side of the railroad lines **Savings potential: $0 to $1,000,000**
16	Utilize spread footings for all bridge foundations **Savings potential: $400,000**
18	Shorten bridge span over HSP parking lot **Savings potential: $177,600**
20	Eliminate trail tunnel (contingent upon proposal No. 3/8) **Savings potential: $250,000**
27 and 58	Change N. River Street to a one-way (with on-street parking)/add in bike trail adjacent to N. River Street **Savings potential: $215,000**
30	Use "top-down" abutment construction at south end of Grand Avenue Bridge **Savings potential: $40,000**
31	Move the south abutment of the Grand Avenue Bridge to the location of Pier 7 **Savings potential: $790,000**
34	SH 82 Bridge width reduction at north flare **Savings potential: $180,000 to $350,000**
36	Use single column piers at pedestrian bridge **Savings potential: $240,000**
40	Pedestrian bridge width reduction **Savings potential: $600,000**
41	SH82 Bridge curb width reduction **Savings potential: $100,000**
46	Do not remove existing retaining walls **Savings potential: $25,000 to $60,000**
52	Switch proposed walls to slopes **Savings potential: $200,000**
	Total Savings potential = $5,507,600 to 6,712,600
Review Board Response to Option 2: No Comments	

Proposal No.	**Option 3 – Alternative 1 Package (Bridge)**
1	SH82 Bridge structure depth is shallower over UPRR **Savings potential: $200,000**
4 and 23	Re-evaluate Alternate 1/Construct SH 82 bridge on existing alignment **Savings potential: $13,500,000**
13 and 42	Pedestrian bridge considered Truss structure type/Put a top on pedestrian bridge **Savings potential: $390,000**
14 and 54	SH 82 Bridge downtown unit use precast pretensioned components **Savings potential: $200,000**
15	Land south end of pedestrian bridge on the north side of the railroad lines **Savings potential: $0 to $1,000,000**
16	Utilize spread footings for all bridge foundations **Savings potential: $400,000**
30	Use "top-down" abutment construction at south end of Grand Avenue Bridge **Savings potential: $40,000**
31	Move the south abutment of the Grand Avenue Bridge to the location of Pier 7 **Savings potential: $790,000**
36	Use single column piers at pedestrian bridge **Savings potential: $240,000**
40	Pedestrian bridge width reduction **Savings potential: $600,000**
41	SH82 Bridge curb width reduction **Savings potential: $100,000**
46	Do not remove existing retaining walls **Savings potential: $25,000 to $60,000**
	Total Savings potential = $16,485,000 to 17,520,000
Review Board Response to Option 3: No Comments	

Proposal No.	Option 4 – Alternative 1 Package (Bridge and Operational Improvements)
1	SH82 Bridge structure depth is shallower over UPRR **Savings potential: $200,000**
4 and 23	Re-evaluate Alternate 1/Construct SH 82 bridge on existing alignment **Savings potential: $13,500,000**
3 and 8 (or 33)	Reconfigure 6th/Laurel intersection/Use 2 roundabouts instead of 3 closely spaced **Additional Cost: $4,000,000** (cost of new intersection improvements to offset cost of intersections removed in proposal 4 and 23)
13 and 42	Pedestrian bridge considered Truss structure type/Put a top on pedestrian bridge **Savings potential: $390,000**
14 and 54	SH 82 Bridge downtown unit use precast pretensioned components **Savings potential: $200,000**
15	Land south end of pedestrian bridge on the north side of the railroad lines **Savings potential: $0 to $1,000,000**
16	Utilize spread footings for all bridge foundations **Savings potential: $400,000**
30	Use "top-down" abutment construction at south end of Grand Avenue Bridge **Savings potential: $40,000**
31	Move the south abutment of the Grand Avenue Bridge to the location of Pier 7 **Savings potential: $790,000**
36	Use single column piers at pedestrian bridge **Savings potential: $240,000**
40	Pedestrian bridge width reduction **Savings potential: $600,000**
41	SH82 Bridge curb width reduction **Savings potential: $100,000**
46	Do not remove existing retaining walls **Savings potential: $25,000 to $60,000**
57	Roundabout at Pine Street/6th Street Intersection **Additional Cost: $150,000**
	Total Savings potential = $12,335,000 to 13,370,000
Review Board Response to Option 4: No comments	

Section 7 – Brainstorm Ideas

The following table identifies all of the ideas that the VE Team developed in an initial brainstorming activity. The purpose of this initial activity is to think of all the possible ideas that could improve the value without any reservations. From this idea list, the VE Team evaluated the merits of each idea and developed a recommended action. Ideas that the VE Team agreed were worthy to investigate with the time available were then carried forward.

Idea No.	Idea Description	Recommended Action
1	SH82 Bridge structure depth is shallower over UPRR	Incorporate
2	Mix steel box girders with precast prestressed concrete box girders	Incorporate
3	Reconfigure 6th/Laurel intersection	Incorporate
4	Re-evaluate Alt. 1-Existing alignment (bridge only)	Incorporate
5	Construction staging area	Design consideration
6	Use new pedestrian bridge to assist with maintenance of traffic ("MOT")	Design consideration
7	Launch pedestrian bridge from the North	Design consideration
8	Use 2 roundabouts instead of 3 intersections closely spaced (1 roundabout and 2 signalized intersection)	Combine with 3
9	Move pedestrian bridge to the west and land inside the future development	Do not evaluate
10	(Regional traffic) Direct connections to existing I-70 Interchange	Design consideration
11	Tighten Grand Avenue Bridge horizontal curve	Design consideration
12	Grade separate WB regional traffic	Do not evaluate
13	Pedestrian bridge consider Truss structure type	Incorporate
14	SH 82 Bridge downtown unit use precast pretensioned components	Incorporate
15	Land south end of pedestrian bridge on the north side of the railroad lines	Incorporate
16	Utilize spread footings for all bridge foundations	Incorporate
17	Provide structured parking to reduce bridge height and span	Design consideration
18	Shorten bridge span over HSP parking lot	Incorporate
19	Use portion of existing Grand Avenue Bridge for new pedestrian bridge	Incorporate
20	Eliminate trail tunnel (contingent upon proposal No. 3/8)	Incorporate
21	Float in Bridge (ABC)	Do not evaluate
22	Attach new pedestrian bridge to a portion of the Grand Avenue Bridge	Eliminated
23	Construct SH 82 bridge on existing alignment (Alt 1)	Combine with 4
24	Optimize skews	Incorporate
25	Improve WB off ramp and EB ramp merge and termini	Design consideration
26	Use geothermal for snow melt on both bridges	Design consideration
27	Change N. River street to a one-way (with on street parking)	Incorporate
28	(Regional traffic) Redirect Grand Avenue Bridge to tie into ramps at Exit 116	Combine with 10
29	Eliminate River Street Frontage Road	Do not evaluate
30	Use "top-down" abutment construction at south end of Grand Avenue Bridge	Incorporate

Idea No.	Idea Description	Recommended Action
31	Move the south abutment of the Grand Avenue Bridge to the location of Pier 7	Incorporate
32	SH 82 Bridge slide interface location	Design consideration
33	One lane roundabout	Incorporate
34	SH 82 Bridge width reduction at north flare	Incorporate
35	Vibrational monitoring before, during and after construction	Design consideration
36	Use single column piers at pedestrian bridge	Incorporate
37	SH 82 Bridge and pedestrian bridge consistent girder shape	Design consideration
38	Use Rapid Placed Fill to reduce construction time	Design consideration
39	Use 7th Street as a detour in lieu of 8th St.	Do not evaluate
40	Pedestrian bridge width reduction	Incorporate
41	SH82 Bridge curb width reduction	Incorporate
42	Put a top on pedestrian bridge	Combine with 13
43	Use temporary bridge from Grand Avenue Bridge to Cooper Avenue	Do not evaluate
44	Revisit decoupling local traffic from regional traffic by adding new bridge to west	Do not evaluate
45	Lower UPPR by ±2’ (lower Grand Avenue Bridge profile)	Do not evaluate
46	Do not remove existing retaining walls	Incorporate
47	Cantilever downtown roadway section past retaining walls	Design consideration
48	Move WB I-70 off ramp to east and connect to 6th Street	Eliminated
49	Closure of Laurel Street	Eliminated
50	Separate permitting of pedestrian bridge from Grand Avenue Bridge in order to allow early action project	Design consideration
51	Adjust signal timing during construction	Design consideration
52	Switch proposed walls to slopes	Incorporate
53	Alternative stormwater configuration	Design consideration
54	Utilize precast elements in downtown section (include substructure)	Combine with 14
55	Monitor pre- and post- construction groundwater conditions	Design consideration
56	Dam up (aqua barriers) river to create depth for barges	Do not evaluate
57	Roundabout at Pine Street/6th Street Intersection	Design consideration
58	Add in bike trail adjacent to N. River Street	Combine with 27

Section 8 – Proposal Descriptions

Value Engineering Proposal No. 1
SH 82 Bridge Structure Depth Shallower over UPRR
Recommended Action: Incorporate

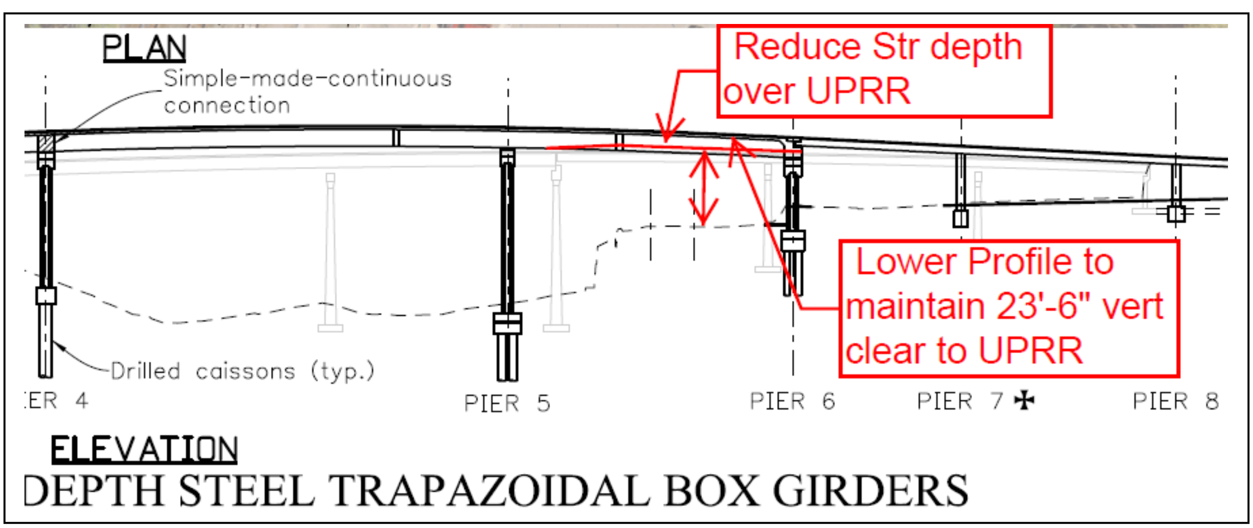
Summary
SH 82 Bridge structure depth could be made shallower over UPRR, by reducing the depth of the girders in the span over UPRR. The shallower structure depth would then accommodate lowering the SH 82 profile over the UPRR, resulting in cost reductions to the bridge and the south approach to the SH 82 Bridge.

Estimated potential cost savings: $ 0.2 million

Discussion:
SH 82 Bridge structure depth could be made shallower in the span over UPRR, by reducing the depth of the girders in this span where the bending moment demand and shear demand are not as large as the demands in the other longer spans. A shallower structure depth could be adequate for bending strength, bending service stresses, bending service deflections, and shear strength. SH 82 Bridge structure depth could be reduced by an estimated 1.5' to 2' of girder depth.

One of the controlling locations for the SH 82 profile is SH 82 over UPRR, where 23'-6" vertical clearance is required for UPRR under the SH 82 Bridge. By reducing the SH 82 Bridge structure depth by an estimated 1.5' to 2', the SH 82 profile could be lowered over UPRR by the same 1.5' to 2'. Since the SH 82 profile would be lowered at a controlling location, the lowering would taper in depth and extend 300' south until the profile tied in to the proposed profile. The SH 82 profile lowering would also extend north over the crest vertical curve.

The lowered SH 82 profile over the UPRR would result in cost reductions to the bridge Piers 2-8, superstructure main unit (due to reduced weight), and retaining walls and embankment material supporting the south approach to the SH 82 Bridge.



Related Value Engineer proposal:
No related proposals. The potential lowering of UPRR under the SH 82 Bridge was discussed during brain-storming, but was determined to be not feasible.

Advantages of this Proposal:
Shallower SH 82 structure depth over UPRR, and lowering the SH 82 profile a corresponding amount, achieve the following advantages:

- Reduced cost of SH 82 Bridge Piers 2-8;
- Reduced cost of SH 82 Bridge superstructure, due to moving lighter unit;
- Reduced cost of retaining walls supporting south approach, due to reduced wall height;
- Reduced cost of embankment material in south approach to SH 82 Bridge;
- Reduced construction duration for constructing shorter retaining walls;
- Reduced construction duration for placing less embankment material;
- Improved view sheds of Grand Avenue in downtown, since bridge and south approach will be lower.

Advantages of original design concept:
Constant-depth girders are less complex to fabricate. Superstructure main unit girders that are constant-depth are about the same cost as girders with reduced depth in one span, because the cost of material for the constant-depth girders is about the same as the complexity for reduced-depth girders with less material. The amount of material in the constant-depth webs and bottom flange is slightly more than the amount of material in reduced-depth webs and wider bottom flange.

Risks associated with implementing this Proposal:
Slight increase in fabrication complexity, offset by the reduction in weight to fabricate, ship and move SH 82 Bridge superstructure with slightly less weight.

Calculations:

Value Engineering Proposal 1 : SH 82 Bridge Structure Depth Shallower over UPRR

Cost Estimate						
Component	Quantity	Length (ft)	Height (ft)	Area (ft^2)	Unit Cost ($ / ft^2)	**Estimated Cost** (nearest $ 10 k)
Bridge Pier 2	1		-0.5		$ 20,000	$ (10,000)
Bridge Pier 3	1		-1.0		$ 20,000	$ (20,000)
Bridge Pier 4	1		-1.5		$ 20,000	$ (30,000)
Bridge Pier 5	1		-2.0		$ 20,000	$ (40,000)
Bridge Pier 6	1		-2.0		$ 20,000	$ (40,000)
Bridge Pier 7	1		-1.5		$ 10,000	$ (15,000)
Bridge Pier 8	1		-1.0		$ 10,000	$ (10,000)
Superstructure main unit move, lighter weight	-0.01				$ 1,000,000	$ (10,000)
Retaining walls supporting south approach	2	140	-0.5	-140	$ 80	$ (11,000)
Embankment at south approach	-1				$ 4,000	$ (4,000)
Mobilization on above, shorter duration	-1				$ 10,000	$ (10,000)
						$ -
					Total	$(200,000)

Value Engineering Proposal No. 2
Mix steel box girders with precast prestressed concrete box girders
Recommended Action: Incorporate

Summary: Optimize the efficiency of the structure by utilizing the most cost effective structure type for each span. Use a concrete box girder for the spans that do not require a lateral slide and use a steel box girder for spans which require a lateral slide. The two spans over the river and railroad tracks require a lateral slide.

Estimated potential cost savings: $1,000,000

Discussion: We optimized the benefit by only using the steel box for the spans moved into place. Much of the benefit of steel box girders is due to the lighter weight of the steel box girders, reduction in erection costs and reduction in lateral move costs. Additional steel savings may be available if the post tensioning is incorporated into the steel box.

Note that this concept accommodates numerous connection methods at pier 4.

- Use an expansion joint.
- Use a "continuous for liveload" connection similar to the current concept.
- Use a post tensioned connection that ties back into the concrete box. The post tensioning can also extend through the steel box as exposed strands in the box and increase the steel box capacity.

Attached is a sample photo of a location in the Denver area that switched from concrete I girders to steel I girders. This method has is also used in numerous other states to control structure costs.

Related Value Engineer proposal: NA

Advantages of this Proposal:

- Reduced cost.

- Less maintenance for precast concrete girders.
- Reduced price and schedule risk due use of precast prestressed concrete box girders.

Advantages of original design concept:

- Perceived aesthetics.
- Reduction in construction impacts in the parking lot due to reduced construction time.
- Painting of concrete for aesthetics is not required.
- Eliminates risk due to difficult erection and splicing of precast prestressed concrete box girders over I-70.

Risks associated with implementing this Proposal: Design of the connection between the two structure types may be challenging, but solutions are possible. If a continuity detail is used an expansion joint is required. Adding an expansion joint reduces cost savings, increases girder costs due to span arrangement inefficiencies and adds a maintenance item.

Calculations: The cost savings is based on a SF cost of $260/sf for a steel box, and $225/sf for a concrete box the potential savings is approximately $1,000,000. The $1,000,000 assumes a savings of $1,140,000 minus approximately $140,000 to account for inefficiencies at pier 4, additional connection complexity, and painting/staining the concrete girder to match the look of the weathering steel.

Value Engineering Proposal # 3 & 8
Reconfigure 6th/Laurel Intersection; Double roundabout instead of 3 Closely Spaced Intersections
Recommended Action: Proposal

Summary

A double roundabout is proposed as an alternative to the original concept design, which includes a roundabout at Laurel/6th Street and the signalized intersections on the revised SH 82 alignment included in EA Alternative 3. Additionally, this proposal replaces the stop controlled I-70 WB ramp terminal intersection and the I-70 EB off ramp terminal with single lane roundabouts.

This proposal develops substantial modifications to the proposed intersections at Laurel/6th St in EA Alternative 3 and are intended to address geometrics, operations, safety (conflict points), way-finding and cost. Due to the close proximity of the proposed intersection(s) and realigned SH 82 to the I-70 WB off ramp terminal, the ramp terminal was also evaluated in this VE proposal.

A tear drop roundabout at the I-70 EB exit ramp terminal is also a potential benefit to the corridor and access from I-70 to Glenwood Springs.

In addition, a similar design of the double roundabouts are proposed for capacity and safety improvements at the 6th/Laurel St intersection and the I-70 ramp terminals under VE Proposal #4 where the new bridge would remain in its existing location.

Estimated potential cost savings: Approximately $500k in construction cost savings is expected with the elimination of two new signals proposed in EA Alternative 3. Other life cycle costs such as signal maintenance and future delay costs, emissions, and reduction in crashes may also realized with this alternative.

Discussion:

See attached concept sketches for more details.

This option simplifies traffic flows along the extension of SH 82 from the re-aligned Grand Avenue Bridge through the I-70 interchange. Regional and local destinations and associated travel paths are more intuitive and can be traversed through conventional intersection configurations. All turning paths would be smooth and direct and at consistent speeds (15 to 25 mph).

With EA Alternative #3, SH 82 via the realigned Grand Avenue bridge is proposed to connect into the Laurel/6th Street intersection via a series of two signalized intersections with both local and US 6 traffic using a single lane roundabout approximately 100 ft from each signalized intersection. Potential for excessive queuing into the roundabout exists.

The Laurel St/6th St roundabout included in this VE proposal is a 2x1 roundabout (180 ft ICD – a conservative footprint for concept design) and the I-70 ramp terminal roundabout (120 ft ICD) is a single lane roundabout.

All of these roundabouts show acceptable capacity for the construction year with longevity provided in the design. See attached capacity analysis (HCM calibrated models).

A sensitivity analysis for the roundabout design at Laurel St and 6th St is recommended to avoid over design during opening year. Many state DOTs (CA, WI, MN, GA, WA, NY) are designing their roundabout to handle the projected volumes for the first 10 to 15 years after construction. Projections beyond that point are often unreliable and uncertain enough to warrant sensitivity analysis and phased construction over time.

This proposal allows for keeping Laurel St connected to 6th Street either via its existing location or a slight realignment to the west. Business access and residential access is still maintained.

Ingress to River St. and the Hot Springs Pools is maintained with the roundabouts.

Access to the Hot Springs would be provided near the existing driveway location with both NB and SB turning movements accommodated. Access was also maintained to all businesses with this alternative design.

Large areas of unused pavement – required for local truck turning movements - would be minimized.

In short, a simplified, relatively conventional and intuitive design would be presented to local, regional and visitor traffic, thereby minimizing opportunities for confusion and resultant collisions and/or driver frustration.

Related Value Engineer proposal: 11, 20, 34

If accepted, this proposal is complimentary to VE Proposal # 11 - Tighten Grand Avenue Bridge curve and move closer to I-70 - as low, uniform travel speeds would be achieved between downtown Glenwood Springs and the area north of the river, consistent with those already present in these areas.

If accepted, this proposal supports VE Proposal # 20 – Eliminate multi-use path tunnel under SH 82 structure – as a multi-use trail can cross at grade throughout.

If accepted, this proposal supports VE Proposal #34 - Reduce flare width at north end of bridge – by moving the first intersection at the north end of the new Grand Avenue Bridge.

Advantages of this Proposal: This option provides consistent intersection control strategies with more defined decision points and travel paths for local, regional and visitor traffic.

Additional advantages:

- Slow and consistent speeds through intersections (15 to 25 mph)
- Intersection approach angles are not skewed.
- Fewer conflict points
- Provides equal priority at intersections to local, regional and tourist traffic.
- Queuing into adjacent intersections is unlikely.
- Maintains direct access to Hot Springs Pool.
- Capacity improvements 24 hour a day (rather than focused on peak hour(s))
- Potential gateway/aesthetic improvements at I-70 interchange.
- Connectivity from I-70 to downtown Glenwood Springs.
- Intersections are on relatively flat grades.
- A net decrease of signalized intersections along SH 82 would be achieved.
- The use of roundabouts at interchanges along I-70 and at adjacent intersections within the adjoining communities is common practice in western Colorado.
- Potential right of way savings or land available for future capacity expansion of roundabout(s).

Advantages of original design concept: This option would provide a relatively direct connection of SH 82 to I-70 with a priority given to regional traffic.

Risks associated with implementing this Proposal: None identified

Calculations:

Assume $250,000 for each signalized intersection. Total of $500,000.

Eliminating tunnel for $250,000.

Total estimated savings to EA Proposal Alternative 3 is $750,000.

Double Roundabout for EA Alternative 3

Estimated Capacity MOE's for proposed roundabout at 6th and Laurel St for EA Alternative 3 Future Volumes

VE Proposal # 3/8/33										
Measures of Effectiveness (Calibrated HCM Model)										
Double Roundabout w/EA Option 3A.										
			Future (2035)							
			AM				**PM**			
Intersection	**Approach**	**Movement**	**V/C**	**LOS**	**Delay**	**Queue**	**V/C**	**LOS**	**Delay**	**Queue**
6th / Laurel / SH 82	NW (US 6)	Thru/Left	0.25	A	6.6	25	1.2	F	157.1	372
		Thru/Right	0.32	A	7.1	34	1.15	F	132.1	382
	E (6th St)	Thru/Left/Right	0.28	A	8.8	28	0.81	F	71.6	146
	SE (Grand Ave)	Thru/Left	0.58	A	10	99	0.95	D	34.5	425
		Thru/Right	0.19	A	4.6	17	1.04	F	57	616
	S (S Laurel)	Thru/Left	0.82	C	21.6	246	0.6	B	12.7	103
		Thru/Right	0.69	B	13.7	144	0.4	A	8.1	48

Note: Traffic volumes used in the analysis are based on the SYNCHO model provided by TSH as modified to be comparable to the *SH 82 Corridor Optimization Study*, 2007.

Double Roundabout for VE Proposal #4

Estimated Capacity MOE's for proposed roundabout at 6^{th} and Laurel St intersection for VE Proposal 4 (EA Alternative 1) Future Volumes

VE Proposal # 3/8/33										
Measures of Effectiveness (Calibrated HCM Model)			EA Alternative Alt 1 (Existing Alignment)							
			Future (2035)							
			AM				**PM**			
Intersection	**Approach**	**Movement**	**V/C**	**LOS**	**Delay**	**Queue**	**V/C**	**LOS**	**Delay**	**Queue**
6th / Laurel / SH 82	NW (US 6)	Thru/Right	0.31	A	7.9	33	1.11	F	126	330
		Right	0.44	A	9.5	56	1.06	F	101.7	327
	E (6th St)	Thru/Left	0.46	A	7.5	66	0.97	E	36.6	469
		Thru/Right	0.46	A	7.6	37	0.91	D	36.6	361
	S (from 70)	Thru/Left	0.88	D	27.5	300	0.46	A	9.9	64
		Thru/Right	0.77	C	18	199	0.41	A	8.7	53

Note: Traffic volumes used in the analysis are based on Figure 5 of the *SH82 Corridor Optimization Study*, 2007. Volumes do not reflect manual adjustment of 100 to 150 vph to/from the pool area identified by TSH in their *Grand Avenue Bridge Traffic Notes* document.

Estimated Capacity MOE's for proposed roundabout at 6th and Laurel St intersection for VE Proposal 4 (EA Alternative 1) Existing Volumes

VE Proposal # 3/8/33

Measures of Effectiveness (Calibrated HCM Model) EA Alternative 1 (existing bridge alignment)

			Existing							
			AM				PM			
Intersection	**Approach**	**Movement**	**V/C**	**LOS**	**Delay**	**Queue**	**V/C**	**LOS**	**Delay**	**Queue**
6th / Laurel / SH 82	NW (US 6)	Thru/Right	0.16	A	4.8	13	0.3	B	10.4	31
		Right	0.21	A	5.3	20	0.39	B	11.3	47
	E (6th St)	Thru/Left	0.16	A	4.1	12	0.57	A	9.4	95
		Thru/Right	0.39	A	6.4	38	0.53	A	8.6	81
	S (from 70)	Thru/Left	0.52	B	10	61	0.27	A	6.2	27
		Thru/Right	0.49	A	9.3	48	0.23	A	6.7	22

Note: Traffic volumes used in the analysis are based on Figure 5 of the *SH82 Corridor Optimization Study* , 2007. Volumes do not reflect manual adjustment of 100 to 150 vph to/from the pool area identified by TSH in their *Grand Avenue Bridge Traffic Note* s document.

Value Engineering Proposal 4 and 23
Re-Evaluate Alternate 1 / Construct SH 82 bridge on existing Alignment
Recommended Action: Incorporate

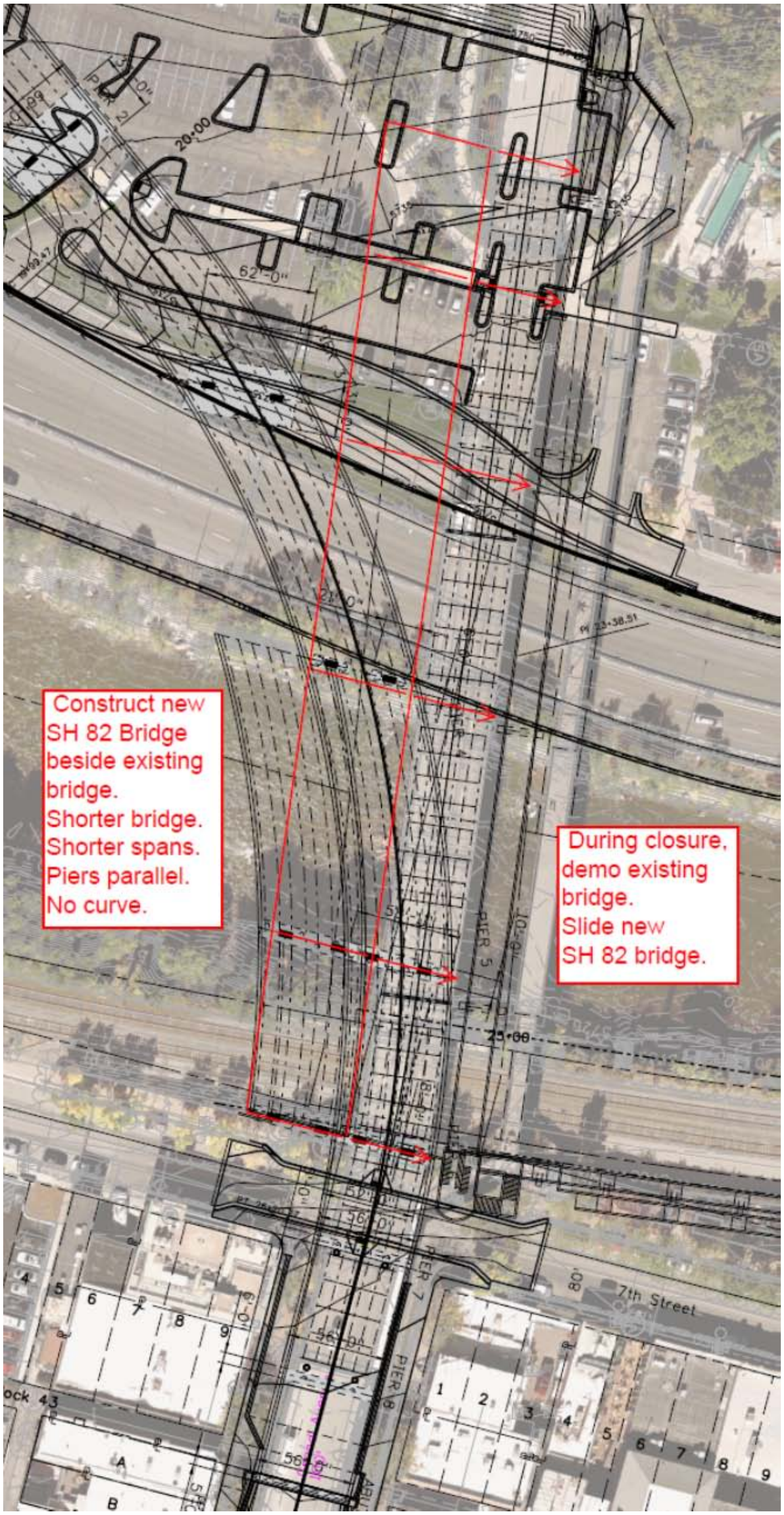
Summary:
Although the design team has already thoroughly vetted Alternative 1, and although the guidelines presented to the VE team lists Alternative 3's alignment as a "non- touchable", at first glance it appears that Alternate 1 is a significant cost savings over Alternate 3. This savings appears to not have been previously quantified, and therefore a re-evaluation seems warranted.

Estimated potential cost savings:
$13.5 million:

1. $11 million based on the $56 million estimate from the *Opinion of Probable Construction Costs* produced by Stanton. Estimated $6 million in construction costs and $5 million in reduced contingencies.
2. $500,000 in design savings for not having to design the roadway, walls, drainage, etc. related to the intersections on the north side.
3. $2.0 million in reduced ROW acquisitions.

Discussion:
<u>Cost</u>
There are large cost savings due to Alt 1 appearing to not require any reconstruction of the intersections north of the bridge and due to the Alt 1 bridge being considerably shorter than Alt 3. It also appears the main reasons Alternate 3 is currently the preferred option is because this is what the outreach effort showed the locals prefer and for the soft positives that come with the design. It is difficult to quantify these soft improvements. It is easier to quantify the cost savings. The information provided as to why Alt 1 was ultimately screened out did not provide a quantitative analysis of what the savings are over Alt 3. It appears the savings are significant enough to warrants a cost analysis. This cost analysis may put Alternate 1 back on the table as the build option.
<u>Constructability</u>
In contradiction to the Alternatives Analysis document, it appears Alt 1 would have reduced construction impacts compared to Alt 3. This is primarily because Alt 1 does not reconstruct the roadways north of the bridge.
Also, the construction impacts related directly to the construction of the bridge appear to be similar for each Alternate. Below are two options for building Alt 1, which have similar construction impacts to Alt 3.
Option 1: Build the new SH82 main unit. Close SH 82 and demo the existing bridge or slide it over on temp supports for removal later. Slide the new structure into its permanent alignment. Slide the new bridge into its final location.
Option 2: Slide the existing SH 82 bridge east on temporary supports and build the tie-ins to use the existing structure as a detour. Build the new SH 82 bridge in its final location.

In summary this asks the question "Does $13.5 million in cost savings outweigh the benefits of Alt 3 over Alt 1?"


Construct new
SH 82 Bridge
beside existing
bridge.
Shorter bridge.
Shorter spans.
Piers parallel.
No curve.
During closure,
demo existing
bridge.
Slide new
SH 82 bridge.
7th Street

Related Value Engineer proposal:
NA

Advantages of this Proposal:
1. Significant cost savings due to less roadway and intersection work north of I-70 and a shorter bridge.
2. Potential decrease in construction time due to less roadway and intersection work north of I-70 and due to construction of a shorter bridge.
3. Significant decrease in construction impacts since the intersections on the north side are not reconstructed.
4. Reduced ROW acquisition and related costs.
5. Reduced design due to not having to design roadways north of I-70.
6. The savings are so significant enough to fund other Bridge Enterprise projects, resulting in improved performance of the Bridge Enterprise program.
7. Increased traffic safety due to constructing a straight bridge.
8. Lower maintenance and inspection costs due to shorter and simpler bridge structure.

Advantages of original design concept:
Locals may prefer it.
There are some improvements for bus, bike, and pedestrian utilization.

Risks associated with implementing this Proposal:
Locals may feel they were not heard since Alt 3 was highly favored over Alt 1.
Does not improve traffic flow from the bridge to the I-70 Interchange.

Calculations:

ENGINEERS SCOPING ESTIMATE

COLORADO DEPARTMENT OF HIGHWAYS

ENGINEERS SCOPING ESTIMATE

Proj. No.

Subaccount

SH 82, Grand Ave Bridge Replacement (F-07-A) | Date: | Prepared By: TSH

Item Numb	ITEM	UNIT	PRICE	AMOUNT	Alt 1 Est Costs	SAVINGS	
	Removals						
	Grand Ave Bridge Removal	LS	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ -	
	Structure Removal - Gas Station	LS	$ 250,000	$ 250,000	$ -	$ 250,000	
	Other removals - curb, gutter, sidewalk, pavemen	LS	$ 196,300	$ 196,300	$ 30,000	$ 166,300	
					$ -	$ -	
	Structure Costs				$ -	$ -	
*	Vehicular Bridge - Downtown Unit	LS	$ 1,685,667	$ 1,685,667	$ 1,685,667	$ -	
*	Vehicular Bridge - Main Unit (4 Span Steel Tub G	LS	$ 11,110,195	$ 11,110,195	$ 9,326,000	$ 1,784,195	assumes Alt 1 bridge to be appro
*	Pedestrian Bridge (Suspension Bridge Option)	LS	$ 6,906,000	$ 6,906,000	$ 6,906,000	$ -	no change
*	Pedestrian Ramps Structure -South Landing	LS	$ 1,062,816	$ 1,062,816	$ 1,062,816	$ -	no change
	Pedestrian Underpass	LS	$ 250,000	$ 250,000	$ -	$ 250,000	
*	Walls	LS	$ 995,280	$ 995,280	$ 450,000	$ 545,280	Assumes half of all the walls not
					$ -	$ -	
	Roadway Costs				$ -	$ -	
	HMA	Ton	$ 75	$ 161,292	$ 80,000	$ 81,292	Assume half
	Concrete Pavement	CY	$ 50	$ 686,208	$ 114,000	$ 572,208	assume one sixth of cost
	Curb, Gutter & Sidewalk	LS	$ 231,960	$ 231,960	$ 38,000	$ 193,960	assume one sixth of cost
	Embankment Material (CIP)	CY	$ 15	$ 261,870	$ 43,500	$ 218,370	assume one sixth needed
	Excavation (CIP)	CY	$ 10	$ 110,000	$ 18,000	$ 92,000	assume one sixth needed
					$ -	$ -	
	Traffic Control				$ -	$ -	
	Signals	Each	$ 191,550	$ 383,100	$ -	$ 383,100	assume non need
	Sign Structures	Each	$ 30,000	$ 30,000	$ -	$ 30,000	assume no need
	Signing & Striping	LS	$ 42,200	$ 42,200	$ 14,000	$ 28,200	assume one third
					$ -	$ -	
	Construction Traffic Control				$ -	$ -	
*	Long Term Traffic Control (Midland to 27th)	LS	$ 513,888	$ 513,888	$ 513,888	$ 257,000	assume half
*	Short Term Traffic Control - While Bridge is out	LS	$ 421,434	$ 421,434	$ 421,434	$ 210,000	assume half
				$ -	$ -	$ -	
	Drainage & Water Quality				$ -	$ -	
	Pipe, Inlets, Manholes	LS	$ 1,098,800	$ 1,098,800	$ 200,000	$ 898,800	assume 1 fifth
	Erosion Control	LS	$ 200,000	$ 200,000	$ 40,000	$ 160,000	assume 1/5th
					$ -	$ -	
	Utilities				$ -	$ -	
	Gas line & Substation Relocation	LS	$ 100,000	$ 100,000	$ 100,000	$ -	no change
	Water line (8") Across Bridge	LF	$ 75	$ 52,500	$ 52,500	$ -	no change
	Street Lighting	LS	$ 191,250	$ 191,250	$ 40,000	$ 151,250	assume 1 fifth
					$ -	$ -	
	Railroad Cost				$ -	$ -	
	Railroad Flagging	Day	$ 2,000	$ 520,000	$ 520,000	$ -	no change
	Access Across Railroad	LS	$ 200,000	$ 200,000	$ 200,000	$ -	no change
					$ -	$ -	
	Miscellaneous				$ -	$ -	
	River Access	LS	$ 576,500	$ 576,500	$ 576,500	$ -	no change
	Restroom Building - Demo and New	LS	$ 200,000	$ 200,000	$ 200,000	$ -	no change
	Landscaping & Urban Aesthetics	LS	$ 500,000	$ 500,000	$ 100,000	$ 400,000	assume 1/5th
	Gazebo Near RR- Reset or Demo and New	LS	$ 50,000	$ 50,000	$ 50,000	$ -	no change
	Elevator at South Ped Ramp	LS	$ 500,000	$ 500,000	$ 500,000	$ -	no change
*	Temporary ADA Ramp at S.End Existing Ped Br	LS	$ 100,000	$ 100,000	$ 100,000	$ -	no change
					$ -	$ -	
	OTHER IMPROVEMENTS				$ -	$ -	
	I-70 EB Ramp Improvements	LS	$ 1,253,475	$ 1,253,475	$ 1,253,475	$ -	no change
*	SH 114 Improvements (Ramp widening)	LS	$ 765,012	$ 765,012	$ 765,012	$ -	no change
					$ -	$ -	
	Total			$ 32,605,748	$ 26,400,792	$ 6,204,956	

		Rang	% Used	Cost	Cost		
	Project Construction Bid Items			$ 32,605,748	$ 26,400,792	$ 6,204,956	
	Utilities - Relocation	(%) OF	1.50%	$ 489,086	$ 396,012	$ 93,074	
	Mobilization	% of (A)+(	10.00%	$ 3,309,483	$ 2,679,680	$ 629,803	
	Contingencies	% of (A)+(	25.00%	$ 9,101,079	$ 7,369,121	$ 1,731,958	
	Total of Construction Bid Items	(A)+(B)+©	-------	$ 45,505,397	$ 36,845,606	$ 8,659,791	
	Force Account - Misc (MCRs)	% of (E)	10.00%	$ 4,550,540	$ 3,684,561	$ 865,979	
	Escalation of Construction Cost - 4% per year for 3 years	(D) +(E)	4.00%	$ 6,250,184	$ 4,922,531	$ 1,327,653	
					$ -	$ -	
		Opinion of Probable Construction Cost		$ 56,306,121	$ 45,452,698	$ 10,853,424	

Value Engineering Proposal No. 5
Construction Staging Area
Recommended Action: Design Consideration

Summary

At the beginning of the project build a temporary parking lot for Hot Springs Pool (HSP) customers in the area of the current Shell Station footprint, bordered by North River Street, North River Drive, 6th Drive, and the Dairy Cream Property / Abutment 1 on the East Side. Also, build a pedestrian walkway from this proposed parking lot to the HSP. The pedestrian walkway would be in proximity to, and just to the south of the adjacent buildings. The next step would be to close the current HSP parking lot. This area would then be used for construction staging. See Figures 1 and 2.

Figure 1: Proposed configuration keeping N. River Street open during construction.
Figure 2: Proposed configuration closing N. River Street during construction.

Estimated potential cost savings:

Not Evaluated

Discussion:

This proposal would have to be discussed with and approved by the HSP. If the area available for the temporary parking lot is not large enough for negotiating with the HSP, consider closing North River Street in this area to expand the temporary parking lot. This may also expand the construction staging area.

Related Value Engineer proposal:

None

Advantages of this Proposal:

Provide an area for construction activities and staging in a convenient location. This area is located in the area of a portion of the bridge.

Advantages of original design concept:

Construction staging was not addressed in original design concept.

Risks associated with implementing this Proposal:

1. If N. River Street is not closed, construction activities will have to cross N. River Street. This is a risk to public safety.

2. Reduces the likelihood of vehicles/pedestrians entering the work area. Will need to separate all work areas with proper fencing, barriers, etc.
3. In order to open new Grand Avenue bridge after downtown closure, all intersection work will need to be complete, thereby necessitating concurrent construction of intersection and the main bridge.

Calculations:
None

Figure 1
Proposed Configuration keeping N. River Street open during construction (NTS)

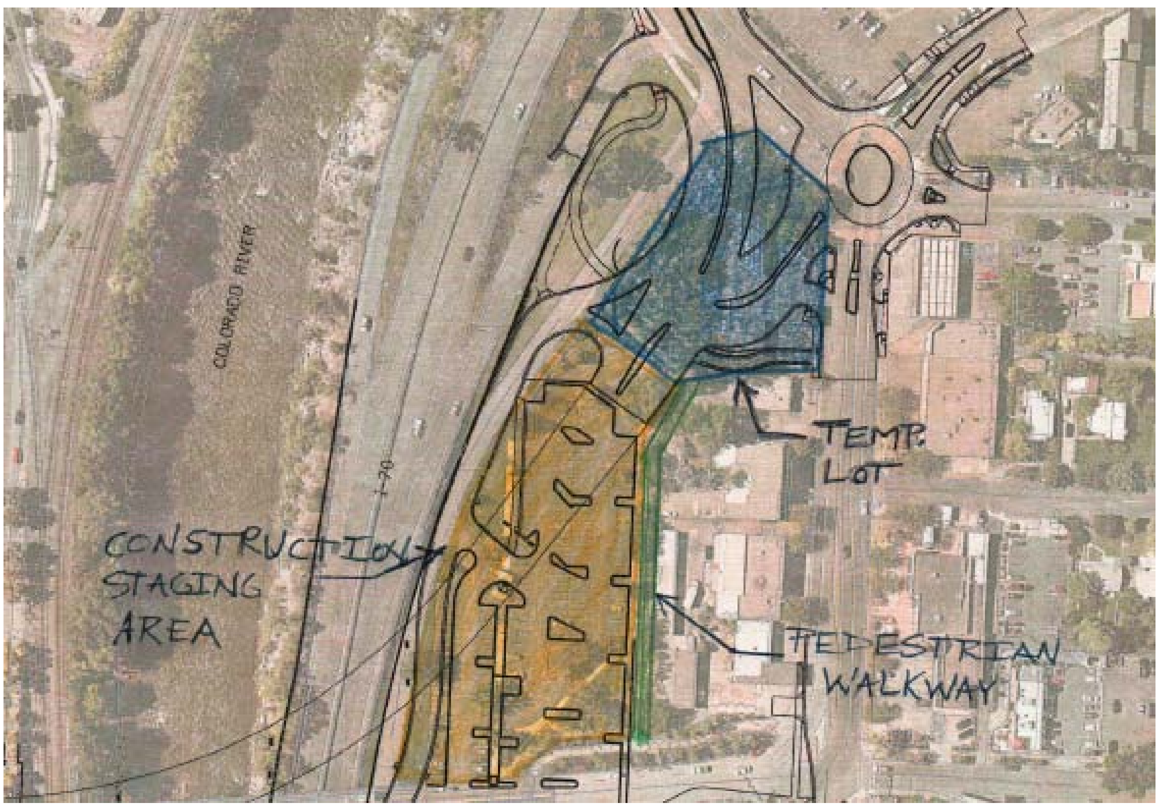
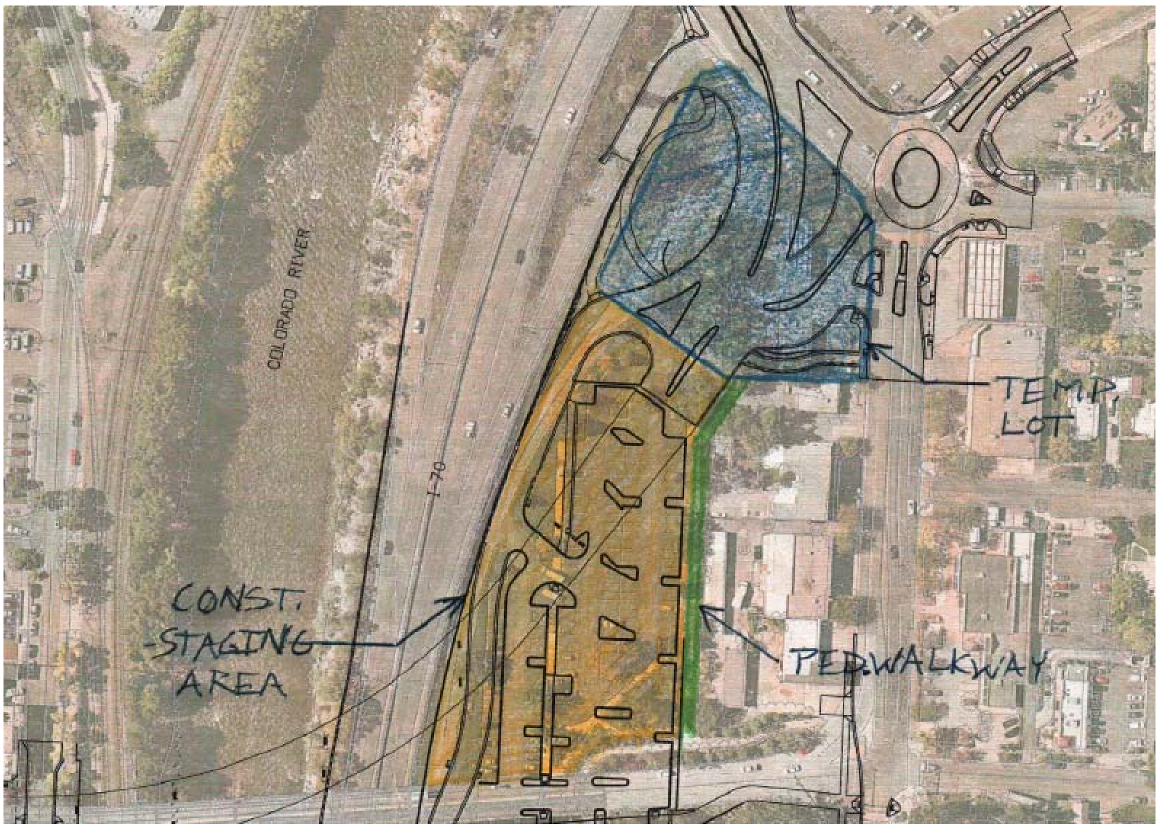


Figure 2
Proposed Configuration closing N. River Street during construction (NTS)



Value Engineering Proposal No. 6
Use new pedestrian bridge to assist with maintenance of traffic ("MOT")
Recommended Action: Design Consideration

Summary
Use new pedestrian bridge to help with MOT during reconstruction of the Grand Avenue Bridge ("GAB").

Estimated potential cost savings:
Uncertain; savings related to potentially less traffic on detour

Discussion:
Current proposed detour route is Midland Avenue between exit 114 and 27th street; however there is local opposition to this route because many consider Midland Avenue, south of 8th street, a "residential collector" street. Additionally, this road is most likely not designed to accommodate the increased traffic that would be a result of the Grand Avenue Bridge closure.

Using 8th street as an alternate detour route is currently being investigated by the Grand Avenue Bridge project team along with the City of Glenwood Springs. The City has an interest in this route being used for the GAB project because it is a project that is in their master plan. Using either Midland Avenue or 8th Street as a detour route will keep the traffic out of the downtown section – a benefit to the contractor but potentially negative for the businesses.

As designed, the new pedestrian bridge currently measures 18'-0" out-to-out with 16'-0" clear (ultimately). In order to have traffic use this bridge, barrier will need to be installed along the outside edges. After the barrier is placed and attached to the bridge deck there will be 14'-0" clear which is adequate for one lane of traffic (12'-0") with 2'-0" shy distance (1'-0") on each side.

This proposal assumes the existing pedestrian bridge will be left in place to allow mobility for pedestrians and cyclists between the north and south sides of the river.

Related Value Engineer proposal:
40, Pedestrian bridge width reduction. If proposal 40 is accepted, this proposal will no longer be possible.

Advantages of this Proposal:
1. This design consideration allows one additional lane of traffic to access the downtown area during the downtown closure period. This could be used as a "flex lane" allowing alternating directions of traffic based on peak traffic flows.
2. Improved accessibility to downtown businesses for traffic north of GAB.
3. Improved accessibility for Emergency Medical Services ("EMS") – consider restricting use of the new pedestrian bridge as described in this Design

Consideration solely to Emergency Vehicles, thereby eliminating potential delays in response times.

Advantages of original design concept:
None

Risks associated with implementing this Proposal:
1. Getting a touchdown point on the south end of the new pedestrian bridge for traffic to get access to the bridge.
2. Will necessitate additional cost to furnish, install, and remove jersey barrier along edges of bridge deck.
3. Accommodating traffic in work zone

Calculations:
None

Value Engineering Proposal No. 7
Launch Pedestrian Bridge From The North
Recommended Action: Design Consideration

Summary

Rather than utilizing conventional methods for erection of steel girders for the Pedestrian Bridge consider using a "Launching" technique from the North Abutment in order to minimize temporary construction impacts to the Hot Springs Pool (HSP), I-70 traffic, Colorado River and the Railroad.

Estimated potential cost savings: Not Evaluated

Discussion:

In order to construct the Pedestrian Bridge using conventional erection techniques the contractor will need to occupy more space for a longer period of time in the HSP parking lot; will need to detour traffic on I-70; will need to build a substantially larger temporary work pad in the Colorado River; will need to cross the railroad tracks more often. By utilizing a launching technique the contractor will only need to occupy enough space and for a period of time sufficient to construct the substructure. Since the launched structure is a completed, stable structure on permanent supports some owners have permitted advancing the structure over live traffic. The launching technique is a relatively safer operation over traditional erection techniques This option will also reduce the overall impacts to the adjacent stakeholders.

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Related Value Engineer proposal:

None

Advantages of this Proposal:

1. Reduce the amount of time of temporary impact in the HSP parking lot
2. CDOT May consider allowing the advancement of the structure over live traffic. However, at a minimum, the advancement operation takes substantially less time to perform and does not require any equipment to be located with the I-70 travel way which allows I-70 traffic to be slowed down using off-duty officers during the advancement of girders to create short gaps in traffic rather than detouring traffic on to 6th.
3. Size of temporary work pad in the Colorado River will be substantially reduced
4. Reduced number of trips over railroad tracks
5. Greater control over schedule allows contractor to better coordinate with rail traffic
6. All girders can be delivered to project via 6th Avenue during off-peak hours. Current approach would need to deliver girders through a number of different routes resulting in greater impacts.

Advantages of original design concept:

None

Risks associated with implementing this Proposal:

Haunched girder shape has the potential to complicate launch

Calculations:

Not evaluated quantitatively

Estimated potential cost savings

This option will likely result in additional costs to design and procurement of the steel girders as well as the additional costs to furnish the temporary launching nose and pier rollers, however, some of this cost will be offset by a savings in temporary work pad costs. However, the main benefit of this option is the reduced impacts to the adjacent stakeholders during the construction process.

The costs to perform the actual bolt-up and launch would be similar to traditional erection methods. There is some risk that the haunched shape of the girder may necessitate providing a temporary support frame at the piers to carry the girders from the top during the launching process resulting in additional costs. Design Team may want to consider eliminating the hanuched shape in order to simplify the launching process, making the Pedestrian Bridge girders shape consistent with the Grand Avenue Bridge girders and ultimately reducing the cost of the girders.

Value Engineering Proposal No. 10 and 28
Regional Traffic Connection to 116 Interchange
Recommended Action: Design Consideration

Summary
Proposals 10 and 28 were determined to be essentially the same and are combined for this evaluation.

From a vehicular mobility perspective, the ideal solution to improve traffic operations and overall connectivity in Glenwood Springs would be to provide connections to I-70 at Grand Avenue (SH82). The majority of traffic within the project area is regional traffic that moves from points west of Glenwood Springs to points south of Glenwood Springs using SH82. Providing a direct connection to I-70, would allow this regional traffic to avoid going through north Glenwood, where the ability to provide additional capacity is limited. However, there are significant constraints at Grand Avenue to make this connection.

This design consideration identifies a possible connection to I-70 from Grand Avenue that allows regional traffic direct access to SH82.

Estimated potential cost savings: <u>$0</u>
This concept would require the Alternative 1 alignment in order to develop the intersection for the ramps to connect to. VE Proposal #4 evaluated the Alternative 1 concept and established a cost of $26M. Using the costs and calculations on the following pages, the cost of construction items of the concept discussed herein would be:

Alternative 1 + West Ramps = $26M+ $9M = $35M

The Alternative 3 cost of construction items was estimated at $32.5M.

It is estimated that this alternative would result in a net $2,500,000 construction cost *increase*. This may be offset by savings due to little or no ROW acquisition.

Discussion:
By providing a direct connection, 70-75% of the peak hour traffic will be removed from the existing SH82 roadway network that extends from the interchange to 6th Street to Grand Avenue.

To provide these direct connections for regional traffic, an elevated intersection with Grand Avenue is proposed over I-70. This configuration for Grand Avenue would be compatible with Alternative 1 that has been studied by the project design team. The concept is to provide direct connections from the intersection to tie into the ramps at the 116 interchange. This proposal potentially allows for a narrower bridge width between north Glenwood and the ramp intersection due to lower traffic volumes. It also eliminates all of the improvements and property acquisitions at the north end of the Alternative 3 bridge as well as the associated construction impacts.

The attached concept depicts one option of providing this connection. Alternatives that could also be considered are:

- Realign the existing 116 westbound off-ramp to enable landing the proposed westbound ramp prior to SH82
- Adjusting the indicated tie-in location to the north or south on Grand Avenue to optimize ramp profiles and connections
- Curving the ramp connections to the south at Grand Avenue to allow for a slightly higher speed of access

Related Value Engineer proposal:
Proposal 4

Advantages of this Proposal:

- Better connectivity to I-70 with less conflict points than an at-grade intersection.
- Eliminates reconstruction of the SH82, 6th Street and Laurel Avenue intersection and all associated property acquisitions.
- Maintains the Grand Avenue Bridge in or near its existing location.
- The impacts to the view sheds are comparable to Alternative 3, with the west ramps occupying the same view plane for much of their alignment.
- Appears to require no additional ROW, leaving the maximum available for redevelopment.
- Reduced traffic on 6th Street allows for potential change to make the area more pedestrian friendly.

Advantages of original design concept:
Potentially shorter construction duration during demolition and construction of the new bridge.

Risks associated with implementing this Proposal:

- Potentially longer construction.
- Potential 1601 process requiring longer approval time from FHWA.
- More costly in construction cost, could be offset by reduced ROW costs and construction traffic control costs.
- Incorporation of intersection into bridge profile.

Calculations:

COMP.

CK.

DATE 11-6-13

WILSON &COMPANY

LOC.

PROJ. Grand Ave

SUBJ. VE #10

FILE

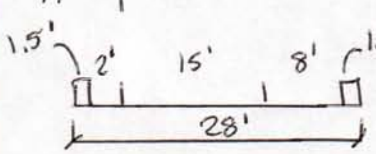
SHEET 1

OF

Quantities

		ON FILL	BRIDGE
Ramps - Estimated Length	Eastbound	250'	615'
	Westbound	370'	1060'

Ramp Section



Bridge

Bridge Area

Eastbound 615 x 28 = 17,220 sf

Westbound 1060 x 28 = 29,680 sf

Additional at Intersection = 7,910 sf

54,810 sf

Fill Section - Embankment Assumed

Eastbound: 250 x 28 x 12/2 = 42,000 cf = 1,556 cy

Westbound: 370 x 28 x 14/2 = 72,520 cf = 2,686 cy

4,241 cy

Retaining Wall

Eastbound (River side only): 325 x 12/2 = 1950 sf

Westbound (Ex. Ramp side): 370 x 14/2 = 2,590 sf

4,540 sf

Pavement (Approaches)

Eastbound: 25 x 325 = 8,125 sf

Westbound: 25 x 370 = 9,250 sf

17,375 sf = 1,930 sy

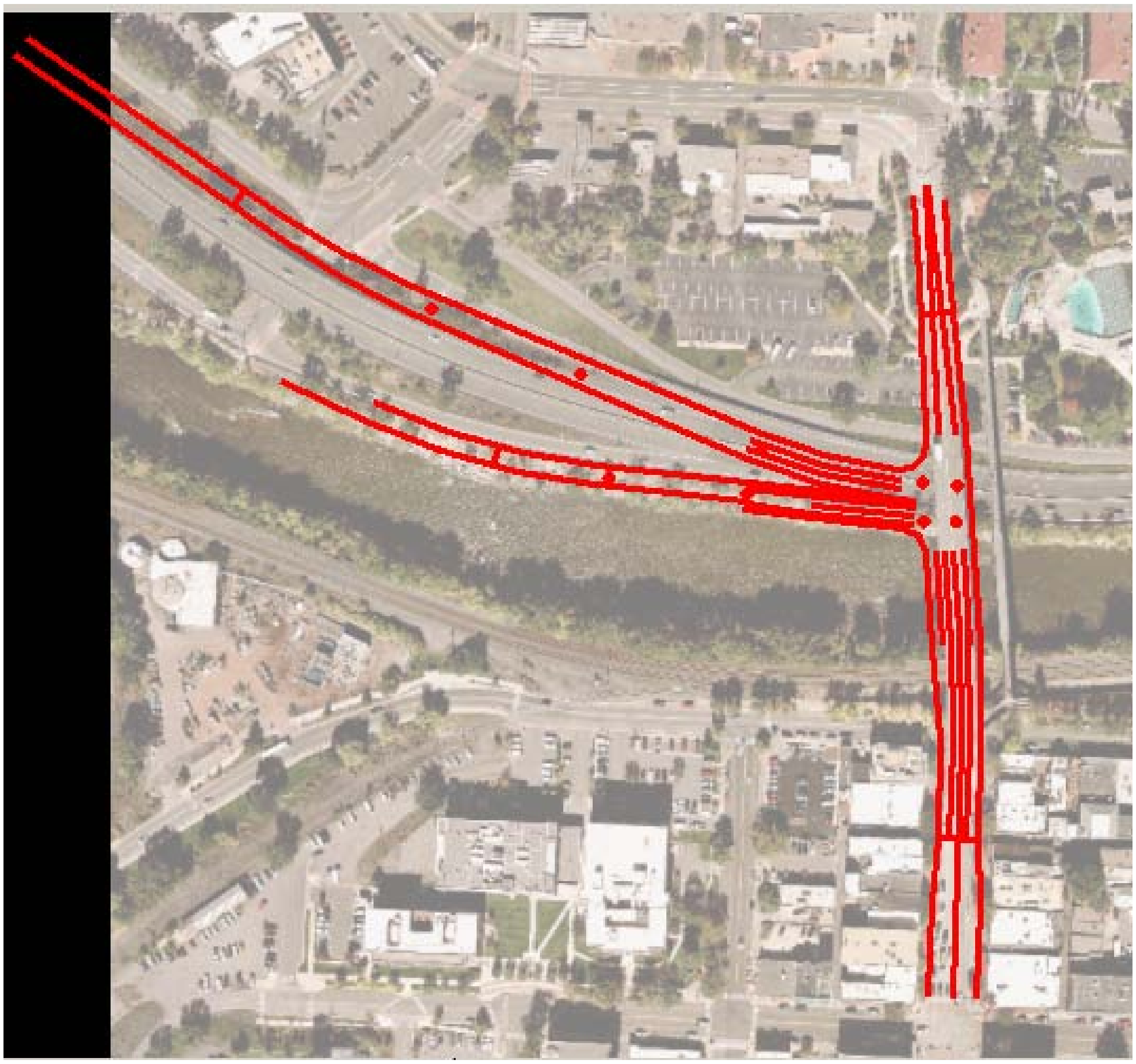
HMA = $\frac{12''}{}$ x 1930 x $\frac{110 \text{ lbs}}{\text{sy in}}$ = 2,548,333 lbs = 1,274 tons

Cost Calculations:

ENGINEERS SCOPING ESTIMATE

COLORADO DEPARTMENT OF HIGHWAYS ENGINEERS SCOPING ESTIMATE				Proj. No. Subaccount	
SH 82, Grand Ave Bridge Replacement (F-07-A)		Date: 11/6/2013		Prepared By: MTD	
Item Number	ITEM	UNIT	QUANTITY	PRICE	AMOUNT
	Structure Costs				
	Vehicular Bridge - Westbound Ramp	SF	36,255	$ 150.00	$ 5,438,250
	Vehicular Bridge - Eastbound Ramp	SF	18,555	$ 150.00	$ 2,783,250
*	Walls	SF	4540	$ 75	$ 340,500
	Roadway Costs				
	HMA	Ton	1,274	$ 75	$ 95,550
	Embankment Material (CIP)	CY	4,241	$ 15	$ 63,615
	Traffic Control				
	Signals	Each	1	$ 191,550	$ 191,550
	Total				**$ 8,912,715**

General Configuration



Value Engineering Proposal No. 11
Tighten Grand Avenue Bridge Curve
Recommended Action: Design Consideration

Summary

By reducing the radius of the horizontal curve at the north end of the proposed downtown portion of the SH 82 structure using an approximately 30 mph design speed, low, uniform speeds can be achieved between downtown Glenwood Springs and the area north of the river. These speeds would be consistent with speeds in both of those areas.

Estimated potential cost savings: Relative to EA Alternative 3, this alternative would add approximately $1 million dollars in cost, due largely to the increased length of bridge that would need to be moved laterally into position. See attachment.

Discussion: This option provides for low and uniform speeds along SH 82 throughout the project area. This has benefits along the elevated, curved segment in terms of potential minimization of:

- collisions,
- noise in a relatively sensitive area, and
- particulate pollution

This horizontal alignment is compatible with both EA Alternative 3 and VE Proposal 3+8. Because the PC of the horizontal curve is nearly coincident with the crest of the vertical curve over the river, drivers heading north on Grand Avenue will see the curve before they begin their descent towards the north side of the river. Conversely, southbound drivers will exit the curve at a low speed as they descend into the downtown area. See attachment.

Related Value Engineer proposal: 3 + 8

Advantages of this Proposal: Low, uniform speeds consistent with surrounding environment, potentially leading to minimized collisions; reduced impacts to the human environment

Advantages of original design concept: Relatively lower cost.

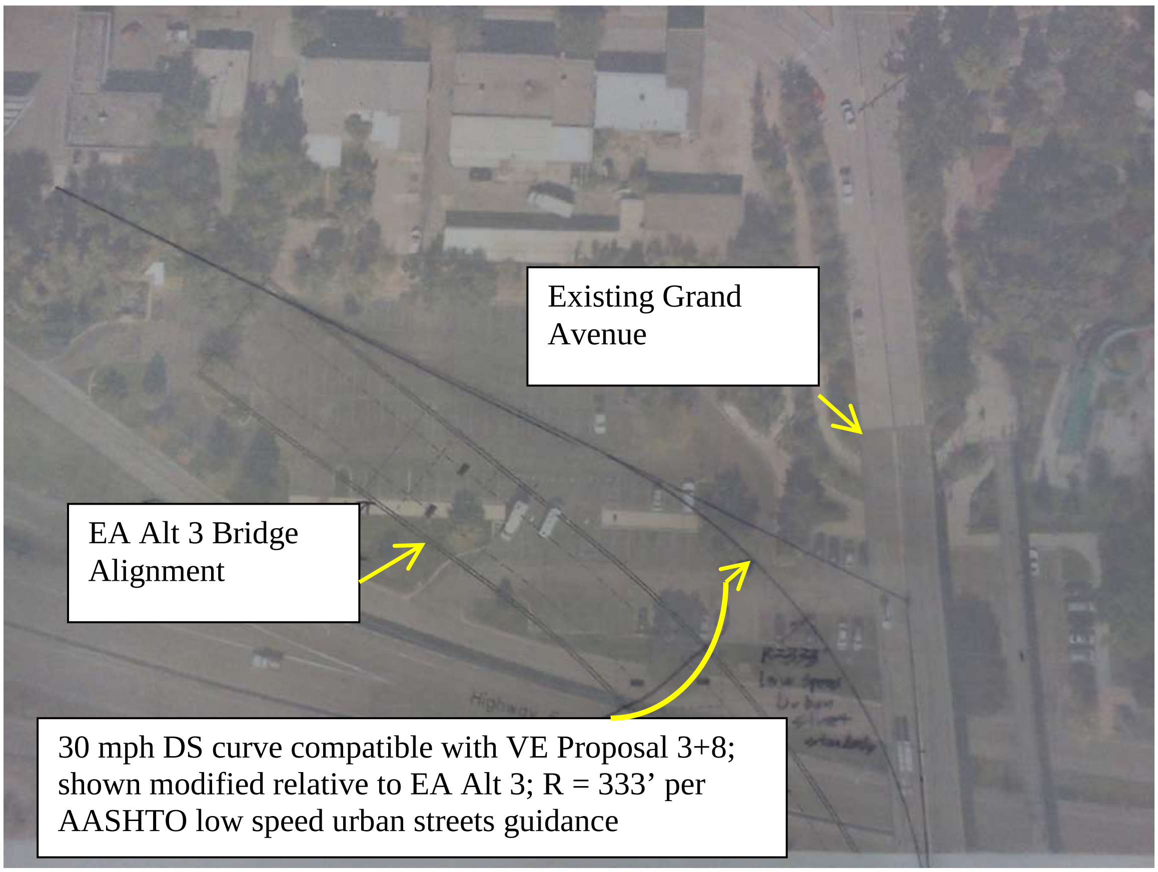
Risks associated with implementing this Proposal:

- Increased length of SH 82 bridge requiring slide-in
- Complicated slide due to pier angle in GHS parking lot near
- Increased impact to GHS parking

Calculations: See attached

Value Engineering Proposal 11 : Tighten SH 82 horizontal curve

Cost Estimate						
Component	Quantity	Width (ft)	Length (ft)	Area (ft^2)	Unit Cost ($ / ft^2)	**Estimated Cost**
Bridge Superstructure: length of lateral move increased 267' to 475'	0.5				$ 1,000,000	$ 500,000
Bridge Superstructure: decreased length of main spans over river, I-70	1				$ (700,000)	$ (700,000)
Bridge Superstructure: increased length of main unit from 782' to 835'		74	53	3922	$ 200	$ 780,000
Bridge Substructure: additional pier at parking lot	1				$ 200,000	$ 200,000
						$ -
					Total	$ 780,000



Value Engineering Proposal No. 13 and 42
Pedestrian Bridge Consider Truss Structure Type
Recommended Action: Incorporate

Summary

Pedestrian Bridge could achieve increased value through cost reductions, by considering more efficient superstructure type. Truss superstructure would be more efficient and less costly.

Estimated potential cost savings: $ 0.39 million

Discussion:

Pedestrian Bridge superstructure type consisting of low-truss or through-truss superstructure types would be more efficient, because truss structure types provide strength by using tension and compression members configured to efficiently span large distances. The truss components are located outside the bridge deck, and efficiently support fence or railings mounted on the truss to provide safety containment of pedestrians and other bridge users. A portion of the truss extends below the deck and connects to floor beams spanning transversely between trusses. For low-truss structure types, the portion of the truss that extends above the bridge deck can be configured to provide the main elements of railings, thereby minimizing the fence/railing components. Through-truss structure types consist of the main trusses on the sides, the lower floor beams, and upper bracing; a roof can be installed on the upper bracing if an enclosed bridge is desired to prevent intentional or unintentional falls, or to reduce maintenance by keeping snow/ice off the bridge deck. A Pedestrian Bridge superstructure consisting of low-truss or through-truss superstructure types would achieve increased value through cost reductions.

Related Value Engineer proposal:

Value Engineer Proposal 15: Land Pedestrian Bridge north of UPRR, is related. A through-truss lowers the profile and either reduces the grade or shortens the ramps. Value Engineer Proposal 13 could be implemented with or without Value Engineer Proposal 15.

Value Engineer Proposal 36: Single Column Piers, is related. Value Engineer Proposal 13 could be implemented with or without Value Engineer Proposal 36.

Value Engineer Proposal 40: Pedestrian Bridge Width, is related. Value Engineer Proposal 13 could be implemented with or without Value Engineer Proposal 40.

Advantages of this Proposal:

- Pedestrian Bridge superstructure type consisting of low-truss or through-truss superstructure types would be more efficient and achieve cost reductions.
- Through-truss structure type lowers the profile and potentially shortens the ramps along 7th Street by approximately 50'.

Advantages of original design concept:
Pedestrian Bridge provides architectural theme.

Risks associated with implementing this Proposal:
Implementation of this proposal would not change project risks.

Calculations:

Value Engineering Proposal 13 : Pedestrian Bridge Consider Truss Structure Type

Cost Estimate						
Component	Quantity				Unit Cost ($ / ft^2)	**Estimated Cost** (nearest $ 10 k)
Pedestrian Bridge superstructure, 10% less cost than preliminary cost for Pedestrian Bridge in preliminary plans	-0.1				$ 3,900,000	$ (390,000)
						$ -
					Total	$ (390,000)

Value Engineering Proposal No. 14 & 54
SH 82 Bridge Downtown Unit Use Precast Pretensioned Components
Recommended Action: Incorporate

Summary
SH 82 bridge Downtown Unit could achieve increased value through cost reductions and through construction duration reductions, by considering precast concrete and precast pretensioned concrete structure components for the downtown unit. Pretensioned concrete girders are less costly, reduce construction duration, and provide better serviceability over the life of the structure. Precast concrete columns, pier caps, and abutment caps reduce construction duration.

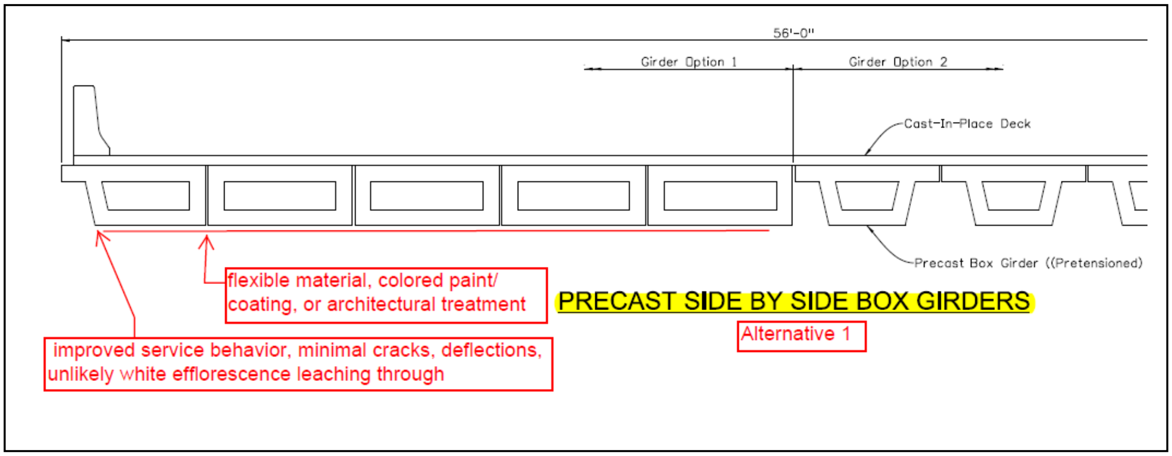
Estimated potential cost savings: **$ 0.2 million**

Discussion:
SH 82 Bridge Downtown Unit superstructure using precast pretensioned concrete girders in side-by-side configuration with cast-in-place reinforced concrete composite topping slab structure depth is a more efficient structure type. Using precast pretensioned concrete box girders, a 2’-6” girder depth would provide adequate strength and provide stresses complying with the service limit states for 75’ span length. A nominal 5.5” thick reinforced concrete slab cast-in-place on the girders achieves composite behavior.

There are a variety of architectural treatment approaches to address any concerns about the visual aspects of the gaps between the girders on the bottom of the bridge. The small gaps between the pretensioned girders can be covered with flexible material, made un-noticeable by a colored paint/coating.

By using precast pretensioned concrete box girders, the construction duration will be reduced by approximately one week compared to a reinforced concrete slab superstructure, which would require forming, placement of reinforcing, and placement of a large quantity of cast-in-place concrete in a constrained area. Reduction of construction duration provides value by reducing the number of Grand Avenue closure days required to construct the SH 82 Bridge Downtown Unit.

Precast pretensioned concrete girders achieve better service behavior than reinforced concrete slab superstructures. The pretensioned concrete girders are designed to provide adequate strength, and more importantly, designed to achieve stresses within allowable stresses for crack control and deflection control. Conversely, reinforced non-tensioned concrete superstructure members subject to bending and shear often provide adequate strength, but are susceptible to service issues, such as crack control, white efflorescence leaching through cracks after several years, and deflections that contribute to further cracking. Pretensioned concrete superstructure members benefit from the concrete pre-compression, resulting in minimal cracking and deflections.



Precast reinforcing concrete or precast pretensioned concrete components are possible solutions for reducing cost and reducing construction duration of the Downtown Unit substructure. Precast concrete columns with grouted connections to the foundations, could be used for the pier columns to reduce construction duration by approximately one week. Precast pretensioned concrete pier caps with grouted connections to the columns could be used to reduce construction duration by approximately one week. Precast mildly reinforced or precast pretensioned concrete abutment cap with grouted connection to abutment foundations could reduce construction duration by approximately 0.8 week, compared to forming and placing reinforced cast-in-place concrete.

Related Value Engineer proposal:
No related proposals.

Advantages of this Proposal:
SH 82 Bridge Downtown Unit using precast concrete and precast pretensioned concrete structure components, achieves value to the project in the following ways:

- Reduced cost of SH 82 Bridge Downtown Unit superstructure;
- Improved service behavior of SH 82 Bridge Downtown Unit, such as minimal cracks, minimal deflections, and unlikely white efflorescence leaching through cracks in the superstructure;
- Reduced construction duration of approximately one week for SH 82 Downtown Unit superstructure construction;
- Reduced construction duration of approximately 2.8 weeks for SH 82 Downtown Unit substructure pier columns, pier caps, and abutment cap;
- Reduction of need for high-early concrete in structural components.

Advantages of original design concept:
On the bottom of the SH 82 Downtown Unit, the reinforced cast-in-place concrete superstructure would provide a smooth bottom surface.

Risks associated with implementing this Proposal:

Limited access in downtown area for delivery and setting girders.

Calculations:

SH 82 Grand Avenue Bridge Replacement VE Study

Value Engineering Proposal 14 : SH 82 Bridge Downtown Unit Use Precast Prestressed Components

Cost Estimate				
Component		Area (ft^2)	Unit Cost ($ / ft^2)	**Estimated Cost** (nearest $ 10 k)
Downtown Unit: Superstructure and Substructure in preliminary plans: preliminary cost estimate results		-11,400	$ 158.82	$ (1,810,000)
Downtown Unit: Superstructure and Substructure using precast pretensioned concrete box girders, composite deck topping, and precast substructure components		11,400	$ 140	$ 1,600,000
				$ -
				$ -
			Total	$ (210,000)

Value Engineering Proposal No. 15
Land south end of pedestrian Bridge on the north side of the railroad lines
Recommended Action: Incorporate

Summary: Land the pedestrian bridge on the north side of the railroad lines and provide an at-grade crossing of the railroad tracks in the Glenwood Springs ROW under the existing Grand Avenue Bridge.

Estimated potential cost savings: The cost savings are difficult to quantify since the ramp portion of the pedestrian bridge is not well defined. Savings will range from approximately $0 to $1,000,000.

Discussion: By landing the pedestrian bridge on the north side of the tracks we eliminate the need for steps, elevators, and bridge ramps between the railroad and 7th street. It is our understanding that Glenwood Springs owns the ROW under the Grand Avenue bridge and the railroad has a use easement. This should make it easier to get permission for an at-grade crossing.

I-70 is approximately 12 feet below the top of rail elevation. Assuming 17.5’ of minimum clearance at I-70 and a 6’ constant depth structure, the pedestrian bridge needs to drop about 12’ from the I-70 crossing to the at-grade railroad crossing. At a 4.5% grade the bridge will drop about 8’ over 175’ from the I-70 clearance point to the pier on the south side of the river. The pedestrian bridge pier at the south edge of the river would remain at its current location. At this point the bridge turns 90 degrees and heads west 20’ to 30’ and then U-turn back 50’ to 100’. This portion of pedestrian ramp is on a bridge outside of the RR right of way and looks like a cantilevered walkway above the existing walls. The additional bridge length with the u-turn provides an additional 4’ drop to the RR grade. See figure 1.

A constant depth structure was assumed since the continuity at the south end was eliminated and the haunched portion of the bridge may clip the I-70 clearance envelope.

The pedestrian crossing is located as far west as possible within the Glenwood springs ROW. This allows room for the passenger trains to stop at the depot without blocking the pedestrian walkway. At-grade crossings and pedestrian safety is always a concern. Signed, controlled access pedestrian crossings have a very good safety rating. Currently pedestrians often wander across the tracks to view the river in uncontrolled crossings. The addition of a controlled access crossing may be an improvement over current conditions when viewed from a pedestrian safety standpoint.

Freight train operations need to be modified slightly. Team members are aware that the freight train operators occasionally stop at the depot to let canyon traffic clear and to have dinner at local restaurants. An agreement would need to be in place requiring the freight trains stop before the depot to eliminate the possibility of a freight train parked in the pedestrian crossing.

The potential for a pedestrian undercrossing in addition to the at-grade crossing exists. The undercrossing could accommodate pedestrians when trains are parked in the path. A pedestrian undercrossing is very difficult for a number of reasons including:

- Limited ROW
- High water forces the undercrossing down towards Colorado Avenue if the undercrossing is designed to remain above high water at all times. At Colorado Avenue is the service entrance for the depot which limits locations of the undercrossing. The service road pushes the ramp from the tunnel up to 7th street close to 7th street and will require retaining walls approaching 20'.
- Difficulties in constructing the undercrossing without impacting rail traffic.
- The service access to the depot would have to be reconfigured since the service road and the at-grade ramps interfere with each other.
- Construction of the ramp to the pedestrian undercrossing could not be completed until after the bridge slide.

The variation in cost savings is high for the following reasons:

- A plain set of pedestrian ramps versus an aesthetic set of ramps could change the estimated cost/sf from $100/sf to $130/sf.
- Cost savings due to eliminating the elevator (approximately $400,000) is only applicable if an elevator is included in the base option.
- Depending on the location of the proposed ramps the length of elevated ramps eliminated varies from 50' to 300'.
- If a pedestrian undercrossing is not provided savings from eliminating the bridge ramps could be used to improve the existing at-grade ramps up to 7th street which could include 150' of retaining wall.
- The type and style of pedestrian crossing gates vary significantly in costs. The minimum cost option is a simple fence and signing. The maximum cost option provides an automated gate to physically block access to the crossing when trains are approaching.
- A railroad undercrossing culvert for pedestrians is a high cost item due to the difficulty in constructing the culvert while maintaining traffic on the railroad tracks, the additional bridge length outside the railroad ROW required to get the ramp grade low enough to go under the railroad lines, and the additional at-grade ramp and walls to bring pedestrians back up to grade at 7th street.

Related Value Engineer proposal:

Advantages of this Proposal:

- Reduces cost when a pedestrian undercrossing is not provided.
- Reduces construction impacts.
- Eliminates visually unappealing pedestrian ramps.
- Eliminates need for an elevator.
- Provides a controlled access point for pedestrians who want to get close the the water.

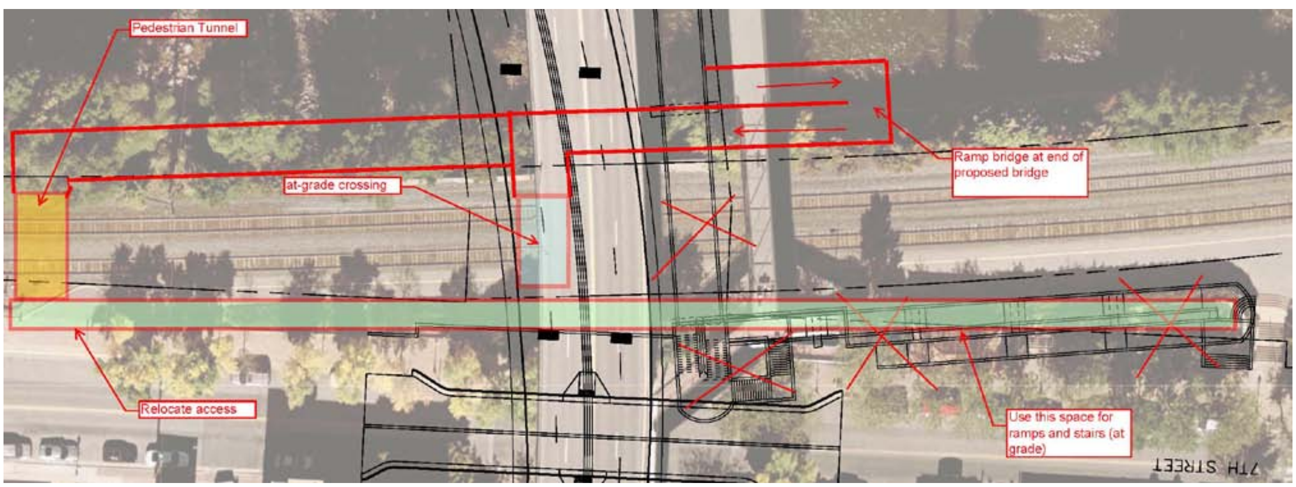
- The ramp bridges at edge of river could be constructed as a boardwalk type area and provide a pleasant area to view the river.
- Eliminates pedestrian bridge construction over railroad.

Advantages of original design concept:

- Eliminates at-grade crossing.
- Utilities do not require boring under the railroad.
- Vertical clearance allows for haunched girders for aesthetics.
- Provides more freeboard under pedestrian bridge.

Risks associated with implementing this Proposal: Obtaining approval from Railroad will be difficult but the controlled access could be considered an improvement over the current conditions. Utilities may object to relocation under railroad tracks.

Calculations: Eliminates 80' of 16' wide box, eliminates 350' of elevated ramp bridges on south side of tracks. Adds 50' to 150' of ramp bridge near track level if an undercrossing is not provided. Adds 200' of ramp bridge and 200' of at grade ramps if an undercrossing is provided. Adds approximately 125' of at-grade ramps to bring pedestrians up to 7th street if the existing ramps are not used.



Value Engineering Proposal No. 16
Utilize Spread Footings For All Bridge Foundations

Recommended Action: Incorporate

Summary
Use shallow foundations (spread footings) at each bridge substructure location to achieve cost savings, reduce differential settlement, and achieve foundation consistency.

Estimated potential cost savings: $400,000

Discussion:
The current bridge layout consists of shallow foundations at the abutments and Piers 2, 3, 7, and 8. Drilled shafts are proposed at Piers 4, 5, and 6. Originally, drilled shafts were proposed for all bridge foundations; however, a preliminary change to spread footings suggests a cost savings of $990,000 based on previous analysis by TSH (Attachment 1).

This proposal will change the remaining drilled shaft foundations at Piers 4, 5, and 6 into spread footings to match the other foundations and the pedestrian bridge foundations. Additional geotechnical exploration and analysis will be required to develop final design recommendations. The scour depth is understood to be 5 feet, which may require deepening the footings for Piers 4 and 5 adjacent to the Colorado River. As part of the proposal estimate, an allowance was created for additional geotechnical analysis and/or ground improvement to improve the design confidence in the use of spread footings.

The current bridge is supported on spread footings and there are no known foundation performance issues.

Related Value Engineer proposal: None

Advantages of this Proposal:
- Reduces cost of bridge foundations.
- Eliminates the deeper drilled shaft excavations into the subgrade which could create a perceived impact to the Glenwood Hot Springs pool hydrogeologic conditions.
- Reduces risk for construction delay and claims due to difficulties with shaft installation in alluvium with boulders and potential travertine deposits.
- Bridge foundation type will be consistent which reduces the potential for differential movement between foundation elements.
- Standardized foundation construction methods for the contractor.
- Mobilization for a drilled shaft contractor is not required. Additionally, the staging area will not need to accommodate a large drilling rig and reinforcing steel lay down area.

- Eliminates potential delay/extension of downtown closure duration if unforeseen conditions are encountered while drilling shafts at Pier 6.
- Preliminary drilled shaft design includes the use of base grouted shafts, which have limited use in Colorado in general and have not been used by CDOT yet. Use of spread footings eliminates the need for specialized out-of-state construction resources that may not have familiarity with geotechnical conditions in CDOT Region 3.
- Provides additional flexibility in the slide options/configuration, potentially reducing the lateral slide costs.

Advantages of original design concept:

- There is familiarity with drilled shaft installation and design within CDOT and the Glenwood Springs area.
- Drilled shafts have a smaller footprint relative to spread footings.
- Drilled shafts provide superior scour protection.

Risks associated with implementing this Proposal:

- Excavations adjacent to the river.
- Design for scour mitigation.

Calculations:

Grand Avenue Bridge Value Engineering Proposal No. 16
Cost Analysis - Use of footings at all substructure locations

Current Foundation Cost Reduction With Footings		
Number of abutments/piers with footings	6	(Abutment 1 and 9, Piers 2, 3, 7, and 8)
Number of piers with drilled shafts	3	
Previously estimated VE savings	$990,000	Per analysis by TSH
Approximate cost savings per element	$165,000	
Additional Cost Reduction Analysis		
Estimated gross savings with conversion to footings	$495,000	Assumes footings at Piers 4, 5, and 6
Footing Width	66	Feet
Footing Length	33	Feet
Estimated volume for deeper excavation at Pier 4	495	Assume 5 foot deeper excavation with sloped sides
Estimated volume for deeper excavation at Pier 5	403	Assume 5 foot deeper excavation with shoring
Additional Quantity - Item 206-00000, Structure Excavation	898	Cubic Yards
Unit Cost, 206-00000	$20	Per CMGC Contractor Estimate
Additional Structure Excavation Cost	$17,967	
Allowance for shoring at Pier 5	$50,000	
Allowance for ground improvement at each new footing	$10,000	Use testing/improvement to for geotech confidence

Net estimated savings for footings at Piers 4, 5, and 6 $397,033

Attachment 1 – TSH cost analysis for use of spread footings at Abutment 1 and 9 and Piers 2, 3, 7 and 8.

TSIOUVARAS SIMMONS HOLDERNESS
CONSULTING ENGINEERS

Project: Grand
Subject: SPREAD FOOTING COMPARISON

Job No.: 1201263
By: CMK
Date: 11/6/2013

GRAND AVE. BRIDGE SPREAD FOOTING DIME

	LENGTH (FT	WIDTH (FT	HEIGHT (FT)
ABUT 1	9.0	74.0	1.5
PIER 2	33.0	66.0	5.5
PIER 3	31.0	62.0	5.5
PIER 6	15.0	60.0	6.0
PIER 7	5.0	56.0	5.5
PIER 8	6.0	56.0	5.5
ABUT 9	5.0	56.0	1.0

GRAND AVE. BRIDGE SPREAD FOOTING QUANTITIES

			SUBSTRUCTURE						
ITEM NO.	DESCRIPTION	UNIT	ABUTMENT 1	PIER 2	PIER 3	PIER 7	PIER 8	ABUTMENT 9	TOTAL
601	CONCRETE (CLASS D)	CY	37	444	392	57	68	10	1008
602	REINFORCING STEEL	LB	7400	88733	78304	11407	13689	2074	201607
206	EXCAVATION	CY	163	633	454	368	370	103	2091
206	BACKFILL	CY	110	171	57	309	300	80	1028

COST ESTIMATE SPREAD FOOTINGS

ITEM NO.	DESCRIPTION	UNIT	SUBSTRUCTURE	UNIT COST	ITEM COST
206-00000	STRUCTURE EXCAVATION	CY	2091	$ 20.00	$ 41,818
206-00200	STRUCTURE BACKFILL (CLASS 2)	CY	1028	$ 7.00	$ 7,195
601-03040	CONCRETE CLASS D (BRIDGE)	CY	1008	$ 550.00	$ 554,420
602-00000	REINFORCING STEEL	LB	201607	$ 0.95	$ 191,527
				subtotal	$ 794,961

GRAND AVE. BRIDGE CAISSON AND CAP QUANTITIES

			SUBSTRUCTURE						
ITEM NO.	DESCRIPTION	UNIT	ABUTMENT 1	PIER 2	PIER 3	PIER 7	PIER 8	ABUTMENT 9	TOTAL
601	CONCRETE (CLASS D)	CY	90	90	90	50	50		369
602	REINFORCING STEEL	LB	17906	17906	17906	10000	10000		73718
206	EXCAVATION	CY	463	453	457	219	225	305	2122
206	BACKFILL	CY	108	326	322	167	170	4	1098
503	DRILLED CAISSON (30 INCH, BASE GROUTED)	LF	276					204	480
503	DRILLED CAISSON (48 INCH, BASE GROUTED)	LF				140	140		280
503	DRILLED CAISSON (60 INCH, BASE GROUTED)	LF		320					320
503	DRILLED CAISSON (72 INCH, BASE GROUTED)	LF			280				280

COST ECAISSON AND CAP COSTS

ITEM NO.	DESCRIPTION	UNIT	SUBSTRUCTURE	UNIT COST	ITEM COST
206-00000	STRUCTURE EXCAVATION	CY	2122	$ 20.00	$ 42,436
206-00000	STRUCTURE BACKFILL (CLASS 2)	CY	1098	$ 7.00	$ 7,686
503-00030	DRILLED CAISSON (30 INCH, BASE GROUTED)	LF	480	$ 900.00	$ 432,000
503-00048	DRILLED CAISSON (48 INCH, BASE GROUTED)	LF	280	$1,050.00	$ 294,000
503-00060	DRILLED CAISSON (60 INCH, BASE GROUTED)	EA	320	$1,200.00	$ 384,000
503-00072	DRILLED CAISSON (72 INCH, BASE GROUTED)	LF	280	$1,350.00	$ 378,000
601-03040	CONCRETE CLASS D (BRIDGE)	CY	320	$ 550.00	$ 176,000
602-00000	REINFORCING STEEL	LB	73718	$ 0.95	$ 70,032
				subtotal	$ 1,784,154
				Delta	$ 989,193

Value Engineering Proposal No. 17
Provide Structured Parking to Reduce Bridge Height & Span
Recommended Action: Design Consideration

Summary:
Reduce the parking footprint of the Hot Springs Pool (HSP) surface lot thereby affording more flexibility in the design of the north end of the main and pedestrian bridges.

Estimated potential cost savings:
Not Evaluated

Discussion:
One of the bridge profile controls is the desire to maintain 14'6" vertical clearance above the reconstructed HSP parking lot. Eliminating a portion of the surface parking lot would (1) enable a portion or all of the northernmost bridge span to be eliminated in favor of retaining walls; (2) the bridge profile to be lowered over I-70 thereby reducing project costs and visual impacts. It may also afford comparable changes to the pedestrian bridge.

Related Value Engineer proposal:
18- Shorten Bridge Span over HSP Parking Lot
34 – Reduce Flare Width at North End of Bridge

Advantages of this Proposal:
A two-level parking structure has the potential to add 50 or more additional parking spaces; helping alleviate parking demand issues in the downtown area. It may be possible to directly connect between the parking structure and pedestrian bridge to facilitate connections to downtown.

A direct connection off of 6th Street along the old Grand Avenue alignment could be provided if desirable.

It would also provide more parking for the pool which may be of value during peak demand periods.

It would also provide some covered parking which is a benefit during the winter.

Advantages of original design concept:
Surface parking may be more aesthetically appealing for users of the pedestrian bridge.

Risks associated with implementing this Proposal:
Improved efficiencies for the bridge designs may not be sufficient to offset the cost of structured parking.

Calculations:
Not evaluated quantitatively.

Value Engineering Proposal No. 18
Shorten bridge span over HSP Parking Lot
Recommended Action: Incorporate

Summary
The length of the bridge span over the HSP parking lot could be reduced to achieve a cost reduction.

Estimated potential cost savings: $177,600

Discussion:
The current design increases the hot springs parking lot capacity by approximately fifteen (15) spaces. Eliminating one row of parking will result in a loss of ten (10) spaces compared to the current design; but still results in more spaces (+5) than currently exist. Elimination of these spaces will enable the north abutment to be shifted approximately 20 feet south on the current alignment thereby shortening the bridge span by 20 feet.

Related Value Engineer proposal:
17 – Provide structured parking to reduce bridge height and span.
27 – Change N. River St to a one-way one lane road for eastbound. This option will add on-street parking thereby offsetting lost spaces.
34 – Reduce flare width at north end of bridge

Advantages of this Proposal:
Shortening of the bridge span is a cost savings.

Advantages of original design concept:
The original concept provides ten (10) more parking spaces than this proposal.

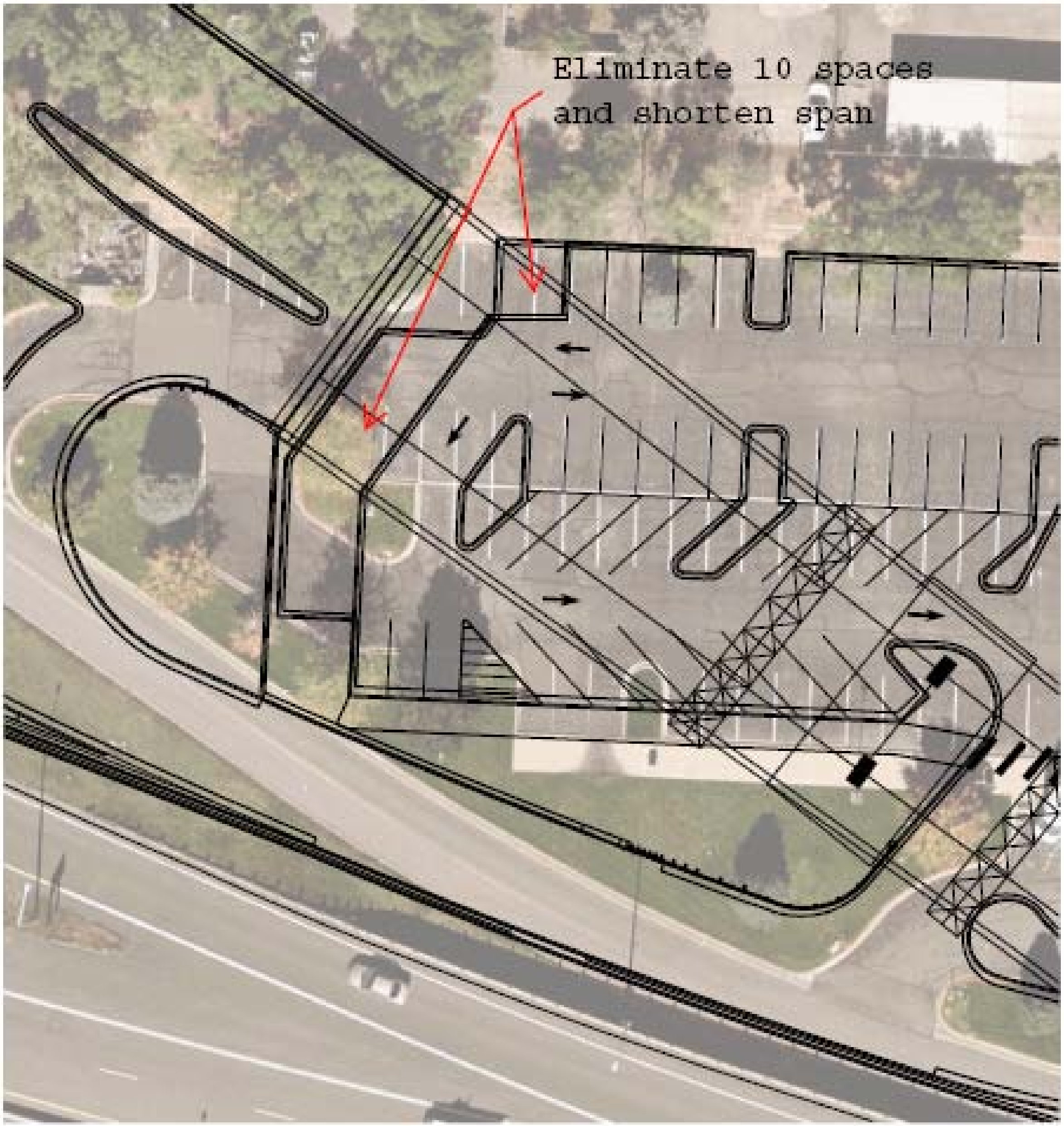
Risks associated with implementing this Proposal:
None known.

Calculations:

SH 82 Grand Avenue Bridge Replacement VE Study

Value Engineering Proposal 18

Cost Estimate					
Component	Width (ft)	Length (ft)	Area (ft^2)	Unit Cost ($ / ft^2)	**Estimated Cost**
Bridge Superstructure, includes substructure	74	20	1480	$ 200	$ 296,000
Parking lot pavement	74	20	1480	$ 10	$ 14,800
Additional Retained Embankment and Concrete Pavement	74	20	1480	$ 90	$ (133,200)
				Total	$ 177,600


Eliminate 10 spaces
and shorten span

Value Engineering Proposal 19
Use Portion of existing Grand Avenue Bridge for new pedestrian bridge.
Recommended Action: Incorporate

Summary:
A cost savings could be generated if the north section of the existing Grand Avenue Bridge could be used (re-purposed) as a portion of the new pedestrian bridge. The re-purposed section could be converted/utilized as a scenic overlook or something similar The City or locals may see value in preserving a portion of the existing bridge.

Estimated potential cost savings:
$1,339,000

Discussion:
The proposed pedestrian bridge is approximately 608 feet long. This VE proposal is for a 560 foot long bridge, of which 192 ft of the northernmost portion of the existing SH 82 bridge is kept in place (up to the pier between I-70 and North River Street), and re-purposed as pedestrian bridge. A new pier would be built at this location and the new pedestrian bridge would continue south and land at the currently proposed location.

There are many variations of this idea. One is to keep the existing SH 82 in place all the way across I-70 and construct the new pedestrian bridge starting at that point. Another option is to reduce the width of the existing SH 82 bridge to match the width of the newly constructed pedestrian bridge.

Related Value Engineer proposal:
None

Advantages of this Proposal:
Cost savings
Decreased construction time
Decreased construction impacts
Gain public perception by re-purposing an existing structure.
Re-purposed bridge section is very wide and can be converted into possible scenic overlook.

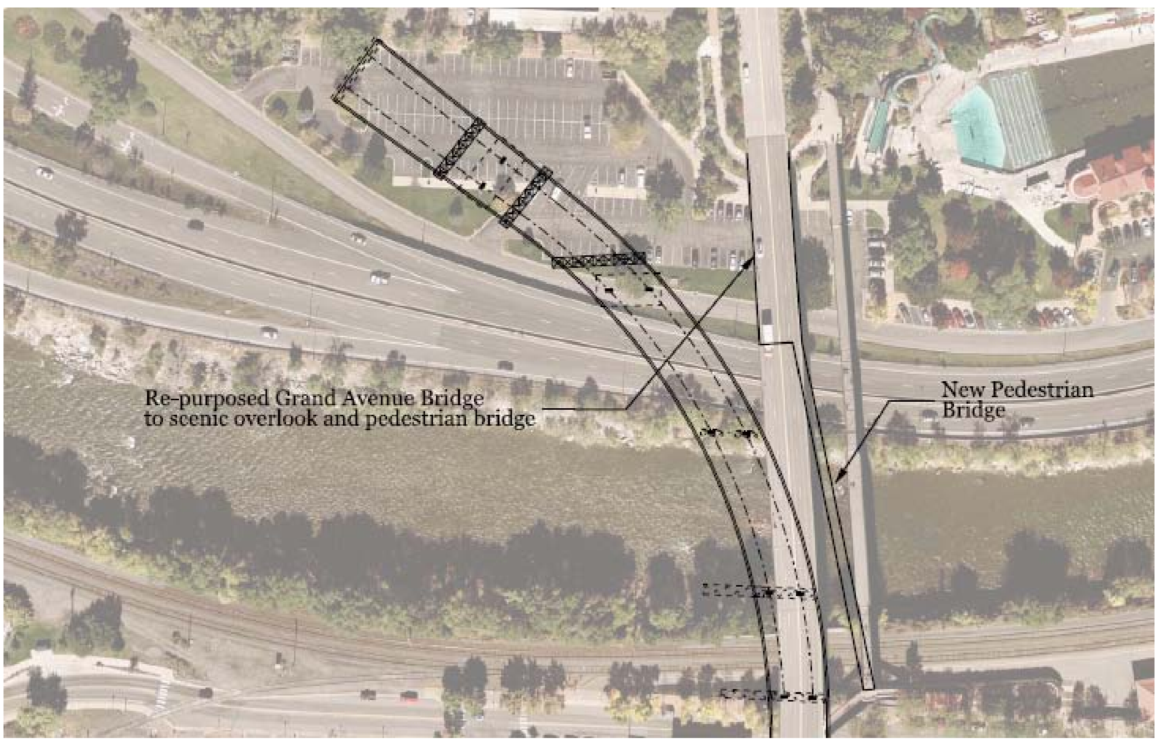
Advantages of original design concept:
All new construction
Aesthetically consistent.

Risks associated with implementing this Proposal:
Maintaining an old structure.

Calculations:

Proposed pedestrian bridge length = 608 lf
VE proposed length = 560 lf
GAB length proposed to remain in place = 192 lf

Current Stanton Estimate	$3,900,929
Savings from non-removal of 192 lf of existing SH 82 bridge	-200,000
Savings for not building 240 lf of proposed 608 ft long bridge	-1,539,000
Improve aesthetics of re-purposed SH 82 bridge	200,000
Additional costs to refurbish repurposed SH 82 bridge substructure	200,000
Subtotal	$2,561,929
Proposed Savings	**$1,339,000**



Value Engineering Proposal No. 20
Eliminate Trail Tunnel (contingent upon Proposal #3/8)
Recommended Action: Proposal

Summary

The proposed realignment of SH 82 includes a pedestrian/multi-use path tunnel under SH 82 bridge approach to provide connectivity to East 6th St.

Tunnels can have a perceived security stigmatism and sometimes do not get used unless they are large and have significant lighting and visibility through the tunnels as well as on the entrance and exit. Further they require frequent cleaning and sweeping to remove accumulated debris.

The roundabout alternative provides low speed at grade crossings for the pedestrians and multi-use path users near the Laurel St and 6th Street intersection.

Estimated potential cost savings: A $ 250,000 savings could be realized by eliminating a 130 ft by 15 ft multi-use tunnel. Additional life-cycle savings are realized through lower maintenance and electrical costs. These costs could be significant.

Discussion: Pedestrian tunnels tend to be less desired by pedestrians and can have a perceived security issue. It is unknown if this will be an issue at this location but it could impact use of this area by pedestrians.

The longer the underpass the larger the structure required to eliminate the "tunneling" affect. This may push the floor elevation lower than the proposed drainage pond.

The shaded areas of the tunnel also will lead to early icing creating a safety risk and maintenance would be needed. Pedestrians and bicyclists may avoid the tunnel during icy periods forcing them to cross the roadway at grade outside a designated crosswalk.

Cost effective alternatives are available with the roundabout intersection alternative.

Related Value Engineer proposal: 3/8/33

VE Proposal #3/8 or #33 would need to be accepted to implement this Proposal.

Advantages of this Proposal: Eliminating the tunnel offers a construction and maintenance cost savings and allows for an alternative that keeps the area focused on multi modal use in a low speed environment.

Advantages of original design concept: Grade separation provides a roadway crossing with no conflict points between pedestrians/bicyclists and vehicles.

Risks associated with implementing this Proposal: At grade intersections have increased ped/vehicle conflict points.

Calculations:

$60/sf x 130 ft x 17 ft = ~$135,000 plus grading and lighting
TSH estimate is $250,000

Value Engineering Proposal No. 22
Attach new pedestrian bridge to a portion of the Grand Avenue Bridge
Recommended Action: Eliminated

Summary

Instead of installing a completely new pedestrian bridge, attach a portion of the new pedestrian bridge to the new Grand Avenue Bridge ("GAB") until pier 4, then split it off and land it at the same point the current pedestrian bridge lands.

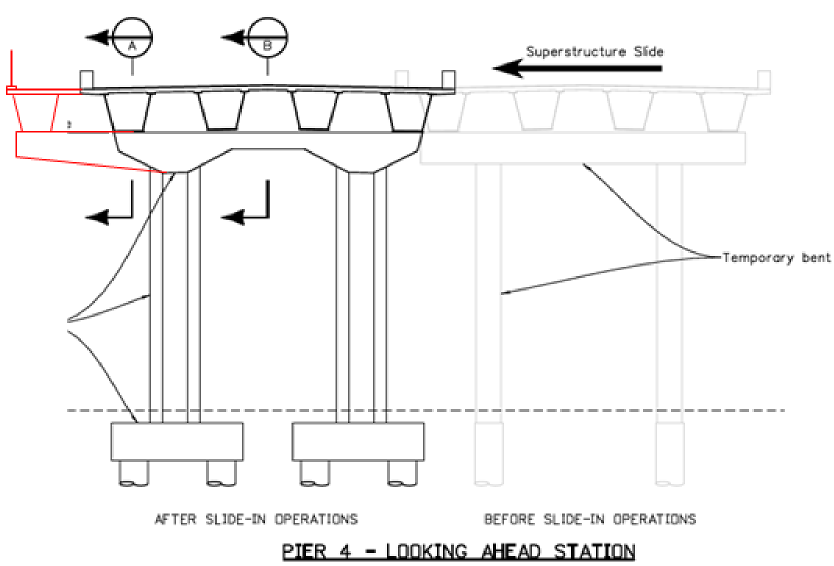
Estimated potential cost savings:

Not evaluated

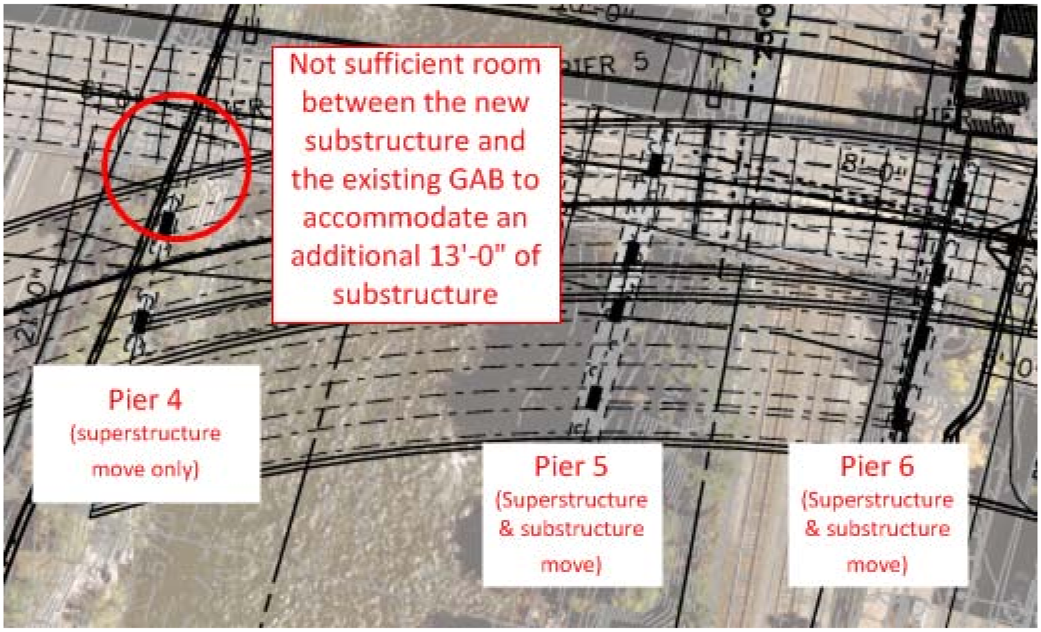
Discussion:

The idea was to eliminate the new pedestrian bridge in the proposed location, make use of the substructure for the new GAB, and narrow the proposed ped bridge from 18'-0" to 13'-0" (12'-0" multi-modal path plus the 1'-0" architectural fence/footing currently shown on the proposed ped bridge drawing). It made sense to attach the ped bridge to the main bridge between the south touchdown point and pier 4 and then split it off and land it at the current ped bridge touchdown on the north side. While investigating this proposal some fatal flaws were discovered:

1. A portion of the new GAB is going to be constructed to the west of the alignment and then moved into place using ABC techniques (either slide or slide and drop). ***The ped bridge would attach to the new GAB bridge on the east side and would require the temporary support structure to be moved an additional 13'-0" to the west, causing potential additional infringement in the Colorado River on the north side (pier 4) and into 7th street (pier 6)***. This presumes no new, dedicated substructure would be required for the pedestrian bridge, but rather, the substructure for the new GAB would be increased to support the additional load of the ped bridge (see sketch below).



2. The current plans show constructing the substructure at pier 4 in place and only moving the superstructure. At piers 5 and 6 both the substructure and superstructure are planned to be moved into place. ***Attaching the pedestrian bridge to the east side of the GAB bridge will require the substructure at pier 4 to be constructed off alignment and then moved into place with the superstructure because there is not sufficient room between the east side of pier 4's substructure and the existing GAB to allow pier 4's substructure to be extended an additional 13'-0" to the east and built in place*** (see picture below).



Related Value Engineer proposal:
40

Advantages of this Proposal:
Reducing some cost associated with constructing the new pedestrian bridge.

Advantages of original design concept:
Potentially less complicated

Risks associated with implementing this Proposal:

1. Increasing new GAB superstructure
2. Infringing upon the Colorado River at pier 4
3. Infringing upon 7th street at pier 6
4. Adding an additional girder for the ped bridge between abutment 9 and pier 4
5. Impacting downtown businesses between 7th and 8th streets by adding an additional 13'-0" to the bridge width thereby further reducing their natural light by moving the bridge closer to their storefronts

Calculations:

None

Value Engineering Proposal No. 24
Optimize Skews
Recommended Action: Incorporate

Summary: Adjust or eliminate skews at piers 3, 4, 5, and 6. Consider single column supports at piers 3, 4, 5, and 6.

Estimated potential cost savings: $0 to $100,000

Discussion: It appears the extreme skew at pier 3 is driven by placing 2 columns between River Road and I-70. A single column support will permit adjustment of the skew at pier 3 to help balance out girder lengths and improve constructability at this location. Piers 4, 5 and 6 can also be adjusted to balance out girder lengths. There is also an option to place the piers radially. On the radial pier option, the slide is accommodated by sliding the bridge on supports located away from the pier. The bridge is raised so the bridge would slide above the constructed in place portion and then lowered into place.

Related Value Engineer proposal:

Advantages of this Proposal:

Adjusting skews but not eliminating the skew improves constructability.
Adjusting skews improves structure performance.
Reduce costs.

Advantages of original design concept:

Simplifies substructure construction.
Simplifies bridge lateral slide.

Risks associated with implementing this Proposal:

Single column piers may increase quantities.
Eliminating the skew altogether significantly complicates the bridge slide.
Eliminating the skew altogether increases the shoring tower quantities and places temporary towers closer to or in the river.

Calculations: Not evaluated quantitatively.

Value Engineering Proposal No. 25
Improve I-70 WB off ramp and I-70 EB ramp merge and termini
Recommended Action: Design Consideration

Summary

EA Alternative 3 has a direct connection to I-70 Exit 116. Additional safety and operational value can be realized at this location by widening and lengthening of the I-70 EB acceleration ramp and increasing the length of the I-70 WB off ramp. Vertical sight distance could be improved on both ramps.

Estimated potential cost savings: Life cycle cost analysis should be conducted to demonstrate the cost benefits of these options in terms of reduction in collisions.

Discussion: These improvements compliment proposed systemic mobility and safety improvements. Making significant improvements to the Grand Ave Bridge/SH 82 and not making improvements to the roadways that connect I-70 to SH 82/Grand Ave would be an oversight for a project of this magnitude.

Non-Bridge Enterprise funds could be explored for these improvements.

Related Value Engineer proposal: 3/8

VE Alternatives #3/8 include a modification to the I-70 EB off ramp by removing the existing signal and replacing it with a single lane tear drop roundabout.

Advantages of this Design Consideration: These design improvements would provide additional operational and safety improvements for this connection to SH 82 and 6th Street.

Advantages of original design concept: Lower cost; preservation of BE funds.

Risks associated with implementing this Design Consideration: Additional costs.

Calculations: None

Value Engineering Proposal No. 26
Use Geothermal for Snowmelt on Both Bridges
Recommended Action: Design Consideration

Summary

Develop a geothermal exchange system to capture the waste heat from the Hot Springs Pool (HSP) outfall or the alluvial groundwater on the north side of the Colorado River and use the heat as an anti-icing method for both bridges.

Estimated potential cost savings:

The estimated costs for de-icing is estimated to be $14,000/year versus an average yearly capital cost of $56,200 for a geothermal exchange system for both bridges.

Discussion:

Estimated Cost for Snow/Ice Removal

The Michigan Department of Transportation in 1990 conducted an evaluation of the direct costs for de-icing, cost of bridge deck replacement and vehicle damage due to de-icing agents. The estimated costs in 1990 dollars ranged from $11,861 to $12,296 per equivalent mile (e-mile equals 1 mile of 2 lane highway). The CPI index from 1990 to 2013 is 107%. Estimated cost for 2013 is assumed to be $24,800 per year per e-mile. Grand Ave Bridge including approaches is approximately 0.2 miles or 0.4 e-miles and the pedestrian bridge is 0.15 e-miles. Assume 0.55 e-miles for both bridges. The estimated cost for snow removal and de-icing is $14,000 per year.

Estimated Cost for Heat Exchange System

The basis for this discussion and cost estimate is to develop an alluvial groundwater heat exchange system. Temperatures from the HSP outfall are likely warmer. Titanium heat exchangers are used in the Yampa Spring to provide heat from the Yampa Spring to the HSP. Titanium heat exchangers will be more heat transfer efficient and reduce the space required for heat transfer but they are costly and likely require more maintenance. Distance from the HSP Outfall to the GAB will reduce heating efficiency. To simplify the cost analysis we have assumed an alluvial groundwater heat exchange using HDPE pipes.

Heat exchange assumptions used in this analysis are based on conceptual level design for the proposed CDOT facility located approximately ¾ of a mile to the west of the HSP. Assume alluvial groundwater is 85 degrees. This assumption can be confirmed during the geotechnical investigation. The proposed geothermal system is a separate system from the alluvial groundwater and will pump a glycol fluid. Assume 5,000 linear feet of 1.5-inch HDPE pipe (85 degrees) within the alluvial groundwater can heat approximately 25,000 square feet of deck (>32 degrees) pumping at 40 gpm.

Grand Avenue Bridge (GAB) deck with approaches is approximately 60,000 square feet and the pedestrian bridge deck is approximately 13,800 square feet. Assume 1 linear foot of 1.5-inch HDPE pipe per square foot of deck. Total linear feet of pipe for the GAB is 12,000 within the alluvium and 60,000 within the deck for 72,000 linear feet. Total linear feet of pipe for the pedestrian bridge is 3,000 linear feet within the ground and 13,800 linear feet within the deck for 16,800 linear feet of pipe. Assume $2.50 per foot for purchase and installation of the 1.5-inch HDPE pipe. Estimated pipe capital costs are $222,000.

Assume 4 (1-hp pumps at 40gpm) ($25,000/each) pumps are required to pump the fluid in the GAB. Assume 2(1-hp pumps at 40gpm) ($25,000/each) pumps to pump the fluid to the pedestrian bridge. Estimated cost for the pumps is $150,000. Assume a $50,000 lump sum for electric service. Estimated capital costs for the geothermal exchange system assuming $150,000 in engineering and 50% contingency is $858,000. Assuming at 25-year design life and a 4 percent interest rate, the Capital Recovery Factor is 0.064. The estimated yearly annualized cost for the geothermal exchange system is $55,000.

Estimated yearly operating costs for a pump assuming $0.07 per kw-hr and 4000 hours of operating per year is $200/yr or $1,200/year for all six pumps. The estimated annual cost is $56,200 per year.

The geothermal exchange system does not pay for itself based on the assumptions discussed above ($14,000/year snow/ice removal versus an annual capital cost of $56,200/year for the geothermal exchange system).

There may be additional environmental benefits by using a geothermal snow/ice melt system since deicer fluids will not be entering the Colorado River system. A reduction in air emissions may be realized due to reduced CDOT maintenance traffic on the bridge and less sand placed on the bridge deck therefore less airborne dust. Snow storage on GAB will be difficult and pose a safety hazard and the geothermal exchange system would minimize the snow storage requirements. Safety may be improved if the geothermal system is always on and melting snow and ice instead of CDOT maintenance crews recognizing there is a safety hazard and mobilize crews to mitigate icing on the bridge. Costs for snow removal/de-icing for the pedestrian bridge may be under-estimated because the equipment necessary to remove the snow and apply deicer on the smaller pedestrian bridge needs to be specifically mobilized versus the CDOT equipment that is already operating during storms on Highway 82 for the GAB.

Alternatively, the Design Team may want to consider installing a geothermal heat system for just the pedestrian bridge.

Related Value Engineer proposal:

None

Advantages of this Proposal:

- Environmentally friendly approach to snow removal.
- Demonstration project for potential future CDOT projects.
- Reduction in air emissions and improvement in water quality runoff.
- Interpretive signage and education about geothermal resources and benefits.
- Safety improvements.

Advantages of original design concept:

CDOT crews are already operating on the approaches to the bridge and likely will need to cross the GAB to continue snow removal efforts. Savings for the GAB is probably not that great. CDOT Maintenance Crews are familiar with snow removal routines. CDOT maintenance crews are not likely accustomed to maintaining a heat exchange system and a learning curve will be required.

Risks associated with implementing this Proposal:

The installation of the HDPE pipes within the deck will cause additional effort to install the pipe to prevent floating of the pipe and to work around the pipes while placing concrete. Leaks may develop within the pipe and at the connections through time and glycol may cause additional corrosion of the deck and bridge.

Calculations:

See above

Value Engineering Proposal No. 27 and 58
Change N. River Street to a one-way, one lane road Eastbound, with on-street parking, add in bike trail adjacent to N. River Street
Recommended Action: Proposal

Summary

Convert N. River Street to one-way, one-lane, eastbound to improve safety in relation to egress onto N. River Street via reducing conflict points at the N. River Street/N. River Drive intersection, and the N. River Street/6th Street intersection, and reducing conflict points at all the accesses along N. River Street.

On-street parking and a bike lane will be added to N. River Street.

N. River Street access from N. River Drive would be right-in only.

Estimated potential cost savings:

$215,000

Discussion:

This will simplify traffic movements in the intersections north of the proposed structure and near I-70, reduce conflict points, increase safety and desirability for bicyclists, and increase parking in the area.

The width of N. River Street was not decreased from originally planned so that on-street parking and a bike lane can be added in. Costs between the original design concept and this design proposal are considered to be approximately the same.

Related Value Engineer proposal:

27 and 58 were combined
27: Change N. River Street to a one-way road eastbound
58: Add in bike trail adjacent to N. River Street
52: Switch Proposed Walls to Slopes
34: SH 82 bridge width reduction at North Flare, reason 2

Advantages of this Proposal:

1. Reduced conflict points for traffic movements
2. Added bike lane along N. River Street
3. Additional parking for the area
4. Narrow the Grand Avenue Bridge at the north end as the median at the N. River Street access would not be required.

5. Eliminate concrete pavement, and the island at the end of the Grand Avenue Bridge.
6. Improved safety for pedestrians with reduced volume and elimination of bidirectional traffic.

Note: See Figure 1 for eliminated items that lead to cost savings.

Risks associated with implementing this Proposal:

Reduced egress to Hot Springs parking facilities North of N. River Street

Calculations:

Savings:

Reduced Bridge Width = $198,400
Adjacent Roadway = $7,400
Island Elimination = $10,000

Total = $215,400

See Figure 2

Figure 1
Eliminated Items (NTS)

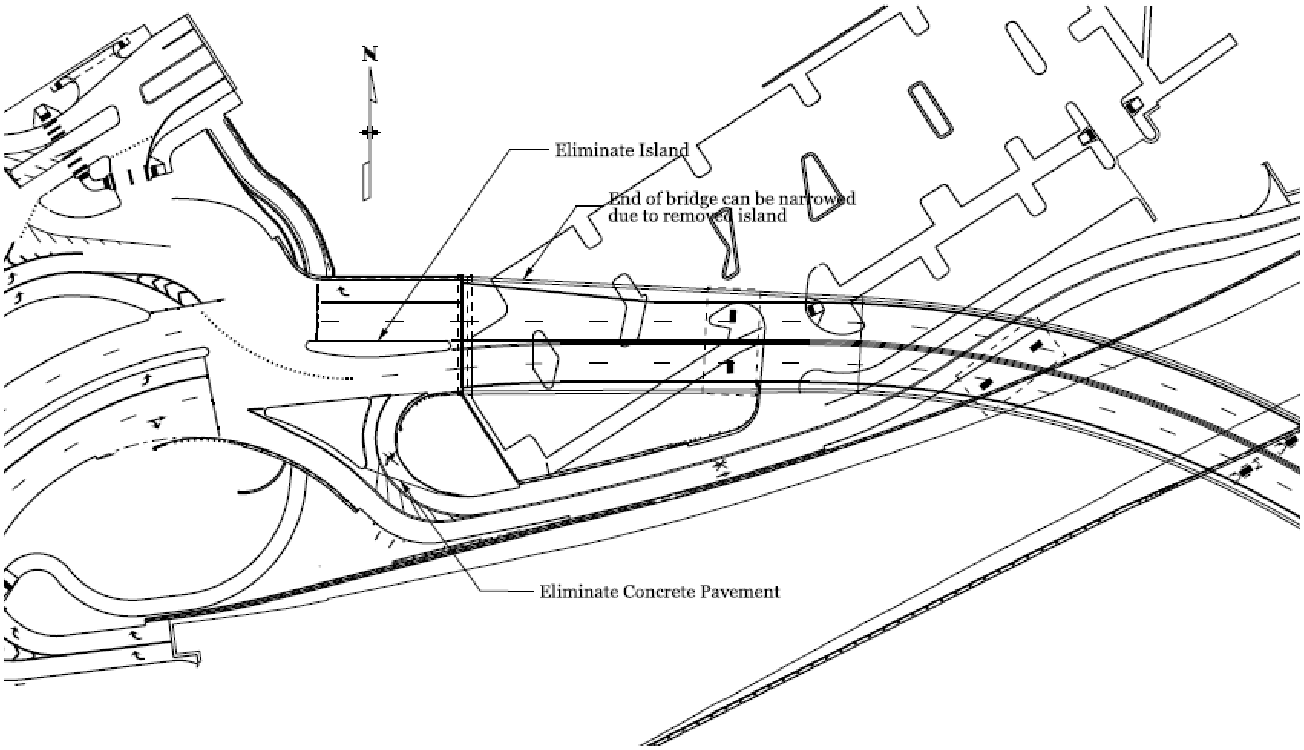
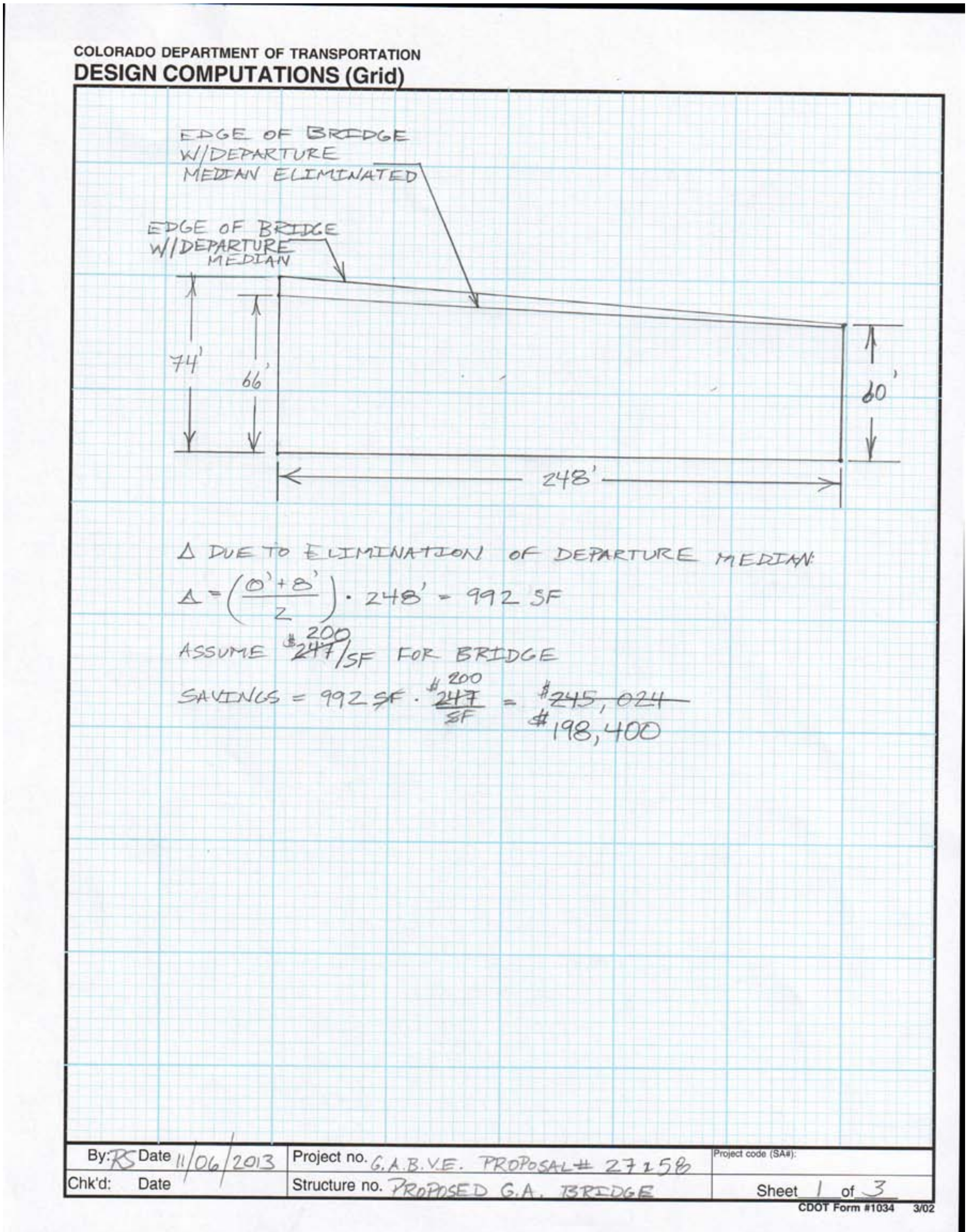

N
Eliminate Island
End of bridge can be narrowed
due to removed island
Eliminate Concrete Pavement

Figure 2



COLORADO DEPARTMENT OF TRANSPORTATION

DESIGN COMPUTATIONS (Grid)

Δ DUE TO ELIMINATION OF DEPARTURE MEDIAN:

$\Delta = \left(\frac{0' + 8'}{2}\right) \cdot 248' = 992\ SF$

ASSUME ~~\$247~~ \$200/SF FOR BRIDGE

SAVINGS = 992 SF · ~~\$247~~ \$200 / SF = ~~\$245,024~~ \$198,400

By: RS Date 11/06/2013	Project no. G.A.B. V.E. PROPOSAL # 27158	Project code (SA#):
Chk'd: Date	Structure no. PROPOSED G.A. BRIDGE	Sheet 1 of 3

CDOT Form #1034 3/02

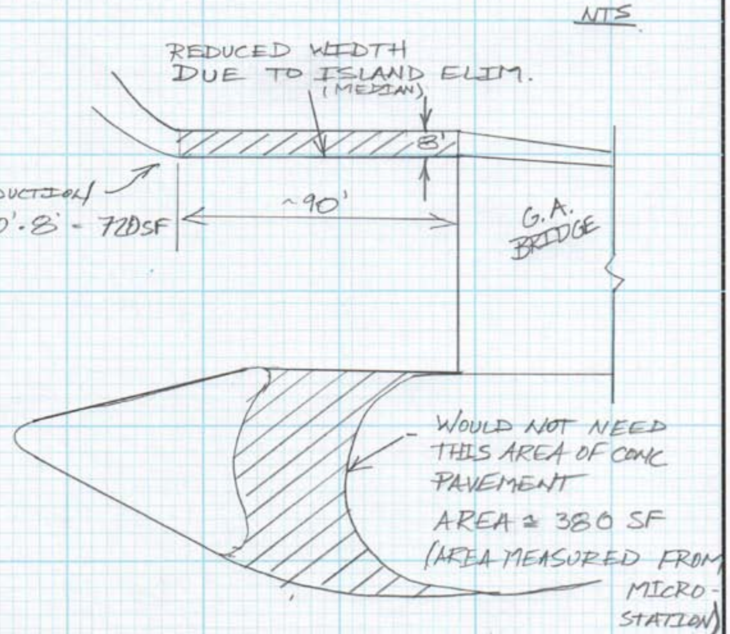
COLORADO DEPARTMENT OF TRANSPORTATION

DESIGN COMPUTATIONS (Grid)

REDUCTION IN CONCRETE PAVEMENT

\$60/SY

= \$6.67/SF



TOTAL CONC. PAVEMENT REDUCTION (INCLUDES SUB-BASE)

720 SF + 380 SF = 1100 SF → 1100 SF · \$6.67/SF = \$7,337

ELIMINATION OF DEPARTURE MEDIAN (ISLAND ~ \$10,000

TOTAL SAVINGS = ~~\$321,000~~ \$215,000

BRIDGE = \$ ~~245,024~~ \$198,400

ADJACENT ROAD = \$7,337

ISLAND = \$10,000

By: RS Date 11/06/2013	Project no. GAB V.E. PROPOSAL # 27 & 58	Project code (SA#):
Chk'd: Date	Structure no.	Sheet 2 of 3

CDOT Form #1034 3/02

COLORADO DEPARTMENT OF TRANSPORTATION

DESIGN COMPUTATIONS (Grid)

ADDITIONAL COST FOR BIKE LANE ADJACENT TO N. RIVER STREET: LENGTH = 620 LF WIDTH = 10 LF

COST = $3/SF

AREA = 6200 SF

COST = 6200 SF · $3/SF = $18,600

NOTE: THIS COST IS NOT NECESSARY. THIS IS BECAUSE A BIKE LANE CAN BE PROVIDED BY STRIPING. NO ADDITIONAL CONCRETE WOULD BE NECESSARY.

· IF RIVER ST. IS CHANGED TO ONE-WAY, ALL CHANGES IN COST ~~ARE NEGLIGIBLE BECAUSE~~ IN RELATION TO A BIKE LANE AND ON-STREET PARKING ARE NEGLIGIBLE, BECAUSE RIVER STREET CAN BE BUILT AS PLANNED, WITH MINOR CHANGES TO STRIPING.

By: RS Date 11/06/2013	Project no. G.A.B. V.E PROPOSAL #27258	Project code (SA#):
Chk'd: Date	Structure no.	Sheet 3 of 3

CDOT Form #1034 3/02

Value Engineering Proposal No. 30
Use “Top-Down” Abutment Construction at South End of Grand Avenue Bridge

Recommended Action: Incorporate

Summary
Use “top-down” abutment construction methods for construction of Abutment 9 of the new Grand Avenue Bridge, downtown unit, to minimize traffic impacts and potentially reduce construction cost.

Estimated potential cost savings: $40,000

Discussion:
The current abutment construction plan consists of a temporary shoring box that is advanced into the subgrade during night work activities. The temporary shoring box installation will require closure of two lanes for 1 to 2 nights. The shoring box will accommodate construction of the spread footings and abutment face while maintaining traffic. A concrete or steel plate will be placed over the box during non-work periods for uninterrupted traffic flow.

This proposal will modify the abutment construction to perform top-down construction and incorporate the temporary shoring into permanent bridge foundations.

Two potential options are proposed:
Option 1 – Install a line of drilled shafts during temporary, night time lane closures and cover for traffic during day. At the conclusion of drilled shaft installation, construct abutment cap beam during night closures. Once the bridge span is completed, excavation can occur without further disturbance to abutment (See Concept Sheets 1 and 2).

Option 2 - Install two drilled shafts for the abutment substructure and construct cap beam during temporary night closures. This option assumes the next construction phase would involve construction of the bridge deck on the existing subgrade. Once the deck is complete, excavation for the abutment would progress using a permanent soil nail wall (See Concept Sheets 3 and 4).

Option 3 – Install at spread footing within the current wall mass during night closures. Once Grand Avenue is closed, remove most fill but leave the abutment below the footing at a temporary stable slope configuration. Once the bridge is completed, remove the fill in front of abutment and place a soil nail wall under the spread footing.

The preliminary analysis suggests the cost savings could be minimal (+$40,000 to -$10,000) but further design quantities are required for confidence in the cost savings.

Related Value Engineer proposal: None

Advantages of this Proposal:

- Less disturbance for businesses and traffic during night work due to smaller volume of soil excavation.
- Current plan requires contractor to excavate and install temporary shoring in one night and could create risk should work not be completed as scheduled.
- Reduces excavation and backfill volumes at the new abutment location
- Potentially could be completed with a single lane temporary lane closure at night.
- Minimizes temporary construction methods/materials in lieu of permanent materials.
- Potentially reduces the construction duration of the Grand Avenue full closure.

Advantages of original design concept:

- None

Risks associated with implementing this Proposal:

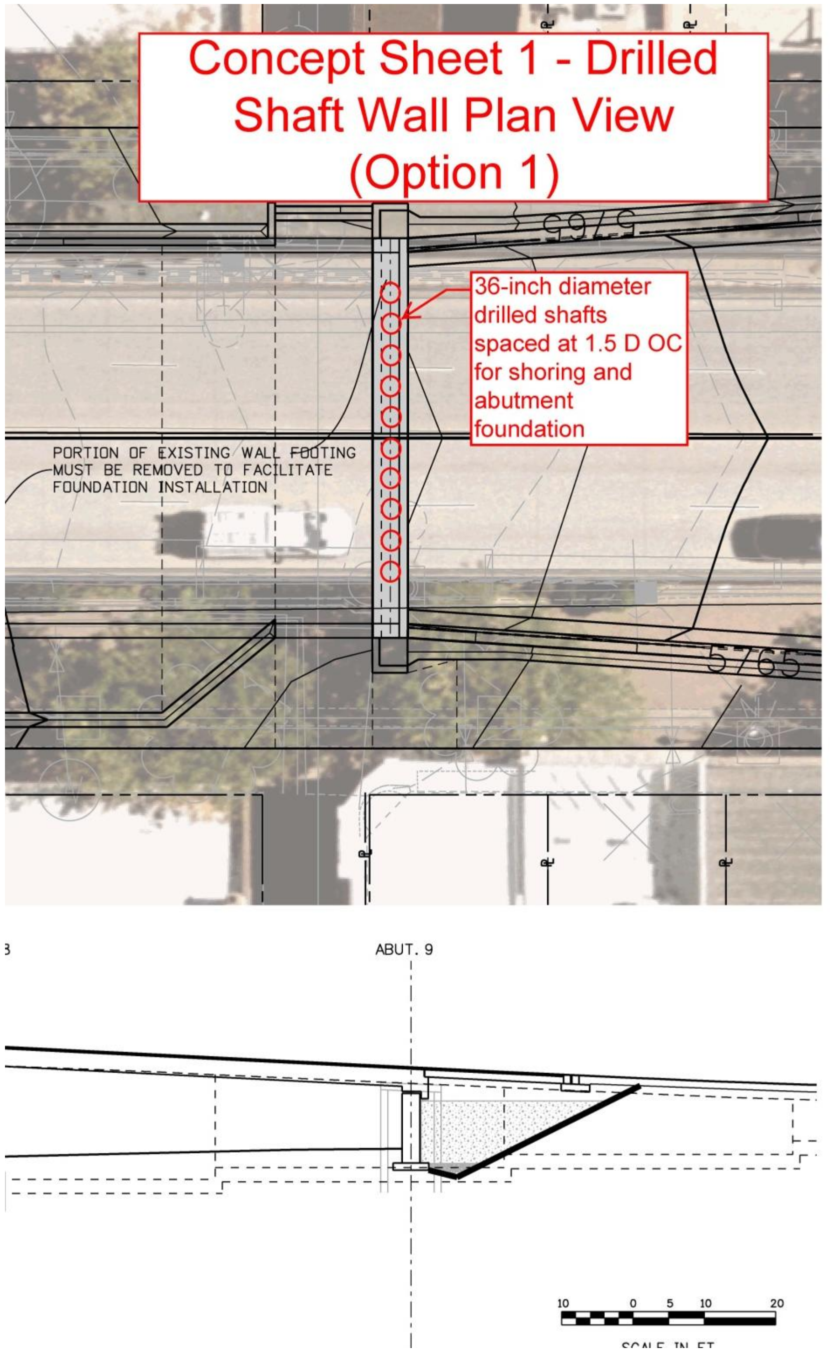
- With a drilled shaft option there is potential for differential movement between Abutment 9 on a drilled shaft foundation and Pier 8 on spread footings.
- With the spread footing option, the potential span length could increase up to 5 feet to set spread footing back from wall face to improve wall stability.

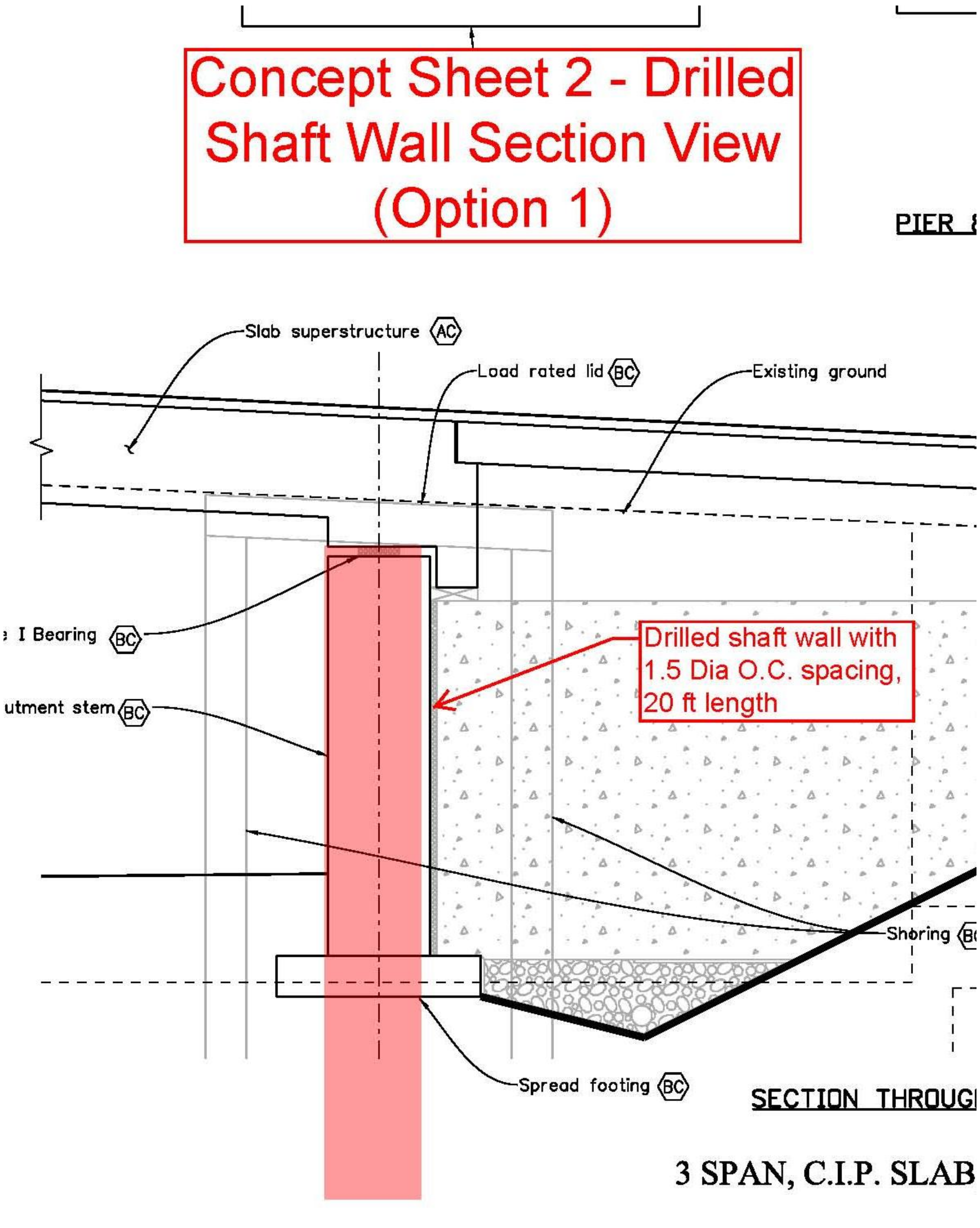
Calculations:

Grand Avenue Bridge Value Engineering Proposal No. 30
Cost Analysis - Use of Top Down Excavation for South Abutment

Current Abutment Costs		
Temporary Shoring	$50,000	Based on preliminary estimates from Granite
Spread footing cost	$10,000	Costs from TSH analysis for Abutment 9
Structure Excavation Quantity	187	CY volume for temp excavation (assume 14' deep x9' wide)
Structure Excavation Cost	$3,733	Use $20/CY per CMGC Estimate
Abutment Concrete (Class D) Cost	$50,000	From CMGC Estimate
Backfill	$3,333	Assume a flow fill ($75/cy) behind abutment (3'x10'x40')
Subtotal	$117,067	
Drilled Shaft Wall (Option 1)		
Number of drilled shafts	10	Assume 3 ft diameter, 1.5 dia O.C. spacing
Shaft length	20	Assume 1:1 ratio versus cantilever and embedment
Item 503 - Drilled Shaft quantity	200	Feet
Item 503 - Drilled Shaft unit cost	$500	Lineal foot
Item 503 - Drilled Shaft total cost	$100,000	
Structure Excavation Cost	$0	Permanent quantity in front of abutment is same between options
Facing	$25,000	Assume facing cost is reduced by 50% to Abutment Class D cost
Subtotal	$125,000	

Delta **-$7,933**


Concept Sheet 1 - Drilled Shaft Wall Plan View (Option 1)
36-inch diameter drilled shafts spaced at 1.5 D OC for shoring and abutment foundation
PORTION OF EXISTING WALL FOOTING MUST BE REMOVED TO FACILITATE FOUNDATION INSTALLATION
5765
5765
ABUT. 9
10 0 5 10 20

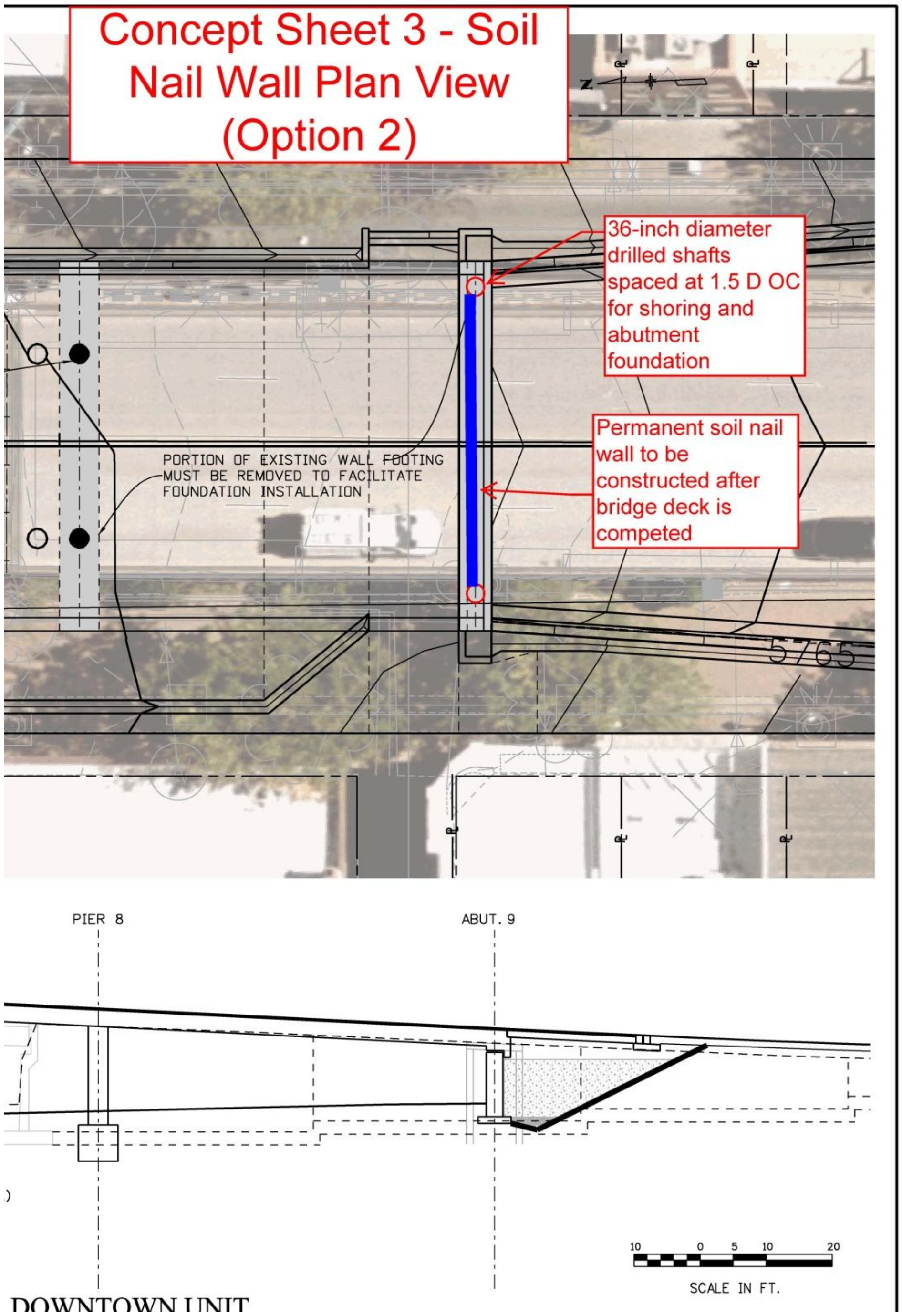


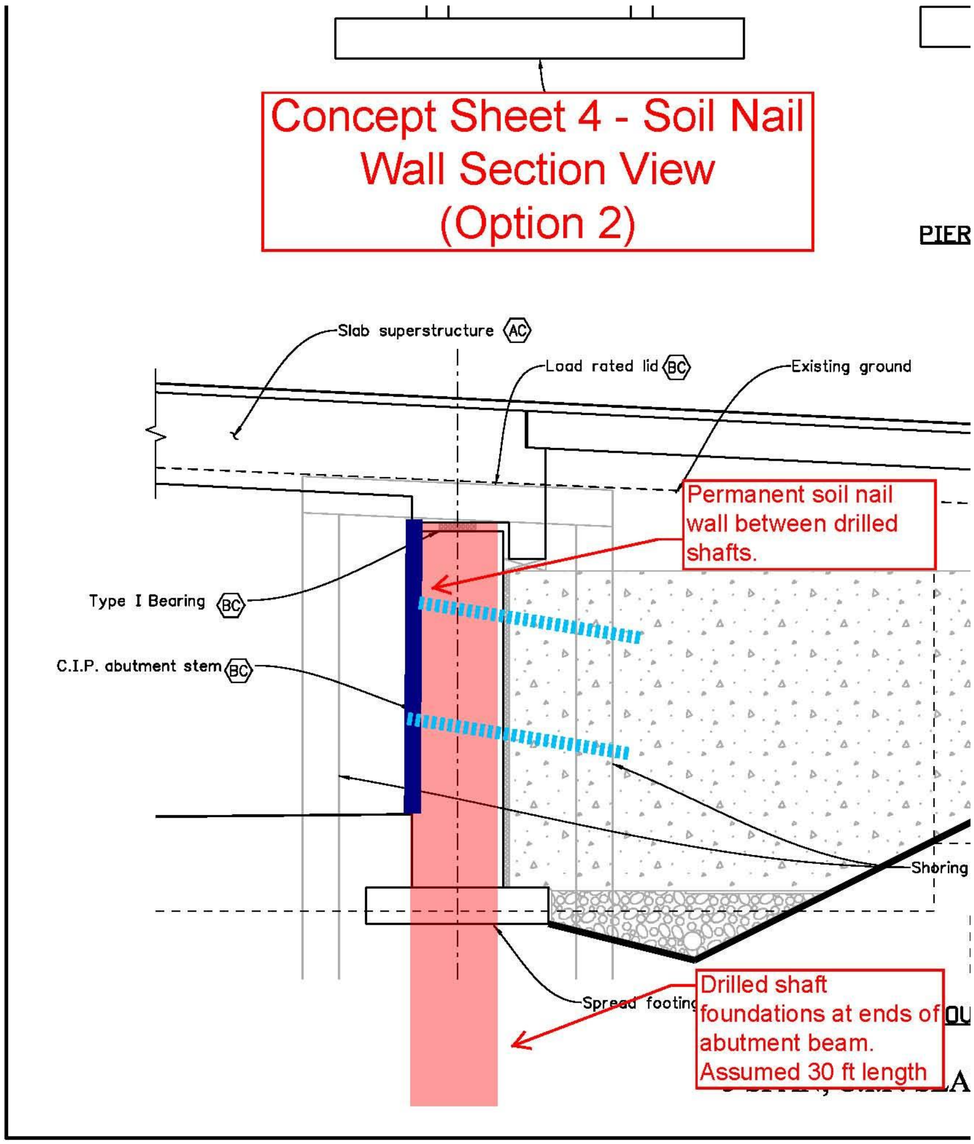
Concept Sheet 2 - Drilled Shaft Wall Section View (Option 1)
PIER
Slab superstructure AC
Load rated lid BC
Existing ground
I Bearing BC
utment stem BC
Drilled shaft wall with 1.5 Dia O.C. spacing, 20 ft length
Shoring
Spread footing BC
SECTION THROUG
3 SPAN, C.I.P. SLAB

Grand Avenue Bridge Value Engineering Proposal No. 30
Cost Analysis - Use of Top Down Excavation for South Abutment

Current Abutment Costs		
Temporary Shoring	$50,000	Based on preliminary estimates from Granite
Spread footing cost	$10,000	Costs from TSH analysis for Abutment 9
Structure Excavation Quantity	187	CY volume for temp excavation (assume 14' deep x9' wide)
Abutment Concrete (Class D) Cost	$50,000	From CMGC Estimate
Structure Excavation Cost	$3,733	Use $20/CY per CMGC Estimate
Backfill	$3,333	Assume a flow fill ($75/cy) behind abutment (3'x10'x40')
Subtotal	$117,067	
Proposed Costs for Soil Nail Wall (Option 2)		
Number of drilled shafts	2	Assume 3 ft diameter at edges of abutment
Shaft length	30	Feet
Item 503 - Drilled Shaft quantity	60	Feet
Item 503 - Drilled Shaft unit cost	$500	LF for 36 inch diameter shafts
Item 503 - Drilled Shaft total cost	$30,000	
Soil Nail Facing Length	40	Feet
Soil Nail Facing Height	10	Feet
Soil Nail Wall Cost	$20,000	Assume $50/square foot
Facing	$25,000	Assume facing cost is reduced by 50% to Abutment Class D cost
Subtotal	$75,000	

Delta	**$42,067**


Concept Sheet 3 - Soil Nail Wall Plan View (Option 2)
36-inch diameter drilled shafts spaced at 1.5 D OC for shoring and abutment foundation
Permanent soil nail wall to be constructed after bridge deck is competed
PORTION OF EXISTING WALL FOOTING MUST BE REMOVED TO FACILITATE FOUNDATION INSTALLATION
5765
PIER 8
ABUT. 9
10 0 5 10 20
SCALE IN FT.
DOWNTOWN UNIT


Concept Sheet 4 - Soil Nail Wall Section View (Option 2)
PIER
Slab superstructure AC
Load rated lid BC
Existing ground
Permanent soil nail wall between drilled shafts.
Type I Bearing BC
C.I.P. abutment stem BC
Shoring
Spread footing
Drilled shaft foundations at ends of abutment beam. Assumed 30 ft length

Value Engineering Proposal No. 31
Move the South Abutment of the Grand Avenue Bridge To The Location of Pier 7
Recommended Action: Incorporate

Summary
Move the South Abutment of the Grand Avenue Bridge to the approximate location of Pier 7 in order to reduce cost and reduce construction volume during Off-Season Shutdown of Grand Avenue.

Estimated potential cost savings:
$790,000

Discussion:
The current design is to have three spans connecting to the main spans at Pier 6 extending south over 7^{th} street to Abutment 9. This Proposal recommends eliminating two spans from Pier 7 through Abutment 9 by utilizing a conventional earthen embankment, or rapid placed fill, retained by CIP retaining walls on both sides running parallel to Grand Avenue.

Related Value Engineer proposal:
VE Proposal 38 – Use Rapid Placed Fill to Reduce Construction Time

Advantages of this Proposal:

1. Reduced construction costs by eliminating two suspended spans with an earthen approach
2. Retaining walls and majority of the new Abutment 7 work can be completed prior to the Off-Season Shutdown of Grand Avenue resulting in a reduced construction duration during the Shutdown.
3. Reduced temporary impacts to Grand Avenue traffic due to not needing to construct Abutment 9 under traffic
4. Reduced Maintenance due to elimination of two suspended spans
5. Potential to extend trapezoidal tub girders through Span 6 across 7^{th} Street creating a more consistent appearance. This option would result in additional cost due to additional girder purchase and additional costs associated with tying this span in with the ABC section.
6. Larger retaining walls along Grand Avenue as well as at the new Abutment 7 would create greater opportunity for architectural treatments and lighting in order to enhance the appearance of the area
7. Some of the cost savings could be directed toward other Project elements to offset impacts to pedestrians and aesthetics

Advantages of original design concept:

1. Creates a useable space under the Grand Avenue Bridge downtown unit

Risks associated with implementing this Proposal:

1. This Proposal reduces risk by reducing the volume of work completed during the Off-Season Shutdown
2. There is a risk of not addressing two of the community's desires:
    a. An open area under the down town unit between Pier 7 and Abutment 9
    b. A direct connection of the alley between the east side and the west side of Grand Avenue

Calculations:

See attached spreadsheet for detailed calculations of estimated savings.

Estimated potential cost savings

The estimated savings of incorporating this Proposal is $790,000.

If the option of extending the trapezoidal tubs through Span 6 is incorporated this would add a cost of approximately $310,000 resulting in a net savings of $480,000.

Please see attached spreadsheet for detailed cost estimate calculation. Also note that the estimated savings is based on some assumed dimensions of structural members. As design progresses the actual savings realized may vary from this estimate.

DOWNTOWN UNIT - Revised One 67' Span CIP Slab Bridge 3ft deep solid slab

SUMMARY OF QUANTITIES

ITEM NO.	DESCRIPTION	UNIT	SUPERSTRUCTURE	SUBSTRUCTURE			Walls	TOTAL
				Abutment 7	Pier 8	Pier 9		
206	STRUCTURE EXCAVATION	CY		175	0	0	600	775
206	STRUCTURE BACKFILL (CLASS 2)	CY		90	0	0	420	510
	Embankment Construction	CY					3275	3275
503	DRILLED CAISSON (30 INCH, BASE GROUTED)	LF		0				0
503	DRILLED CAISSON (48 INCH, BASE GROUTED)	LF			0	0		0
512	BEARING DEVICE (TYPE I)	EA		5				5
518	BRIDGE EXPANSION DEVICE (0-4 INCH)	LF	57					0
519	THIN BONDED OVERLAY (POLYESTER CONCRETE)	CF	640					0
	Retaining Walls	CY					325	325
601	CONCRETE CLASS D (BRIDGE)	CY	290	134	0	0		134
601	STRUCTURAL CONCRETE COATING	SY	600	114	0	0	387	501
602	REINFORCING STEEL	LB		31300	0	0	49000	80300
602	REINFORCING STEEL (EPOXY COATED)	LB	76504					0
606	BRIDGE RAIL TYPE 10M (SPECIAL)	LF	175				268	268
607	FENCE CHAIN LINK	LF	175				268	268
613	LIGHTING	LS	1					0

COST ESTIMATE

SUBSTRUCTURE

ITEM NO.	DESCRIPTION	UNIT	SUBSTRUCTURE	UNIT COST	ITEM COST
206	STRUCTURE EXCAVATION	CY	175	$ 20.00	$ 3,500
206	STRUCTURE BACKFILL (CLASS 2)	CY	90	$ 7.00	$ 630
503	DRILLED CAISSON (30 INCH, BASE GROUTED)	LF	0	$ 900.00	$ -
503	DRILLED CAISSON (48 INCH, BASE GROUTED)	LF	0	$ 1,050.00	$ -
512	BEARING DEVICE (TYPE I)	EA	5	$ 1,500.00	$ 7,500
601	CONCRETE CLASS D (BRIDGE)	CY	134	$ 775.00	$ 103,850
601	STRUCTURAL CONCRETE COATING	SY	114	$ 13.00	$ 1,482
602	REINFORCING STEEL	LB	31300	$ 0.95	$ 29,735
				subtotal	$ 146,697

RETAINING WALLS

ITEM NO.	DESCRIPTION	UNIT	WALLS	UNIT COST	ITEM COST	
206	STRUCTURE EXCAVATION	CY	600	$ 20.00	$ 12,000	
206	STRUCTURE BACKFILL (CLASS 2)	CY	420	$ 7.00	$ 2,940	
	Embankment Construction	CY	3275	$ 15.00	$ 49,125	
	Additional Roadway Draianage	LS	1	$ 10,000.00	$ 10,000	
	Roadway Base and Grading	SY	900	$ 10.00	$ 9,000	
	Concrete Paving	SY	900	$ 45.00	$ 40,500	
	Retaining Walls	CY	325	$ 775.00	$ 251,875	
601	STRUCTURAL CONCRETE COATING	SY	387	$ 13.00	$ 5,031	
602	REINFORCING STEEL	LB	49000	$ 0.95	$ 46,550	Utilized 150#/CY
606	BRIDGE RAIL TYPE 10M (SPECIAL)	LF	268	$ 200.00	$ 53,600	
607	FENCE SPECIAL	LF	268	$ 50.00	$ 13,400	
613	LIGHTING	LS	1	$ 75,000.00	$ 75,000	
XXX	ARCHITECTURAL TREATMENTS	LS	1	$ 100,000.00	$ 100,000	
				subtotal	$ 669,021	

SUPERSTRUCTURE

ITEM NO.	DESCRIPTION	UNIT	SUPERSTRUCTURE	UNIT COST	ITEM COST
518	BRIDGE EXPANSION DEVICE (0-4 INCH)	LF	57	$ 450.00	$ 25,650
519	THIN BONDED OVERLAY (POLYESTER CONCRETE)	CF	640	$ 125.00	$ 80,000
601	CONCRETE CLASS D (BRIDGE)	CY	290	$ 950.00	$ 275,500
601	STRUCTURAL CONCRETE COATING	SY	600	$ 13.00	$ 7,800
602	REINFORCING STEEL (EPOXY COATED)	LB	76504	$ 1.10	$ 84,154
606	BRIDGE RAIL TYPE 10M (SPECIAL)	LF	175	$ 200.00	$ 35,000
607	FENCE SPECIAL	LF	175	$ 50.00	$ 8,750
613	LIGHTING	LS	1	$ 25,000.00	$ 25,000
xxx	ARCHITECTURAL TREATMENTS	LS	1	$ 30,000.00	$ 30,000
				subtotal	$ 571,854

Total	$ 1,387,572
SF Deck	11400
Cost/SF	$ 121.71

MISCELLANEOUS

ITEM NO.	DESCRIPTION	UNIT	MISC	UNIT COST	ITEM COST
	IN WATER WORK PADS	TN	0	$30.00	$0
	CRANE MOBILIZATION	EA	1	$25,000	$25,000
	ON-SITE CRANE MOBILIZATIONS	EA	0	$20,000	$0
	GENERAL MOBILIZATION	LS	1	$100,000	$100,000
	SURVEY	LS	1	$25,000	$25,000
	TRAFFIC CONTROL	LS	1	$75,000	$75,000
	RAILROAD COORDINATION/FLAGGERS	HR	0	$200.00	$0
	RAILROAD CROSSING	LS	0	$75,000.00	$0
	COFFERDAMS	SF	0	$50	$0
	OTHER SHORING	LS	1	$10,000	$10,000
				subtotal	$235,000

TOTAL OF ALL DIRECT COSTS			$1,622,572
JOBSITE INDIRECTS	%	15	$243,386
CMGC FEE	%	8	$149,277
INSURANCE	%	0.5	$10,076
BOND	%	0.75	$15,190
OPTION TOTAL			$2,040,501

Option to Extend Tub Girders Through Span 6

SUPERSTRUCTURE

ITEM NO.	DESCRIPTION	UNIT	SUPERSTRUCTURE	UNIT COST	ITEM COST
		UNIT			
	DESCRIPTION				
601	CONCRETE CLASS D (BRIDGE)	CY	-170	$ 950.00	$ (161,500)
602	REINFORCING STEEL (EPOXY COATED)	LB	-39,800	$ 1.10	$ (43,780)
509-00000	STRUCTURAL STEEL	LBS	167,000	$ 2.40	$ 400,800
622-00000	Added ABC Costs	LS	1	$ 50,000.00	$ 50,000
				subtotal	$ 245,520

JOBSITE INDIRECTS	%	15	$36,828
CMGC FEE	%	8	$22,588
INSURANCE	%	0.5	$1,525
BOND	%	0.75	$2,298
OPTION TOTAL			$308,759

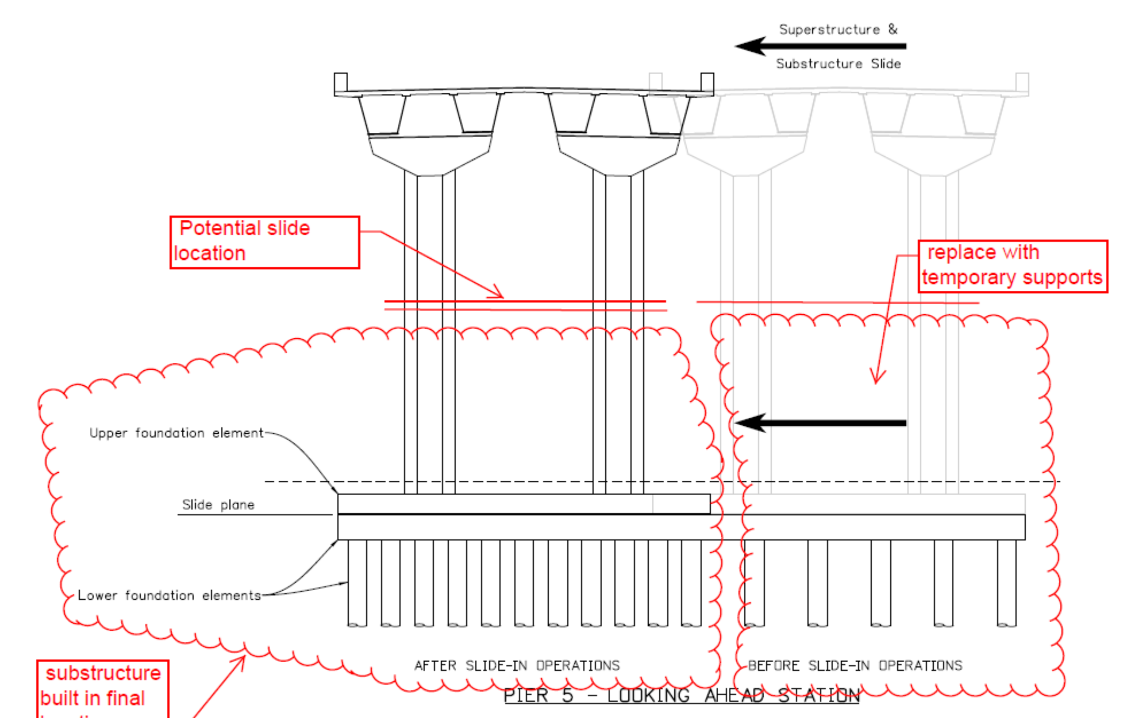
Value Engineering Proposal No. 32
SH 82 Bridge Slide Interface Location
Recommended Action: Design Consideration

Summary
SH 82 Bridge replacement preliminary bridge plans show Pier 5 and Pier 6 being moved with the superstructure; the slide interface is located at the foundation level. Another potential solution is to adjust the slide interface location higher.

Estimated potential cost savings: **Not evaluated**

Discussion:
SH 82 Bridge replacement uses Accelerated Bridge Construction (ABC) to move two spans laterally during a closure period, minimizing the duration of the closure period. Preliminary bridge plans show Pier 5 and Pier 6 being moved with the superstructure; the slide interface is located at the foundation level. This concept provides a stable surface for the slide, using the upper foundation sliding on the lower foundation footing.

Another potential solution is to adjust the slide interface location higher, to reduce the temporary foundation construction in a cofferdam. A potential slide interface located below the existing bridge superstructure would allow more of the permanent pier components to be constructed in their final position. A slide interface located below the existing bridge superstructure would be part-way up the pier columns, and minimize the weight of the components being moved. The lateral bridge move would slide the superstructure and upper portion of piers, using temporary supports for the slide.



5-SPAN MAIN UNIT, CONSTANT DEPTH STEEL TRAPAZOIDAL BOX GIRDERS

Related Value Engineer proposal:
No related proposals.

Advantages of this Proposal:
SH 82 bridge replacement slide interface location shifted higher, potentially achieves the following advantages:

- Increases the amount of the permanent piers that can be constructed in their final position, minimizing temporary components;
- Reduces the weight of components being moved, potentially making the lateral bridge move more efficient.

Advantages of original design concept:
SH 82 bridge replacement slide interface location at the foundation level provides a stable surface for the slide.

Risks associated with implementing this Proposal:

- Potential risk increase by moving the slide interface higher, requiring adequate controls and stiffness for stability;
- Potential risk decrease by reducing the weight of the components being moved.

Calculations: Qualitative evaluation only.

Value Engineering Proposal No. 33
One Lane Roundabout
Recommended Action: Proposal

Summary

One roundabout at 6th St and Laurel St to reduce conflict points and improve intuitive way finding.

Estimated potential cost savings: The potential cost savings exist in eliminating the two signalized intersections and the pedestrian tunnel. This is approximately a $750,000 savings ($250,000 for each signalized intersection and $250,000 for the pedestrian tunnel).

Discussion:

The configuration of the proposed 3 intersections (one roundabout and two signalized intersections) at Laurel St/6th St and realigned SH 82 includes numerous conflict points and complicated geometry and movements, especially for local and recreational traffic.

One roundabout (conservatively sized at 180 ft ICD for concept design) was suggested in place of the 3 intersections.

Access to River St (SB left) would need to be provided with a break in the median.

The I-70 WB off ramp intersection would remain as a stop control.

Additionally, I-70 EB off ramp would remain signalized.

This alternative is similar to VE Proposal #3/8 but with only one roundabout. The roundabout at Laurel St and 6th Avenue has the same design.

During the design phase, options can be further explored to design the roundabout smaller (less than the 180 ft ICD) and provide for future capacity expansion.

Related Value Engineer proposal: 3/8 and 20

This is an alternative to VE Proposal #3/8. These are mutually exclusive proposals. If one is chosen the other would not be selected.

Proposal #20 – Removing the pedestrian tunnel – would be included with this proposal.

Advantages of this Proposal: A reduction in conflict points with one intersection rather than three intersections. It also provides for more intuitive way finding for local, regional and tourist traffic as well as pedestrians.

Pedestrian crossings at grade instead of the tunnel may be preferred for security purposes.

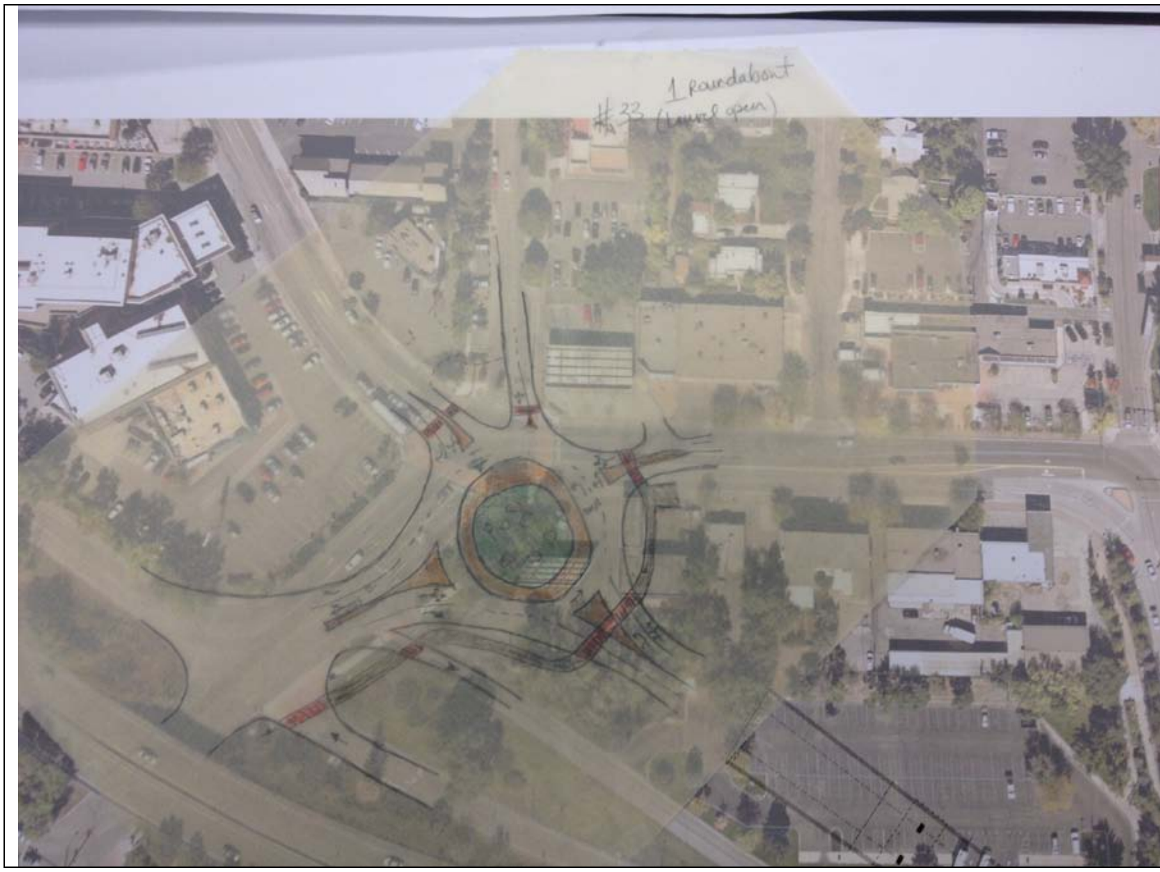
See VE Proposal #3/8 for additional Advantages.

Advantages of original design concept: The original concept design provides a direct connection from I-70 to the Grand Avenue bridge/SH 82.

Risks associated with implementing this Proposal: None identified.

Calculations: None

Roundabout for EA Alternative 3



Estimated Capacity MOE's for proposed roundabout at 6th and Laurel St for EA Alternative 3 Future Volumes

VE Proposal # 3/8/33

Measures of Effectiveness (Calibrated HCM Model)

Double Roundabout w/EA Option 3A.

			Future (2035)							
			AM				PM			
Intersection	**Approach**	**Movement**	**V/C**	**LOS**	**Delay**	**Queue**	**V/C**	**LOS**	**Delay**	**Queue**
6th / Laurel / SH 82	NW (US 6)	Thru/Left	0.25	A	6.6	25	1.2	F	157.1	372
		Thru/Right	0.32	A	7.1	34	1.15	F	132.1	382
	E (6th St)	Thru/Left/Right	0.28	A	8.8	28	0.81	F	71.6	146
	SE (Grand Ave)	Thru/Left	0.58	A	10	99	0.95	D	34.5	425
		Thru/Right	0.19	A	4.6	17	1.04	F	57	616
	S (S Laurel)	Thru/Left	0.82	C	21.6	246	0.6	B	12.7	103
		Thru/Right	0.69	B	13.7	144	0.4	A	8.1	48

Note: Traffic volumes used in the analysis are based on the SYNCHO model provided by TSH as modified to be comparable to the *SH 82 Corridor Optimization Study*, 2007.

Estimated Capacity MOE's for proposed roundabout at 6th and Laurel St intersection for VE Proposal 4 (EA Alternative 1) Future Volumes

VE Proposal # 3/8/33

Measures of Effectiveness (Calibrated HCM Model) EA Alternative Alt 1 (Existing Alignment)

			Future (2035)							
			AM				PM			
Intersection	**Approach**	**Movement**	**V/C**	**LOS**	**Delay**	**Queue**	**V/C**	**LOS**	**Delay**	**Queue**
6th / Laurel / SH 82	NW (US 6)	Thru/Right	0.31	A	7.9	33	1.11	F	126	330
		Right	0.44	A	9.5	56	1.06	F	101.7	327
	E (6th St)	Thru/Left	0.46	A	7.5	66	0.97	E	36.6	469
		Thru/Right	0.46	A	7.6	37	0.91	D	36.6	361
	S (from 70)	Thru/Left	0.88	D	27.5	300	0.46	A	9.9	64
		Thru/Right	0.77	C	18	199	0.41	A	8.7	53

Note: Traffic volumes used in the analysis are based on Figure 5 of the *SH82 Corridor Optimization Study* , 2007. Volumes do not reflect manual adjustment of 100 to 150 vph to/from the pool area identified by TSH in their *Grand Avenue Bridge Traffic Note* s document.

Estimated Capacity MOE's for proposed roundabout at 6th and Laurel St intersection for VE Proposal 4 (EA Alternative 1) Existing Volumes

VE Proposal # 3/8/33

Measures of Effectiveness (Calibrated HCM Model) EA Alternative 1 (existing bridge alignment)

			Existing							
			AM				PM			
Intersection	**Approach**	**Movement**	**V/C**	**LOS**	**Delay**	**Queue**	**V/C**	**LOS**	**Delay**	**Queue**
6th / Laurel / SH 82	NW (US 6)	Thru/Right	0.16	A	4.8	13	0.3	B	10.4	31
		Right	0.21	A	5.3	20	0.39	B	11.3	47
	E (6th St)	Thru/Left	0.16	A	4.1	12	0.57	A	9.4	95
		Thru/Right	0.39	A	6.4	38	0.53	A	8.6	81
	S (from 70)	Thru/Left	0.52	B	10	61	0.27	A	6.2	27
		Thru/Right	0.49	A	9.3	48	0.23	A	6.7	22

Note: Traffic volumes used in the analysis are based on Figure 5 of the *SH82 Corridor Optimization Study* , 2007. Volumes do not reflect manual adjustment of 100 to 150 vph to/from the pool area identified by TSH in their *Grand Avenue Bridge Traffic Note* s document.

Value Engineering Proposal No. 34
SH 82 Bridge Width Reduction at North Flare
Recommended Action: Incorporate

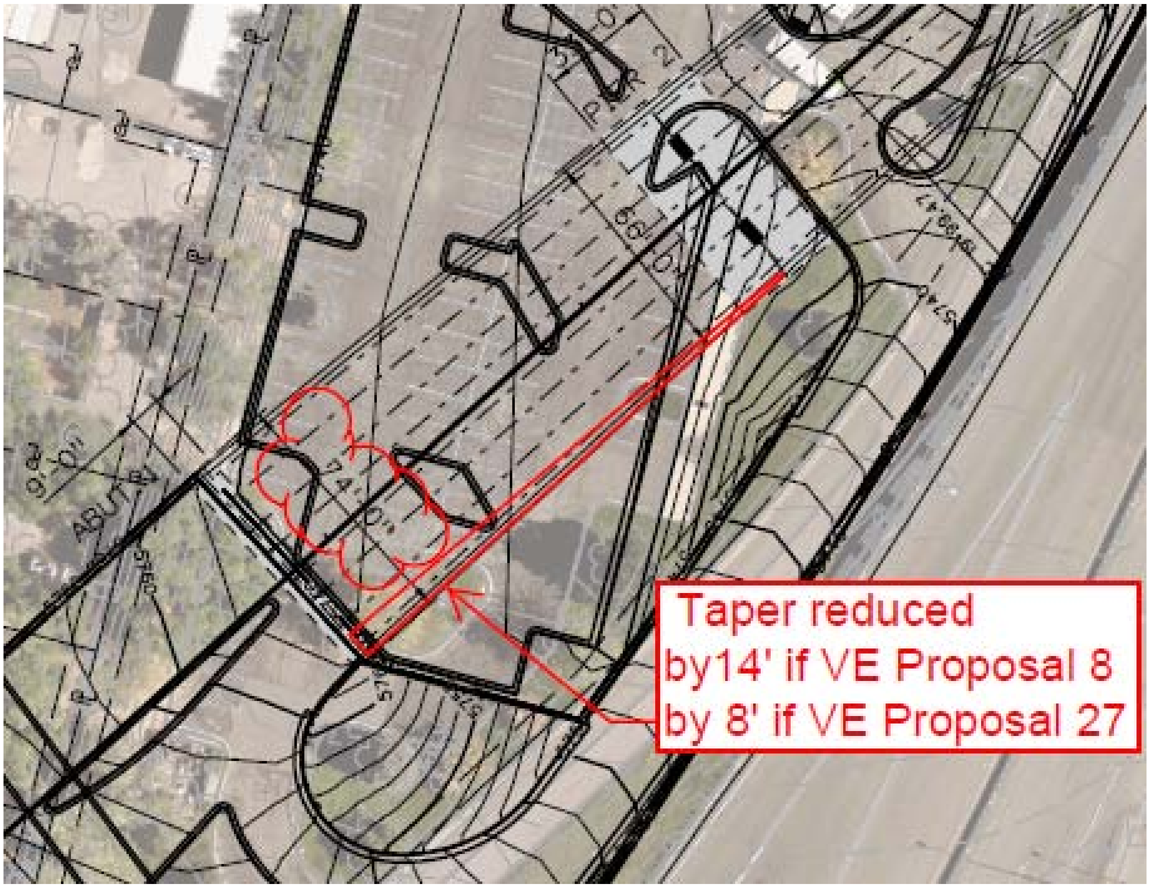
Summary
SH 82 Bridge width could be reduced at the north flare to achieve cost reductions. A narrower SH 82 Bridge superstructure would be more efficient and less costly, thereby increasing value. Abutment 1 and Pier 2 quantities are reduced. Removing the width flare eliminates the need for extra plow trips to remove snow in the flared section.

Estimated potential cost savings: **$ 0.35 million if north taper eliminated**
$ 0.20 million if north taper reduced
$ 0.18 million if north span length reduced

Discussion:
SH 82 Bridge superstructure width could be reduced at the north flare due to several reasons.

1. If the Double Roundabout configuration is implemented, as described in Value Engineering Proposal No. 8, the taper onto the SH 82 bridge would not be needed. The elimination of the taper onto the SH 82 bridge would reduce the SH 82 bridge width between Abutment 1 and Pier 2 by 14' at Abutment 1 to 0' beyond Pier 2, over a length of 248'. The SH 82 bridge area would be reduced by 1,736 square feet. Eliminating the taper would improve the deck design, removing the potential for required transverse post-tensioning in the wider deck spans between flaring girders.
2. If the westbound River Street loop ramp to southbound SH 82 were eliminated, as described in Value Engineering Proposal No. 27, the median in the center of SH 82 just northeast of the bridge could be eliminated, and the taper for SH 82 that extends from the center median onto the SH 82 bridge would not be needed. The elimination of the taper onto the SH 82 bridge would reduce the width taper by 8' at the median to 0' beyond Pier 2, over a length of 248'. The SH 82 bridge area would be reduced by 992 square feet.
3. If the pool parking space total is reduced to a zero-net-gain or 5-space-gain, instead of the preliminary layout with a 12 parking space gain, as described in Value Engineering Proposal No. 18, the SH 82 bridge Abutment 1 could be moved 20' closer to Pier 2. The result would be a span length reduction of 20' at the beginning of span 1, where the SH 82 bridge is 74 wide. The SH 82 bridge area would be reduced by 1,480 square feet.

Figure 1: SH 82 Bridge Width Reduction at North Flare



A narrower SH 82 Bridge superstructure would result in cost reductions, achieving more value to the project.

Related Value Engineer proposal:
Value Engineer Proposal 8: Double Roundabout, is related. Value Engineer Proposal 34 scenario 1 is implemented with Value Engineer Proposal 8.

Value Engineer Proposal 27: River Street one-way, is related. Value Engineer Proposal 34 scenario 2 is implemented with Value Engineer Proposal 27.

Value Engineer Proposal 18: Shorten SH 82 Bridge by no net-gain in parking, is related. Value Engineer Proposal 34 scenario 3 is implemented with Value Engineer Proposal 18.

Advantages of this Proposal:

- Reduced SH 82 bridge superstructure area;
- Reduced deck thickness in end span, or elimination of potential for transverse post-tensioning in the deck;
- Reduced abutment length;
- Reduced pier 2 quantity;
- Improved constructability due to elimination of variable-spacing girders;
- Removing the width flare eliminates the need for extra plow trips to remove snow in the flared section.

Advantages of original design concept:
SH 82 Bridge provides width taper for the roadway configuration shown in the preliminary plans.

Risks associated with implementing this Proposal:
None.

Calculations:

SH 82 Grand Avenue Bridge Replacement VE Study

Value Engineering Proposal 34 : SH 82 Bridge Width Reduction at North Flare

Cost Estimate 1 : If Double Roundabout configuration is implemented, VE Proposal No. 8				
Component		Area (ft^2)	Unit Cost ($ / ft^2)	**Estimated Cost** (nearest $ 10 k)
SH 82 Bridge main unit Superstructure taper reduced		-1,736	$ 200.00	$ (350,000)
				$ -
			Total	$ (350,000)

Cost Estimate 2 : If River Street loop ramp to southbound SH 82 is eliminated, VE Proposal No. 27				
Component		Area (ft^2)	Unit Cost ($ / ft^2)	**Estimated Cost** (nearest $ 10 k)
SH 82 Bridge main unit Superstructure taper reduced		-992	$ 200.00	$ (200,000)
				$ -
			Total	$ (200,000)

Cost Estimate 3 : If parking is zero-net-gain, shorten SH 82 Bridge, VE Proposal No. 18				
Component		Area (ft^2)	Unit Cost ($ / ft^2)	**Estimated Cost** (nearest $ 10 k)
SH 82 Bridge main unit Superstructure length reduced 20'		-1,480	$ 200.00	$ (300,000)
Parking lot pavement		-1,480	$ 10.00	$ (10,000)
Additional retained embankment and pavement, replaces bridge length reduction		1,480	$ 90.00	$ 130,000
				$ -
			Total	$ (180,000)

Value Engineering Proposal No. 35
Vibrational Monitoring Before, During, and After Construction
Recommended Action: Design Consideration

Summary

It is recommended that the project set-up seismic monitoring devices at strategic locations throughout the project site, and adjacent high risk locations.

Estimated potential cost savings:

None

Discussion:

Vibrational monitoring should be done as early as possible to establish a baseline of ground accelerations prior to construction activities taking place. Monitoring should be continued during construction. If construction vibrations are found to have impacts to adjacent areas, construction can be modified to mitigate any adverse affects.

There are numerous examples of CDOT projects where adjacent land owners claim that vibrations from activities such as soil compaction, pile driving, and blasting have caused damage to elements on their property such as foundations, walls, sanitary sewers, etc. Having adequate vibrational information will help the project team assess the validity of such claims.

Areas that are at a high risk of being impacted by construction vibration are the historic buildings at the south end of the project, and the areas adjacent to the Hot Springs, including a possible historic culvert running under the Hot Springs parking lot.

Having pre, during, and post-construction vibrational information will help the project team assess if the project has caused any post-construction damage. This can protect CDOT from any unfounded claims.

This is a common practice for claim mitigation when working in urban areas. Several contractors can efficiently provide this service. This was also recently performed for the US 6 over Eagle River bridge replacement.

Consider also adding pre-construction video of critical items to provide pre-construction condition records in case of claimed damage.

Consider also adding in maximum allowable acceleration criteria to the project that the contractor would have to adhere to during construction.

Related Value Engineer proposal:

None

Advantages of this Proposal:

Vibrational information related to before, during, and after conditions can help CDOT avoid having to pay for unsubstantiated claims against the project.

Advantages of original design concept:

N/A

Risks associated with implementing this Proposal:

None

Calculations:

None

Value Engineering Proposal No. 36
Use Single Column Piers at Pedestrian Bridge
Recommended Action: Incorporate

Summary
Use single column piers for proposed pedestrian bridge

Estimated potential cost savings: $240,000

Discussion:
The current pedestrian bridge utilizes two columns at each pier. For an 18-foot wide bridge, a single column of similar size as the current columns would be sufficient.

Related Value Engineer proposal:
None

Advantages of this Proposal:
Reduces cost
Slightly improves hydraulic performance
Improves constructability
Reduces structure footprint in parking and at river

Advantages of original design concept:
Perceived aesthetic advantage

Risks associated with implementing this Proposal:

1. Aesthetic design may need to be revisited if single columns are used.

Calculations:
Current cost estimate for Ped bridge is $6.95 Million. Reduction of pier quantities at piers 2-5 results in a total of $6.71 Million for a total savings of $240,000.

PEDESTRIAN BRIDGE: GIRDER OPTION (STEEL TUBS) - with single column Bents

SUMMARY OF QUANTITIES

				SUBSTRUCTURE						
ITEM NO.	DESCRIPTION	UNIT	SUPERSTRUCTURE	ABUTMENT 1	PIER 2	PIER 3	PIER 4	PIER 5	ABUTMENT 6	TOTAL
503	DRILLED CAISSON (30 INCH) (NON-BASE GROUTED	LF		135					135	270
503	DRILLED CAISSON (36 INCH) (BASE GROUTED)	LF			54	54	54	54		216
504	STONE FACING	SF		1256	1390	1582	1763	2248	1310	9549
509	STRUCTURAL STEEL	LB	691200							691200
512	BEARING DEVICE (TYPE I)	EA		2	2	2	2	2	2	12
514	PEDESTRAIN RAIL	LF	1256							1256
518	BRIDGE EXPANSION DEVICE (0-4 INCHES)	LF	18							18
518	BRIDGE EXPANSION DEVICE (0-6 INCHES)	LF	18							18
601	CONCRETE (CLASS D)	CY	384	36	24	27	30	38.4	38	577.4
601	STRUCTURAL CONCRETE COATING	SY	689	54					54	797
602	REINFORCING STEEL (EPOXY COATED)	LB	61890							61890
602	REINFORCING STEEL	LB		15124	4728	5380.8	5997.6	7650	15424	54304.4
613	DECK HEATING SYSTEM	SF	13824							13824
613	BRIDGE LIGHTING	LS	1							1
XXX	ROOF STRUCTURES	EA		1	1	1	1	1	1	6

COST ESTIMATE

SUBSTRUCTURE

ITEM NO.	DESCRIPTION	UNIT	SUBSTRUCTURE	UNIT COST	ITEM COST
503	DRILLED CAISSON (30 INCH) (NON-BASE GROUTED	LF	270	$500	$135,000
503	DRILLED CAISSON (36 INCH) (BASE GROUTED)	LF	216	$950	$205,200
504	STONE MASONRY	SF	9549	$30	$286,470
512	BEARING DEVICE (TYPE I)	EA	8	$1,500	$12,000
512	BEARING DEVICE (TYPE II)	EA	4	$10,000	$40,000
601	CONCRETE (CLASS D)	CY	193.4	$500	$96,700
601	STRUCTURAL CONCRETE COATING	SY	108	$15	$1,620
602	REINFORCING STEEL	LB	54304.4	$0.95	$51,589
XXX	ROOF STRUCTURES	LF	6	$20,000	$120,000
				subtotal	$948,579

excludes any casing or obstruction risk
excludes any casing or obstruction risk

SUPERSTRUCTURE

ITEM NO.	DESCRIPTION	UNIT	SUPERSTRUCTURE	UNIT COST	ITEM COST
509	STRUCTURAL STEEL	LB	435000	$2.50	$1,087,500
514	PEDESTRAIN RAIL	LF	1256	$200	$251,200
518	BRIDGE EXPANSION DEVICE (0-4 INCHES)	LF	18	$500	$9,000
518	BRIDGE EXPANSION DEVICE (0-6 INCHES)	LF	18	$2,000	$36,000
601	CONCRETE (CLASS D)	CY	384	$1,000	$384,000
601	STRUCTURAL CONCRETE COATING	SY	689	$15	$10,335
602	REINFORCING STEEL (EPOXY COATED)	LB	61890	$1.10	$68,079
613	DECK HEATING SYSTEM	SF	13824	$15	$207,360
613	BRIDGE LIGHTING	LS	1	$500,000	$500,000
				subtotal	$2,553,474

Includes all temp shoring towers for erection

Includes Debris Shield over River, I-70 and RX

Total	$3,502,053
SF Deck	13,824
Cost/SF	$253

MISCELLANEOUS

ITEM NO.	DESCRIPTION	UNIT	MISC	UNIT COST	ITEM COST
	IN WATER WORK PADS	TN	20000	$30.00	$600,000
	CRANE MOBILIZATION	EA	2	$25,000	$50,000
	ON-SITE CRANE MOBILIZATIONS	EA	1	$20,000	$20,000
	GENERAL MOBILIZATION	LS	1	$350,000	$350,000
	SURVEY	LS	1	$80,000	$80,000
	TRAFFIC CONTROL	LS	1	$150,000	$150,000
	RAILROAD COORDINATION/FLAGGERS	HR	250	$200.00	$50,000
	RAILROAD CROSSING	LS	1	$75,000.00	$75,000
	COFFERDAMS	SF	8600	$50	$430,000
	OTHER SHORING	LS	1	$30,000	$30,000
				subtotal	$1,835,000

TOTAL OF ALL DIRECT COSTS			$5,337,053
JOBSITE INDIRECTS	%	15	$800,558
CMGC FEE	%	8	$491,009
INSURANCE	%	0.5	$33,143
BOND	%	0.75	$49,963
OPTION TOTAL			$6,711,726

Value Engineering Proposal No. 37
SH 82 Bridge and Pedestrian Bridge Consistent Girder Shape
Recommended Action: Design Consideration

Summary

SH 82 Bridge main unit girders shown in the preliminary plans and Structure Selection Report are constant-depth trapezoidal steel box girders (sloping webs). Pedestrian bridge recommended girders are variable-depth rectangular steel box girders (vertical webs). Providing consistent shape girders would help achieve visual consistencies and fabrication efficiencies. Consider use of constant-depth girders and precast spliced post-tensioned concrete tub girders.

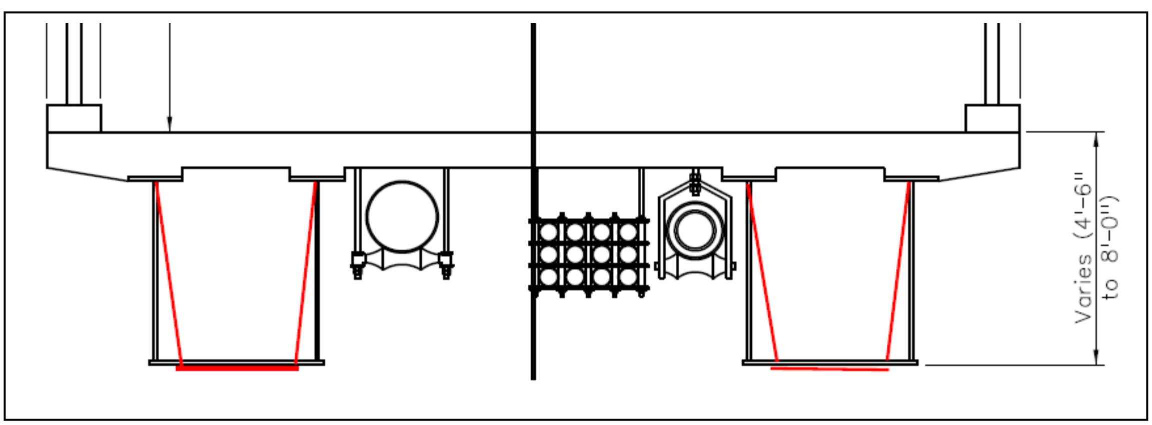
Estimated potential cost savings: **Not evaluated**

Discussion:

SH 82 Bridge main unit recommended girders are constant-depth trapezoidal steel box girders (sloping webs). Trapezoidal steel box girders are feasible for constant-depth superstructures, including the horizontally curved alignment. This girder type can accommodate variable bridge width by either widening the trapezoidal steel box girders or by increasing the spacing between the girders.

Pedestrian bridge recommended girders are variable depth rectangular steel box girders (vertical webs). Rectangular steel box girders are feasible for variable-depth superstructures. Trapezoidal steel box girders could be used by varying the bottom flange width as the depth varies; the fabrication complexity would increase, and the amount of bottom flange material would decrease. The design could consider constant-depth girders.

Providing consistent shape girders would help achieve visual consistencies and fabrication efficiencies. Providing both bridges with trapezoidal steel box girders is feasible. Pedestrian bridge girders could be revised to trapezoidal steel box girders, where the bottom flange width would vary as the depth varies, or constant-depth girders.



Consider the use of constant-depth steel box girders. Minimum structure depth of 4'-6" results is span-to-depth ratio of 34.4. A slightly deeper depth would achieve a lower span-to-depth ratio.

Precast prestressed spliced post-tensioned concrete tub girders were evaluated in the preliminary design and Structure Selection Report. The preliminary evaluation showed the cost efficiency was good, but the weight of the segments, geometric constraints for temporary support location, impacts to the pool parking lot, and moving a much heavier bridge superstructure were aspects of concern. Additional preliminary design evaluations should continue to addressing the concerns. The geometric constraints for the temporary supports seems to be the biggest issue, such as temporary supports for splices over I-70. Segment weight issues can be overcome. The superstructure weight for the lateral bridge move can be overcome.

Use of precast prestressed splice post-tensioned concrete tub girders could achieve consistent girder shape for the SH 82 bridge and Pedestrian bridge.

Related Value Engineer proposal:
Value Engineer Proposal 2: Mix Concrete and Steel Girders, is related. Value Engineer Proposal 37 could be implemented with or without Value Engineer Proposal 2.

Value Engineer Proposal 15: Land Pedestrian Bridge north of UPRR, is related. Value Engineer Proposal 37 could be implemented with or without Value Engineer Proposal 15.

Advantages of this Proposal:
SH 82 bridge main unit and Pedestrian bridge girders could be revised to provide consistent shape girders, achieving the following advantages:

- Increases visual consistency between the SH 82 bridge main unit and Pedestrian bridge;
- Potentially increases fabrication consistency.

Advantages of original design concept:
SH 82 Bridge main unit girder shape is efficient for the SH 82 Bridge span configuration and for constant-depth superstructure.

Pedestrian Bridge girder shape and variable-depth girders, provides one solution for the span configuration.

Risks associated with implementing this Proposal:

- Potential risk increase by increasing fabrication complexity of variable-depth trapezoidal steel box girders.
- Constant-depth girders would change the aesthetics of the Pedestrian bridge.

Calculations: Qualitative evaluation only.

Value Engineering Proposal No. 38
Use Rapid Placed Fill to Reduce Construction Time
Recommended Action: Design Consideration

Summary
Use rapid fill placement methods for reduced construction time in the downtown section.

Estimated potential cost savings: Not Evaluated Quantitatively

Discussion:
The construction of bridge and embankments for the downtown bridge section is on the critical path for the construction schedule. There are fill methods and materials available that can permit rapid embankment construction and structure backfill. These methods include:

- Expanded Polystyrene (Geofoam)
- Flow fill (including high, early strength mixes)
- Cellular concrete or foamed flow fill (light-weight cementitious material)

Related Value Engineer proposal:
- Proposal 31 – Move south abutment north to Pier 7: VE Proposal 38 could be implemented with or without implementing VE Proposal 31

Advantages of this Proposal:
- Rapid construction
- Various options can be combined
- Commonly used methods reduce risk
- Low disturbance during construction

Advantages of original design concept:
- Likely lower initial cost, not considering user impacts

Risks associated with implementing this Proposal:
- Potential differential settlement due to different consolidation or settlements of different embankment materials. This risk can be mitigated with appropriate design.

Calculations:
Recent bid prices or estimated costs for potential options:
- Geofoam: CDOT bid cost data (below) from 2004 to 2013 indicates prices have ranged from $56-$80/cubic, with the most recent being $65/cubic yard.

Project Development Branch
Construction Estimate & Market Analysis Unit

Search for Items / Bid Cost Between Selected Date

Select ITEM # Between	203-00850	AND	203-00851
Bid Letting Date Between	01/01/00	AND	10/04/13

Submit Reset

#	Bid Date	Cntrct ID	Location	Unit	Awarded To	Item	Quantity	Unit Cost
1	OCT 21 2004	C15068	US160 Montoya Slide #1	E	NIELSONS SKANSKA, INC.	203-00850	6250.000	72.00000
2	MAY 05 2005	C14978	US160 Slides W Durango	E	NIELSONS SKANSKA, INC.	203-00850	7700.000	80.00000
3	FEB 07 2008	C15918	SH 13 RIO BLANCO SLIP	E	AMERICAN CIVIL CONSTRUCTORS, INC.	203-00850	5500.000	80.00000
4	SEP 16 2010	C17738A	SH 50 CERRO SLIDE REPAIR	E	TEZAK HEAVY EQUIPMENT CO., INC.	203-00850	22087.000	56.39000
5	MAR 15 2012	C18145	US 50 CERRO SLIDE REPAIR PHASE 2	E	TRICON 2, LLC	203-00850	4102.000	64.92000
6	NOV 08 2012	C17735	US 50 BLUE CREEK WEST	E	SEMA CONSTRUCTION, INC.	203-00850	9746.000	65.00000

*Region zero means the project is done by CDOT Maintenance unit

- Flow Fill: Recent CDOT cost data for Flow Fill indicates a cost of around $75 to $80/cy for common applications and a range of approximately $150 to $200/cy for specialized applications.
- Cellular Concrete: CDOT cost data for a 2012 project with inplace cellular concrete was $160/cy.

Value Engineering Proposal No. 40
Pedestrian Bridge Width Reduction
Recommended Action: Incorporate

Summary
Pedestrian bridge width could be reduced from 16’ to 11’ usable path, to achieve cost reductions. The substructure would also require smaller and less costly components.

Estimated potential cost savings: $ 0.6 million

Discussion:
Pedestrian bridge superstructure width could be reduced, resulting in cost reductions. A more appropriate narrower width Pedestrian bridge superstructure would be less costly, increasing value. The width between the curb/rails is determined from applicable references.

The AASHTO Guide for the Development of Bicycle Facilities, 4th edition, 2012, provides guidance for width of pedestrian facilities and multi-use trails. The guide states that 10’ paved width is minimum for a two-directional shared use path. AASHTO section 5.2.1 states that 11’ to 14’ widths are recommended in locations with two-way bike traffic and high pedestrian volumes, and “ 11’ wide pathways are needed to enable a bicyclist to pass another path user going the same direction, at the same time a path user is approaching from the opposite direction.” Although bike traffic is anticipated on the bridge, pedestrians are likely the predominant users of the bridge. Figure 1 shows the minimum width needed to facilitate passing on a shared use path. Based on this guidance, the Pedestrian bridge should provide an 11’ wide surface between curbs/rails.

Figure 1: AASHTO Guide for the Development of Bicycle Facilities Figure 5.2 Minimum Width Needed to Facilitate Passing on a Shared Use Path

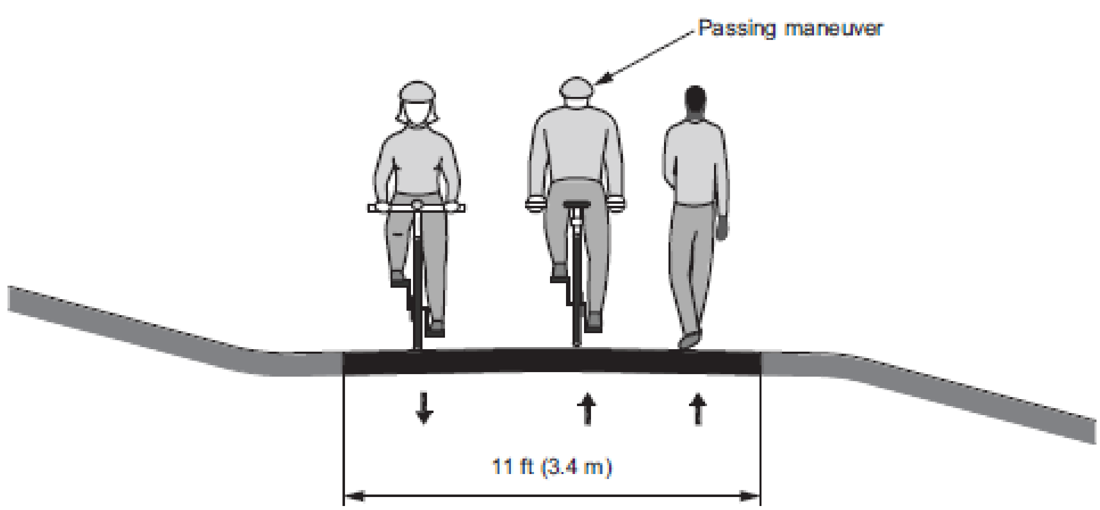


Figure 5-2. Minimum Width Needed to Facilitate Passing on a Shared Use Path

The Shared Use Path Level of Service Calculator, FHWA HRT-05-138, 2006, commonly referred to as the FHWA Trail Level of Service (LOS) Calculator, was used to evaluate relevant bridge widths for pedestrian volumes shown in the Alternatives Analysis pages 45-46. The existing 10’ wide pedestrian bridge was evaluated for current peak 150 pedestrians each way, resulting in LOS D. VE recommended 11’ wide surface and 16’ wide Pedestrian bridge in preliminary plans were evaluated for the 2035 projected 250 pedestrian each way. VE recommended 11’ width resulted in LOS D, and preliminary design width 16’ resulted in LOS C. See Figure 2 below.

Figure 2: FHWA Trail Level of Service Calculator:

Shared Use Path Flow Analysis Tool

Trail Level of Service (LOS) Calculator

Draft Spreadsheet Based on Federal Highway Administration Shared Use Path Study

North Carolina State University and Toole Design Group

Trail LOS Scale	
LOS Score	LOS Grade
X≥4.0	A
3.5≤X<4.0	B
3.0≤X<3.5	C
2.5≤X<3.0	D
2.0≤X<2.5	E

Existing Pedestrian Bridge and Volumes

Click Here for Default Mode Split

Segment Name	Path Width	Centerline	Volume (users ... Mode Split							User Perception		Delayed Passings Adjustment				Prelim LOS Score	Trail Level of Service	
	Closest 0.5 ft.	0=No Centerline	Volume	Mode Split (%)*								Adj. Factor (subtract from User Percep. score)						
Name	Width (ft)	1=Centerline	One-Way (per hour)	Adult Bicyclists	Pedestrians	Runners	In-Line Skaters	Child Bicyclists	All Modes	Score	Grade	Percent	# Per Hr	Pre Adj Fac	Fin Adj Fac	Prelim LOS Score	LOS Score	LOS Grade
Existing	10.0	0	150.0	55.0%	20.0%	10.0%	10.0%	5.0%	100.0%	3.62	B	####	93.75	0.78	0.78	2.84	2.84	D

*Default mode split is 55% adult bicyclists, 20% pedestrians, 10% runners, 10% in-line skaters, and 5% child bicylists.

Click Here for Default Mode Split

Baseline Pedestrian Bridge and Volumes

Segment Name	Path Width	Centerline	Volume (users per hour in 1 direction) and Mode Split							User Perception		Delayed Passings Adjustment				Prelim LOS Score	Trail Level of Service	
	Closest 0.5 ft.	0=No Centerline	Volume	Mode Split (%)*								Adj. Factor (subtract from User Percep. score)						
Name	Width (ft)	1=Centerline	One-Way (per hour)	Adult Bicyclists	Pedestrians	Runners	In-Line Skaters	Child Bicyclists	All Modes	Score	Grade	Percent	# Per Hr	Pre Adj Fac	Fin Adj Fac	Prelim LOS Score	LOS Score	LOS Grade
Baseline	16.0	0	250.0	55.0%	20.0%	10.0%	10.0%	5.0%	100.0%	4.05	A	####	68.77	0.57	0.57	3.48	3.48	C

*Default mode split is 55% adult bicyclists, 20% pedestrians, 10% runners, 10% in-line skaters, and 5% child bicylists.

Click Here for Default Mode Split

VE Proposal

Segment Name	Path Width	Centerline	Volume (users per hour in 1 direction) and Mode Split							User Perception		Delayed Passings Adjustment				Prelim LOS Score	Trail Level of Service	
	Closest 0.5 ft.	0=No Centerline	Volume	Mode Split (%)*								Adj. Factor (subtract from User Percep. score)						
Name	Width (ft)	1=Centerline	One-Way (per hour)	Adult Bicyclists	Pedestrians	Runners	In-Line Skaters	Child Bicyclists	All Modes	Score	Grade	Percent	# Per Hr	Pre Adj Fac	Fin Adj Fac	Prelim LOS Score	LOS Score	LOS Grade
VE Proposal	11.0	1	250.0	55.0%	20.0%	10.0%	10.0%	5.0%	100.0%	3.31	C	####	95.74	0.80	0.80	2.51	2.51	D

*Default mode split is 55% adult bicyclists, 20% pedestrians, 10% runners, 10% in-line skaters, and 5% child bicylists.

Click Here for Default Mode Split

Click Here for Default Mode Split

MODEL ASSUMPTIONS

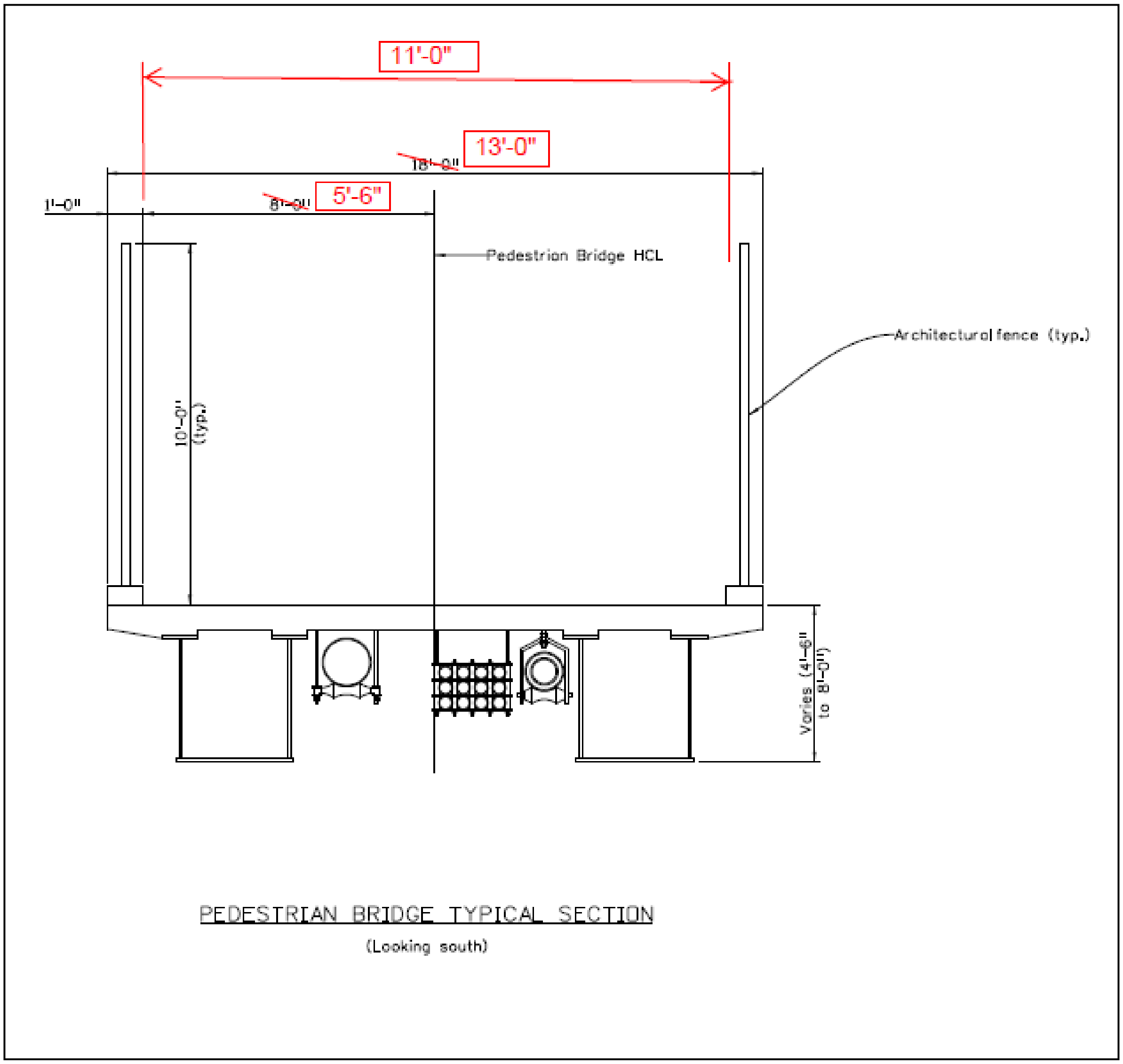
Trail volume represents the actual number of users counted in the field (the model adjusts this volume based on a peak hour factor of 0.85).

Bicyclists will pass all trail users that are traveling less than 12.8 miles per hour (average bicyclist speed)

Potential for viewing area(s) remain, with this proposal, that will provide users a designated location to pull over and enjoy the view, take pictures, or take a rest.

Reduced width Pedestrian bridge can be supported by superstructure girders required to carry less weight (dead load) and less user load (live load). With the reduction in applied loads, the girders would require less bending strength, less shear strength, and less stiffness to limit deflections, which results in reduction to girder member thicknesses, flange widths, and depth. The reduction in girder sizes achieves cost reductions. See Figure 3 for the reduced width Pedestrian bridge.

Figure 3: Pedestrian Bridge Width Reduction:



Two girder lines is still a feasible superstructure solution for the narrower Pedestrian bridge. The two girder lines still provide space between the girders for carrying utilities.

Another feasible superstructure solution is a single box girder. The reduced bridge width correlates well with one box girder. Dry utilities could be placed inside the box girder. The water utility could be placed inside the Pedestrian bridge box girder by mitigating potential leaks with screened-covered openings in the bottom flange, or the water utility could be carried on the SH 82 bridge. The gas utility should not be located inside the box girder unless the potential fire concern is mitigated; a feasible location for the gas utility is under one of the deck overhangs outside the box girder.

The reduction in superstructure dead load and live load would result in less load demand on the substructure piers and foundations, requiring smaller and less costly components.

Related Value Engineer proposal:
Value Engineer Proposal 13: Pedestrian Bridge Consider Truss Structure Type, is related. Value Engineer Proposal 40 could be implemented with or without Value Engineer Proposal 13.

Value Engineer Proposal 36: Single Column Piers, is related. Value Engineer Proposal 40 could be implemented with or without Value Engineer Proposal 36.

Advantages of this Proposal:

- Pedestrian bridge width reduction would be more efficient and achieve cost reductions.
- A narrower width bridge would require less structural maintenance and less maintenance to clear debris or snow/ice.

Advantages of original design concept:

- Pedestrian bridge provides width larger than the required width, achieving LOS C for shared use path for 2035.
- Locating gas utility between two box girders has better perceived aesthetics than locating gas utility outside single box girder (one of two options for narrower Pedestrian bridge) under the deck overhang.

Risks associated with implementing this Proposal:
Gaining consensus from stakeholders for implementation of this proposal has increased risk to the project.

Calculations:

SH 82 Grand Avenue Bridge Replacement VE Study

Value Engineering Proposal 40 : Pedestrian Bridge Width Reduction

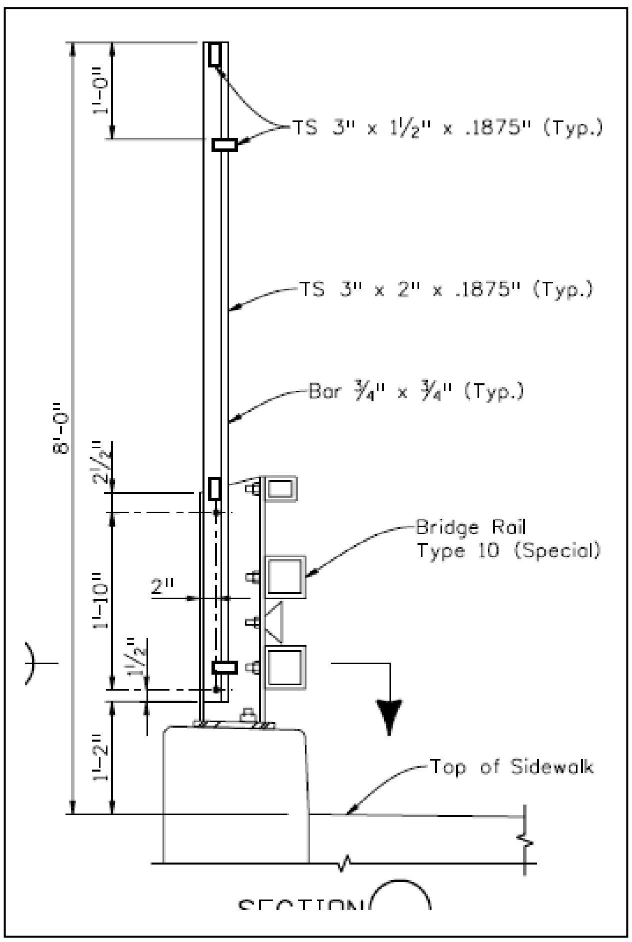
Cost Estimate					
Component	Width (ft)	Length (ft)	Area (ft^2)	Unit Cost ($ / ft^2)	**Estimated Cost** (nearest $ 10 k)
Pedestrian Bridge Superstructure width reduction; unit cost from preliminary estimate $ 282/sf ; lower unit cost used for width reduction	-5	610	-3,050	$ 200.00	$ (610,000)
					$ -
				Total	$ (610,000)

Value Engineering Proposal No. 41
SH 82 Bridge Curb Width Reduction
Recommended Action: Incorporate

Summary
SH 82 bridge curb width could be reduced and the overall bridge deck width reduced, to achieve cost reductions. A narrower SH 82 bridge superstructure would be more efficient and less costly, thereby increasing value. The substructure abutments would also be shorter length and less costly.

Estimated potential cost savings: $ 0.1 million

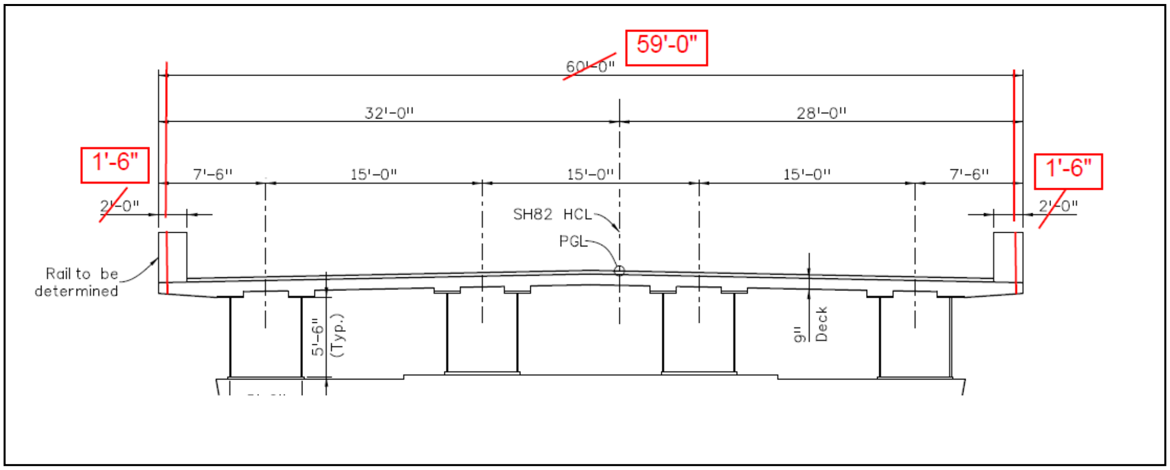
Discussion:
SH 82 Bridge superstructure curb width could be reduced from 2’ to 1.5’, each side. Curb width 1.5’ wide is adequate to accommodate the bridge rail that resists lateral vehicle loads and provide width to mount any potential fence or rail on the bridge rail posts. Pedestrians and bicycles are not intended to use the SH 82 Bridge, so there is no requirement to use fence in addition to the bridge rail to contain pedestrians or cyclists. The UPRR will require fence for the portion of the bridge superstructure over and near the UPRR tracks. The figure below shows an efficient bridge rail with fence mounted on the bridge rail posts.



The 1.5' wide curb will accommodate architectural features.

Reduction in the curb width from 2' to 1.5' each side will result in a 1' reduction in superstructure bridge deck width. The reduction in bridge deck width achieves cost reductions, since the bridge deck requires less reinforced concrete on each edge.

The figure below shows the reduction in bridge deck width.



A narrower SH 82 Bridge superstructure will result in cost reductions, achieving more value to the project.

Related Value Engineer proposal:
None.

Advantages of this Proposal:
SH 82 Bridge superstructure area is reduced, and abutment length is reduced, resulting in cost reductions. The cost reductions achieve project value.

Advantages of original design concept:
None.

Risks associated with implementing this Proposal:
Potential risk of 1.5' wide curb not being wide enough to accommodate architectural treatments that are wider than normally envisioned.

Calculations:

SH 82 Grand Avenue Bridge Replacement VE Study

Value Engineering Proposal 41 : SH 82 Bridge Width Curb Reduction

Cost Estimate					
Component	Width (ft)	Length (ft)	Area (ft^2)	Unit Cost ($ / ft^2)	**Estimated Cost** (nearest $ 10 k)
SH 82 Bridge Superstructure main unit width reduction; unit cost from preliminary estimate $ 219/sf ; lower unit cost used for deck width reduction	-1	782	-782	$ 120.00	$ (90,000)
SH 82 Bridge Superstructure downtown unit width reduction; unit cost from preliminary estimate $ 158/sf ; lower unit cost used for deck width reduction	-1	200	-200	$ 120.00	$ (20,000)
					$ -
				Total	$ (110,000)

Value Engineering Proposal No. 46
Do not remove existing retaining walls
Recommended Action: Incorporate

Summary: Leave the existing retaining walls at the south approach in place.

Estimated potential cost savings: $25,000 to $60,000

Discussion: Removing the existing walls is an unnecessary expense and creates construction and schedule risk. The new wall can also benefit from leaving the existing walls in place. There are several ways to account for the existing retaining wall when designing the new retaining wall including:

- Ignore the existing wall in the design of the new wall.
- Account the reduced soil pressures due to the existing wall in the design.
- Use the existing wall as a tieback element.
- Place geofoam in front of the old wall and apply a facing element in front of the geofoam.
- Incorporate a flow fill or cellular concrete as a backfill element between the new wall and existing wall.

Related Value Engineer proposal: 38**,** 47

Advantages of this Proposal:

- Minimizes construction time and cost.
- Utilizes existing structures and reduces waste of materials.
- Reduces excavation and removal extents which reduces construction duration and costs.

Advantages of original design concept: Simple design.

Risks associated with implementing this Proposal: Use of the existing wall as a tieback element requires that the existing wall is in good condition and can accommodate the future loading.

Calculations: There is approximately 200’ of retaining wall on the west side of Grand Avenue and 80’ of retaining wall on the east side of Grand Avenue. Each wall averages about 6’ in height. At a $15/sf wall removal cost leaving the wall in place reduces construction cost by approximately $25,000. Accounting for the existing wall in the design of the new wall could save approximately $20/sf in cost of the new wall or about $35,000.

Value Engineering Proposal No. 47
Cantilever downtown roadway section past retaining walls
Recommended Action: Design Consideration

Summary: Design the concrete pavement to cantilever out past the existing walls to eliminate the need for new walls and provide additional usable space under the edge of the bridge.

Estimated potential cost savings: $0 to $25,000

Discussion: Near the 8th street intersection the future section is not much wider than the existing section allowing reuse of the existing wall with a 2' or 3' overhang. The Grand Avenue width varies near the 8th street intersection. The right turn lane (SB Grand Avenue to WB 8th) is added to the Grand Avenue typical section. In this area the cantilever varies from 2' to 12' and back to 8'. In this area it may be appropriate to limit the overhanging portion to approximately 5' to 8' with the new wall working with the old wall as described in proposal 46.

Related Value Engineer proposal: 46

Advantages of this Proposal: Minimizes construction time and cost. Increases the useable sidewalk area. Permits seating and open access under the cantilevered section of road. Reduces structure backfill quantities and placement challenges.

Advantages of original design concept: Eliminates reliance on existing wall. Simple solution.

Risks associated with implementing this Proposal: Use of the existing wall as a tieback element or permanent element requires that the existing wall is in good condition and can accommodate the future loading. The cantilever section could represent a future maintenance problem.

Calculations: Not evaluated quantitatively.

Value Engineering Proposal No. 48
Move WB I-70 off Ramp to East & Connect to 6th St.
Recommended Action: Design Consideration - Eliminated

Summary

Permanently move WB I-70 off ramp to the east connecting to 6th Street.

Estimated potential cost savings: A permanent condition would be an increase in costs and potential impacts to the historical areas as well as introduces a higher speed (I-70 mainline posted speed 50 mph) at the exit ramp (I-70 WB off ramp deceleration) where a pedestrian and bicycle dominated environment exists.

Discussion:

The existing geometry of I-70 WB aligns with 6th St which could present itself as an opportunity to move the I-70 WB off ramp from Exit 116 and provide a more direct connection from I-70 WB to SB SH 82. This design consideration would only apply with VE Proposal #4 or a No Build alternative.

It is already known that this alternative is being considered as a temporary condition during construction phasing/staging.

Making significant improvements to the Grand Ave bridge/SH 82 and not making improvements to the roadways that connect I-70 to SH 82/Grand Ave would be an oversight for a project of this magnitude.

Different funding sources could be explored for these improvements.

Related Value Engineer proposal: 4

VE Proposal 4 – Re-evaluate EA Alternative 1 (existing Grand Ave Bridge alignment) – This Design consideration would have more value with the acceptance of VE Proposal 4.

Advantages of this Design Consideration: This alternative would eliminate conflicts at an already congested area near 6th St/Laurel/I-70 interchange. It would also provide a direct connection for I-70 WB users wanting to access Grand Avenue/SH 82.

Advantages of original design concept: Existing alignment of I-70 Ramp. No cost.

Risks associated with implementing this Design Consideration: Increasing conflict points in a pedestrian and bicycle environment where the speed differential could be significant. Potential noise impacts to the Hot Springs Pool.

Calculations: None

Value Engineering Proposal No. 49
Closure of Laurel Street
Recommended Action: Eliminate

Summary

Close Laurel St to the north of 6th Street to improve intersection operations.

Estimated potential cost savings: No cost savings estimated however alternative access to 6th Street would need to be determined for residential and existing business access at the intersection.

Discussion:

Each of the proposed intersection alternatives include in the VE keep Laurel St open to all traffic either with its existing alignment or a slight realignment to the west through the NW quadrant of the existing intersection.

Related Value Engineer proposal: None

Advantages of this Proposal: Reduction in conflict points at 6th Street and Laurel St. intersection.

Advantages of original design concept: Access remains intact.

Risks associated with implementing this Proposal: Public and business dislike and alternative access needs to be provided.

Calculations: None

Value Engineering Proposal No. 50
Separate Permitting of Pedestrian Bridge From Grand Avenue Bridge In Order to Allow Early Action Project
Recommended Action: Design Consideration

Summary
Separate out the permitting and the design of the pedestrian bridge from the remainder of the project in order to create an "Early Action Project" for the pedestrian bridge.

Estimated potential cost savings: Not Evaluated

Discussion:
The current concept is to utilize the new pedestrian bridge to carry the utilities that are currently on the existing Grand Avenue Bridge. The transfer of utilities needs to be completed prior to demolishing the existing Grand Avenue Bridge. Currently the Grand Avenue Bridge is not scheduled for design completion until sometime in the 4th Quarter of 2014. The contractor is currently anticipating a 5.5 month duration for shop drawings and procurement of the steel girders and approximately 14 months of construction time to complete the pedestrian bridge. Considering some concurrent activities, the anticipated completion date of the pedestrian bridge is in the 2nd Quarter of 2016. If the permitting and design were separated to the point that the contractor could start on the pedestrian bridge 3 to 4 months earlier the construction could be complete by the end of the 4th Quarter of 2015 or the 1st Quarter of 2016. This allows for the possibility of being able to perform the shutdown of the Grand Avenue Bridge during the first "Shoulder Season" in 2016 rather than the second shoulder season, thereby, completing the project approximately 4 months earlier.

Related Value Engineer proposal:
None

Advantages of this Proposal:
1. Earlier project completion resulting in earlier user benefits and improved public perception
2. Creates project schedule contingency that would still allow the work to be completed in 2016 if the project experiences a significant schedule impact.

Advantages of original design concept:
1. Possible concurrent construction of pedestrian bridge with other work

Risks associated with implementing this Proposal:
None

Calculations:
Not evaluated quantitatively

Estimated potential cost savings

There is some potential that permitting and design costs would increase due to separating the packages; however, this cost will likely be offset by the reduction of risk associated with labor and material escalation impacts, improved user benefits and added schedule contingency.

Value Engineering Proposal No. 51
Adjust Signal Timing During Construction
Recommended Action: Design Consideration

Summary

During construction, it is estimated and expected that many of the signalized intersections and potentially stop controlled intersections in and around Glenwood Springs will experience excess delays.

It is recommended that adjustments of signal timing and phasing be continually monitored and modified based on construction phasing and traffic conditions. Temporary installation and use of loops/video detection to provide signal actuation may be required to ensure efficient operations during construction.

Estimated potential cost savings: The value of this design consideration will be realized in reduced delays and driver/business frustration.

Discussion: Adjusting signal times within the project area of influence is critical to the drivers experience during this project. A performance specification could be written to outline contractor responsibilities during construction.

A traffic management specialist may need to be on the project at all times to make real time adjustments. MHT submittals should incorporate signal timing considerations.

Related Value Engineer proposal: None

Advantages of this Design Consideration: Minimize delays and queues for detours and signalized intersections in the area impacted by the construction.

Advantages of original design concept: NA

Risks associated with implementing this Design Consideration: None

Calculations: None

Value Engineering Proposal No. 52
Switch Proposed Walls to Slopes
Recommended Action: Incorporate

Summary
Use reinforced or unreinforced slopes at the Wall H-a and H-b location.

Estimated potential cost savings: Up to $200,000

Discussion:
The current layout consists of over 900 feet of retaining wall between I-70 and North River Street and the storm water quality area. The wall is designated as Wall H-a and Wall H-b and is shown on the attached layout. At this time the wall type and height is not known but are assumed to be 5 feet or less.

This proposal will change all or portions of the wall into a slope. The slope could consist of a 2:1horizontal:vertical (H:V) slope, which is possible if Class 1 Backfill (or similar) is used with aggressive re-vegetation or slope reinforcement mat. Alternatively, a 1:1 H:V reinforced soil slope could be used with a permanent facing. Both options create a savings. This option also allows for the mix of walls and slopes if required for grading plans.

Related Value Engineer proposal:
- Proposal 27 – Make North River Street one-way (Optional)

Advantages of this Proposal:
- Simple earthwork construction.
- Rapid construction.
- Can be partially implemented.
- Lower long term maintenance and inspection requirement.
- Reduces risk for traffic delay and stability monitoring due to difficulties with temporary wall excavations adjacent to I-70.
- Potential cost savings.

Advantages of original design concept:
- No vegetation maintenance.

Risks associated with implementing this Proposal:
- Additional right-of-way required.
- Erosion of slopes.
- Less width for North River Street.
- Minor reduction in storm water capacity in detention area.
- Maintenance of vegetation on a 2:1 slope.
- Local interests may not desire a larger footprint.

Calculations:

Grand Avenue Bridge Value Engineering Proposal No. 52
Cost Analysis - Use of Slopes at Wall H-a and H-b location

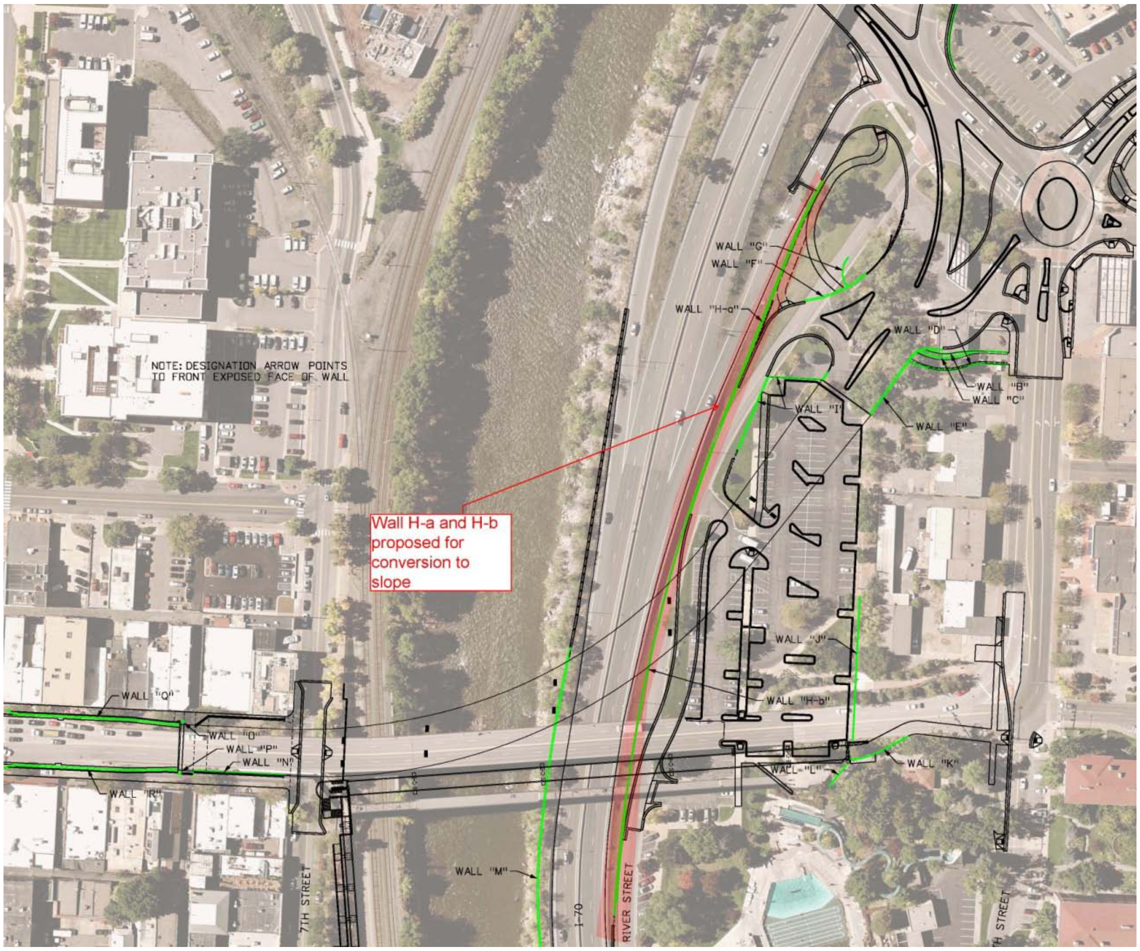
Current Configuration		
Proposed Wall Length	900	Lineal feet (approximate)
Assumed Average Wall Height	5	Feet
Assumed Wall Unit Cost	$50	per square foot of facing (assumes MSE, all inclusive)
Estimated Wall Cost	$225,000	

Option 1: Convert to unreinforced slope		
Proposed Slope Length	900	Feet
Slope inclination	26.5 degrees	Assumes 2:1 H:V slope
Volume of Fill for 5 Foot Slope	833	CY
Unit Cost for Class 1 Structure Backfill	$12	$/CY - Assume Class 1 to permit steeper slopes
Total Cost for Structure Backfill	$10,000	
Unit Cost for Revegetation	$2	$/SF - Assume aggressive application
Revegetation Quantity	10080	SF
Revegetation Cost	$20,160	
Subtotal	$30,160	

Option 2: Convert to reinforced slope		
Proposed Slope Length	900	Feet
Slope inclination	45 degrees	Assumes 1:1 H:V slope
Volume of Fill for 5 Foot Slope	417	CY
Unit Cost for Class 1 Structure Backfill	$12	$/CY - Assume Class 1 to permit steeper slopes
Total Cost for Structure Backfill	$5,000	
Cost for Reinforcement	$6,250	$/CY based on current CDOT EEMA data ($15/cy)
Unit Cost for Hard Facing	$10	$/SF (Permanent cells or gabions)
Facing Quantity	6390	SF
Facing Cost	$63,900	
Subtotal	$75,150	

	Unreinforced 2:1 Slope	
Total Delta For Entire Wall Length	**$194,840**	
Delta per Unit Length of Wall Eliminated	**$216**	**per lineal foot of wall/slope**

	Reinforced 1:1 Slope	
Total Delta For Entire Wall Length	**$149,850**	
Delta per Unit Length of Wall Eliminated	**$167**	**per lineal foot of wall/slope**


NOTE: DESIGNATION ARROW POINTS TO FRONT EXPOSED FACE OF WALL
Wall H-a and H-b proposed for conversion to slope
WALL "G"
WALL "F"
WALL "H-a"
WALL "D"
WALL "B"
WALL "C"
WALL "I"
WALL "E"
WALL "J"
WALL "H-b"
WALL "K"
WALL "L"
WALL "Q"
WALL "O"
WALL "P"
WALL "N"
WALL "R"
WALL "M"
7TH STREET
I-70
RIVER STREET

Value Engineering Proposal No. 53
Alternative Stormwater Configuration
Recommended Action: Design Consideration

Summary

The intent for this recommendation is for a design consideration to re-evaluate the location, function and depth of the stormwater pond located between the I-70 WB off ramp and North River St.

Estimated potential cost savings:

Not evaluated

Discussion

We understand at this time, no detailed stormwater evaluations have been conducted and the location of this pond is a place holder in the design process until a more detailed analysis can be conducted. We also understand there are limited locations for stormwater detention and water quality improvements within the project area.

The concern raised by VE Team is due to a 5-foot vertical drop near the pavement edge into the pond, the pond may become a traffic safety concern. The pond likely will need to have guard rail placed along the top of the pond. The pond would then become difficult to maintain as a grass lined detention pond and may become a visual eyesore. Consideration should be given to underground stormwater measures due to the limited surface locations for stormwater quality ponds and detention.

An additional safety concern is the 10-foot vertical drop from North River St roadway entrance to the pedestrian/bike path near the stormwater pond. Motorist traveling west on North River St will observe a 15-foot vertical drop from North River St within a short distance to the bottom of the stormwater pond.

Related Value Engineer Proposal

None

Advantages of this Proposal:

Improved visual entrance to Glenwood Springs and improved traffic safety.

Advantages of original design concept:

Less cost

Risks associated with implementing this Proposal:

None

Calculations:

None

Value Engineering Proposal No. 55
Monitor Pre- and Post-Construction Groundwater Conditions
Recommended Action: Design Consideration

Summary

The intent for this design consideration is to monitor pre- and post-construction groundwater elevations and temperature in both the alluvium and within the Leadville aquifer. The monitoring will help the project team defend against potential allegations and will allow the project team to adjust construction methods during execution if monitoring indicates a concern.

Estimated potential cost savings:

Not evaluated

Discussion

This design consideration involves collecting from the Hot Springs Pool (HSP) their past and future Yampa Spring elevations, temperature and flows. To our knowledge the HSP collects this data on a daily basis. These data can be used to evaluate typical range of elevations and flows by season. Manually collect daily data from the HSP during construction on a monthly basis and compare to historic data.

After the geotechnical investigation are completed, select locations for the installation of the piezometers on both the north and south sides of the river. Preferably the alluvial monitoring holes should be installed one year prior to foundation installation to establish seasonal fluctuation in the alluvial aquifer.

Alluvial groundwater on the north side of the river is believed to be associated with up flow from the Leadville aquifer and through the leaky Belden Shale Formation and groundwater inflows from percolation on the surrounding slopes to the north. It is believed up flow will increase laterally as you approach naturally occurring faults within the Belden Shale Formation. It is believed there is a naturally occurring fault in between the Yampa Spring and the Wright Water Well. Due to the depth to the Belden on the south side of the bridge, it is more likely the only groundwater influence is due to percolation of groundwater from the east. Groundwater on the south side is observed to be high during spring runoff and is likely 8-feet below ground surface (BGS) during the spring. This observation is based on local business owners near the south abutment reporting groundwater within their basements during the spring runoff.

The monitoring will compile groundwater, temperature and conductivity data that will enable the project team to defend against potential allegations and will allow the project team to adjust construction methods during execution if monitoring indicates a concern.

Related Value Engineer Proposal

Proposal No. 35 – Vibration Monitoring

Advantages of this Proposal:

CDOT and the Contractor can routinely monitor the alluvial and Leadville aquifer to confirm no construction impact to the local groundwater resources. If a potential issue with groundwater elevations due to construction activities were to develop due the project team will have a factual basis to discuss a potential claims.

Advantages of original design concept:

None

Risks associated with implementing this Proposal:

None

Calculations:

Estimated cost for the installation of the monitoring holes and three options were evaluated for data collection:

Assume installation of the alluvial piezometers with ODEX drill. Assume $250/hr for ODEX drill. Assume alluvial depth to Belden Shale is 50-feet. Assume the ODEX rig can drill and install a PVC monitoring hole in 1.5 days (12 hours) per monitoring hole. The estimated materials cost for the monitoring holes, sand, bentonite plug and steel locking cap is estimated to be $1,000 per monitoring hole. Assume 6 monitoring holes on the south side and 2 monitoring holes on the north side. Assume $25,000 for engineering to permit the monitoring holes, coordination with the drilling sub-contractor and installation oversight. Estimated cost assuming a 30% contingency is $74,000.

Estimated Monitoring Hole Installation Costs

Item	Estimated Cost
Materials	$8,000
Drilling Subcontractor	$24,000
Engineering/Permitting	$25,000
30% Contingency	$17,000
Estimated Total	**$74,000**

Option 1 – Manual data monitoring and data collection

Cost to monitor monthly during construction is approximately $400 per month assuming ½ day to collect piezometric data and collect and evaluate information from the HSP. Assume data will be collected 1 year prior to construction, 2 years during construction and 1 year after construction. Estimated data collection cost for 4 years is $20,000.

Option 2 – Automated data monitoring and manual data collection

Alternatively, vibrating wire piezometers with data loggers can be installed for approximately $1,500 per monitoring hole to automate data collection and get more frequent observations. The advantage of installing vibrating wire piezometers and data loggers is data is automatically recorded on a frequent basis (such as daily) and the data loggers can be downloaded every three months and the batteries replaced. Assuming installation of vibrating wire piezometers, temperature and conductivity probe is estimated to be $2,000 in equipment and $500 in labor, the cost of automation would be approximately $20,000 for the 8 monitoring holes and the labor for the 4 year data collection period would be (4 hrs per quarter) $6,400.

Option 3 – Automated data monitoring and automated data collection

Option 3 would require the same data monitoring equipment as Option 2. Option 3 would also include cell or radio transmission equipment ($1,500/monitoring hole) to transfer the data collection back to a selected project team computer for monitoring and $500 in labor per monitoring hole to install the equipment. The software ($5,000) used to store the automated data collection can be programed to alert the project team if any of the data is outside of anticipated levels. The same automated data collection system can be used for the vibration monitoring. Labor for periodically maintaining the monitoring equipment is $3,200 (4 hrs per 6 months).

Estimated Costs for Data Collection and Monitoring

Item	Option 1	Option 2	Option 3
Equipment/Software	$0	$20,000	$41,000
4 yr Labor Cost	$20,000	$6,400	$3,200
30% Contingency	$6,000	$8,000	$13,300
Estimated Cost	**$26,000**	**$34,400**	**$57,500**

Value Engineering Proposal No. 57

Roundabout at Pine St/6th St Intersection

Recommended Action: Design Consideration

Summary

The existing Pine St/6th St intersection was recently operationally improved for vehicular traffic with priority given to the right turning vehicles from 6th Street to the Grand Avenue Bridge and the left turns from the Grand Avenue Bridge to 6th Street. The eastbound and westbound pedestrian movements on the south side of the intersection were prohibited and rerouted to the side of the intersection and underneath the bridge.

The existing Pine St/6th St intersection could be reconfigured from a signalized intersection to a roundabout with *either* EA Alternative #1 (VE Proposal #4) or EA Alternative #3. In either case, it would improve traffic operations and better accommodate pedestrian and cyclist mobility.

Estimated potential cost savings: This would be an additional cost to the project, estimated at $150,000.

Discussion: If VE Proposal #4 is moved forward, there may still be a desire to provide a more pedestrian friendly environment on 6th Street between Pine St and Laurel St. The roundabout design encourages vehicle speeds between 15 to 25mph and could restore the at-grade pedestrian crossing on all approaches.

Rectangular Rapid Flash Beacons (RRFB) could be installed at the pedestrian crossings to further enhance the pedestrian movements.

See attached conceptual design.

See attached capacity analysis.

Related Value Engineer proposal: 3/8, 33 and 4

VE Proposal #4 – Re-evaluate EA Alternative 1 – would keep the Grand Avenue bridge in its current location and this intersection alternative could provide traffic calming along 6th St if regional traffic remains on this corridor.

VE Proposal #3/8 and #33 – Roundabout(s) at 6th St and Laurel St would provide a roundabout corridor as the gateway to Glenwood Springs from I-70 to the Grand Avenue bridge.

Advantages of this Design Consideration: The roundabout could be used as traffic calming design at this intersection.

Advantages of original design concept: NA (Does not apply with EA Alternative 3)

Risks associated with implementing this Design Consideration: Increases the pedestrian conflict points at 6th and Pine.

Calculations: None