Submitted by
Colorado Department of Transportation

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Concrete Box Culvert and Corrugated Metal Pipe Culvert Program (Region 2 Bundle)

In Response to Federal Highway Administration's Notice of Funding Opportunity for the Department of Transportation's Competitive Highway Bridge Program for Fiscal Year 2018

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Application Overview

Application Information

The following table contains summary information about the Concrete Box Culvert and Corrugated Metal Pipe Culvert Program (referred to as the Region 2 Bundle).

Table 1: Application Summary

Applicant Name	Colorado Department of Transportation
Applicant Key Contact	Michael Collins, PE State Bridge Engineer Colorado Department of Transportation 2829 W Howard Place Denver, CO 80204 303.757.9190 Michael.Collins@state.co.us
Project Name	Concrete Box Culvert and Corrugated Metal Pipe Culvert Program (Region 2 Bundle)
Project Description	This project comprises the replacement of fourteen (14) rural bridges spread across key highway corridors in southern and western Colorado. These bridges are located on key corridors for rural mobility as well as intra- and interstate commerce, particularly for the movement of agricultural and access to tourist destinations. All of the bridges are well past their design life and 13 of the bridges are at least 80 years old. The condition for 13 of the bridges is categorized as 'poor', leading to increased frequency and intensity of maintenance.
State Priority Ranking	2
Previously Incurred Project Eligible Costs	N/A
Project Previously Submitted for Federal Grants	No
If so, which?	N/A
Total Project Cost	$34,255,000
Project Cost Expended in Rural Region	100%
Non-Federal Match	$17,127,500 (50%)
Competitive Bridge Program Grant Funds Requested	$17,127,500 (50%)
Federal (DOT) Funding including Program Funds Requested	$17,127,500 (50%)

Project Description

Project Description

Colorado is one of the fastest growing states in the country, and with that growth comes significant strain on aging transportation systems that has significant and tangible consequences in the form of growing safety and mobility problems. The rural highways which house the bridges put forward in this grant application are essential to enabling not just the mobility of the populace which lives in the southern and western portions state, but are also key to supporting intra- and interstate commerce, particularly regarding the movement of agricultural products and access to tourist destinations. This application seeks partial funding from the Federal Highway Administration (FHWA) for the replacement of a bundle of bridges on three rural highway corridors in southern and western Colorado. As all the bridges are located within Colorado Department of Transportation's (CDOT's) Region 2, this grouping of candidate bridges for replacement is called the Region 2 Bundle.

The three rural highway corridors – State Highway (SH) 9, United States Highway (US) 24, and US 350 - serve as vital transportation routes for rural communities, freight movement, and support for agriculture. The importance of the corridors includes:

SH 9 Corridor

- Provides vital access for residents and tourists to many of the recreation destinations in the Rocky Mountains, which is essential to supporting the rural tourist-based communities
- Major north/south corridor through the middle part of Colorado
- Alternate route for floods & fires, community evacuation route

US 24 Corridor

- Part of the National Highway System
- Provides route across the Rocky Mountains
- Vital economic corridor connecting front range communities to western slope communities
- One of only three major east/west alternatives in Colorado

US 350 Corridor

- Provides a connection between Interstate 25 (I-25) and US 50 (saving many miles for freight traffic)
- Designated route for hazardous waste, gasoline, diesel, and liquefied petroleum
- Major access point to the US Army's Pinyon Canyon Maneuver Site

The identification of the bridges to include in the Bundle was based on field inspections and evaluations that assessed the bridge conditions and identified potential safety risks, while looking for long-term improvements to the corridors. The structures were also bundled based on similar site characteristics and probable replacement type, with the goal of achieving economy of scale. The probable replacement type for each of the structures in the bundle is a Concrete Box Culvert or Reinforced Concrete Pipe based on

hydraulic analysis and high level scoping performed by CDOT. Culverts are an inexpensive replacement design and construction allowing CDOT to address the replacements while meeting all design requirements. Reduction in replacement cost allows CDOT to maximize the amount of bridges addressed in this project with a low maintenance asset that will reduce long term treatment costs. Based on the evaluation, 14 bridges were identified as candidates for replacement and comprise the Region 2 Bundle (Table 2). All of the bridges are decades past their original design life, with 13 of the bridges being at least 80 years old. None of the bridges meet FHWA roadway standard shoulder width or current construction standards. Three (3) of the bridges are Load Restricted limiting trucking routes through major sections of the US 24 and US 350 corridors. Thirteen (13) of the bridges are rated as "Poor" per the FHWA National Bridge Inspection Standards (NBIS) and are eligible for funding through CDOT's bridge replacement program, the Colorado Bridge Enterprise (CBE). While the structures are eligible for funding, resources are currently not available to advance the project in its entirety. The remaining bridge is rated "Fair", and it is anticipated that it will continue to deteriorate to "Poor" condition in the near future, despite significant maintenance investments.

Table 2: Bridges Included in Region 2 Bundle

National Bridge Structure Number	Highway Corridor	Year Built	Condition Rating	Load Restricted	Current Bridge Type*	Replacement and Bridge Type*	Replacement Cost
G-12-C	SH 9	1938	Poor	No	CBC	CBC	$1,795,000
J-14-C	SH 9	1934	Fair	No	TTS	CBC	$2,634,000
J-15-G	SH 9	1971	Poor	No	CMP	RCP	$1,441,000
I-13-G	US 24	1937	Poor	Yes	TTS	CBC	$2,902,000
I-15-AO	US 24	1937	Poor	No	CBC	CBC	$2,462,000
I-15-T	US 24	1937	Poor	No	CBC	CBC	$2,184,000
H-13-N	US 24	1937	Poor	No	TTS	CBC	$2,104,000
M-21-B	US 350	1937	Poor	No	CI	CBC	$3,738,000
M-21-C	US 350	1937	Poor	No	CI	CBC	$3,367,000
M-21-J	US 350	1935	Poor	Yes	TTS	CBC	$1,897,000
M-22-U	US 350	1935	Poor	No	CI	CBC	$1,590,000
M-22-Y	US 350	1935	Poor	Yes	TTS	RCP	$1,177,000
N-21-C	US 350	1936	Poor	No	TTS	CBC	$3,289,000
N-21-F	US 350	1937	Poor	No	CI	CBC	$3,672,000
						Total	**$34,255,000**

* Bridge Types:
CBC = concrete box culvert
CMP = corrugated metal pipe
CI = concrete on I-beam
RCP = reinforced concrete pipe
TTS = treated timber stringer

The existing bridges in the Region 2 Bundle are constructed of timber, concrete, and steel. While CDOT has been actively maintaining the bridges, age and severe seasonal weather have led to wooden supports and girders splitting, wooden piles rotting, support walls cracking, concrete spalling, and bridge decks deteriorating. General issues that arise from the major components of the bridges include:

- Timber elements
  - **Loose connections.** Timber decks are just planks on edge that are nailed together. As the bridge ages, the nailed connections loosen and the asphalt above tends to crack, requiring more frequent crack filling, patching, overlays and total replacement.
  - **Timber girders split and crack.** Split girders are often repaired by drilling lag bolts from the bottom up through the crack. Steel plates are often attached to the bottom of the girder for extra strength (often worn-out snowplow blades are used for the plates). When 25 percent of the girders have been repaired the bridge will be rerated, which can result in load posting/restriction of the structure.
  - **Water and timber rot.** Timber piles at the water line are susceptible to section loss from rot. Lagging behind abutments exposed to moist soil can rot over time. Water can degrade curbs or other components.
- Concrete elements
  - **Aggregate quality.** Requirements for aggregate were not as stringent 80 years ago. Smooth river stones were used as aggregate for many of the bridges, which has led to spalling and severe deterioration of the concrete. Angular crushed rock is required today.
  - **Concrete strength.** Required concrete strength for structures was typically 2,500 pounds per square inch (psi), where current standards are 4,500 psi. Lower strength concrete also has greater permeability, which has led to intrusion of deicing chemicals and other contaminants over time.
  - **Erosion of concrete.** Fast moving mountain streams (such as along US 24) carry small abrasive sands and gravels that over time erode the bottom slabs of concrete box culverts (CBCs).
  - **Cracking concrete.** As rust forms on reinforcing steel it expands causing the surrounding concrete to crack, delaminate, and ultimately spall, resulting in a loss of capacity.
- Steel elements
  - **Rust.** Rusting steel rusts over time leads to section loss and, also, may cause the lock-up of bearings and expansion devices.

The frequency and magnitude of maintenance and associated emergency closures of the bridges has accelerated and will reach the point where replacement is the only reasonable option. This need for replacement of the bridges is evident by the replacement of approximately 40 adjacent bridges that has occurred in the same corridors. The bridges replaced by CDOT were of similar age, similar design, and followed similar construction practices as the bridges in the Bundle. This highlights the increased needs of these corridors as the infrastructure ages and also CDOT's ongoing efforts to maintain a state of good repair for the rural highway system.

The implementation and delivery of the replacement of the Region 2 Bundle of bridges represents an opportunity for the State of Colorado to effectively improve mobility and safety outcomes along several of the state's rural corridors while concurrently ensuring that the economic vitality provided by these crucial corridors is maintained.

Replacement of the Region 2 Bundle is a priority of CDOT and the CBE, which is committed to providing approximately $17 million (50 percent) of the required funding to carry out the replacements. Innovative design, contracting, and construction will be utilized throughout the planning and delivery of the bridge replacement. The Bundle will be procured under a single design-build contract that emphasizes expedited construction. It is estimated that bundling the replacement of the bridges together, placing them under a single contract, and utilizing similar design elements and construction activities will result in a total replacement cost $4.9 million (12.3 percent) less than if the bridges were to be replaced individually.

A benefits-cost analysis (BCA) has been developed for the replacement of bridges in the Region 2 Bundle to support the application. The BCA estimated that replacement of the bridges will generate $29.6 million and $65.4 million in net benefits at 7 percent and 3 percent discount rates, respectively. These represent benefit-cost ratios (BCRs) of 2.1:1 and 3.1:1 at their respective discount rates.

Project Location

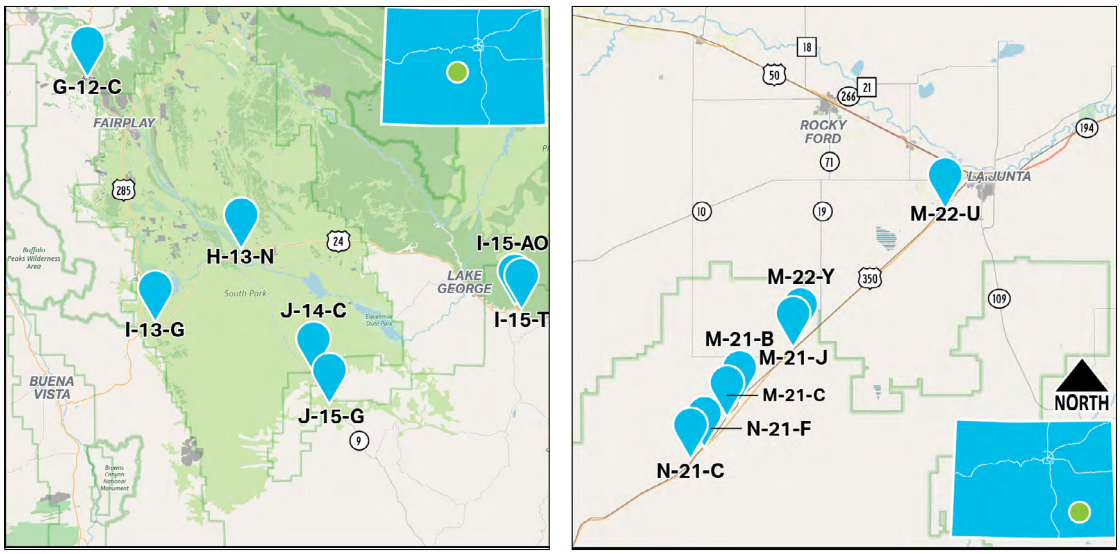
Project Location

The Region 2 Bundle is comprised of 14 bridges located in southern and western Colorado. All of the bridges are located in rural areas on US or state highways. **Table 3** lists the bridges and their location, while **Figure 1** shows their locations in Colorado.

Table 3: Locations of the Bridges in Region 2 Bundle

National Bridge Structure Number	Highway Corridor	Mile Marker	Lattitude	Longitude
G-12-C	SH 9	71.445	39.294832	-106.065515
J-14-C	SH 9	20.107	38.722203	-105.515615
J-15-G	SH 9	15.970	38.670035	-105.484821
I-13-G	US 24	227.095	38.924533	-105.95706
I-15-AO	US 24	271.900	38.945138	-105.254776
I-15-T	US 24	271.691	38.947936	-105.258143
H-13-N	US 24	240.686	39.030422	-105.768882
M-21-B	US 350	51.682	37.771306	-103.826926
M-21-C	US 350	50.582	37.758789	-103.8398
M-21-J	US 350	57.069	37.829246	-103.761091
M-22-U	US 350	69.817	37.954765	-103.589936
M-22-Y	US 350	57.474	37.832897	-103.756219
N-21-C	US 350	47.131	37.722008	-103.882712
N-21-F	US 350	48.744	37.74034	-103.863659

Figure 1: Locations of Bridges in Region 2 Bundle



Source: CDOT

The following sections describe each of the bridges in the bundle in greater detail and provides more focused location maps.

Bridge G-12-C

Bridge G-12-C is a concrete box culvert that was built 80 years ago and is currently well past its design life. **Table 4** provides summary information about the bridge. **Photo 1** shows the bridge.

Table 4: Bridge G-12-C Summary Information

National Bridge Structure Number	G-12-C
Year Built	1938
Construction Type	concrete box culvert
Condition Rating	Poor
Bridge Span Length	23 feet
Bridge Width	38 feet
Water Crossing	Platte Gulch
Detour Length (if closed)	137 miles
ADT (2018)	4,880
Percent Commercial Traffic	6%
Replacement Bridge Type	Concrete box culvert (2 cell, 10 feet x5 feet)
Replacement Cost ($2018)	$1,795,000

Bridge G-12-C is located on SH 9, to the southeast of Fairplay. SH 9 is a key corridor connecting residents and tourists from Colorado Springs and southern Colorado to the recreational activities in the Rocky Mountains. The location of Bridge G-12-C is shown in **Figure 2**.

The age of Bridge G-12-C and the severe deterioration of the concrete structure requires frequent inspection and repair, which includes patching of concrete and the replacement of wing walls. There is severe deterioration of the divider wall, with exposed rebar and up to 75 percent section loss of thickness in some areas. The wing walls also have severe scale and deterioration, with exposed rebar. When the bridge was constructed, river stones were used in the concrete mix, which does not meet current construction standards. This form of aggregate does not have the bonding ability of crushed stones and the use of this material has accelerated the formation of the numerous concrete defects. **Photos 2** and **3** show how the continued disintegration is impacting the wing walls.

Photo 1: Bridge G-12-C
Source: CDOT

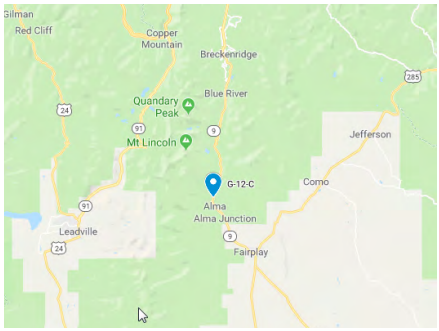


Figure 2: Bridge G-12-C Location
Source: Google, CDOT

Photo 2: Bridge G-12-C – Disintegration of East Wing Wall
Source: CDOT

Photo 3: Bridge G-12-C – Disintegration of West Wing Walls
Source: CDOT

Bridge J-14-C

Bridge J-14-C is a treated timber stringer bridge that was built over 80 years ago, which is well past its design life. **Table 5** provides summary information about the bridge. **Photo 4** shows the bridge.

Table 5: Bridge J-14-C Summary Information

National Bridge Structure Number	J-14-C
Year Built	1934
Construction Type	Treated timber stringer
Condition Rating	Fair
Bridge Span Length	48 feet
Bridge Width	25 feet
Water Crossing	Louis Gulch
Detour Length (if closed)	47 miles
ADT (2018)	930
Percent Commercial Traffic	13%
Replacement Bridge Type	Concrete box culvert (2 cell, 20 feet x8 feet)
Replacement Cost ($2018)	$2,634,000

Bridge J-14-C is located on SH 9, to the southeast of Hartsel. SH 9 is a key corridor connecting residents and tourists from Colorado Springs and southern Colorado to the recreational activities in the Rocky Mountains. The location of Bridge J-14-C is shown in **Figure 3**.

The age of Bridge J-14-C and concerns with the wing walls requires frequent inspection and repair. Inspections have found movement of the abutments, coupled with rotten and bowed timber backing planks. Earlier this year numerous girders were found to be split, and several split girders have already been spliced. Deadmen have been placed at the Abutment #1 wingwall to mitigate previously documented movement. **Photos 5** and **6** show displacement and bulging of the wing walls. Rot, checks, shakes, and deterioration are present throughout numerous primary structural components.

Photo 4: Bridge J-14-C
Source: CDOT

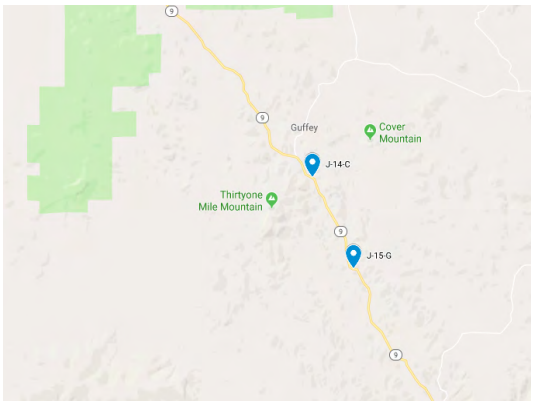


Figure 3: Bridge J-14-C Location
Source: Google, CDOT

Photo 5: Bridge J-14-C – Wing Wall Displaced 13 Inches
Source: CDOT

Photo 6: Bridge J-14-C – Bulge in Wing Wall
Source: Google, CDOT

Bridge J-15-G

Bridge J-15-G is comprised of a set of seven foot diameter corrugated metal pipes that were built almost 50 years ago. The structure is nearing the end of its design life. **Table 6** provides summary information about the bridge. **Photo 7** shows the bridge.

Table 6: Bridge J-15-G Summary Information

National Bridge Structure Number	J-15-G
Year Built	1971
Construction Type	Corrugated metal pipe
Condition Rating	Poor
Bridge Span Length	24 feet
Bridge Width	42 feet
Water Crossing	Mack Gulch
Detour Length (if closed)	124 miles
ADT (2018)	1,240
Percent Commercial Traffic	5%
Replacement Bridge Type	reinforced concrete pipe (3 -6 feet)
Replacement Cost ($2018)	$1,441,000

Photo 7: Bridge J-15-G
Source: CDOT

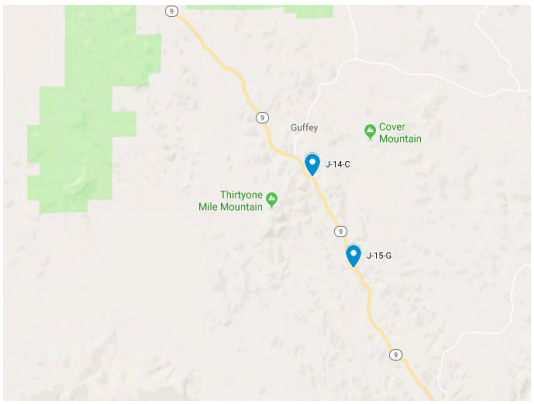


Figure 3: Bridge J-15-G Location
Source: Google, CDOT

Bridge J-15-G is located on SH 9, to the southeast of Hartsel. SH 9 is a key corridor connecting residents and tourists from Colorado Springs and southern Colorado to the recreational activities in the Rocky Mountains. The location of Bridge J-15-G is shown in **Figure 4**.

The age of Bridge J-15-G and corrosion of the pipes require frequent inspection and repair. Due to age, much of the two pipes are severely corroded and areas of section loss ranging from 25 percent to 100 percent are present along the length of the pipes. The corrosion has allowed removal of the surrounding sediment leading to bulging and distortion in several areas. In addition, part of the exposed portion of one pipe shows impact damage. **Photos 8** and **9** show corrosion and bulging of the pipes, respectively.

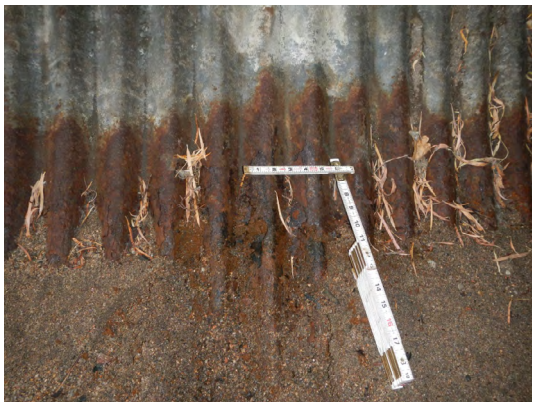


Photo 8: Bridge J-15-G – Corrosion inside Pipe
Source: CDOT

Photo 9: Bridge J-15-G – Bulging of Pipe
Source: CDOT

Bridge I-13-G

Bridge I-13-G is a treated timber stringer bridge that was built over 80 years ago, which is well past its design life. The bridge is load restricted because of the condition. **Table 7** provides summary information about the bridge. **Photo 10** shows the bridge.

Table 7: Bridge I-13-G Summary Information

National Bridge Structure Number	I-13-G
Year Built	1937
Construction Type	Treated timber stringer
Condition Rating	Poor
Bridge Span Length	71 feet
Bridge Width	30 feet
Water Crossing	Seasonal wash
Detour Length (if closed)	48 miles
ADT (2018)	1,670
Percent Commercial Traffic	8%
Replacement Bridge Type	Concrete box culvert (3 cell, 14 feet x 6 feet)
Replacement Cost ($2018)	$2,902,000

Bridge I-13-G is located on US 24, between Hartsel and Antero Junction. US 24 is a major east-west route in Colorado and traverses the Rocky Mountains. The location of Bridge I-13-G is shown in **Figure 5**.

The age of Bridge I-13-G and the condition of the bridge requires frequent inspection and repair. In addition to repairs to the girders, inspections have found the timber posts that were broken/split and heavy erosion of the banks. Rot, mold, water staining, checks, shakes, and deterioration are present throughout numerous primary structural components. **Photo 11** shows repairs to the girders. I-13-G is load restricted, limiting routes through major sections of the US 24 corridor.

Photo 10: Bridge I-13-G
Source: CDOT

Photo 11: Bridge I-13-G – Repaired Girders
Source: CDOT

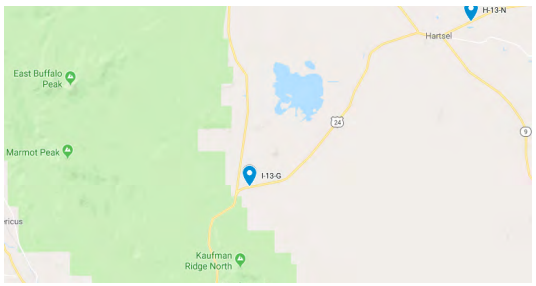


Figure 5: Bridge I-13-G Location
Source: Google, CDOT

Bridge I-15-AO

Bridge I-15-AO is a concrete box culvert that was built over 80 years ago, which is well past its design life. **Table 8** provides summary information about the bridge. **Photo 12** shows the bridge.

Table 8: Bridge I-13-G Summary Information

National Bridge Structure Number	I-15-AO
Year Built	1937
Construction Type	Concrete box culvert
Condition Rating	Poor
Bridge Span Length	21 feet
Bridge Width	45 feet
Water Crossing	Seasonal wash
Detour Length (if closed)	11 miles
ADT (2018)	6,480
Percent Commercial Traffic	6%
Replacement Bridge Type	Concrete box culvert (2 cell, 10 feet x 8 feet)
Replacement Cost ($2018)	$2,462,000

Bridge I-15-AO is located on US 24, to the east of Hartsel. US 24 is a major east-west route in Colorado and traverses the Rocky Mountains. The location of Bridge I-15-AO is shown in **Figure 6**.

The age of Bridge I-15-AO and the severe deterioration of the concrete structure requires frequent inspection and repair, which includes patching of concrete and the replacement of wing walls. Currently, there are numerous failed shotcrete repairs throughout the structure. The right wall has deteriorated to the point that there is now seepage and disintegration to the top slab behind the headwall. When the bridge was constructed, river stones were used in the concrete mix, which does not meet current construction standards. This form of aggregate does not have the bonding ability of crushed stones and the use of this material has accelerated the formation of the numerous concrete defects. Timber planks have been used to stabilize fill above the headwall. **Photo 13** and **14** show how disintegration is impacting the headwall and efforts to stabilize fill.

Photo 12: Bridge I-15-AO
Source: CDOT

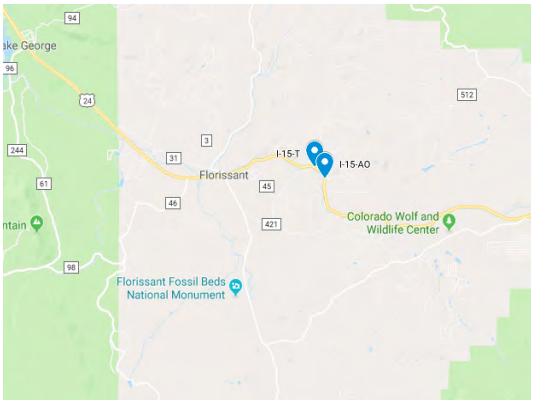


Figure 6: Bridge I-15-AO Location
Source: Google, CDOT

Photo 13: Bridge I-15-AO – Timber Planks Retaining Roadway
Source: CDOT

Photo 14: Bridge I-15-AO – Disintegration of Concrete
Source: Google, CDOT

Bridge I-15-T

Bridge I-15-T is a concrete box culvert that was built over 80 years ago, which is well past its design life. **Table 9** provides summary information about the bridge. **Photo 15** shows the bridge.

Table 9: Bridge I-15-T Summary Information

National Bridge Structure Number	I-15-T
Year Built	1937
Construction Type	Concrete Box Culvert
Condition Rating	Poor
Bridge Span Length	21 feet
Bridge Width	41 feet
Water Crossing	Seasonal wash
Detour Length (if closed)	11 miles
ADT (2018)	6,480
Percent Commercial Traffic	6%
Replacement Bridge Type	Concrete Box Culvert (2 cell, 10 feet x 8 feet)
Replacement Cost ($2018)	$2,184,000

Bridge I-15-T is located on US 24, to the east of Hartsel. US 24 is a major east-west route in Colorado and traverses the Rocky Mountains. The location of Bridge I-15-T is shown in **Figure 7.**

The age of Bridge I-15-T and the severe deterioration of the concrete structure requires frequent inspection and repair. There is heavy deterioration of the bottom slab, head walls, and wing walls. The bottom slab of one cell has exposed rebar its entire length and severe deterioration at the bottom slab-wall interface. When the bridge was constructed, river stones were used in the concrete mix, which does not meet current construction standards. This form of aggregate does not have the bonding ability of crushed stones and the use of this material has accelerated the formation of the numerous concrete defects. Timber beams have been installed to retain the embankment. **Photo 16** and **17** are representative of the condition of concrete elements throughout the structure.

Photo 15: Bridge I-15-T
Source: CDOT

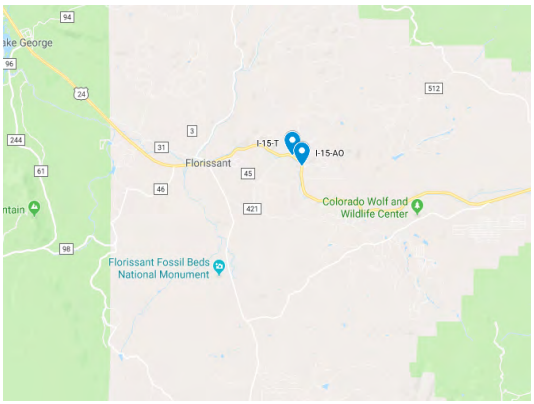


Figure 7: Bridge I-15-T Location
Source: Google, CDOT

Photo 16: Bridge I-15-T – Deteriorating Concrete and Timber Retaining Wall Repair
Source: CDOT

Photo 17: Bridge I-15-T – Exposed Bottom Slab Rebar at Wall Interface
Source: CDOT

Bridge H-13-N

Bridge H-13-N is a treated timber stringer bridge that was built over 80 years ago, which is well past its design life. **Table 10** provides summary information about the bridge. **Photo 18** shows the bridge.

Photo 18: Bridge H-13-N
Source: CDOT

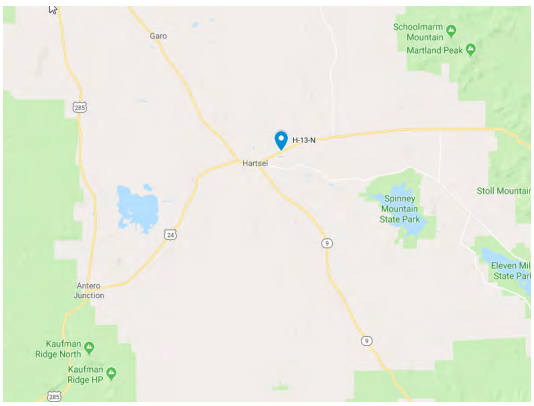


Figure 8: Bridge H-13-N Location
Source: Google, CDOT

Table 10: Bridge Bridge H-13-N Summary Information

National Bridge Structure Number	H-13-N
Year Built	1937
Construction Type	Treated timber stringer
Condition Rating	Poor
Bridge Span Length	24 feet
Bridge Width	30 feet
Water Crossing	Seasonal wash
Detour Length (if closed)	24 miles
ADT (2018)	2,950
Percent Commercial Traffic	5%
Replacement Bridge Type	Concrete box culvert (2 cell, 12 feet x 10 feet)
Replacement Cost ($2018)	$2,104,000

Bridge H-13-N is located on US 24, to the east of Hartsel. US 24 is a major east-west route in Colorado and traverses the Rocky Mountains. The location of Bridge H-13-N is shown in **Figure 8**.

The age of Bridge H-13-N and ongoing issues requires frequent inspection and repair. Issues include the piles splitting (requiring banding) and being pushed out from beneath the abutment caps (**Photo 19**), resulting in loss of load bearing at numerous piles. The worst case is one pile with a 60 percent loss of bearing. The settling of pavement on the approaches has caused issues with the road surface (**Photo 20**).

Photo 19: Bridge H-13-N – Deflection of Repaired Piling
Source: CDOT

Photo 20: Bridge H-13-N – Settling of Roadway
Source: CDOT

Bridge M-21-B

Bridge M-21-B is a concrete on I-beam bridge that was built over 80 years ago, which is well past its design life. **Table 11** provides summary information about the bridge. **Photo 21** shows the bridge.

Table 11: Bridge M-21-B Summary Information

National Bridge Structure Number	M-21-B
Year Built	1937
Construction Type	Concrete on I-beam
Condition Rating	Poor
Bridge Span Length	84 feet
Bridge Width	33 feet
Water Crossing	Tree Arroyo
Detour Length (if closed)	170 miles
ADT (2018)	600
Percent Commercial Traffic	15%
Replacement Bridge Type	Concrete box culvert (3 cell, 20 feet x 8 feet)
Replacement Cost ($2018)	$3,738,000

Bridge M-21-B is located on US 350, southwest of La Junta. US 350 is a key corridor between La Junta and Trinidad and connects Interstate 25 (I-25) and US 50. The location of Bridge M-21-B is shown in **Figure 9**.

The age of Bridge M-21-B requires frequent inspection and repairs. Cracking has been found on the wing walls and abutments, some 0.25 inches wide. Bearing anchor bolts have been bending and shearing due to movement and apparent seized expansion bearings. The underside of the deck has cracking and efflorescence throughout. The deck overhangs have severe cracking, spalls with exposed reinforcing, active leakage, rust staining, efflorescence, and loose coarse aggregate the full length of the bridge. **Photos 22** and **23** show cracking of the substructure units and deterioration of the deck overhang.

Photo 21: Bridge M-21-B
Source: CDOT

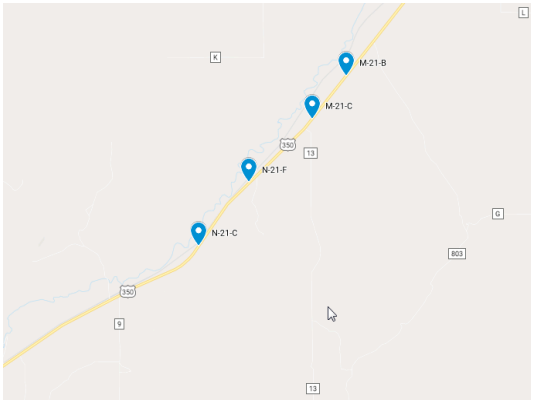


Figure 9: Bridge M-21-B Location
Source: Google, CDOT

Photo 22: Bridge M-21-B – Typical Cracking of Substructure Units
Source: CDOT

Photo 23: Bridge M-21-B – Typical Deterioration of Deck Overhang
Source: CDOT

Bridge M-21-C

Bridge M-21-C is a concrete on I-beam bridge that was built over 80 years ago, which is well past its design life. **Table 12** provides summary information about the bridge. **Photo 24** shows the bridge.

Table 12: Bridge M-21-C Summary Information

National Bridge Structure Number	M-21-C
Year Built	1937
Construction Type	Concrete on I-beam
Condition Rating	Poor
Bridge Span Length	126 feet
Bridge Width	33 feet
Water Crossing	Hoe Ranch Arroyo
Detour Length (if closed)	170 miles
ADT (2018)	600
Percent Commercial Traffic	15%
Replacement Bridge Type	Concrete box culvert (3 cell, 20 feet x 8 feet)
Replacement Cost ($2018)	$3,367,000

Photo 24: Bridge M-21-C
Source: CDOT

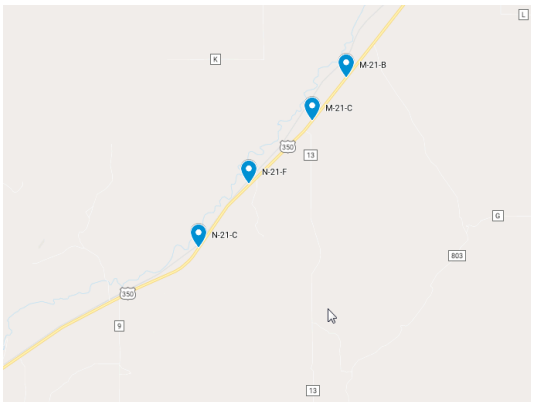


Figure 10: Bridge M-21-C Location
Source: Google, CDOT

Photo 25: Bridge M-21-C – Hole in Deck at Pier Joint
Source: CDOT

Photo 26: Bridge M-21-C – Deterioration of Concrete and Exposed Rebar
Source: CDOT

Bridge M-21-C is located on US 350, southwest of La Junta. US 350 is a key corridor between La Junta and Trinidad and connects I-25 and US 50. The location of Bridge M-21-C is shown in **Figure 10**.

The age of Bridge M-21-C and the deterioration of the concrete elements requires frequent inspection and repair. Issues have been identified with movement and cracking of the abutments and wing walls and heavy spalling on the bridge overhangs. Additionally, the underside of the deck has cracking and efflorescence throughout. Deterioration of the deck ends at the expansion joints continues to worsen with holes developing near the curbline. When the bridge was constructed, river stones were used in the concrete mix, which does not meet current construction standards. This form of aggregate does not have the bonding ability of crushed stones and the use of this material has accelerated the formation of the numerous concrete defects. **Photos 25** and **26** are representative of the overall condition of the bridge deck.

Bridge M-21-J

Bridge M-21-J is a treated timber stringer bridge that was built over 80 years ago, which is well past its design life. **Table 13** provides summary information about the bridge. P**hoto 27** shows the bridge.

Table 13: Bridge M-21-J Summary Information

National Bridge Structure Number	M-21-J
Year Built	1937
Construction Type	Treated timber stringer
Condition Rating	Poor
Load Restricted	Yes
Bridge Span Length	47 feet
Bridge Width	26 feet
Water Crossing	Seasonal wash
Detour Length (if closed)	170 miles
ADT (2018)	600
Percent Commercial Traffic	17%
Replacement Bridge Type	Concrete box culvert (2 cell, 18 feet x 6 feet)
Replacement Cost ($2018)	$1,897,000

Photo 27: Bridge M-21-J
Source: CDOT

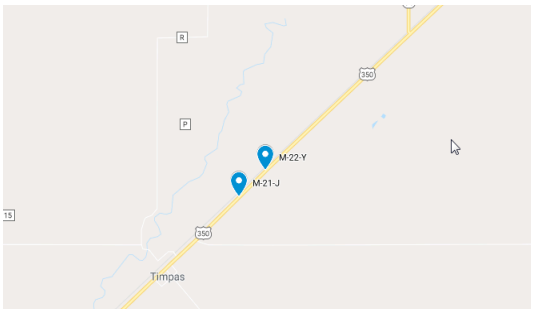


Figure 11: Bridge M-21-J Location
Source: Google, CDOT

Photo 28: Bridge M-21-J – Repaired Girders (Typical)
Source: CDOT

Photo 29: Bridge M-21-J – Heavy Splintering of Guardrail
Source: CDOT

Bridge M-21-J is located on US 350, southwest of La Junta. US 350 is a key corridor between La Junta and Trinidad and connects I-25 and US 50. The location of Bridge M-21-J is shown in **Figure 11**.

The age of Bridge M-21-J requires frequent inspection and repairs. Thirty-seven (37) percent of the girders have been repaired with lag bolts, so it is now considered a temporary structure. Other issues include:

- Exterior girders are weathered
- Thirteen piles have cracks penetrating 5-50 percent of pile thickness
- All wing walls are bowed and have been pushed outward
- Guard rails are weathered and splintered
- Rot, mold, water staining, checks, shakes, and deterioration are present throughout numerous primary structural components

Because of the condition, M-21-J is load restricted, which limits trucking routes through major sections of the US 350 corridor.

Photos 28 and **29** show repairs to the girders and heavy splintering of the guardrail.

Bridge M-22-U

Bridge M-22-U is a concrete on I-beam bridge that was built over 80 years ago, which is well past its design life. **Table 14** provides summary information about the bridge. **Photo 30** shows the bridge.

Table 14: Bridge M-22-U Summary Information

National Bridge Structure Number	M-22-U
Year Built	1935
Construction Type	Concrete on I-beam
Condition Rating	Poor
Bridge Span Length	44 feet
Bridge Width	33 feet
Water Crossing	Otero Ditch
Detour Length (if closed)	30
ADT (2018)	600
Percent Commercial Traffic	9%
Replacement Bridge Type	Concrete box culvert (14 feet x 10 feet)
Replacement Cost ($2018)	$1,590,000

Bridge M-22-U is located on US 350, just southwest of La Junta. US 350 is a key corridor between La Junta and Trinidad and connects I-25 and US 50. The location of Bridge M-22-U is shown in **Figure 12**.

The age of Bridge M-22-U and the deterioration of the concrete elements requires frequent inspection and repair. The abutments have cracks and spalling of concrete and 65 percent of the deck has map cracks, efflorescence, and exposed aggregate. **Photos 31** and **32** show the typical condition of the deck and the state of the wearing surface.

Photo 30: Bridge M-22-U
Source: CDOT

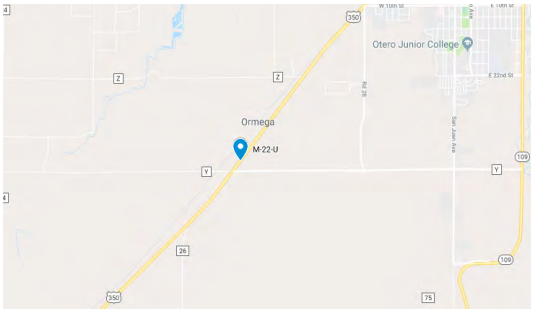


Figure 12: Bridge M-22-U Location
Source: Google, CDOT

Photo 31: Bridge M-22-U – Typical Deck Condition
Source: CDOT

Photo 32: Bridge M-22- U – Deteriorated Wearing Surface on Approach
Source: CDOT

Bridge M-22-Y

Bridge M-22-Y is a treated timber stringer bridge that was built over 80 years ago, which is well past its design life. **Table 15** provides summary information about the bridge. **Photo 33** shows the bridge.

Table 15: Bridge M-22-Y Summary Information

National Bridge Structure Number	M-22-Y
Year Built	1935
Construction Type	Treated timber stringer
Condition Rating	Poor
Load Restricted	Yes
Bridge Span Length	24 feet
Bridge Width	26 feet
Water Crossing	Seasonal wash
Detour Length (if closed)	170 miles
ADT (2018)	600
Percent Commercial Traffic	17%
Replacement Bridge Type	Reinforced concrete pipe (5 feet)
Replacement Cost ($2018)	$1,177,000

Photo 33: Bridge M-22-Y
Source: CDOT

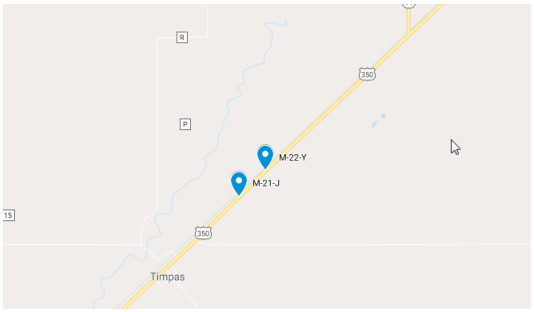


Figure 13: Bridge M-22-Y Location
Source: Google, CDOT

Photo 34: Bridge M-22-Y – Repaired Girders
Source: CDOT

Photo 35: Bridge M-22- Y – Splintered Wing Wall
Source: CDOT

Bridge M-22-Y is located on US 350, southwest of La Junta. US 350 is a key corridor between La Junta and Trinidad and connects I-25 and US 50. The location of Bridge M-22-Y is shown in **Figure 13**.

M-22-Y is Load Restricted limiting trucking routes through major sections of the US 350 corridor. Because of the age and condition of Bridge M-22-Y, it requires frequent inspection and repair. All of the girders are water stained and 33 percent of the girders have been repaired with lag bolts. Ten (10) of the piles have cracks that are between 5 and 50 percent of the pile thickness. All of the wing walls have deflected and segments of the wall are splintered. Rot, mold, water staining, checks, shakes, and deterioration are present throughout numerous primary structural components. **Photos 34** and **35** show repaired girders and damage to the wing wall.

Bridge N-21-C

Bridge N-21-C is a treated timber stringer bridge that was built over 80 years ago, which is well past its design life. **Table 16** provides summary information about the bridge. **Photo 36** shows the bridge.

Table 16: Bridge N-21-C Summary Information

National Bridge Structure Number	N-21-C
Year Built	1936
Construction Type	Treated timber stringer
Condition Rating	Poor
Bridge Span Length	69 feet
Bridge Width	30 feet
Water Crossing	Seasonal wash
Detour Length (if closed)	170 miles
ADT (2018)	600
Percent Commercial Traffic	15%
Replacement Bridge Type	Concrete box culvert (3 cell, 14 feet x 6 feet)
Replacement Cost ($2018)	$3,289,000

Photo 36: Bridge N-21-C
Source: CDOT

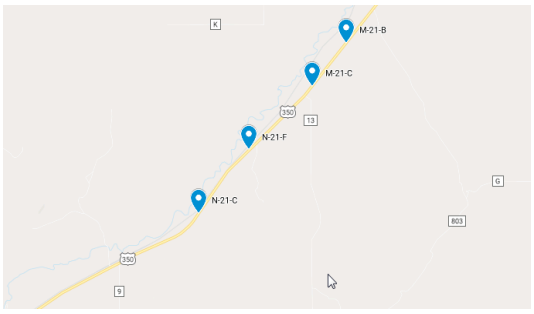


Figure 14: Bridge N-21-C Location
Source: Google, CDOT

Photo 37: Bridge N-21-C – Displaced Wing Wall
Source: CDOT

Photo 38: Bridge N-21-C – Wearing Surface Deterioration
Source: CDOT

Bridge N-21-C is located on US 350, southwest of La Junta. US 350 is a key corridor between La Junta and Trinidad and connects I-25 and US 50. The location of Bridge N-21-C is shown in **Figure 14**.

The age of Bridge N-21-C and condition of the bridge requires frequent inspection and repair. A number of the girders have been repaired with lag bolts, and the deck is loose in some bays due to excessive abutment movement and corresponding displacement and twisting of numerous girders. The piles are leaning due to the abutment pushing them in, with some displaced four inches. The abutments are severely displaced and are 10-14 inches out of plumb. Rot, mold, water staining, checks, shakes, and deterioration are present throughout numerous primary structural components. **Photos 37** and **38** show displaced wing wall and deterioration of the wearing surface.

Bridge N-21-F

Bridge N-21-F is a concrete on I-beam bridge that was built over 80 years ago, which is well past its design life. **Table 17** provides summary information about the bridge. **Photo 39** shows the bridge.

Table 17: Bridge N-21-F Summary Information

National Bridge Structure Number	N-21-F
Year Built	1937
Construction Type	Concrete on I-beam
Condition Rating	Poor
Bridge Span Length	166 feet
Bridge Width	33 feet
Water Crossing	Sheep Canyon Arroyo
Detour Length (if closed)	170 miles
ADT (2018)	600
Percent Commercial Traffic	15%
Replacement Bridge Type	Concrete box culvert (3 cell, 20 feet x 8 feet)
Replacement Cost ($2018)	$3,672,000

Bridge N-21- is located on US 350, southwest of La Junta. US 350 is a key corridor between La Junta and Trinidad and connects I-25 and US 50. The location of Bridge N-21-F is shown in **Figure 15**.

The age of Bridge N-21-F and condition of the bridge requires frequent inspection and repair. Spalling has exposed rebar in many of the bays and potholes are going through the concrete deck. Movement and rotation of abutment has sheared anchor bolts and is displacing and twisting the girders. **Photos 40** and **41** show deteriorated deck and displaced girders.

Photo 39: Bridge N-21-F
Source: CDOT

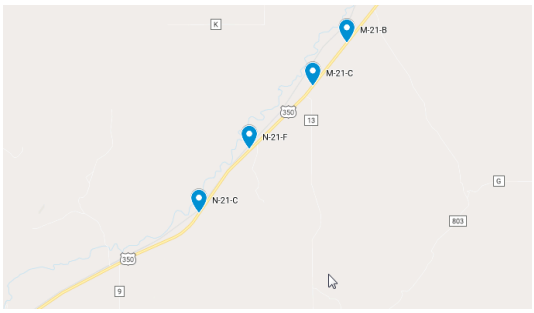


Figure 15: Bridge N-21-F Location
Source: Google, CDOT

Photo 40: Bridge N-21-F – Exposed Rebar and Hole Through Deck
Source: CDOT

Photo 41: Bridge N-21-F – Displacement and Twisting of Girder due to Abutment Rotation
Source: CDOT

Project Parties

Project Parties

The Colorado Department of Transportation (CDOT) and the Colorado Bridge Enterprise (CBE) will be the responsible parties to complete the replacement of the bridges in the Region 2 Bundle. These entities have collaborated on over 100 bridge replacement projects throughout the state.

CDOT exists to ensure that Colorado has a safe and efficient highway system by building and maintaining interstates, U.S. highways and state highways. CDOT:

- Maintains, repairs and plows over 23,000 total lane miles of highway
- Maintains 3,447 bridges
- Oversees 28 billion miles of vehicle travel annually

The CBE was formed in 2009 as part of Colorado's Funding Advancement for Surface Transportation and Economic Recovery (FASTER) legislation. CBE operates as a government-owned business within the Colorado Department of Transportation, but derives its dedicated funding from annual vehicle registration fees. The CBE has a separate board of directors that convenes each month to monitor program progress and approve programming plans and budget supplements. The statutory purpose of the CBE is to finance, repair, reconstruct and replace designated bridges.

In addition to the CDOT and CBE, the program to replace the bridge in the Region 2 Bundle is strongly supported by Federal representatives, Governor Hickenlooper, state representatives, and local jurisdictions. Letters of support are provided in **Appendix A – Letters of Support**.

Grants, Funds, Sources and Uses of All Project Funds

Grant Funds, Sources, and Uses of Project Funds

The following sections present the costs for the Region 2 Bundle and how the project will be funded.

Project Costs

The total estimated project cost for delivering the Region 2 Bundle is approximately $34.3 million. Project funding will go toward the staged replacement of the 14 candidate rural bridges and include costs for construction, professional services (such as design and project management), and for temporary acquisition of right of way (if required). Project costs were built from a granular level and were subjected to a probabilistic risk assessment. The P70 cost estimate (representing an appropriate level of risk and associated uncertainty with project costs) were used.

Funding

The total cost of the Region 2 Bundle is $34.3 million. Half of the total project cost, $17.13 million, will be provided by the Colorado Bridge Enterprise (a non-federal source) with the remaining 50 percent coming from the requested Federal funding. To demonstrate commitment to completing the program, CBE has signed a resolution committing the CBE to providing the non-federal match (see **Appendix B – Funding Commitment** for executed resolution). This grant request is the only request for Federal funds that have been sought for the Region 2 Bundle. **Table 18** provides a summary of the funding sources.

Table18: Project Funding Summary

Entity	Contribution
Colorado Bridge Enterprise	$17,127,500
Total Non-Federal Match	$17,127,500 (50% of total cost)
Federal Funds Sought (Grant Ask)	$17,127,500
Total Project Cost	**$34,255,000**

Budget

The total cost of the project is $34.3 million. **Table 19** provides a summary of the costs for each bridge in the Region 2 Bundle. A full breakdown of costs for each individual bridge can be found in **Appendix C – Detailed Cost Estimate**.

Table19: Summary of Project Cost by Bridge

National Bridge Structure Number	ROW (including utilities)	Professional Services	Construction	Total
G-12-C	$28,000	$58,000	$1,709,000	$1,795,000
J-14-C	$87,000	$176,000	$2,372,000	$2,634,000
J-15-G	$35,000	$71,000	$1,335,000	$1,441,000
I-13-G	$79,000	$160,000	$2,663,000	$2,902,000
I-15-AO	$72,000	$146,000	$2,244,000	$2,462,000
I-15-T	$46,000	$94,000	$2,043,000	$2,184,000
H-13-N	$44,000	$90,000	$1,970,000	$2,104,000
M-21-B	$137,000	$278,000	$3,323,000	$3,738,000
M-21-C	$121,000	$245,000	$3,002,000	$3,367,000
M-21-J	$56,000	$113,000	$1,728,000	$1,897,000
M-22-U	$67,000	$136,000	$1,388,000	$1,590,000
M-22-Y	$25,000	$50,000	$1,103,000	$1,177,000
N-21-C	$115,000	$234,000	$2,940,000	$3,289,000
N-21-F	$134,000	$272,000	$3,267,000	$3,672,000
Total	**$1,045,000**	**$2,122,000**	**$31,089,000**	**$34,255,000**

Note: Right-of-way (ROW) includes utility relocation and any temporary easements that may be needed during construction. No permanent acquisition of property will be required for the replacement bridges.

Selection Criteria

Selection Criteria

As discussed in the Notice of Funding Opportunity, the following sections describe how the Region 2 Bundle exceeds expectations for the selection criteria.

Innovation

This section describes the innovative technologies, project delivery, and financing that will be implemented to successfully replace the bridges in the Region 2 Bundle. The innovative methods will reduce costs and ensure timely completion of the program.

Innovative Technologies

CDOT and CBE will be using a number of innovative technologies and strategies for the replacement of the bridges in the Region 2 Bundle. Their efforts include using Accelerated Bridge Construction and enhancing the service life of the bridges.

Accelerated Bridge Construction

CDOT and CBE have successfully leveraged Accelerated Bridge Construction (ABC), and have identified potential methods for replacing a bridge that reduce costs. ABC techniques such as Prefabricated Bridge Elements and Systems (PBES), bridge movement technologies such as bridge moves with Self Propelled Modular Transporters (SPMT) and "lateral sliding" of bridges have been successfully leveraged on numerous bridge projects throughout the state. CDOT and CBE will continue to investigate and evaluate other ABC techniques and will champion these techniques where appropriate.

The bridges in the Region 2 Bundle are expected to be replaced with concrete box culverts or reinforced concrete pipes. Since the project will be delivered using the Design-Build model, multiple DB teams will have an opportunity to value engineer structures within the bundle that are expected to have similar replacement types. Efficiencies in cost and project schedule are expected through utilization of prefabricated structural elements to replace structures that are located in close geographic proximity. Construction crews will benefit from a steep learning curve that will result in increased production rates.

In this scenario, the culverts and pipes would be constructed off-site and transported to the site for placement. Constructing the culverts off-site would allow for greater control over the quality (i.e., better control over the concrete mixture and site conditions) and reduce the amount of time that is needed at the site to replace the bridge – saving time and reducing the impact on the public.

Additionally, the Request-for-Proposal (RFP) will stipulate that full road closures are not permitted to further reduce the impact on the public. Based on site evaluations performed during scoping and preliminary design, it appears that temporary detour roadways can be constructed adjacent to the existing structures and within CDOT ROW at the majority of the project sites. Implementing these detours will eliminate the need for roadway closures.

Enhanced Service Life

As part of its mission, the CBE is charged with bringing innovation to the practice of bridge design and construction through research and implementation of innovative practices. As funding for bridge projects becomes impacted by large replacement projects, CBE realized that one way to get the most long-term benefit from available funding was to design and construct bridges that are able to provide significantly longer terms of service, balanced with higher initial costs. As part of the effort, CBE researched and developed strategies for enhancing the service life of bridges.

The current AASHTO Bridge Design Guidelines provide a standardized approach to bridge design and indicates a 75-year design life is expected when the guidelines are implemented. These guidelines are applied nationwide, but are not able to account for the microclimates across North America. Taking into consideration the microclimates of Colorado, CBE research[1] identified strategies that enhance the AASTHO guidelines to increase the expected service life of bridges to 100 years. For example, the strategies that reduce corrosion of the superstructure and substructure include macro and micro fiber reinforcement, using corrosion inhibiting admixtures, and using low carbon chromium reinforcing steel. The strategies will be used to enhance the service life of the bridges in the Region 2 Bundle to 100 years.

Innovative Project Delivery

The project delivery method is the process by which a construction project is comprehensively designed and constructed, including project scope definition, organization of designers, constructors and various consultants, sequencing of design and construction operations, execution of design and construction, and closeout and start-up. Thus, the different project delivery methods are distinguished by the manner in which contracts between the agency, designers and builders are formed and the technical relationships that evolve between each party inside those contracts.

Currently, there are several types of project delivery systems available for publicly funded transportation projects. The most common systems are Design-Bid-Build (DBB), Design-Build (DB), and Construction Manager/General Contractor (CMGC). No single project delivery method is appropriate for every project. Each project must be examined individually to determine how it aligns with the attributes of the delivery methods.

The grant application team has performed a preliminary evaluation of the grant application bundles through the use of the CDOT Project Delivery Selection Matrix (PDSM) tool. The general logic of the PDSM tool is illustrated in the flowchart below.

[1] See research document Strategies for Enhancing Bridge Services Life, Colorado Bridge Enterprise, June 30, 2015

Figure 16: CDOT Decision Making Process for Determining Optimal Project Delivery Method
Source: CDOT

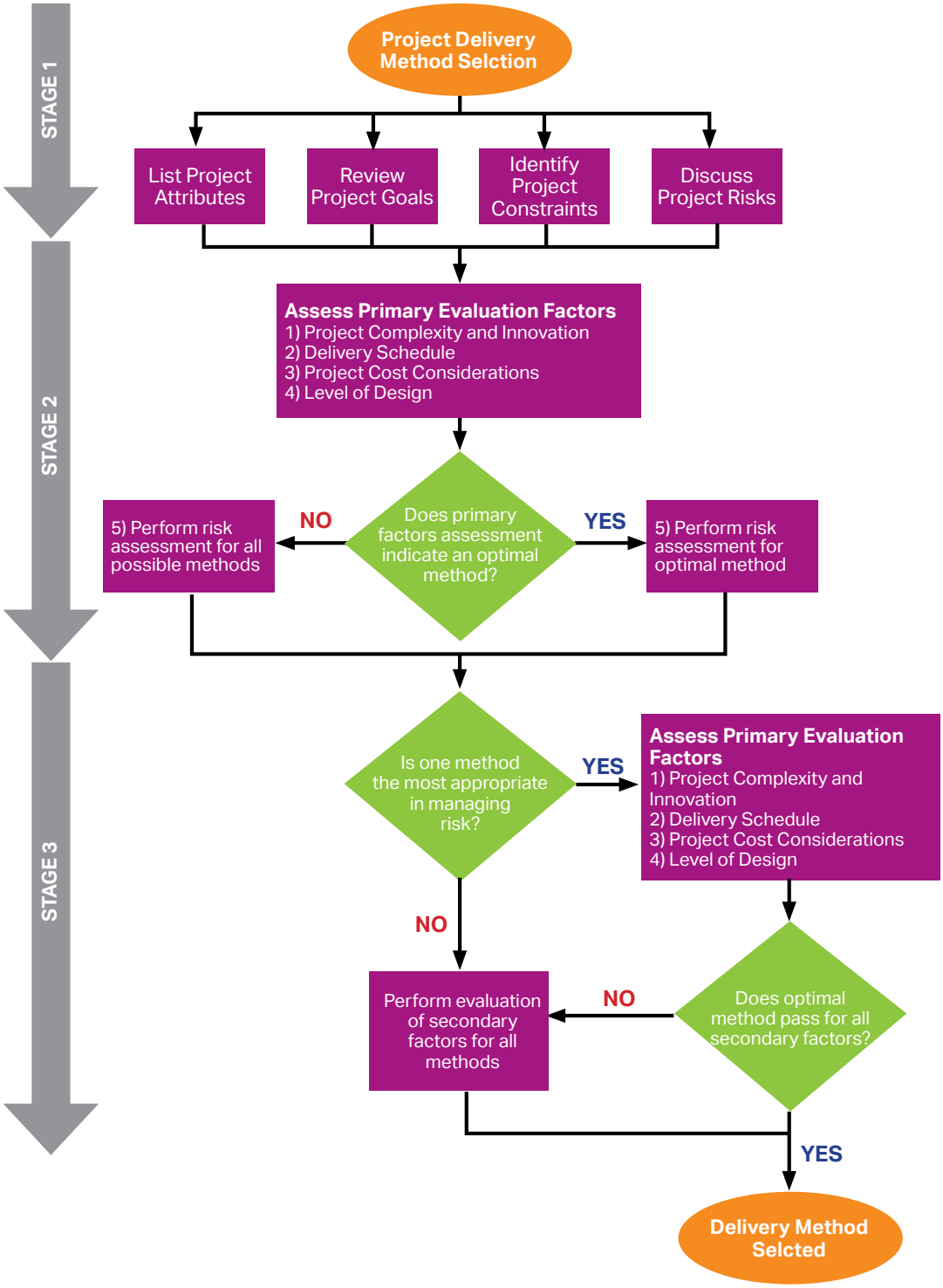


Table 20: CDOT GRANT APPLICATION #2 (Region 2 CBC/CMP Bundle)
PROJECT DELIVERY METHOD OPPORTUNITY/OBSTACLE SUMMARY

	Design/Bid/ Build (DBB)	Design/Build (DB)	Const. Mgr./ Gen Contractor (CMGC)
Primary Section Factors			
1. Project Complexity & Innovation	++	+	-
2. Project Delivery Schedule	X	++	+
3. Project Cost Considerations	+	++	-
4. Level of Design	-	+	++
5. Risk Assessment	++	-	+
Secondary Selection Factors			
6. Staff Experience/Availability (Agency)	++	+	++
7. Level of Oversight and Control	++	-	+
8. Competition and Contractor Experience	++	+	+

Rating Key	
++	Most appropriate delivery method
+	Appropriate delivery method
–	Least appropriate delivery method
X	Fatal flaw (discontinue evaluation of this method)
NA	Factor not applicable or not relevant to the selection

Project Delivery Selection Summary

Evaluation of the bundle resulted in the following:

- DBB was identified as fatally flawed due to the potential for delays extending beyond the CHBP funding obligation deadline. Additionally, this delivery method limits the contractor's ability to innovate, and does not allow for contractor input on ABC construction techniques and/or construction phasing to limit impacts to the travelling public.
- DB is likely to be the most cost effective solution since multiple DB teams will have an opportunity to value engineer structures within the bundle that are expected to have similar replacement types. Efficiencies in project schedule are expected through utilization of prefabricated structural elements to replace structures that are located in close geographic proximity on three corridors. Construction crews will benefit from a learning curve that will result in increased production rates. Initial analysis has discovered that right-of-way and environmental are low risk. Utilizing CDOT's well established templates will allow assembly of the essential procurement documents quickly so that we can focus on managing higher risk register entries such as project agreements to be executed. CDOT has a great deal of experience utilizing the DB model to deliver complex projects typically in 11 months, and does not see reason that this project would be an exception.
- CMGC has similar advantages as DB, however not to the extent or as early in the delivery process. Innovation may be limited when compared to DB since the design will be optimized to the strengths of a single contractor. Additionally, with an absolute fixed scope, the CMGC delivery process may expose CDOT to cost control challenges during the "CAP" negotiations. The design flexibility afforded by this delivery method has marginal value for Region 2 Bundle structures which are located in close geographic proximity and have similar, well-known site characteristics. Risks that would be allocated to Contractor are well-defined, which would minimize contractor contingency pricing, giving a slight advantage to DB over CM/GC.

* Design-build was selected as the preferred project delivery method.

Innovative Financing

On March 2, 2009, former Colorado Governor Bill Ritter signed into law Colorado State Senate Bill 09-108, Funding Advancement for Surface Transportation and Economic Recovery, otherwise known as FASTER. The legislation was the first new dedicated and sustainable funding source for Colorado transportation infrastructure in nearly twenty years.

The law increases revenues from various sources for transportation improvements at the state and local level. A portion of the funding designated as the "Bridge Safety Surcharge" is imposed on vehicle registration based on vehicle weight and ranges from $13 to $32. Revenues from the surcharge are dedicated specifically for Colorado's most deficient bridges — those bridges rated "poor" by the Colorado Department of Transportation (CDOT) and by statute cannot be used for other CDOT purposes.

To focus on Colorado's poor bridges, the legislation in addition to authorizing the Bridge Safety Surcharge, created the Colorado Bridge Enterprise (CBE). The CBE is an autonomous program that is a wholly owned subsidiary of CDOT, established to "finance, repair, reconstruct, and replace any designated bridge in the state" per C.R.S. 43-4-805 (2) (b) and is, by statute, to have a separate Board of Directors.

On June 18, 2009, the CBE Board officially approved the enactment of the Bridge Safety Surcharge, as required by law. In Fiscal Year 2018, Bridge Safety Surcharge revenues were $106M. The current outstanding CBE program liability for eligible structures is estimated at $1.5B, and the funding shortfall is projected to increase over time as additional structures become eligible for the program. Current forecasts estimate that the outstanding program liability will increase to nearly $2.5B by Fiscal Year 2040.

Pursuant to one of the program goals adopted by the Bridge Enterprise Board of Directors (a program delivery plan that evaluates various options, encourages creativity, and a variety of innovative solutions), the program continues to explore and deploy innovative contracting delivery methods that (1) expedite the start of construction, and/or (2) accelerate overall project completion. This includes utilization of both Design/Build (D/B), Construction Manager/General Contractor (CM/GC), and Public Private Partnership (P3) contract delivery methods.

Since program inception, CBE has addressed 33 bridges using Design-Build, 8 bridges through CM/GC, and 8 bridges through P3s. This experience, along with CDOT's extensive knowledge of alternative delivery, will be leveraged for the replacement of the bridges in the Region 2 Bundle.

Life-Cycle Costs and State of Good Repair

As previously noted, all of the bridges in the Region 2 Bundle are decades past their original design life. Because of their age and deterioration, maintenance activities are increasing over time. While maintenance activities have been ongoing, several issues were identified with the bridges that are inherent in their design and/or original construction. These issues include loose connections and differential movement in timber bridges that leads to rapid deterioration of the wearing surface, and poor quality concrete used in the concrete structures that has led to deterioration of the bridges. These issues have resulted in 13 of the bridges in the Region 2 Bundle being rated as "poor". Structural Inventory and Appraisal Item 41 is coded "D" for three of the structures in the bundle, which indicates the bridges are Load Restricted - limiting trucking routes through major sections of the US 24 and US 350 corridors.

The need for replacement of the bridges in the Region 2 Bundle is evident by the replacement activities of other bridges in the same corridors (**Figure 16**). The bridges that have already been replaced by CDOT were of similar age, similar design, and followed similar construction practices as the bridges in the Bundle. This highlights the increased needs of these corridors as the infrastructure ages and also CDOT's ongoing efforts to maintain a state of good repair for the rural highway system.

Following bridge replacement, all for the bridges will be ranked as "good", indicating that there are no design or structural issues with the bridges. The replacement of these bridges is expected to address all deficient bridges in the corridors, which will provide a good state of repair to the length of these major rural corridors. For example, US 350 between La Junta and Trinidad will not be weight restricted to oversize loads and allow for easier movement of large loads.

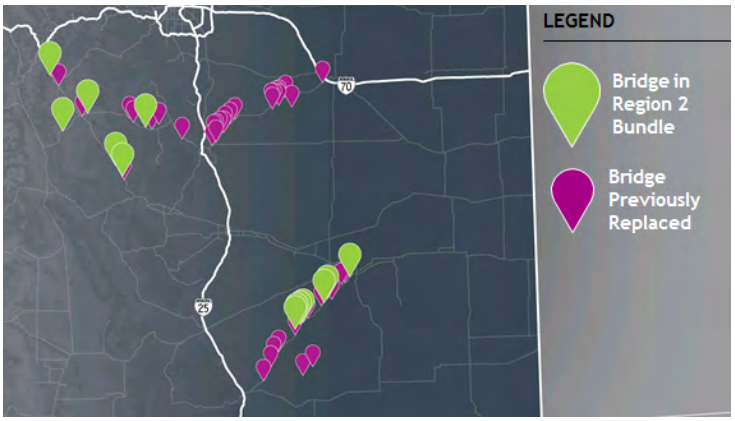


Figure 16: Similar Bridges Already Replaced by CDOT

As discussed previously, enhanced strategies will be used to extend the service life of the replaced bridges to 100 years, which will provide assurance of a good state of repair for a century. In addition, maintenance activities are anticipated to be limited to preventative maintenance for the replaced bridges, leading to less vehicle delays during these activities.

Replacement of these structures will allow CDOT to divert resources to keep other bridges throughout Colorado in a state of good repair.

Economic Vitality

The replacement of the bridges in the Region 2 Bundle will deliver economic benefits to the rural region, the state, and the nation. To estimate the economic benefits, a benefit-cost analysis (BCA) was conducted in accordance with the 2018 Benefit-Cost Analysis Guidance for Discretionary Grant Programs. Project benefits following replacement were estimated over a 20-year analysis period (2023 through 2042). The BCA estimated that replacement of the bridges will generate $29.6 million and $65.4 million in net benefits at 7 percent and 3 percent discount rates, respectively. These represent benefit-cost ratios (BCRs) of 2.1:1 and 3.1:1 at their respective discount rates. **Table 21** summarizes the results of the BCA. Details of the BCA can be found in **Appendix D - Benefit Cost Analysis**.

Table 21: BENEFITS COSTS ANALYSIS IMPACT MATRIX

Current Status/ Baseline & Problem to be Addressed	Change to Baseline or Alternatives	Types of Impacts	Affected Population	Economic Benefit (Net Present Values, $2018 M)	
				Discounted at 7%	Discounted at 3%
Fourteen (14) bridges are past their useful life and as a result require frequent maintenance and have the potential for emergency closure. The emergency closures create delays and detours for motorists. These delays and detours result in costs incurred by motorists, CDOT, and trucking businesses.	The project would replace 14 bridges, bringing them up to a state of good repair, and thus reducing maintenance expenditures and driving miles incurred by motorists due to detours. The reduced driving miles results in travel cost savings for autos, operating cost savings for trucks, emissions savings, safety improvements and crash reductions, and roadway maintenance savings.	**Safety**			
		Reduced Roadway Fatalities and Crashes	Traveling Public	$7.72	$13.04
		Safety Improvements at Bridges	Traveling Public	$0.09	$0.15
		State of Good Repair			
		Roadway Maintenance Savings	CDOT	$0.04	$0.07
			Taxpayers		
		Net Operating & Maintenance	CDOT	$21.22	$33.13
		Environmental Protection			
		Emissions Savings	The Public	$0.60	$1.01
		Economic Competitiveness			
		Travel Time Savings	Traveling Public	$9.66	$16.28
		Auto Travel Cost Savings	Drivers	$10.43	$17.61
		Residual Savings	CDOT	$2.14	$7.24
			Taxpayers		
		Truck Operating Savings	Freight operators	$4.54	$7.65
			Shippers		
			Customers		
		Total Benefits ($2018M)		$56.45	$96.17
		Capital Costs		$27.09	$30.91
		Net Benefits ($2018M)		$29.35	$65.26
		Benefits-Costs Ratio		2.1	3.1

Source: AECOM

The largest generator of economic benefits is the savings in travel time and truck operating savings reflective of the avoidance of emergency closures of bridges, and the subsequent emergency replacement of the bridges. Additional benefits generated by the implementation of the Region 2 Bundle include a reduction in accidents and fatalities and nominal reductions in emissions and roadway wear and tear. The replacement of the bridges in the Regions 2 Bundle will improve the aggregate State of Good Repair along these rural highway and interstate corridors, thereby ensuring that the both commercial and personal traffic can continue to functional as normal.

AECOM'S cost estimation team estimated that bundling the replacement of the bridges together, placing them under a single contract, and utilizing similar design elements and construction activities will result in a total replacement cost 12.3%, or $4.9 million, less than if the bridges were to be replaced individually. As this is a comparison between build options, and not viewed against the baseline do-nothing option, this cost savings is not incorporated into the BCA.

Project Readiness

Planning by the CDOT and CBE for the replacement of the bridges in the Region 2 Bundle has been ongoing. The planning activities will continue, which will allow the project to be implemented immediately after grant award by the FHWA. The following sections discuss the project feasibility and schedule that demonstrate the project readiness of the Region 2 Bundle.

Project Feasibility

Thirteen (13) of the bridges in the Region 2 Bundle have been identified by the CBE as candidates for replacement based on their classification of "poor". These structures have been included in the CBE Prioritization Plan; the majority of the structures fall within the top two tiers of the plan, which correlates high or medium priority. Since then, CDOT engineers in Region 2 have performed high-level scoping and hydrologic analysis to identify potential project risks and identify the probable structure replacement type. Standardized designs were selected for the replacement bridges, which will speed construction and reduce costs. Standard design drawings and construction documents have been prepared for each bridge (see **Appendix E – Design Examples**). Currently, the design level is approximately 10 percent, which will allow for expedited development of design-build procurement documents if the grant is awarded.

The bridges are included in the Statewide Transportation Improvement Program (STIP) under STIP ID: SST8000.126, which will allow CDOT Region 2 to continue design efforts up to the 30 percent design level. Following grant award, the project will be fully funded and the STIP will be amended to include the construction phase.

Project Schedule

A schedule has been prepared by CBE for the replacement of the bridges in the Region 2 Bundle (**Figure 17**). It is anticipated that the actual replacement of the bridges will occur between January 2021 and October 2022. Design-build procurement will ensure that funding is obligated more than a year in advance of the statutory deadline for Competitive Highway Bridge Program funds (September 30, 2021). Additionally, project completion has been scheduled over three years in advance of the September 30, 2026 deadline.

A number of steps have already been taken to move the process forward to ensure that the schedule can be met, including:

- Conducted preliminary engineering and hydraulic analysis
- Performed high level scoping and site visits to identify potential project risks
- Executed a resolution committing the CBE to providing the non-Federal funding match so that that obtaining required funding will not be a concern
- Incorporated the bridges into the STIP (30 percent design)
- Verified that no local agency approvals are required to advance the project
- Confirmed that the majority of the replacements can be performed within CDOT ROW - temporary easements may be obtained for construction of temporary detour roadways, however it is feasible to phase the construction of each structure to mitigate this need
- Prepared list of qualified contractors who can complete the bridge replacement - each of the contractors has the required experience and capabilities to replace the 14 bridges in the Region 2 Bundle under one contract and within the scheduled time

Right-of-Way

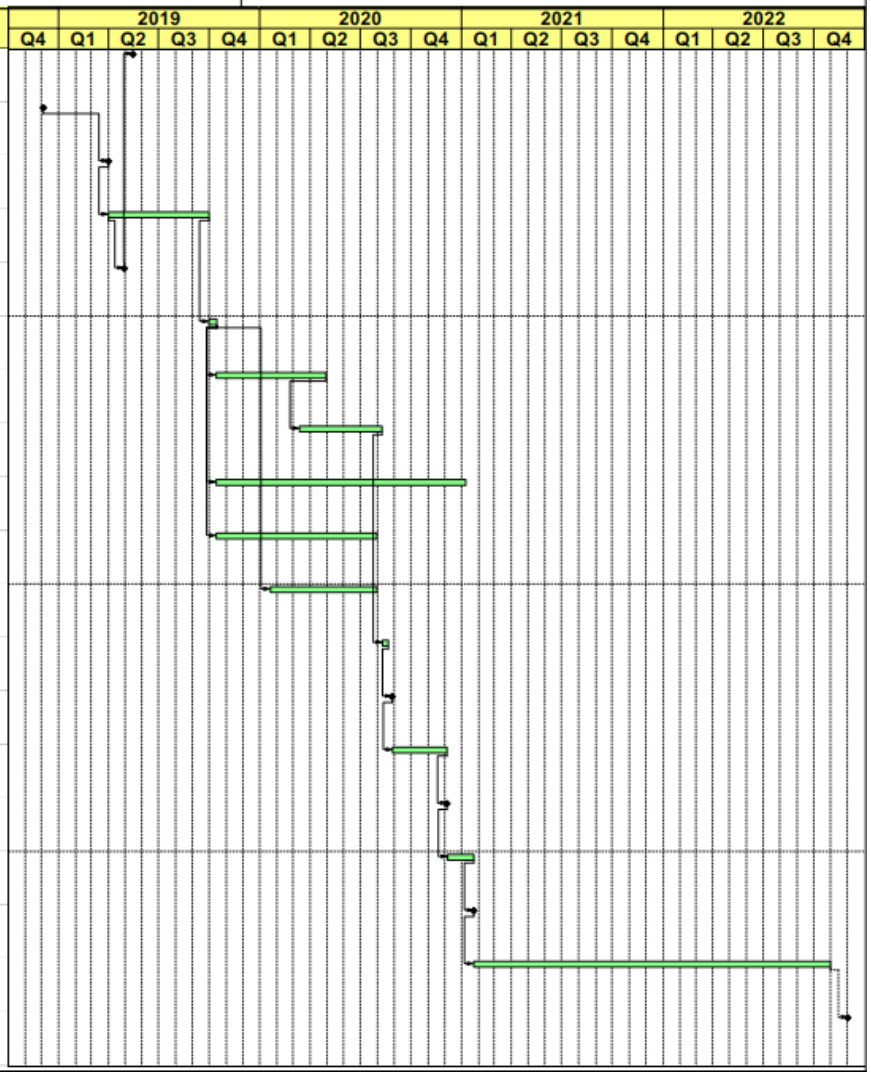
The existing bridges and adjacent property are owned by CDOT, therefore no permanent easement or land acquisition will be required to replace the bridges. For some bridges, temporary easements may be needed for construction staging and traffic bypass routes. These easements would only be required during construction activities and the property would be brought back to its current state following construction. CDOT and CBE have a lot of experience obtaining temporary easements for bridge maintenance and replacement activities; therefore, no issues are expected that would stop or delay replacement activities.

Figure 17: Schedule for Region 2 Bundle

COLORADO
Department of Transportation

Region 2 CBC Project
Application #2 Schedule

Activity Name	Orig Dur	Rem Dur	Start	Finish
CDOT Transportation Commision STIP Adoption	0	0	16-May-19	
CDOT Grant Submission	0	0	04-Dec-18*	
FHWA Grant Awarded	0	0	01-Apr-19	
FHWA Negotiation Period	183	183	01-Apr-19	30-Sep-19
CDOT STIP Final Design and Construction Amendment	0	0	30-Apr-19	
FHWA Design Phase Authorization	15	15	30-Sep-19	14-Oct-19
CDOT Design Development	200	200	14-Oct-19	30-Apr-20
Contract Documents	150	150	12-Mar-20	08-Aug-20
ROW Acquisition	453	453	14-Oct-19	08-Jan-21
Environmental Clearance (CATEX)	292	292	14-Oct-19	31-Jul-20
Utility Coordination and Agreements	194	194	20-Jan-20	31-Jul-20
FHWA Construction Phase Authorization / Obligation	12	12	10-Aug-20	21-Aug-20
Request for Proposals	0	0		27-Aug-20
Procurement	100	100	28-Aug-20	05-Dec-20
CDOT Award	0	0	05-Dec-20	
Contract Execution	48	48	06-Dec-20	22-Jan-21
Notice-to-Proceed	0	0		22-Jan-21
Construction	648	648	22-Jan-21	31-Oct-22
Project Complete	0	0		02-Dec-22*



Environmental Readiness

Environmental Readiness

CDOT has institutionalized several FHWA Every Day Counts measures to ensure streamlined project delivery while maintaining regulatory compliance and environmental stewardship:

- **Mitigation Banking:** CDOT has created the first Permanent Water Quality (PWQ) Mitigation program of its type: it uses a mitigation fund for more effective watershed-level projects instead of on-site mitigation-by-project for Permanent Water Quality (PWQ) impacts, it encourages partnerships with our municipal stakeholders that should also reduce the maintenance burden on CDOT crews, and compliance is easily tracked by use of funds instead of tracking water or area treated.
- **Programmatic Agreements:** CDOT has agreements with EPA, CPW, USFWS, CDPHE, USACE, USFS, BLM, FHWA, SHPO. All establish streamlined approaches for handling routine environmental requirements, reducing review times and accelerating project delivery. While each bridge will be evaluated, it is anticipated that all of the bridge projects in the Region 2 Bundle will be approved as categorical exclusions (CEs).
- **NEPA 404 Merger:** Integrate NEPA and the permitting process seeks to transform how agencies and stakeholders conduct concurrent, synchronize environmental and permitting reviews, saving time and cost for the agencies involved.
- **Implementing Quality Environmental Documents:** CDOT has developed templates for CEs, EAs and FONSIs. This has streamlined the NEPA process: reducing costs and review times while maintaining document quality.
- **Liaisons:** CDOT also uses liaisons with USFWS and the state health department (CDPHE) to ensure consistency and accelerate project delivery.

As noted above, it is anticipated that replacement of all of the bridges in the Region 2 Bundle will be approved as categorical exclusions (CEs) based on existing programmatic agreements. The anticipation of CEs is based on CDOT's previous experience replacing similar bridges (both in type of bridge and existing environment) within the two highway corridors covered in the bundle and throughout the Colorado highway system.

Project Risks and Mitigation Strategies

Project Risks and Mitigation Strategies

Several project risks and their mitigation strategies have been discussed throughout this application. Steps taken by CDOT and CBE include:

- Completed multiple actions to reduce the risk to the schedule (see Project Schedule)
- Design-Build procurement will provide cost certainty earlier in the project (see Innovative Project Delivery)
- Incorporation of the bridges into the STIP and verification that no local agency approvals are necessary to advance the project (see Project Feasibility)
- Institutionalizing several FHWA Every Day Counts measures to ensure streamlined project delivery (see Environmental Readiness)
- Conducting high level scoping, preliminary design and hydraulic analysis to identify potential project risks and identify probable replacement type for the bridges (see Project Feasibility)
- Obtaining a signed resolution from the CBE Board of Directors committing CBE to providing the non-federal match (see Funding)

CDOT and CBE have extensive experience collaborating to replace bridges and care for aging infrastructure, with CBE being established for the purpose of addressing aging bridges in Colorado. This experience reduces the risk since the knowledge and lessons learned will be put to use when replacing the bridges in the Region 2 Bundle.

Appendix A
Letters of Support

COLORADO
Gov. John Hickenlooper

November 30, 2018

The Honorable Elaine Chao
Secretary
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, D.C. 20590

RE: Colorado Department of Transportation USDOT Competitive Highway Bridge Replacement Grant Applications

Dear Secretary Chao:

I am writing in support of the Colorado Department of Transportation's (CDOT) application for funding under the USDOT Competitive Highway Bridge Replacement Grant Program for our bridge projects. The three grant requests include partial funding for the replacement of 33 bridges throughout the state, including 1) The replacement of ten bridges on Interstate 70 (I-70) near Golden between Colfax Ave. and Harlan Street; 2) The replacement of fourteen bridges on US 350 in Colorado between Delhi and La Junta and in the area of US 24 near Hartsel, CO; and 3) The replacement of 9 bridges on rural highways and service roads in Northeastern Colorado.

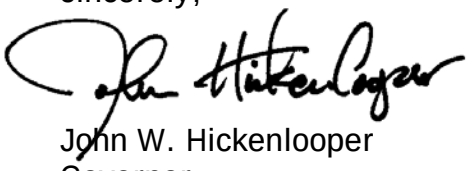
The State of Colorado is facing severe and growing transportation challenges that threaten the safety, efficiency, and economy of Colorado. The State's transportation infrastructure has seen usage and congestion grow significantly, reflective of both the increased population and economic boom the state has enjoyed over the past decade. This has meant a substantial cohort of the state's bridges are now operating past their design life and/or are in poor condition. In the case of the bridges proposed for replacement in CDOT's applications, their deterioration has accelerated in recent years, leading to escalating maintenance costs and an increasing frequency of lane and bridge closures to carry out planned and unplanned repairs.

Interstate 70 is the primary gateway to the recreational areas of the Rocky Mountains and, as part of the National Freight System, it is the most significant east-west highway for goods movement in the state. Seven of the bridges in the second bundle of 14 are along US 350, which is a significant rural highway that provides a crucial transportation corridor for agriculture and freight between La Junta and Trinidad, connecting Interstate 25 and US 50. The other seven bridges are located on US 24 and Route 9, near Hartsel, which is another primary gateway to the recreational areas of the Rocky Mountains.

These corridors are some of the most highly trafficked roadways in the state and ensuring improvements that maintain their condition is imperative. Road closures and delays as a result of planned and unplanned maintenance on bridges due to their deterioration have had an adverse impact on the efficacy of the larger transportation network. In fact, closures of these bridges incur significant delays, causing detour distances of over 100 miles in some instances. Improving their condition will ensure Colorado's continued economic competitiveness.

The implementation and delivery of the replacement of these three bundles of bridges represent an opportunity for the State of Colorado to effectively improve mobility and safety outcomes along the state's busiest road corridors while concurrently ensuring that the economic vitality provided by these crucial routes are maintained. Thank you for your consideration.

Sincerely,



John W. Hickenlooper
Governor

Teller County

(719) 689-2988 www.co.teller.co.us Fax (719) 686-7900

November 14, 2018

The Honorable Elaine Chao
Secretary, U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, D.C. 20590

RE: Colorado Department of Transportation FHWA Rural Bridge Replacement Grant Application – Concrete Box Culvert and Corrugated Metal Pipe Culvert Program – (Region 2 Bundle).

Honorable Secretary Chao:

I am writing on behalf of Teller County to express our support of the Colorado Department of Transportation's (CDOT) application for the funding under the FHWA Rural Bridge Replacement Grant Program for their project, Region 2 Bundle. The grant request is for partial funding for the replacement of 14 bridges on US 350 between Delhi and La Junta and in the area of US 24 near Hartsel.

The State of Colorado is facing severe and growing transportation problems that threaten the safety, efficiency, and economy of Colorado. Within the context of stagnate or declining funding, the State's transportation infrastructure has seen usage and congestion grow significantly, reflective of both the increased population and economic boom the state has endured over the past decade. A substantial cohort of the state's bridges are operating past their design life and/or are in poor condition. In the case of the bridges proposed for replacement in CDOT's application, their deterioration has accelerated in recent years, leading to escalating maintenance costs and an increasing frequency of lane/bridge closures to carry out planned and unplanned repairs.

Seven of the bridges in this bundle of 14 are along US 350, which is a significant rural highway that provides a crucial transportation corridor for agriculture and serves as a key freight link between La Junta and Trinidad by connecting I-25 and US 50. The other seven bridges are located on US 24 and Route 9, near Hartsel, which is a primary gateway to the recreational areas of the Rocky Mountains and provides access for recreationists and the goods needed to support the rural economies that survive on the recreational opportunities of the area. Road closures and delays along these corridors as a result of planned and unplanned maintenance on its bridges due to their deterioration have had an adverse impact on the efficacy of the larger transportation network and will hinder the region's economic competitiveness if they are not replaced in the near term.

The implementation and delivery of the replacement of the Region 2 Bundle of bridges represents an opportunity for the State of Colorado to effectively improve mobility and safety outcomes along important state road corridors while concurrently ensuring that the economic vitality provided by these crucial rural routes is maintained.

Kind regards,

Marc Dettenrieder, MBA
Teller County Commissioner

112 North "A" Street P.O. Box 959 Cripple Creek, CO 80813-0959

Fremont County Board of Commissioners

615 Macon Ave., Room 105 - Cañon City, Colorado 81212
Phone (719) 276-7300 - Fax (719) 276-7412

Tim Payne	Debbie Bell	Dwayne McFall
District 1	District 2	District 3

November 15, 2018

The Honorable Elaine Chao
Secretary, U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, D.C. 20590

RE: Colorado Department of Transportation FHWA Rural Bridge Replacement Grant Application – Concrete Box Culvert and Corrugated Metal Pipe Culvert Program – (Region 2 Bundle).

Honorable Secretary Chao:

We are writing on behalf of Fremont County, Colorado, to express our support for the Colorado Department of Transportation's (CDOT) application for funding under the FHWA Rural Bridge Replacement Grant Program for the project known as Region 2 Bundle. The grant request is for partial funding for the replacement of 14 bridges on US 350, between Delhi and La Junta, and in the area of US 24 and Route 9, near Hartsel.

The Highway 9 corridor is a major access into our county, providing entrance from Park and Teller Counties. The thoroughfare is vital to our economy which relies heavily on recreational opportunities. Frequent closures threatens our region's vitality and economic competitiveness.

The State of Colorado is facing severe and growing transportation problems that threaten the safety, efficiency, and economy of Colorado. Within the context of stagnate or declining funding, a substantial cohort of the state's bridges are operating past their design life and/or are in poor condition. In the case of the bridges proposed for replacement in CDOT's application, their deterioration has accelerated in recent years, leading to escalating maintenance costs and an increasing frequency of lane/bridge closures to carry out planned and unplanned repairs.

The implementation and delivery of the replacement of the Region 2 Bundle of bridges represents an opportunity for the State of Colorado to effectively improve mobility and safety outcomes along important state road corridors while concurrently ensuring that the economic vitality provided by these crucial rural routes is maintained.

Sincerely,

Tim Payne	Debbie Bell	Dwayne McFall
Commissioner, District 1	Commissioner, District 2	Commissioner, District 3

Apppendix B
Funding Commitment

COLORADO
Department of Transportation
Statewide Bridge Enterprise

2829 W Howard Pl., 3rd Floor
Denver, CO 80204

MEMORANDUM

TO: BRIDGE ENTERPRISE BOARD OF DIRECTORS
FROM: JERAD ESQUIBEL, DIRECTOR OF PROJECT SUPPORT
DATE: NOVEMBER 15, 2018
SUBJECT: RESOLUTION TO APPROVE STATE FUNDING MATCH FOR FY 2018-19 FHWA COMPETITIVE HIGHWAY BRIDGE GRANT

Purpose:
The Bridge Enterprise Board of Directors (Board) is being asked to approve the attached resolution that endorses the grant applications for the fiscal year (FY) 2018-19 FHWA Competitive Highway Bridge Program, and commits Bridge Enterprise funding for BE eligible structures as a portion of the state funding match.

Background:
In October, CDOT Staff Bridge Branch and BE Staff held a joint workshop to inform the Board and the Transportation Commission of key details provided in the Notice of Funding Opportunity (NOFO) released by the FHWA on September 5, 2018, and to provide the selection methodology for the structure bundles being submitted in the grant applications. State funding match levels are recommended at 50% or greater to increase the probability of award. Based on the selection criteria outlined in the NOFO, the following projects and funding matches were recommended:

App#	Description	Requested CBE Match (est.)	Requested TC Match	USDOT Grant	Total Cost (est.)
1	R1: I-70 between Colfax Ave. and Harlan St. (10 Structures)	$41.7M	$15M	$24.3M	$81M
2	R2: Concrete Box Culvert and Corrugated Metal Pipe Culvert Program (14 Structures)	$17M	-	$17M	$34M
3	R1/R4: Eastern Plains Timber Bridge Replacement Program (9 Structures)	$11M	-	$11M	$22M
	Total Match Being Requested	**$69.7M**	**$15M**	**$52.3M**	**$137M**

Staff requested consideration and feedback from the Board and the Transportation Commission regarding the proposed grant applications and funding levels and the response was positive. As discussed in the October workshop, the potential exists for USDOT to award multiple grants. Based on BE program forecasts, the estimated $69.7M maximum in CBE match funding is currently available between FY 2019-20 and FY 2024-25 in the unlikely event that all three grants are awarded.

Next Steps:
1. Staff will submit applications for all three project bundles by the FHWA December 4th deadline
2. If any bundle is awarded, BE staff will return to the Board requesting specific funding for each project within the bundles as part of the monthly budget supplement process.

Attachment:
Attachment A: Resolution # BE 18-11-X: Instructing the Department to submit an application under the Competitive Highway Bridge Program and support priority bridge projects submitted by the Colorado Bridge Enterprise and CDOT Staff Bridge Program

Resolution #BE-18-11-07

Instructing the Department to submit an application under the USDOT Competitive Highway Bridge Program and support priority bridge projects submitted by the Colorado Bridge Enterprise and CDOT Staff Bridge Program

Approved by the Colorado Bridge Enterprise Board of Directors on November 15, 2018

WHEREAS, the Colorado General Assembly created the Colorado Bridge Enterprise (CBE) in C.R.S. 43-4-805 as a government-owned business within the Colorado Department of Transportation (CDOT or Department) for the business purpose of financing, repairing, reconstructing, and replacing Designated Bridges, defined in C.R.S. 43-4-803(10) as those bridges identified as structurally deficient or functionally obsolete and rated poor; and

WHEREAS, The Consolidated Appropriations Act of 2018 made available $225 million for highway bridge replacement and rehabilitation projects on public roads through the Competitive Highway Bridge Program, (Pub. L. 115-141, March 23, 2018); and

WHEREAS, a Notice of Funding Opportunity (NOFO) was issued by U.S. Department of Transportation (USDOT) on September 5, 2018 for the FY 2018 Competitive Highway Bridge Program; and

WHEREAS, applications for the Competitive Highway Bridge Program; are due to the U.S. Secretary of Transportation on December 4, 2018; and

WHEREAS, the USDOT's consideration of Competitive Highway Bridge Program discretionary grant applications will be based on four key program objectives: innovation, supporting economic vitality, life cycle cost and state of good repair and project readiness; and

WHEREAS, projects that are eligible for the Competitive Highway Bridge Program discretionary grant funding must be considered major structures, demonstrate cost savings through bundling and be located on a public road; and

WHEREAS, both CBE and CDOT Staff Bridge have analyzed potential bridge structures for the Department to submit under a unified grant application and identified three project bundles that will be submitted for consideration; and

WHEREAS, all project bundles include CBE eligible structures and project bundles #1 and #3 include non-CBE eligible structures, both the CBE Board and the Transportation Commission are being asked to commit matching funds to increase the competitiveness of the Departments application.

NOW THEREFORE BE IT RESOLVED, the Department is instructed to submit the maximum allowed three applications for the following three different bridge project bundles as part of the Competitive Highway Bridge Program:

1. I-70 between Colfax Ave. and Harlan St. – Region 1
2. Concrete Box Culvert and Corrugated Metal Pipe Culvert Program – Region 2
3. Eastern Plains Timber Bridge Replacement Program – Regions 1 and 4

NOW THEREFORE BE IT FURTHER RESOLVED, the CBE Board commits to providing up to $41.7 million of state match for CBE eligible structures under grant application #1: I-70 between Colfax Ave. and Harlan St. in Region 1 if this grant application is successful.

NOW THEREFORE BE IT FURTHER RESOLVED, the CBE Board commits to providing up to $17 million of state match for CBE eligible structures under grant application #2: Concrete Box Culvert and Corrugated Metal Pipe Culvert Program in Region 2 if this grant application is successful.

NOW THEREFORE BE IT FURTHER RESOLVED, the CBE Board commits to providing up to $11 million of state match for BE eligible structures under grant application #3: Eastern Plains Timber Bridge Replacement Program in Regions 1 and 4 if this grant application is successful.

NOW THEREFORE BE IT FURTHER RESOLVED, in order to show the Department's financial commitment to project bundles and because a state match is required and enhances the viability of the application, the CBE commits to providing up to a combined maximum of $69.7 million of Bridge Safety Surcharge revenue to be used on CBE eligible structures if all three of the Department's grant applications are awarded by the USDOT.

Herman F. Stockinger III

Herman Stockinger, Secretary
Bridge Enterprise Board of Directors

11-15-18

Date

Appendix C Detailed Cost Estimation

	FHWA GRANT PROPOSAL REGION 2 - PRIORITY GROUP 1 QUANTITY ESTIMATE						
			3 x 6' RCP L=60' (45skew)	3 x 20'x 8' CBC L= 50'(0skew)	3 x 14'x6' CBC L=100'(20skew)	2 x 18'x6' CBC L=45'(0skew)	1x5' RCP L=36'(0skew)
			J-15-G	**J-14-C**	**N-21-C**	**M-21-J**	**M-22-Y**
Pay Item	**Description**	**Unit**	**Quantity**				
202-00001	Removal of Structure	EA	1	1	1	1	1
206-00000	Structure Excavation	CY	105	0	0	0	0
206-00100	Structure Backfill (Class 1)	CY	-	185	280	115	-
206-00200	Structure Backfill (Class 2)	CY	20	-	-	-	5
403-33841	Hot Mix Asphalt (Grading SX) (100)(PG 64-22)	Ton	18.5	30.2	26.5	19.8	3.1
601-03030	Concrete Class D (Box Culvert)	CY	42.3	46.2	21.7	20.5	16.4
602-00020	Reinforcing Steel (Epoxy Coated)	LB	2750	5950	3375	3415	1045
603-01600	60 Inch Reinforced Concrete Pipe	LF	-	-	-	-	36
603-01720	72 Inch Reinforced Concrete Pipe	LF	180	-	-	-	-
603-71406	14x6 Foot Concrete Box Culvert (Precast)	LF	-	-	300	-	-
603-71806	18x6 Foot Concrete Box Culvert (Precast)	LF	-	-	-	90	-
603-72008	20x8 Foot Concrete Box Culvert (Precast)	LF	-	150	-	-	-
606-00301	Guardrail Type 3 (6-3 Post Spacing)	LF	628	678	648	628	562
621-00400	1 Lane Detour Bridge	EA	1	1	1	1	1
Notes:							
1. $300k for 1 lane detour bridge; $500k for 2 lane detour bridge							
2. For precast CBC, the bedding and excavation for bedding is included in the work (per M-603-3, Note 3)							
3. For RCP, bedding material assumed to be 3 in thick Backfill Class 2 (per M-603-2, Note 6)							
4. For RCP, headwall concrete and steel quantities per M-601-10							
5. Assumption of 3in HMA on all structures.							
6. Concrete Class D to include headwalls, wingwalls, toewalls with quantities per M-601-2 Sheet 2							
7. Concrete and steel quantities for wingwalls per M-601-20							
8. See M-206-1 for excavation and backfill quantities.							

	FHWA GRANT PROPOSAL REGION 2 - PRIORITY GROUP 2 QUANTITY ESTIMATE						
			3 x 14'x6' CBC L=70'(0skew)	3 x 14'x6' CBC L=62'(0skew)	2 x 12'x10' CBC L=40'(0skew)	4 x 20' x 8' CBC L=70'(0skew)	2 x 14'x10' CBC L=75'(45skew)
			G-12-C	**I-13-G**	**H-13-N**	**M-21-B**	**M-22-U**
Pay Item	Description	Unit	Quantity				
202-00001	Removal of Structure	EA	1	1	1	1	1
206-00000	Structure Excavation	CY	920	0	0	0	0
206-00100	Structure Backfill (Class 1)	CY	195	170	100	315	195
403-33841	Hot Mix Asphalt (Grading SX) (100)(PG 64-22)	Ton	28.3	26.6	15.5	46.8	28.5
601-03030	Concrete Class D (Box Culvert)	CY	28.3	26.6	15.5	46.8	28.5
602-00020	Reinforcing Steel (Epoxy Coated)	LB	3375	3375	3920	6950	5155
603-71210	12x10 Foot Concrete Box Culvert (Precast)	LF	-	-	80	-	-
603-71406	14x6 Foot Concrete Box Culvert (Precast)	LF	210	186	-	-	-
603-714xx	14x10 Foot Concrete Box Culvert (Precast)*	LF	-	-	-	-	150
603-71806	18x6 Foot Concrete Box Culvert (Precast)	LF	-	-	-	-	-
603-72008	20x8 Foot Concrete Box Culvert (Precast)	LF	-	-	-	280	-
606-00301	Guardrail Type 3 (6-3 Post Spacing)	LF	642	642	604	722	638
621-00400	1 Lane Detour Bridge	EA	-	-	-	1	1
621-00400	2 Lane Detour Bridge	EA	1	1	1	-	-
Notes:							
1. $300k for 1 lane detour bridge; $500k for 2 lane detour bridge							
2. For precast CBC, the bedding and excavation for bedding is included in the work (per M-603-3, Note 3)							
3. Assumption of 3in HMA on all structures.							
4. Concrete Class D to include headwalls, wingwalls, toewalls with quantities per M-601-2 Sheet 2							
5. Concrete and steel quantities for wingwalls per M-601-20							
6. See M-206-1 for excavation and backfill quantities.							

	FHWA GRANT PROPOSAL REGION 2 - PRIORITY GROUP 3 QUANTITY ESTIMATE						
			2 x 10'x8' CBC L=50'(0skew)	2 x 10'x8' CBC L=60'(0skew)	3 x 20'x6' CBC L=60'(0skew)	3 x 20'x8' CBC L=90'(45skew)	3 x 20' x 8' CBC L=80'(30skew)
			I-15-T	**I-15-AO**	**O-19-D**	**N-21-F**	**M-21-C**
Pay Item	Description	Unit	Quantity				
202-00001	Removal of Structure	EA	1	1		1	1
206-00000	Structure Excavation	CY	500	610	0	0	0
206-00100	Structure Backfill (Class 1)	CY	105	125	210	335	295
403-33841	Hot Mix Asphalt (Grading SX) (100)(PG 64-22)	Ton	12.4	12.4	34.9	55.0	44.9
601-03030	Concrete Class D (Box Culvert)	CY	28.3	28.3	24.8	53.7	44.1
602-00020	Reinforcing Steel (Epoxy Coated)	LB	2300	2300	5015	6290	5855
603-71008	10x8 Foot Concrete Box Culvert (Precast)	LF	100	120	-	-	-
603-720xx	20x6 Foot Concrete Box Culvert (Precast)	LF	-	-	180	-	-
603-72008	20x8 Foot Concrete Box Culvert (Precast)	LF	-	-	-	270	240
606-00301	Guardrail Type 3 (6-3 Post Spacing)	LF	596	596	678	730	698
621-00400	1 Lane Detour Bridge	EA	-	-	1	1	1
621-00400	2 Lane Detour Bridge	EA	1	1	-	-	-
Notes:							
1. $300k for 1 lane detour bridge; $500k for 2 lane detour bridge							
2. For precast CBC, the bedding and excavation for bedding is included in the work (per M-603-3, Note 3)							
3. Assumption of 3in HMA on all structures.							
4. Concrete Class D to include headwalls, wingwalls, toewalls with quantities per M-601-2 Sheet 2. Same for reinforcing quantities.							
5. Concrete and steel quantities for wingwalls per M-601-20							
6. See M-206-1 for excavation and backfill quantities.							

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: **22-Oct-18**

Project Name	**R2 BUNDLE**
Project Number	**J-15-G**
Sub-Account Number	**XXXXX**
Project Description	**J-15-G**
Project Work Type	**BRIDGE REPLACEMENT**
Estimator:	**E.A.**
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	009B	**Begin MP:**	53.9	**End MP:**	71.4	**Length:**	17.5
CDOT Region:	2	**FIPS City:**	NONE	**FIPS County:**	Park Co		
		FIPS City:	00000	**FIPS County:**	093		
Segment Mid-point	**RefPt** 62.650	**Latitude:**	39.1880	**Longitude:**	-105.9730	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	**Urban-Rural Class:**	1 Rural	**Terrain:**	2 Rolling		
AADT:	1,900	**Truck ADT:**	60	**Tier Class:**	Tier 4	**Primary Surface:**	1 Asphalt

Design Maturity:	0 - Conceptual	**NEPA Action:**	Cat/Ex	**NEPA Status:**	In Progress
Project Delivery Method:	Design-Bid-Build	**Construction Start (MMM-YY)**	Sep-22	**Construction Duration (mo)**	24.0

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	86.2%	$449,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	180	LS	13.8%	$72,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$521,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$12,608
B-02	Environmental	3 - Average	% OF A	6.0%	$31,000
B-03	Structural	5 - Extensive	% OF A	5.0%	$26,050
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$22,403
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$16,047
B-06	Mobilization	3 - Average	% OF A	16.6%	$86,278
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$104,200
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$4,012
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$1,719
		SUBTOTAL (B)	% OF A	58.4%	$304,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**158.3%**	**$825,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$49,500
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$24,750
C-03	F/A - Project Communications		% OF CBI	0.1%	$883
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$75,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**172.7%**	**$900,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$98,550
D-02	Construction Indirects	% OF CI	9.5%	$85,500
	SUBTOTAL (D)	% OF CI	20.4%	$184,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$1,084,000**

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$19,710
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$118,260
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$7,391
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.1%	$145,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) **$1,229,000**

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE DATE: **11/6/2018**

RISK RESERVE 17.2% OF BASE COST **$211,000**

TOTAL PROJECT COST **$1,440,000**

117.2% of Base Cost

ESCALATION

Construction Start	Sep-22	**Escalation from Estimate Date:**	Nov-18	**ESCALATION**	14.1% OF BASE COST **$203,000**
Duration (mo)	24.0	**to Construction Mid-Point Date:**	Sep-23	**ESCALATED PROJECT COST**	**$1,643,000**

133.7% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	J-15-G
Sub-Account Number	XXXXX
Project Description	J-15-G
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	009B	Begin MP:	53.9	End MP:	71.4	Length:	17.5
CDOT Region:	2	City:	NONE	County:	Park Co		
		FIPS City:	00000	FIPS County:	093		
Segment Mid-point	RefPt 62.650	Latitude:	39.1880	Longitude:	-105.9730	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	2
AADT:	1,900	Truck ADT:	60	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

				Model Estimate		Region Estimate	
A-01	EARTHWORK	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-01 Cost:	0.0%	$0	0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-02 Cost:	0.0%	$0	0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)						

A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	105	$21.6	$2,263	$36.0	$3,780
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	0	$45.3	$0	$66.0	$0
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	20	$48.2	$964	$77.0	$1,540
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	19	$83.5	$1,544	$83.5	$1,544
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	42	$960.0	$40,608	$960.0	$40,608
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	2,750	$1.0	$2,767	$2.0	$5,500
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	628	$95.5	$59,961	$33.0	$20,724
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	1	$65,000.0	$65,000	$300,000.0	$300,000
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	0	$50,000.0	$0	$500,000.0	$0
			A-03_CAT300 Cost:		77.5%	$248,000	86.2%	$449,000

A-03_repl	BRIDGE REPLACEMENT						
		A-03_REPL Cost:			0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR						
		A-03_REPA Cost:			0.0%	$0	0.0%	$0
A-03_wall	WALLS						
		A-03_WALL Cost:			0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS				R2			
		A-03_CULV Cost:			0.0%	$0	0.0%	$0

A-03_misc	MISCELLANEOUS STRUCTURES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_misc	60 Inch Reinforced Concrete Pipe	LF	0	$350.0	$0	$350.0	$0
A-03_misc	72 Inch Reinforced Concrete Pipe	LF	180	$400.0	$72,000	$400.0	$72,000
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)	LF	0	$2,000.0	$0	$2,000.0	$0
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)	LF	0	$2,500.0	$0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)	LF	0	$2,700.0	$0	$2,700.0	$0
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*	LF	0	$2,900.0	$0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,100.0	$0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)	LF	0	$3,500.0	$0	$3,500.0	$0
A-03_misc	0	LF	0	$0.0	$0	$0.0	$0
			A-03_MISC Cost:		22.5%	$72,000	13.8%	$72,000
			A-03 Cost:		100.0%	$320,000	100.0%	$521,000

A-04	TRAFFIC/ITS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost	
			A-04 Cost:	0.0%	$0	0.0%	$0	
A-05	OTHER CATEGORY / OTHER MAJOR ITEMS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost	
			A-05 Cost:	0.0%	$0	0.0%	$0	
A	MAJOR CONSTRUCTION ITEMS	SUBTOTAL (A)	(% of A)	100.0%	$320,000	100.0%	$521,000	42.4% of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		% of (A)	Cost	% of (A)	Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$7,744	2.42%	$12,608
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$19,040	5.95%	$31,000
B-03	Structural	0.0%	0.3%	2.3%	5 - Extensive	Adjusted—>	1.64%	$5,242	5.00%	$26,050
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$13,760	4.30%	$22,403
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$9,856	3.08%	$16,047
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$52,992	16.56%	$86,278
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$64,000	20.00%	$104,200
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$2,464	0.77%	$4,012
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$1,056	0.33%	$1,719
B	MINOR CONSTRUCTION ITEMS				SUBTOTAL (B)	(% of A)	55.05%	$176,000	58.41%	$304,000
CBI	CONTRUCTION BID ITEMS				SUBTOTAL (A + B)	(% of A)	155.05%	$496,000	158.41%	$825,000

67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

							% of CBI	Cost	% of CBI	Cost
C-01	F/A - General						6.00%	$29,760	6.00%	$49,500
C-02	F/A - Minor Contract Revisions (MCR's)						3.00%	$14,880	3.00%	$24,750
C-03	F/A - Project Communications	[Level 4	$825,000	X	0.11%	]	0.11%	$531	0.11%	$883
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)						0.00%	$0	0.00%	$0
C	F/A's & TSM&O				SUBTOTAL (C)	(% of CBI)	9.11%	$45,000	9.11%	$75,000
CI	CONSTRUCTION ITEMS				SUBTOTAL (A + B + C)	(% of A)	169.06%	$541,000	172.74%	$900,000

73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

				% of CI	Cost	% of CI	Cost
D-01	Construction Engineering	(Default: 10.95%)		10.95%	$59,240	10.95%	$98,550
D-02	Construction Indirects	(Default: 9.5%)		9.50%	$51,395	9.50%	$85,500
D	CONSTRUCTION ENGINEERING & INDIRECTS		SUBTOTAL (D)	20.45%	$111,000	20.45%	$184,000
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)			$652,000		$1,084,000

88.2% of Base Cost

E - PRECONSTRUCTION ITEMS

Indirect % 9.50% (Region Estimate: 9.50%)

		AVG %	EFFORT		% of CI	Cost (% CI + Indirect %)	% of CI	Cost (% CI + Indirect %)
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$30,568	2.00%	$19,710
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$71,087	12.00%	$118,260
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$4,443	0.75%	$7,391
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0
E	PRECONSTRUCTION ITEMS		SUBTOTAL (E)	(% of CI)	19.59%	$106,000	16.11%	$145,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)	$758,000	$1,229,000	100.0% of Base Cost
			RE/ME Ratio:	1.62

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE	DATE: 11/6/2018	RISK RESERVE	17.2% OF BASE COST	$211,000
		TOTAL PROJECT COST (P70)		$1,440,000

117.2% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18	ESCALATION	14.1% OF BASE COST	$203,000
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23	ESCALATED COST		$1,643,000

133.7% of Base Cost

COMMENTS: Please document any key assumptions on unit costs or percentages.

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0								

A-02	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0								

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK	
206-00000	109.4	$39.0	$4,266	*	-15%	40%	89	105	147	$11.0	$36.0	$79.0	OK	
206-00100	0.0	$68.8	$0	*	-15%	40%	-	0	-	$34.0	$66.0	$115.0	OK	
206-00200	20.8	$83.1	$1,730	*	-15%	40%	17	20	28	$20.4	$77.0	$170.0	OK	
403-34841	19.3	$88.9	$1,713	*	-15%	40%	16	19	26	$62.7	$83.5	$137.0	OK	
601-03000	44.1	$1,216.7	$53,609	*	-15%	40%	36	42	59	$460.0	$960.0	$3,000.0	OK	
602-00020	2864.6	$2.0	$5,791	*	-15%	40%	2,338	2,750	3,850	$0.7	$2.0	$3.4	OK	
606-10700	654.2	$33.7	$22,024	*	-15%	40%	534	628	879	$20.0	$33.0	$50.0	OK	
621-00411	1.0	$300,000.0	$300,000	*	0%	0%	1	1	1	$270,000.0	$300,000.0	$330,000.0	OK	
621-00412	0.0	$500,000.0	$0	*	0%	0%	-	0	-	$450,000.0	$500,000.0	$550,000.0	OK	
	A-03_CAT300 Cost:	87.0%	$504,858											

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

	A-03_REPL Cost:	0.0%	$0
	A-03_REPA Cost:	0.0%	$0
	A-03_WALL Cost:	0.0%	$0
	A-03_CULV Cost:	0.0%	$0

*MODIFY LS estimate ranges as seem appropriate -->

LUMP SUM COST ESTIMATE RANGES

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
	0.0	$358.3	$0	*	-15%	40%	-	0	-	$300.0	$350.0	$450.0	OK	
	187.5	$400.0	$75,000	*	-15%	40%	153	180	252	$300.0	$400.0	$500.0	OK	
	0.0	$2,000.0	$0	*	-15%	40%	-	0	-	$1,800.0	$2,000.0	$2,200.0	OK	
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK	
	0.0	$2,700.0	$0	*	-15%	40%	-	0	-	$2,430.0	$2,700.0	$2,970.0	OK	
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK	
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK	
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK	
	0.0	$3,500.0	$0	*	-15%	40%	-	0	-	$3,150.0	$3,500.0	$3,850.0	OK	
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK	
	A-03_MISC Cost:	12.9%	$75,000											
	A-03 Cost:	100.0%	$579,858											

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

SUBTOTAL (A)	100.0%	$580,000

B - MINOR ITEMS

	% of (A) RISK	COST RISK	* MIN	ML	MAX
B-01	2.42%	$14,036	0.0%	2.4%	4.8%
B-02	5.95%	$34,510	0.0%	6.0%	11.9%
B-03	4.33%	$25,133	0.0%	5.0%	6.0%
B-04	4.30%	$24,940	0.0%	4.3%	8.6%
B-05	3.08%	$17,864	0.0%	3.1%	6.2%
B-06	16.56%	$96,048	0.0%	16.6%	33.1%
B-07	20.00%	$116,000	0.0%	20.0%	40.0%
B-08	0.00%	$0	0.0%	0.0%	0.0%
B-09	0.77%	$4,466	0.0%	0.8%	1.5%
B-10	0.00%	$0	0.0%	0.0%	0.0%
B-11	0.33%	$1,914	0.0%	0.3%	0.7%
SUBTOTAL (B)	57.7%	$335,000	0.0%	58.4%	112.8%

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

CBI	157.7% (% of A)	$915,000

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$54,900	6.0%	6.0%	6.0%
C-02	3.00%	$27,450	3.0%	3.0%	3.0%
C-03	0.11%	$980	0.1%	0.11%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$83,000			

CI	172.1%	$998,000

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$109,281	10.95%	10.95%	10.95%
D-02	9.50%	$94,810	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$204,000			

CONST	$1,202,000

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$20,958	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$124,750	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$7,485	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.3%	$153,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	54	$1,355,000
BASE COST	26	$1,229,000
RISK RESERVE	17.2% OF BASE COST	$211,000
P70 VALUE	70	$1,440,000

Probabilistic Ranges:

P10	$1,138,000
P50	$1,339,000
P70	$1,440,000
P90	$1,589,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: **22-Oct-18**

Project Name	R2 BUNDLE
Project Number	J-14-C
Sub-Account Number	XXXXX
Project Description	J-14-C
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	009B	Begin MP:	53.9	End MP:	71.4	Length:	17.5
CDOT Region:	2	FIPS City:	NONE	FIPS County:	Park Co		
		FIPS City:	00000	FIPS County:	093		
Segment Mid-point	RefPt 62.650	Latitude:	39.1880	Longitude:	-105.9730	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural	Terrain:	2 Rolling		
AADT:	1,900	Truck ADT:	60	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	47.1%	$468,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	150	LS	52.9%	$525,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$993,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$24,031
B-02	Environmental	3 - Average	% OF A	6.0%	$59,084
B-03	Structural	5 - Extensive	% OF A	5.0%	$49,650
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$42,699
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$30,584
B-06	Mobilization	3 - Average	% OF A	16.6%	$164,441
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$198,600
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$7,646
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$3,277
		SUBTOTAL (B)	% OF A	58.4%	$580,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**158.4%**	**$1,573,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$94,380
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$47,190
C-03	F/A - Project Communications		% OF CBI	0.1%	$1,785
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$143,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**172.8%**	**$1,716,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$187,902
D-02	Construction Indirects	% OF CI	9.5%	$163,020
	SUBTOTAL (D)	% OF CI	20.5%	$351,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$2,067,000**

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$37,580
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$225,482
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$14,093
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.1%	$277,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) **$2,344,000**

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE DATE: **11/6/2018**

RISK RESERVE 12.4% OF BASE COST **$290,000**

TOTAL PROJECT COST **$2,634,000**

112.4% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18	ESCALATION	14.1% OF BASE COST
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23		$371,000

ESCALATED PROJECT COST **$3,005,000**

128.2% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	J-14-C
Sub-Account Number	XXXXX
Project Description	J-14-C
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	009B	Begin MP:	53.9	End MP:	71.4	Length:	17.5
CDOT Region:	2	City:	NONE	County:	Park Co		
		FIPS City:	00000	FIPS County:	093		
Segment Mid-point	RefPt 62.650	Latitude:	39.1880	Longitude:	-105.9730	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	2
AADT:	1,900	Truck ADT:	60	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

				Model Estimate		Region Estimate	
A-01	EARTHWORK	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-01 Cost:	0.0%	$0	0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-02 Cost:	0.0%	$0	0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)						

A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	0	$21.6	$0	$36.0	$0
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	185	$45.3	$8,380	$66.0	$12,210
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	0	$48.2	$0	$77.0	$0
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	30	$83.5	$2,520	$83.5	$2,520
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	46	$960.0	$44,352	$960.0	$44,352
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	5,950	$1.0	$5,987	$2.0	$11,900
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	678	$95.5	$64,735	$33.0	$22,374
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	1	$65,000.0	$65,000	$300,000.0	$300,000
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	0	$50,000.0	$0	$500,000.0	$0
			A-03_CAT300 Cost:		33.6%	$266,000	47.1%	$468,000
A-03_repl	BRIDGE REPLACEMENT							
			A-03_REPL Cost:		0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR							
			A-03_REPA Cost:		0.0%	$0	0.0%	$0
A-03_wall	WALLS							
			A-03_WALL Cost:		0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS				R2			
			A-03_CULV Cost:		0.0%	$0	0.0%	$0

A-03_misc	MISCELLANEOUS STRUCTURES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_misc	60 Inch Reinforced Concrete Pipe	LF	0	$350.0	$0	$350.0	$0
A-03_misc	72 Inch Reinforced Concrete Pipe	LF	0	$400.0	$0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)	LF	0	$2,000.0	$0	$2,000.0	$0
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)	LF	0	$2,500.0	$0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)	LF	0	$2,700.0	$0	$2,700.0	$0
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*	LF	0	$2,900.0	$0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,100.0	$0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)	LF	150	$3,500.0	$525,000	$3,500.0	$525,000
A-03_misc	0	LF	0	$0.0	$0	$0.0	$0
			A-03_MISC Cost:	66.4%	$525,000	52.9%	$525,000
			A-03 Cost:	100.0%	$791,000	100.0%	$993,000

A-04	TRAFFIC/ITS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-04 Cost:	0.0%	$0	0.0%	$0

A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
				A-05 Cost:	0.0%	$0	0.0%	$0

A	MAJOR CONSTRUCTION ITEMS	SUBTOTAL (A)	(% of A)	100.0%	$791,000	100.0%	$993,000	42.4% of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		% of (A)	Cost	% of (A)	Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$19,142	2.42%	$24,031
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$47,065	5.95%	$59,084
B-03	Structural	0.0%	0.3%	2.3%	5 - Extensive	Adjusted—>	1.64%	$12,958	5.00%	$49,650
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$34,013	4.30%	$42,699
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$24,363	3.08%	$30,584
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$130,990	16.56%	$164,441
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$158,200	20.00%	$198,600
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$6,091	0.77%	$7,646
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$2,610	0.33%	$3,277

B	MINOR CONSTRUCTION ITEMS	SUBTOTAL (B)	(% of A)	55.05%	$435,000	58.41%	$580,000	
CBI	CONTRUCTION BID ITEMS	SUBTOTAL (A + B)	(% of A)	155.05%	$1,226,000	158.41%	$1,573,000	67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

C-01	F/A - General					6.00%	$73,560	6.00%	$94,380
C-02	F/A - Minor Contract Revisions (MCR's)					3.00%	$36,780	3.00%	$47,190
C-03	F/A - Project Communications	[Level 4	$1,573,000	X	0.11%]	0.11%	$1,391	0.11%	$1,785
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)					0.00%	$0	0.00%	$0
C	F/A's & TSM&O	SUBTOTAL (C)	(% of CBI)			9.11%	$112,000	9.11%	$143,000
CI	CONSTRUCTION ITEMS	SUBTOTAL (A + B + C)	(% of A)			169.15%	$1,338,000	172.81%	$1,716,000	73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

D-01	Construction Engineering	(Default: 10.95%)		10.95%	$146,511	10.95%	$187,902
D-02	Construction Indirects	(Default: 9.5%)		9.50%	$127,110	9.50%	$163,020
D	CONSTRUCTION ENGINEERING & INDIRECTS	SUBTOTAL (D)	(% of CI)	20.45%	$274,000	20.45%	$351,000
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)			$1,612,000		$2,067,000	88.2% of Base Cost

E - PRECONSTRUCTION ITEMS

					Indirect %	9.50%	Indirect %	9.50%	
		AVG %	EFFORT		% of CI	Cost (% CI + Indirect %)	% of CI	Cost (% CI + Indirect %)	
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$75,600	2.00%	$37,580	
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0	
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$175,813	12.00%	$225,482	
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$10,988	0.75%	$14,093	
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0	
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0	
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0	
E	PRECONSTRUCTION ITEMS	SUBTOTAL (E)	(% of CI)		19.58%	$262,000	16.14%	$277,000	11.8% of Base Cost
	PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)				$1,874,000		$2,344,000	100.0% of Base Cost
							RE/ME Ratio:	1.25	

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE	12.4% OF BASE COST	$290,000	
TOTAL PROJECT COST (P70)		$2,634,000	112.4% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23

ESCALATION	14.1% OF BASE COST	$371,000	
ESCALATED COST		$3,005,000	128.2% of Base Cost

COMMENTS: ***Please document any key assumptions on unit costs or percentages.***

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0								

A-02	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0								

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK	
206-00000	0.0	$39.0	$0	*	-15%	40%	-	0	-	$11.0	$36.0	$79.0	OK	
206-00100	192.7	$68.8	$13,265	*	-15%	40%	157	185	259	$34.0	$66.0	$115.0	OK	
206-00200	0.0	$83.1	$0	*	-15%	40%	-	0	-	$20.4	$77.0	$170.0	OK	
403-34841	31.5	$88.9	$2,797	*	-15%	40%	26	30	42	$62.7	$83.5	$137.0	OK	
601-03000	48.1	$1,216.7	$58,552	*	-15%	40%	39	46	65	$460.0	$960.0	$3,000.0	OK	
602-00020	6197.9	$2.0	$12,530	*	-15%	40%	5,058	5,950	8,330	$0.7	$2.0	$3.4	OK	
606-10700	706.3	$33.7	$23,777	*	-15%	40%	576	678	949	$20.0	$33.0	$50.0	OK	
621-00411	1.0	$300,000.0	$300,000	*	0%	0%	1	1	1	$270,000.0	$300,000.0	$330,000.0	OK	
621-00412	0.0	$500,000.0	$0	*	0%	0%	-	0	-	$450,000.0	$500,000.0	$550,000.0	OK	
	A-03_CAT300 Cost:	49.0%	$526,645											

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-03_REPL Cost:	0.0%	$0	
A-03_REPA Cost:	0.0%	$0	
A-03_WALL Cost:	0.0%	$0	
A-03_CULV Cost:	0.0%	$0	

*MODIFY LS estimate ranges as seem appropriate -->

LUMP SUM COST ESTIMATE RANGES

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
	0.0	$358.3	$0	*	-15%	40%	-	0	-	$300.0	$350.0	$450.0	OK	
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK	
	0.0	$2,000.0	$0	*	-15%	40%	-	0	-	$1,800.0	$2,000.0	$2,200.0	OK	
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK	
	0.0	$2,700.0	$0	*	-15%	40%	-	0	-	$2,430.0	$2,700.0	$2,970.0	OK	
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK	
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK	
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK	
	156.3	$3,500.0	$546,875	*	-15%	40%	128	150	210	$3,150.0	$3,500.0	$3,850.0	OK	
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK	
	A-03_MISC Cost:	50.9%	$546,875											

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-03 Cost:	100.0%	$1,073,520	

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

SUBTOTAL (A)	100.0%	$1,074,000

B - MINOR ITEMS

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS

	% of (A) RISK	COST RISK	* MIN	ML	MAX
B-01	2.42%	$25,991	0.0%	2.4%	4.8%
B-02	5.95%	$63,903	0.0%	6.0%	11.9%
B-03	4.33%	$46,540	0.0%	5.0%	6.0%
B-04	4.30%	$46,182	0.0%	4.3%	8.6%
B-05	3.08%	$33,079	0.0%	3.1%	6.2%
B-06	16.56%	$177,854	0.0%	16.6%	33.1%
B-07	20.00%	$214,800	0.0%	20.0%	40.0%
B-08	0.00%	$0	0.0%	0.0%	0.0%
B-09	0.77%	$8,270	0.0%	0.8%	1.5%
B-10	0.00%	$0	0.0%	0.0%	0.0%
B-11	0.33%	$3,544	0.0%	0.3%	0.7%
SUBTOTAL (B)	57.7%	$620,000	0.0%	58.4%	112.8%

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

CBI	157.7% (% of A)	$1,694,000

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$101,640	6.0%	6.0%	6.0%
C-02	3.00%	$50,820	3.0%	3.0%	3.0%
C-03	0.11%	$1,922	0.1%	0.11%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$154,000			

CI	172.1%	$1,848,000

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$202,356	10.95%	10.95%	10.95%
D-02	9.50%	$175,560	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$378,000			

CONST	$2,226,000

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$38,808	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$231,000	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$13,860	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.4%	$284,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	53	$2,510,000
BASE COST	27	$2,344,000
RISK RESERVE	12.4% OF BASE COST	$290,000
P70 VALUE	70	$2,634,000

Probabilistic Ranges:

P10	$2,182,000
P50	$2,492,000
P70	$2,634,000
P90	$2,860,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: 22-Oct-18

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: 22-Oct-18

Project Name	R2 BUNDLE
Project Number	N-21-C
Sub-Account Number	XXXXX
Project Description	N-21-C
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	Begin MP:	47.1	End MP:	69.8	Length:	22.7
CDOT Region:	2	FIPS City:	NONE	FIPS County:	Otero Co		
		FIPS City:	00000	FIPS County:	089		
Segment Mid-point	RefPt 58.450	Latitude:	37.8382	Longitude:	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural	Terrain:	2 Rolling		
AADT:	340	Truck ADT:	10	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	35.5%	$445,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	300	LS	64.5%	$810,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$1,255,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$30,371
B-02	Environmental	3 - Average	% OF A	6.0%	$74,673
B-03	Structural	5 - Extensive	% OF A	5.0%	$62,750
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$53,965
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$38,654
B-06	Mobilization	3 - Average	% OF A	16.6%	$207,828
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$251,000
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$9,664
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$4,142
		SUBTOTAL (B)	% OF A	58.4%	$733,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**158.4%**	**$1,988,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$119,280
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$59,640
C-03	F/A - Project Communications		% OF CBI	0.1%	$2,327
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$181,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**172.8%**	**$2,169,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$237,506
D-02	Construction Indirects	% OF CI	9.5%	$206,055
	SUBTOTAL (D)	% OF CI	20.5%	$444,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$2,613,000**

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$47,501
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$285,007
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$17,813
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.1%	$350,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) $2,963,000

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE 11.0% OF BASE COST $326,000

TOTAL PROJECT COST $3,289,000

111.0% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18	ESCALATION	14.1% OF BASE COST $464,000
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23	ESCALATED PROJECT COST	$3,753,000

126.7% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	N-21-C
Sub-Account Number	XXXXX
Project Description	N-21-C
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	Begin MP:	47.1	End MP:	69.8	Length:	22.7
CDOT Region:	2	City:	NONE	County:	Otero Co		
		FIPS City:	00000	FIPS County:	089		
Segment Mid-point	RefPt 58.450	Latitude:	37.8382	Longitude:	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	2
AADT:	340	Truck ADT:	10	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

					Model Estimate		Region Estimate	
A-01	EARTHWORK	Unit	Qty		Unit Cost	Cost	Unit Cost	Cost
				A-01 Cost:	0.0%	$0	0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty		Unit Cost	Cost	Unit Cost	Cost
				A-02 Cost:	0.0%	$0	0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)							

A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Model Unit Cost	Model Cost	Region Unit Cost	Region Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	0	$21.6	$0	$36.0	$0
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	280	$45.3	$12,683	$66.0	$18,480
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	0	$48.2	$0	$77.0	$0
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	27	$83.5	$2,212	$83.5	$2,212
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	22	$960.0	$20,832	$960.0	$20,832
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	3,375	$1.0	$3,396	$2.0	$6,750
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	648	$95.5	$61,871	$33.0	$21,384
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	1	$65,000.0	$65,000	$300,000.0	$300,000
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	0	$50,000.0	$0	$500,000.0	$0
				A-03_CAT300 Cost:	22.9%	$241,000	35.5%	$445,000

A-03_repl	BRIDGE REPLACEMENT							
				A-03_REPL Cost:	0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR							
				A-03_REPA Cost:	0.0%	$0	0.0%	$0
A-03_wall	WALLS							
				A-03_WALL Cost:	0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS				R2			
				A-03_CULV Cost:	0.0%	$0	0.0%	$0

A-03_misc	MISCELLANEOUS STRUCTURES	Unit	Qty	Model Unit Cost	Model Cost	Region Unit Cost	Region Cost
A-03_misc	60 Inch Reinforced Concrete Pipe	LF	0	$350.0	$0	$350.0	$0
A-03_misc	72 Inch Reinforced Concrete Pipe	LF	0	$400.0	$0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)	LF	0	$2,000.0	$0	$2,000.0	$0
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)	LF	0	$2,500.0	$0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)	LF	300	$2,700.0	$810,000	$2,700.0	$810,000
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*	LF	0	$2,900.0	$0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,100.0	$0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)	LF	0	$3,500.0	$0	$3,500.0	$0
A-03_misc	0	LF	0	$0.0	$0	$0.0	$0
			A-03_MISC Cost:	77.1%	$810,000	64.5%	$810,000
			A-03 Cost:	100.0%	$1,051,000	100.0%	$1,255,000

A-04	TRAFFIC/ITS	Unit	Qty		Unit Cost	Cost	Unit Cost	Cost
				A-04 Cost:	0.0%	$0	0.0%	$0

A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty		Unit Cost	Cost	Unit Cost	Cost
					A-05 Cost:	0.0%	$0	0.0%	$0
A	MAJOR CONSTRUCTION ITEMS		SUBTOTAL (A)	(% of A)		100.0%	$1,051,000	100.0%	$1,255,000

42.4% of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		% of (A)	Cost	% of (A)	Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$25,434	2.42%	$30,371
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$62,535	5.95%	$74,673
B-03	Structural	0.0%	0.3%	2.3%	5 - Extensive	Adjusted—>	1.64%	$17,217	5.00%	$62,750
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$45,193	4.30%	$53,965
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$32,371	3.08%	$38,654
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$174,046	16.56%	$207,828
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$210,200	20.00%	$251,000
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$8,093	0.77%	$9,664
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$3,468	0.33%	$4,142
B	MINOR CONSTRUCTION ITEMS				SUBTOTAL (B)	(% of A)	55.05%	$579,000	58.41%	$733,000
CBI	CONTRUCTION BID ITEMS				SUBTOTAL (A + B)	(% of A)	155.05%	$1,630,000	158.41%	$1,988,000

67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

							% of CBI	Cost	% of CBI	Cost
C-01	F/A - General						6.00%	$97,800	6.00%	$119,280
C-02	F/A - Minor Contract Revisions (MCR's)						3.00%	$48,900	3.00%	$59,640
C-03	F/A - Project Communications	[Level 4	$1,988,000	X	0.12%	]	0.12%	$1,908	0.12%	$2,327
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)						0.00%	$0	0.00%	$0
C	F/A's & TSM&O				SUBTOTAL (C)	(% of CBI)	9.12%	$149,000	9.12%	$181,000
CI	CONSTRUCTION ITEMS				SUBTOTAL (A + B + C)	(% of A)	169.27%	$1,779,000	172.83%	$2,169,000

73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

					% of CI	Cost	% of CI	Cost
D-01	Construction Engineering	(Default: 10.95%)			10.95%	$194,801	10.95%	$237,506
D-02	Construction Indirects	(Default: 9.5%)			9.50%	$169,005	9.50%	$206,055
D	CONSTRUCTION ENGINEERING & INDIRECTS		SUBTOTAL (D)	(% of CI)	20.45%	$364,000	20.45%	$444,000
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)				$2,143,000		$2,613,000

88.2% of Base Cost

E - PRECONSTRUCTION ITEMS

Indirect % 9.50% (Model Estimate) | Indirect % 9.50% (Region Estimate)

		AVG %	EFFORT		% of CI	Cost (% CI + Indirect %)	% of CI	Cost (% CI + Indirect %)
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$100,517	2.00%	$47,501
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$233,761	12.00%	$285,007
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$14,610	0.75%	$17,813
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0
E	PRECONSTRUCTION ITEMS		SUBTOTAL (E)	(% of CI)	19.62%	$349,000	16.14%	$350,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)	$2,492,000		$2,963,000
			RE/ME Ratio:	1.19

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE	11.0% OF BASE COST	$326,000	
TOTAL PROJECT COST (P70)		$3,289,000	111.0% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23

ESCALATION	14.1% OF BASE COST	$464,000	
ESCALATED COST		$3,753,000	126.7% of Base Cost

COMMENTS: Please document any key assumptions on unit costs or percentages.

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0								

A-02	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0								

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX	
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK
206-00000	0.0	$39.0	$0	*	-15%	40%	-	0	-	$11.0	$36.0	$79.0	OK
206-00100	291.7	$68.8	$20,076	*	-15%	40%	238	280	392	$34.0	$66.0	$115.0	OK
206-00200	0.0	$83.1	$0	*	-15%	40%	-	0	-	$20.4	$77.0	$170.0	OK
403-34841	27.6	$88.9	$2,454	*	-15%	40%	23	27	37	$62.7	$83.5	$137.0	OK
601-03000	22.6	$1,216.7	$27,502	*	-15%	40%	18	22	30	$460.0	$960.0	$3,000.0	OK
602-00020	3515.6	$2.0	$7,107	*	-15%	40%	2,869	3,375	4,725	$0.7	$2.0	$3.4	OK
606-10700	675.0	$33.7	$22,725	*	-15%	40%	551	648	907	$20.0	$33.0	$50.0	OK
621-00411	1.0	$300,000.0	$300,000	*	0%	0%	1	1	1	$270,000.0	$300,000.0	$330,000.0	OK
621-00412	0.0	$500,000.0	$0	*	0%	0%	-	0	-	$450,000.0	$500,000.0	$550,000.0	OK
	A-03_CAT300 Cost:	37.0%	$495,589										

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

	A-03_REPL Cost:	0.0%	$0
	A-03_REPA Cost:	0.0%	$0
	A-03_WALL Cost:	0.0%	$0
	A-03_CULV Cost:	0.0%	$0

*MODIFY LS estimate ranges as seem appropriate -->

LUMP SUM COST ESTIMATE RANGES

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX	
	0.0	$358.3	$0	*	-15%	40%	-	0	-	$300.0	$350.0	$450.0	OK
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK
	0.0	$2,000.0	$0	*	-15%	40%	-	0	-	$1,800.0	$2,000.0	$2,200.0	OK
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK
	312.5	$2,700.0	$843,750	*	-15%	40%	255	300	420	$2,430.0	$2,700.0	$2,970.0	OK
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK
	0.0	$3,500.0	$0	*	-15%	40%	-	0	-	$3,150.0	$3,500.0	$3,850.0	OK
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK
	A-03_MISC Cost:	63.0%	$843,750										
	A-03 Cost:	100.0%	$1,339,339										

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

	SUBTOTAL (A)	100.0%	$1,339,000

B - MINOR ITEMS

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS

	% of (A) RISK	COST RISK	* MIN	ML	MAX
B-01	2.42%	$32,404	0.0%	2.4%	4.8%
B-02	5.95%	$79,671	0.0%	6.0%	11.9%
B-03	4.33%	$58,023	0.0%	5.0%	6.0%
B-04	4.30%	$57,577	0.0%	4.3%	8.6%
B-05	3.08%	$41,241	0.0%	3.1%	6.2%
B-06	16.56%	$221,738	0.0%	16.6%	33.1%
B-07	20.00%	$267,800	0.0%	20.0%	40.0%
B-08	0.00%	$0	0.0%	0.0%	0.0%
B-09	0.77%	$10,310	0.0%	0.8%	1.5%
B-10	0.00%	$0	0.0%	0.0%	0.0%
B-11	0.33%	$4,419	0.0%	0.3%	0.7%
SUBTOTAL (B)	57.7%	$773,000	0.0%	58.4%	112.8%
CBI	157.7% (% of A)	$2,112,000			

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$126,720	6.0%	6.0%	6.0%
C-02	3.00%	$63,360	3.0%	3.0%	3.0%
C-03	0.12%	$2,472	0.1%	0.12%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$193,000			
CI	172.1%	$2,305,000			

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$252,398	10.95%	10.95%	10.95%
D-02	9.50%	$218,975	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$471,000			
CONST		$2,776,000			

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$48,405	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$288,125	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$17,288	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.4%	$354,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	52	$3,130,000
BASE COST	32	$2,963,000
RISK RESERVE	11.0% OF BASE COST	$326,000
P70 VALUE	70	$3,289,000

Probabilistic Ranges:

P10	$2,722,000
P50	$3,119,000
P70	$3,289,000
P90	$3,557,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: **22-Oct-18**

Project Name	**R2 BUNDLE**
Project Number	**M-21-J**
Sub-Account Number	**XXXXX**
Project Description	**M-21-J**
Project Work Type	**BRIDGE REPLACEMENT**
Estimator:	**E.A.**
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	**Begin MP:**	47.1	**End MP:**	69.8	**Length:**	22.7
CDOT Region:	2	**FIPS City:**	NONE	**FIPS County:**	Otero Co		
		FIPS City:	00000	**FIPS County:**	089		
Segment Mid-point	**RefPt** 58.450	**Latitude:**	37.8382	**Longitude:**	-103.7489		GOOGLE MAP LINK
Functional Classification:	4 Minor Arterial	**Urban-Rural Class:**	1 Rural	**Terrain:**	2 Rolling		
AADT:	340	**Truck ADT:**	10	**Tier Class:**	Tier 4	**Primary Surface:**	1 Asphalt

Design Maturity:	0 - Conceptual	**NEPA Action:**	Cat/Ex	**NEPA Status:**	In Progress
Project Delivery Method:	Design-Bid-Build	**Construction Start (MMM-YY)**	Sep-22	**Construction Duration (mo)**	24.0

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	60.7%	$431,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	90	LS	39.3%	$279,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$710,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$17,182
B-02	Environmental	3 - Average	% OF A	6.0%	$42,245
B-03	Structural	5 - Extensive	% OF A	5.0%	$35,500
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$30,530
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$21,868
B-06	Mobilization	3 - Average	% OF A	16.6%	$117,576
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$142,000
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$5,467
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$2,343
		SUBTOTAL (B)	% OF A	58.4%	$415,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**158.5%**	**$1,125,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$67,500
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$33,750
C-03	F/A - Project Communications		% OF CBI	0.1%	$1,233
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$102,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**172.8%**	**$1,227,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$134,357
D-02	Construction Indirects	% OF CI	9.5%	$116,565
	SUBTOTAL (D)	% OF CI	20.5%	$251,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$1,478,000**

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$26,871
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$161,228
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$10,077
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.1%	$198,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) **$1,676,000**

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE DATE: **11/6/2018**

RISK RESERVE 13.2% OF BASE COST **$221,000**

TOTAL PROJECT COST **$1,897,000**

113.2% of Base Cost

ESCALATION

Construction Start	Sep-22	**Escalation from Estimate Date:**	Nov-18	**ESCALATION**	14.1% OF BASE COST **$267,000**
Duration (mo)	24.0	**to Construction Mid-Point Date:**	Sep-23	**ESCALATED PROJECT COST**	**$2,164,000**

129.1% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	M-21-J
Sub-Account Number	XXXXX
Project Description	M-21-J
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	Begin MP:	47.1	End MP:	69.8	Length:	22.7
CDOT Region:	2	City:	NONE	County:	Otero Co		
		FIPS City:	00000	FIPS County:	089		
Segment Mid-point	RefPt 58.450	Latitude:	37.8382	Longitude:	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	2
AADT:	340	Truck ADT:	10	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

				Model Estimate		Region Estimate	
A-01	EARTHWORK	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-01 Cost:	0.0%	$0	0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-02 Cost:	0.0%	$0	0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)						

A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	0	$21.6	$0	$36.0	$0
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	115	$45.3	$5,209	$66.0	$7,590
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	0	$48.2	$0	$77.0	$0
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	20	$83.5	$1,652	$83.5	$1,652
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	21	$960.0	$19,680	$960.0	$19,680
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	3,415	$1.0	$3,436	$2.0	$6,830
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	628	$95.5	$59,961	$33.0	$20,724
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	1	$65,000.0	$65,000	$300,000.0	$300,000
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	0	$50,000.0	$0	$500,000.0	$0
			A-03_CAT300 Cost:	45.2%	$230,000	60.7%	$431,000	

A-03_repl	BRIDGE REPLACEMENT						
		A-03_REPL Cost:	0.0%	$0	0.0%	$0	
A-03_repa	BRIDGE REPAIR						
		A-03_REPA Cost:	0.0%	$0	0.0%	$0	
A-03_wall	WALLS						
		A-03_WALL Cost:	0.0%	$0	0.0%	$0	
A-03_culv	MAJOR CULVERTS			R2			
		A-03_CULV Cost:	0.0%	$0	0.0%	$0	

A-03_misc	MISCELLANEOUS STRUCTURES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_misc	60 Inch Reinforced Concrete Pipe	LF	0	$350.0	$0	$350.0	$0
A-03_misc	72 Inch Reinforced Concrete Pipe	LF	0	$400.0	$0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)	LF	0	$2,000.0	$0	$2,000.0	$0
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)	LF	0	$2,500.0	$0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)	LF	0	$2,700.0	$0	$2,700.0	$0
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*	LF	0	$2,900.0	$0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)	LF	90	$3,100.0	$279,000	$3,100.0	$279,000
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)	LF	0	$3,500.0	$0	$3,500.0	$0
A-03_misc	0	LF	0	$0.0	$0	$0.0	$0
		A-03_MISC Cost:	54.8%		$279,000	39.3%	$279,000
		A-03 Cost:	100.0%		$509,000	100.0%	$710,000

A-04	TRAFFIC/ITS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
		A-04 Cost:	0.0%		$0	0.0%	$0

A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
				A-05 Cost:	0.0%	$0	0.0%	$0

A	MAJOR CONSTRUCTION ITEMS	SUBTOTAL (A)	(% of A)	100.0%	$509,000	100.0%	$710,000	42.4% of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		% of (A)	Cost	% of (A)	Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$12,318	2.42%	$17,182
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$30,286	5.95%	$42,245
B-03	Structural	0.0%	0.3%	2.3%	5 - Extensive	Adjusted—>	1.64%	$8,338	5.00%	$35,500
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$21,887	4.30%	$30,530
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$15,677	3.08%	$21,868
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$84,290	16.56%	$117,576
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$101,800	20.00%	$142,000
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$3,919	0.77%	$5,467
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$1,680	0.33%	$2,343

B	MINOR CONSTRUCTION ITEMS	SUBTOTAL (B)	(% of A)	55.05%	$280,000	58.41%	$415,000	
CBI	CONTRUCTION BID ITEMS	SUBTOTAL (A + B)	(% of A)	155.05%	$789,000	158.41%	$1,125,000	67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

C-01	F/A - General						6.00%	$47,340	6.00%	$67,500
C-02	F/A - Minor Contract Revisions (MCR's)						3.00%	$23,670	3.00%	$33,750
C-03	F/A - Project Communications	[Level 4	$1,125,000	X	0.11%	]	0.11%	$865	0.11%	$1,233
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)						0.00%	$0	0.00%	$0
C	F/A's & TSM&O	SUBTOTAL (C)	(% of CBI)				9.11%	$72,000	9.11%	$102,000
CI	CONSTRUCTION ITEMS	SUBTOTAL (A + B + C)	(% of A)				169.16%	$861,000	172.82%	$1,227,000

73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

D-01	Construction Engineering	(Default: 10.95%)			10.95%	$94,280	10.95%	$134,357
D-02	Construction Indirects	(Default: 9.5%)			9.50%	$81,795	9.50%	$116,565
D	CONSTRUCTION ENGINEERING & INDIRECTS	SUBTOTAL (D)	(% of CI)		20.45%	$176,000	20.45%	$251,000
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)				$1,037,000		$1,478,000

88.2% of Base Cost

E - PRECONSTRUCTION ITEMS

Indirect % 9.50% | Indirect % 9.50%

		AVG %	EFFORT		% of CI	Cost (% CI + Indirect %)	% of CI	Cost (% CI + Indirect %)
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$48,648	2.00%	$26,871
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$113,135	12.00%	$161,228
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$7,071	0.75%	$10,077
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0

E	PRECONSTRUCTION ITEMS	SUBTOTAL (E)	(% of CI)		19.63%	$169,000	16.14%	$198,000
	PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)				$1,206,000		$1,676,000

11.8% of Base Cost

100.0% of Base Cost

RE/ME Ratio: 1.39

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE	13.2% OF BASE COST	$221,000
TOTAL PROJECT COST (P70)		$1,897,000

113.2% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23

ESCALATION	14.1% OF BASE COST	$267,000
ESCALATED COST		$2,164,000

129.1% of Base Cost

COMMENTS: Please document any key assumptions on unit costs or percentages.

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0									

A-02	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0									

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK	
206-00000	0.0	$39.0	$0	*	-15%	40%	-	0	-	$11.0	$36.0	$79.0	OK	
206-00100	119.8	$68.8	$8,246	*	-15%	40%	98	115	161	$34.0	$66.0	$115.0	OK	
206-00200	0.0	$83.1	$0	*	-15%	40%	-	0	-	$20.4	$77.0	$170.0	OK	
403-34841	20.6	$88.9	$1,834	*	-15%	40%	17	20	28	$62.7	$83.5	$137.0	OK	
601-03000	21.4	$1,216.7	$25,981	*	-15%	40%	17	21	29	$460.0	$960.0	$3,000.0	OK	
602-00020	3557.3	$2.0	$7,192	*	-15%	40%	2,903	3,415	4,781	$0.7	$2.0	$3.4	OK	
606-10700	654.2	$33.7	$22,024	*	-15%	40%	534	628	879	$20.0	$33.0	$50.0	OK	
621-00411	1.0	$300,000.0	$300,000	*	0%	0%	1	1	1	$270,000.0	$300,000.0	$330,000.0	OK	
621-00412	0.0	$500,000.0	$0	*	0%	0%	-	0	-	$450,000.0	$500,000.0	$550,000.0	OK	
	A-03_CAT300 Cost:	62.3%	$481,000											

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-03_REPL Cost:	0.0%	$0	
A-03_REPA Cost:	0.0%	$0	
A-03_WALL Cost:	0.0%	$0	
A-03_CULV Cost:	0.0%	$0	

*MODIFY LS estimate ranges as seem appropriate -->

LUMP SUM COST ESTIMATE RANGES

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
	0.0	$358.3	$0	*	-15%	40%	-	0	-	$300.0	$350.0	$450.0	OK	
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK	
	0.0	$2,000.0	$0	*	-15%	40%	-	0	-	$1,800.0	$2,000.0	$2,200.0	OK	
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK	
	0.0	$2,700.0	$0	*	-15%	40%	-	0	-	$2,430.0	$2,700.0	$2,970.0	OK	
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK	
	93.8	$3,100.0	$290,625	*	-15%	40%	77	90	126	$2,790.0	$3,100.0	$3,410.0	OK	
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK	
	0.0	$3,500.0	$0	*	-15%	40%	-	0	-	$3,150.0	$3,500.0	$3,850.0	OK	
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK	
	A-03_MISC Cost:	37.6%	$290,625											
	A-03 Cost:	100.0%	$771,625											

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

SUBTOTAL (A)	100.0%	$772,000

B - MINOR ITEMS

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS

	% of (A) RISK	COST RISK	*	MIN	ML	MAX
B-01	2.42%	$18,682		0.0%	2.4%	4.8%
B-02	5.95%	$45,934		0.0%	6.0%	11.9%
B-03	4.33%	$33,453		0.0%	5.0%	6.0%
B-04	4.30%	$33,196		0.0%	4.3%	8.6%
B-05	3.08%	$23,778		0.0%	3.1%	6.2%
B-06	16.56%	$127,843		0.0%	16.6%	33.1%
B-07	20.00%	$154,400		0.0%	20.0%	40.0%
B-08	0.00%	$0		0.0%	0.0%	0.0%
B-09	0.77%	$5,944		0.0%	0.8%	1.5%
B-10	0.00%	$0		0.0%	0.0%	0.0%
B-11	0.33%	$2,548		0.0%	0.3%	0.7%
SUBTOTAL (B)	57.7%	$446,000		0.0%	58.4%	112.8%
CBI	157.7% (% of A)	$1,218,000				

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$73,080	6.0%	6.0%	6.0%
C-02	3.00%	$36,540	3.0%	3.0%	3.0%
C-03	0.11%	$1,335	0.1%	0.11%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$111,000			
CI	172.1%	$1,329,000			

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$145,526	10.95%	10.95%	10.95%
D-02	9.50%	$126,255	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$272,000			
CONST		$1,601,000			

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$27,909	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$166,125	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$9,968	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.3%	$204,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	54	$1,805,000
BASE COST	28	$1,676,000
RISK RESERVE	13.2% OF BASE COST	$221,000
P70 VALUE	70	$1,897,000

Probabilistic Ranges:

P10	$1,554,000
P50	$1,787,000
P70	$1,897,000
P90	$2,082,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: **22-Oct-18**

Project Name	**R2 BUNDLE**
Project Number	**M-22-Y**
Sub-Account Number	**XXXXX**
Project Description	**M-22-Y**
Project Work Type	**BRIDGE REPLACEMENT**
Estimator:	**E.A.**
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	**Begin MP:**	47.1	**End MP:**	69.8	**Length:**	22.7
CDOT Region:	2	**FIPS City:**	NONE	**FIPS County:**	Otero Co		
		FIPS City:	00000	**FIPS County:**	089		
Segment Mid-point	**RefPt** 58.450	**Latitude:**	37.8382	**Longitude:**	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	**Urban-Rural Class:**	1 Rural	**Terrain:**	2 Rolling		
AADT:	340	**Truck ADT:**	10	**Tier Class:**	Tier 4	**Primary Surface:**	1 Asphalt

Design Maturity:	0 - Conceptual	**NEPA Action:**	Cat/Ex	**NEPA Status:**	In Progress
Project Delivery Method:	Design-Bid-Build	**Construction Start (MMM-YY)**	Sep-22	**Construction Duration (mo)**	24.0

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	96.9%	$412,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	36	LS	3.1%	$13,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$425,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$10,285
B-02	Environmental	3 - Average	% OF A	6.0%	$25,288
B-03	Structural	5 - Extensive	% OF A	5.0%	$21,250
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$18,275
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$13,090
B-06	Mobilization	3 - Average	% OF A	16.6%	$70,380
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$85,000
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$3,273
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$1,403
		SUBTOTAL (B)	% OF A	58.4%	$248,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**158.4%**	**$673,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$40,380
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$20,190
C-03	F/A - Project Communications		% OF CBI	0.1%	$712
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$61,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**172.7%**	**$734,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$80,373
D-02	Construction Indirects	% OF CI	9.5%	$69,730
	SUBTOTAL (D)	% OF CI	20.4%	$150,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$884,000**

88.1% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$16,075
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$96,448
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$6,028
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.2%	$119,000

11.9% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) **$1,003,000**

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE DATE: **11/6/2018**

RISK RESERVE 17.3% OF BASE COST **$174,000**

TOTAL PROJECT COST **$1,177,000**

117.3% of Base Cost

ESCALATION

Construction Start	Sep-22	**Escalation from Estimate Date:**	Nov-18	**ESCALATION**	14.1% OF BASE COST **$166,000**
Duration (mo)	24.0	**to Construction Mid-Point Date:**	Sep-23	**ESCALATED PROJECT COST**	**$1,343,000**

133.9% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	M-22-Y
Sub-Account Number	XXXXX
Project Description	M-22-Y
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	Begin MP:	47.1	End MP:	69.8	Length:	22.7
CDOT Region:	2	City:	NONE	County:	Otero Co		
		FIPS City:	00000	FIPS County:	089		
Segment Mid-point	RefPt 58.450	Latitude:	37.8382	Longitude:	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	2
AADT:	340	Truck ADT:	10	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

				Model Estimate		Region Estimate	
A-01	EARTHWORK	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-01 Cost:	0.0%	$0	0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-02 Cost:	0.0%	$0	0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)						

A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	0	$21.6	$0	$36.0	$0
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	0	$45.3	$0	$66.0	$0
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	5	$48.2	$241	$77.0	$385
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	3	$83.5	$259	$83.5	$259
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	16	$960.0	$15,744	$960.0	$15,744
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	1,045	$1.0	$1,051	$2.0	$2,090
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	562	$95.5	$53,659	$33.0	$18,546
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	1	$65,000.0	$65,000	$300,000.0	$300,000
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	0	$50,000.0	$0	$500,000.0	$0
			A-03_CAT300 Cost:		94.2%	$211,000	96.9%	$412,000
A-03_repl	BRIDGE REPLACEMENT							
			A-03_REPL Cost:		0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR							
			A-03_REPA Cost:		0.0%	$0	0.0%	$0
A-03_wall	WALLS							
			A-03_WALL Cost:		0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS				R2			
			A-03_CULV Cost:		0.0%	$0	0.0%	$0

A-03_misc	MISCELLANEOUS STRUCTURES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_misc	60 Inch Reinforced Concrete Pipe	LF	36	$350.0	$12,600	$350.0	$12,600
A-03_misc	72 Inch Reinforced Concrete Pipe	LF	0	$400.0	$0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)	LF	0	$2,000.0	$0	$2,000.0	$0
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)	LF	0	$2,500.0	$0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)	LF	0	$2,700.0	$0	$2,700.0	$0
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*	LF	0	$2,900.0	$0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,100.0	$0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)	LF	0	$3,500.0	$0	$3,500.0	$0
A-03_misc	0	LF	0	$0.0	$0	$0.0	$0
			A-03_MISC Cost:	5.8%	$13,000	3.1%	$13,000
			A-03 Cost:	100.0%	$224,000	100.0%	$425,000

A-04	TRAFFIC/ITS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-04 Cost:	0.0%	$0	0.0%	$0

A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
				A-05 Cost:	0.0%	$0	0.0%	$0

A	MAJOR CONSTRUCTION ITEMS	SUBTOTAL (A)	(% of A)	100.0%	$224,000	100.0%	$425,000	42.4% of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		% of (A)	Cost	% of (A)	Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$5,421	2.42%	$10,285
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$13,328	5.95%	$25,288
B-03	Structural	0.0%	0.3%	2.3%	5 - Extensive	Adjusted—>	1.64%	$3,670	5.00%	$21,250
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$9,632	4.30%	$18,275
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$6,899	3.08%	$13,090
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$37,094	16.56%	$70,380
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$44,800	20.00%	$85,000
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$1,725	0.77%	$3,273
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$739	0.33%	$1,403

B	MINOR CONSTRUCTION ITEMS	SUBTOTAL (B)	(% of A)	55.05%	$123,000	58.41%	$248,000	
CBI	CONTRUCTION BID ITEMS	SUBTOTAL (A + B)	(% of A)	155.05%	$347,000	158.41%	$673,000	67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

C-01	F/A - General						6.00%	$20,820	6.00%	$40,380
C-02	F/A - Minor Contract Revisions (MCR's)						3.00%	$10,410	3.00%	$20,190
C-03	F/A - Project Communications	[Level 4	$673,000	X	0.11%	]	0.11%	$367	0.11%	$712
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)						0.00%	$0	0.00%	$0
C	F/A's & TSM&O	SUBTOTAL (C)	(% of CBI)				9.11%	$32,000	9.11%	$61,000
CI	CONSTRUCTION ITEMS	SUBTOTAL (A + B + C)	(% of A)				169.20%	$379,000	172.71%	$734,000	73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

D-01	Construction Engineering	(Default: 10.95%)			10.95%	$41,501	10.95%	$80,373
D-02	Construction Indirects	(Default: 9.5%)			9.50%	$36,005	9.50%	$69,730
D	CONSTRUCTION ENGINEERING & INDIRECTS	SUBTOTAL (D)	(% of CI)		20.45%	$78,000	20.45%	$150,000
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)				$457,000		$884,000	88.1% of Base Cost

E - PRECONSTRUCTION ITEMS

Indirect % 9.50% (Model Estimate) | Indirect % 9.50% (Region Estimate)

		AVG %	EFFORT		% of CI	Cost (% CI + Indirect %)	% of CI	Cost (% CI + Indirect %)
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$21,414	2.00%	$16,075
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$49,801	12.00%	$96,448
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$3,113	0.75%	$6,028
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0

E	PRECONSTRUCTION ITEMS	SUBTOTAL (E)	(% of CI)		19.53%	$74,000	16.21%	$119,000	11.9% of Base Cost
	PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)				$531,000		$1,003,000	100.0% of Base Cost
							RE/ME Ratio:	1.89	

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE	17.3% OF BASE COST	$174,000	
TOTAL PROJECT COST (P70)		$1,177,000	117.3% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23

ESCALATION	14.1% OF BASE COST	$166,000	
ESCALATED COST		$1,343,000	133.9% of Base Cost

COMMENTS: ***Please document any key assumptions on unit costs or percentages.***

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0								

A-02	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0								

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK	
206-00000	0.0	$39.0	$0	*	-15%	40%	-	0	-	$11.0	$36.0	$79.0	OK	
206-00100	0.0	$68.8	$0	*	-15%	40%	-	0	-	$34.0	$66.0	$115.0	OK	
206-00200	5.2	$83.1	$433	*	-15%	40%	4	5	7	$20.4	$77.0	$170.0	OK	
403-34841	3.2	$88.9	$287	*	-15%	40%	3	3	4	$62.7	$83.5	$137.0	OK	
601-03000	17.1	$1,216.7	$20,785	*	-15%	40%	14	16	23	$460.0	$960.0	$3,000.0	OK	
602-00020	1088.5	$2.0	$2,201	*	-15%	40%	888	1,045	1,463	$0.7	$2.0	$3.4	OK	
606-10700	585.4	$33.7	$19,709	*	-15%	40%	478	562	787	$20.0	$33.0	$50.0	OK	
621-00411	1.0	$300,000.0	$300,000	*	0%	0%	1	1	1	$270,000.0	$300,000.0	$330,000.0	OK	
621-00412	0.0	$500,000.0	$0	*	0%	0%	-	0	-	$450,000.0	$500,000.0	$550,000.0	OK	
	A-03_CAT300 Cost:	97.1%	$459,138											

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-03_REPL Cost:	0.0%	$0	
A-03_REPA Cost:	0.0%	$0	
A-03_WALL Cost:	0.0%	$0	
A-03_CULV Cost:	0.0%	$0	

*MODIFY LS estimate ranges as seem appropriate -->

LUMP SUM COST ESTIMATE RANGES

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
	37.5	$358.3	$13,438	*	-15%	40%	31	36	50	$300.0	$350.0	$450.0	OK	
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK	
	0.0	$2,000.0	$0	*	-15%	40%	-	0	-	$1,800.0	$2,000.0	$2,200.0	OK	
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK	
	0.0	$2,700.0	$0	*	-15%	40%	-	0	-	$2,430.0	$2,700.0	$2,970.0	OK	
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK	
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK	
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK	
	0.0	$3,500.0	$0	*	-15%	40%	-	0	-	$3,150.0	$3,500.0	$3,850.0	OK	
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK	
	A-03_MISC Cost:	2.8%	$13,438											
	A-03 Cost:	99.9%	$472,576											

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

SUBTOTAL (A)	100.0%	$473,000

B - MINOR ITEMS

	% of (A) RISK	COST RISK	* MIN	ML	MAX
B-01	2.42%	$11,447	0.0%	2.4%	4.8%
B-02	5.95%	$28,144	0.0%	6.0%	11.9%
B-03	4.33%	$20,497	0.0%	5.0%	6.0%
B-04	4.30%	$20,339	0.0%	4.3%	8.6%
B-05	3.08%	$14,568	0.0%	3.1%	6.2%
B-06	16.56%	$78,329	0.0%	16.6%	33.1%
B-07	20.00%	$94,600	0.0%	20.0%	40.0%
B-08	0.00%	$0	0.0%	0.0%	0.0%
B-09	0.77%	$3,642	0.0%	0.8%	1.5%
B-10	0.00%	$0	0.0%	0.0%	0.0%
B-11	0.33%	$1,561	0.0%	0.3%	0.7%
SUBTOTAL (B)	57.7%	$273,000	0.0%	58.4%	112.8%

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

CBI	157.7% (% of A)	$746,000

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$44,760	6.0%	6.0%	6.0%
C-02	3.00%	$22,380	3.0%	3.0%	3.0%
C-03	0.11%	$789	0.1%	0.11%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$68,000			

CI	172.1%	$814,000

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$89,133	10.95%	10.95%	10.95%
D-02	9.50%	$77,330	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$166,000			

CONST	$980,000

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$17,094	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$101,750	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$6,105	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.4%	$125,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	54	$1,105,000
BASE COST	30	$1,003,000
RISK RESERVE	17.3% OF BASE COST	$174,000
P70 VALUE	70	$1,177,000

Probabilistic Ranges:

P10	$911,000
P50	$1,086,000
P70	$1,177,000
P90	$1,324,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: 22-Oct-18

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: 22-Oct-18

Project Name	R2 BUNDLE
Project Number	G-12-C
Sub-Account Number	XXXXX
Project Description	G-12-C
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	009B	Begin MP:	53.9	End MP:	71.4	Length:	17.5
CDOT Region:	2	FIPS City:	NONE	FIPS County:	Park Co		
		FIPS City:	00000	FIPS County:	093		
Segment Mid-point	RefPt 62.650	Latitude:	39.1880	Longitude:	-105.9730	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural	Terrain:	2 Rolling		
AADT:	1,900	Truck ADT:	60	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	98.1%	$678,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	36	LS	1.9%	$13,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$691,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$16,722
B-02	Environmental	3 - Average	% OF A	6.0%	$41,115
B-03	Structural	3 - Average	% OF A	0.3%	$2,280
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$29,713
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$21,283
B-06	Mobilization	3 - Average	% OF A	16.6%	$114,430
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$138,200
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$5,321
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$2,280
		SUBTOTAL (B)	% OF A	53.7%	$371,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**153.7%**	**$1,062,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$63,720
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$31,860
C-03	F/A - Project Communications		% OF CBI	0.1%	$1,159
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$97,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**167.7%**	**$1,159,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$126,911
D-02	Construction Indirects	% OF CI	9.5%	$110,105
	SUBTOTAL (D)	% OF CI	20.4%	$237,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$1,396,000**

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$25,382
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$152,293
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$9,518
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.1%	$187,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) **$1,583,000**

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE 13.4% OF BASE COST $212,000

TOTAL PROJECT COST $1,795,000

113.4% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23

ESCALATION 14.1% OF BASE COST $253,000

ESCALATED PROJECT COST $2,048,000

129.4% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	G-12-C
Sub-Account Number	XXXXX
Project Description	G-12-C
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	009B	Begin MP:	53.9	End MP:	71.4	Length:	17.5
CDOT Region:	2	City:	NONE	County:	Park Co		
		FIPS City:	00000	FIPS County:	093		
Segment Mid-point	RefPt 62.650	Latitude:	39.1880	Longitude:	-105.9730	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	2
AADT:	1,900	Truck ADT:	60	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

					Model Estimate		Region Estimate	
A-01	EARTHWORK	Unit	Qty	Unit Cost	Cost		Unit Cost	Cost
	A-01 Cost:			0.0%	$0		0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty	Unit Cost	Cost		Unit Cost	Cost
	A-02 Cost:			0.0%	$0		0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)							

A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	920	$21.6	$19,829	$36.0	$33,120
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	195	$45.3	$8,833	$66.0	$12,870
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	0	$48.2	$0	$77.0	$0
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	28	$83.5	$2,362	$83.5	$2,362
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	28	$960.0	$27,168	$960.0	$27,168
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	3,375	$1.0	$3,396	$2.0	$6,750
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	642	$95.5	$61,298	$33.0	$21,186
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	0	$65,000.0	$0	$300,000.0	$0
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	1	$50,000.0	$50,000	$500,000.0	$500,000
			A-03_CAT300 Cost:		95.0%	$248,000	98.1%	$678,000
A-03_repl	BRIDGE REPLACEMENT							
			A-03_REPL Cost:		0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR							
			A-03_REPA Cost:		0.0%	$0	0.0%	$0
A-03_wall	WALLS							
			A-03_WALL Cost:		0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS				R2			
			A-03_CULV Cost:		0.0%	$0	0.0%	$0

A-03_misc	MISCELLANEOUS STRUCTURES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_misc	60 Inch Reinforced Concrete Pipe	LF	36	$350.0	$12,600	$350.0	$12,600
A-03_misc	72 Inch Reinforced Concrete Pipe	LF	0	$400.0	$0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)	LF	0	$2,000.0	$0	$2,000.0	$0
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)	LF	0	$2,500.0	$0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)	LF	0	$2,700.0	$0	$2,700.0	$0
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*	LF	0	$2,900.0	$0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,100.0	$0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)	LF	0	$3,500.0	$0	$3,500.0	$0
A-03_misc	0	LF	0	$0.0	$0	$0.0	$0
		A-03_MISC Cost:		5.0%	$13,000	1.9%	$13,000
		A-03 Cost:		100.0%	$261,000	100.0%	$691,000

A-04	TRAFFIC/ITS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
	A-04 Cost:			0.0%	$0	0.0%	$0

A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
		A-05 Cost:			0.0%	$0	0.0%	$0
A	MAJOR CONSTRUCTION ITEMS	SUBTOTAL (A)	(% of A)		100.0%	$261,000	100.0%	$691,000

43.7% of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		% of (A)	Cost	% of (A)	Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$6,316	2.42%	$16,722
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$15,530	5.95%	$41,115
B-03	Structural	0.0%	0.3%	2.3%	3 - Average	Adjusted—>	0.33%	$861	0.33%	$2,280
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$11,223	4.30%	$29,713
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$8,039	3.08%	$21,283
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$43,222	16.56%	$114,430
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$52,200	20.00%	$138,200
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$2,010	0.77%	$5,321
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$861	0.33%	$2,280
B	MINOR CONSTRUCTION ITEMS				SUBTOTAL (B)	(% of A)	53.74%	$140,000	53.74%	$371,000
CBI	CONTRUCTION BID ITEMS				SUBTOTAL (A + B)	(% of A)	153.74%	$401,000	153.74%	$1,062,000

67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

							% of CBI	Cost	% of CBI	Cost
C-01	F/A - General						6.00%	$24,060	6.00%	$63,720
C-02	F/A - Minor Contract Revisions (MCR's)						3.00%	$12,030	3.00%	$31,860
C-03	F/A - Project Communications	[Level 4	$1,062,000	X	0.11%	]	0.11%	$438	0.11%	$1,159
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)						0.00%	$0	0.00%	$0
C	F/A's & TSM&O				SUBTOTAL (C)	(% of CBI)	9.11%	$37,000	9.11%	$97,000
CI	CONSTRUCTION ITEMS				SUBTOTAL (A + B + C)	(% of A)	167.82%	$438,000	167.73%	$1,159,000

73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

				% of CI	Cost	% of CI	Cost
D-01	Construction Engineering	(Default: 10.95%)		10.95%	$47,961	10.95%	$126,911
D-02	Construction Indirects	(Default: 9.5%)		9.50%	$41,610	9.50%	$110,105
D	CONSTRUCTION ENGINEERING & INDIRECTS		SUBTOTAL (D)	20.45%	$90,000	20.45%	$237,000
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)			$528,000		$1,396,000

88.2% of Base Cost

E - PRECONSTRUCTION ITEMS

Indirect % 9.50% (Model Estimate) | Indirect % 9.50% (Region Estimate)

		AVG %	EFFORT		% of CI	Cost (% CI + Indirect %)	% of CI	Cost (% CI + Indirect %)
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$24,748	2.00%	$25,382
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$57,553	12.00%	$152,293
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$3,597	0.75%	$9,518
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0
E	PRECONSTRUCTION ITEMS		SUBTOTAL (E)	(% of CI)	19.63%	$86,000	16.13%	$187,000

11.8% of Base Cost

	PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)	$614,000		$1,583,000

100.0% of Base Cost

RE/ME Ratio: 2.58

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE	13.4% OF BASE COST	$212,000	
TOTAL PROJECT COST (P70)		$1,795,000	113.4% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18	ESCALATION	14.1% OF BASE COST	$253,000	
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23	ESCALATED COST		$2,048,000	129.4% of Base Cost

COMMENTS: ***Please document any key assumptions on unit costs or percentages.***

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0								

A-02	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0								

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK	
206-00000	958.3	$39.0	$37,375	*	-15%	40%	782	920	1,288	$11.0	$36.0	$79.0	OK	
206-00100	203.1	$68.8	$13,982	*	-15%	40%	166	195	273	$34.0	$66.0	$115.0	OK	
206-00200	0.0	$83.1	$0	*	-15%	40%	-	0	-	$20.4	$77.0	$170.0	OK	
403-34841	29.5	$88.9	$2,621	*	-15%	40%	24	28	40	$62.7	$83.5	$137.0	OK	
601-03000	29.5	$1,216.7	$35,866	*	-15%	40%	24	28	40	$460.0	$960.0	$3,000.0	OK	
602-00020	3515.6	$2.0	$7,107	*	-15%	40%	2,869	3,375	4,725	$0.7	$2.0	$3.4	OK	
606-10700	668.8	$33.7	$22,515	*	-15%	40%	546	642	899	$20.0	$33.0	$50.0	OK	
621-00411	0.0	$300,000.0	$0	*	0%	0%	-	0	-	$270,000.0	$300,000.0	$330,000.0	OK	
621-00412	1.0	$500,000.0	$500,000	*	0%	0%	1	1	1	$450,000.0	$500,000.0	$550,000.0	OK	
	A-03_CAT300 Cost:	98.2%	$735,190	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.										
	A-03_REPL Cost:	0.0%	$0											
	A-03_REPA Cost:	0.0%	$0	*MODIFY LS estimate ranges as seem appropriate -->						LUMP SUM COST ESTIMATE RANGES				
	A-03_WALL Cost:	0.0%	$0											
	A-03_CULV Cost:	0.0%	$0											

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
	37.5	$358.3	$13,438	*	-15%	40%	31	36	50	$300.0	$350.0	$450.0	OK	
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK	
	0.0	$2,000.0	$0	*	-15%	40%	-	0	-	$1,800.0	$2,000.0	$2,200.0	OK	
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK	
	0.0	$2,700.0	$0	*	-15%	40%	-	0	-	$2,430.0	$2,700.0	$2,970.0	OK	
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK	
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK	
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK	
	0.0	$3,500.0	$0	*	-15%	40%	-	0	-	$3,150.0	$3,500.0	$3,850.0	OK	
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK	
	A-03_MISC Cost:	1.8%	$13,438	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.										
	A-03 Cost:	100.0%	$748,628											

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.							

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.							
	SUBTOTAL (A)	100.0%	$749,000								

B - MINOR ITEMS

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS

	% of (A) RISK	COST RISK	* MIN	ML	MAX
B-01	2.42%	$18,126	0.0%	2.4%	4.8%
B-02	5.95%	$44,566	0.0%	6.0%	11.9%
B-03	0.33%	$2,472	0.0%	0.3%	0.7%
B-04	4.30%	$32,207	0.0%	4.3%	8.6%
B-05	3.08%	$23,069	0.0%	3.1%	6.2%
B-06	16.56%	$124,034	0.0%	16.6%	33.1%
B-07	20.00%	$149,800	0.0%	20.0%	40.0%
B-08	0.00%	$0	0.0%	0.0%	0.0%
B-09	0.77%	$5,767	0.0%	0.8%	1.5%
B-10	0.00%	$0	0.0%	0.0%	0.0%
B-11	0.33%	$2,472	0.0%	0.3%	0.7%
SUBTOTAL (B)	53.7%	$403,000	0.0%	53.7%	107.5%
CBI	153.7% (% of A)	$1,152,000			

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$69,120	6.0%	6.0%	6.0%
C-02	3.00%	$34,560	3.0%	3.0%	3.0%
C-03	0.11%	$1,257	0.1%	0.11%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$105,000			
CI	167.7%	$1,257,000			

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$137,642	10.95%	10.95%	10.95%
D-02	9.50%	$119,415	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$257,000			
CONST		$1,514,000			

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$26,397	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$157,125	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$9,428	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.4%	$193,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	53	$1,707,000
BASE COST	27	$1,583,000
RISK RESERVE	13.4% OF BASE COST	$212,000
P70 VALUE	70	$1,795,000

Probabilistic Ranges:

P10	$1,469,000
P50	$1,693,000
P70	$1,795,000
P90	$1,957,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: **22-Oct-18**

Project Name	**R2 BUNDLE**
Project Number	**I-13-G**
Sub-Account Number	**XXXXX**
Project Description	**I-13-G**
Project Work Type	**BRIDGE REPLACEMENT**
Estimator:	**E.A.**
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	024A	**Begin MP:**	271.9	**End MP:**	278.0	**Length:**	6.1
CDOT Region:	2	**FIPS City:**	NONE	**FIPS County:**	Teller Co		
		FIPS City:	00000	**FIPS County:**	119		
Segment Mid-point	**RefPt** 274.950	**Latitude:**	38.9330	**Longitude:**	-105.2285	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	**Urban-Rural Class:**	1 Rural	**Terrain:**	3 Mountainous		
AADT:	5,300	**Truck ADT:**	160	**Tier Class:**	Tier 2	**Primary Surface:**	1 Asphalt
Design Maturity:	0 - Conceptual	**NEPA Action:**	Cat/Ex	**NEPA Status:**	In Progress		
Project Delivery Method:	Design-Bid-Build	**Construction Start (MMM-YY)**	Sep-22	**Construction Duration (mo)**	24.0		

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	56.1%	$642,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	186	LS	43.9%	$502,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$1,144,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$27,685
B-02	Environmental	3 - Average	% OF A	6.0%	$68,068
B-03	Structural	3 - Average	% OF A	0.3%	$3,775
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$49,192
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$35,235
B-06	Mobilization	3 - Average	% OF A	16.6%	$189,446
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$228,800
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$8,809
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$3,775
		SUBTOTAL (B)	% OF A	53.7%	$615,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**153.8%**	**$1,759,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$105,540
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$52,770
C-03	F/A - Project Communications		% OF CBI	0.1%	$2,024
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$160,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**167.7%**	**$1,919,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$210,131
D-02	Construction Indirects	% OF CI	9.5%	$182,305
	SUBTOTAL (D)	% OF CI	20.4%	$392,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$2,311,000**

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$42,026
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$252,157
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$15,760
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.2%	$310,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) **$2,621,000**

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE DATE: **11/6/2018**

RISK RESERVE 10.7% OF BASE COST **$281,000**

TOTAL PROJECT COST **$2,902,000**

110.7% of Base Cost

ESCALATION

Construction Start	Sep-22	**Escalation from Estimate Date:**	Nov-18	**ESCALATION**	14.1% OF BASE COST	**$409,000**
Duration (mo)	24.0	**to Construction Mid-Point Date:**	Sep-23	**ESCALATED PROJECT COST**		**$3,311,000**

126.3% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	I-13-G
Sub-Account Number	XXXXX
Project Description	I-13-G
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	024A	Begin MP:	271.9	End MP:	278.0	Length:	6.1
CDOT Region:	2	City:	NONE	County:	Teller Co		
		FIPS City:	00000	FIPS County:	119		
Segment Mid-point	RefPt 274.950	Latitude:	38.9330	Longitude:	-105.2285	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	3
AADT:	5,300	Truck ADT:	160	Tier Class:	Tier 2	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

					Model Estimate		Region Estimate	
A-01	EARTHWORK	Unit	Qty	Unit Cost	Cost		Unit Cost	Cost
	A-01 Cost:			0.0%	$0		0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty	Unit Cost	Cost		Unit Cost	Cost
	A-02 Cost:			0.0%	$0		0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)							

A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	0	$21.6	$0	$36.0	$0
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	170	$45.3	$7,700	$66.0	$11,220
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	0	$48.2	$0	$77.0	$0
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	27	$83.5	$2,220	$83.5	$2,220
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	27	$960.0	$25,536	$960.0	$25,536
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	3,375	$1.0	$3,396	$2.0	$6,750
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	642	$95.5	$61,298	$33.0	$21,186
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	0	$65,000.0	$0	$300,000.0	$0
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	1	$50,000.0	$50,000	$500,000.0	$500,000
			A-03_CAT300 Cost:		30.9%	$225,000	56.1%	$642,000

A-03_repl	BRIDGE REPLACEMENT							
	A-03_REPL Cost:				0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR							
	A-03_REPA Cost:				0.0%	$0	0.0%	$0
A-03_wall	WALLS							
	A-03_WALL Cost:				0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS				R2			
	A-03_CULV Cost:				0.0%	$0	0.0%	$0

A-03_misc	MISCELLANEOUS STRUCTURES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_misc	60 Inch Reinforced Concrete Pipe	LF	0	$350.0	$0	$350.0	$0
A-03_misc	72 Inch Reinforced Concrete Pipe	LF	0	$400.0	$0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)	LF	0	$2,000.0	$0	$2,000.0	$0
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)	LF	0	$2,500.0	$0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)	LF	186	$2,700.0	$502,200	$2,700.0	$502,200
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*	LF	0	$2,900.0	$0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,100.0	$0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)	LF	0	$3,500.0	$0	$3,500.0	$0
A-03_misc	0	LF	0	$0.0	$0	$0.0	$0
	A-03_MISC Cost:			69.1%	$502,000	43.9%	$502,000
	A-03 Cost:			100.0%	$727,000	100.0%	$1,144,000

A-04	TRAFFIC/ITS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
	A-04 Cost:			0.0%	$0	0.0%	$0

A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
	A-05 Cost:				0.0%	$0	0.0%	$0

A	MAJOR CONSTRUCTION ITEMS	SUBTOTAL (A)	(% of A)	100.0%	$727,000	100.0%	$1,144,000	43.6%	of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		% of (A)	Cost	% of (A)	Cost	
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$17,593	2.42%	$27,685	
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$43,257	5.95%	$68,068	
B-03	Structural	0.0%	0.3%	2.3%	3 - Average	Adjusted—>	0.33%	$2,399	0.33%	$3,775	
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$31,261	4.30%	$49,192	
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$22,392	3.08%	$35,235	
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$120,391	16.56%	$189,446	
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$145,400	20.00%	$228,800	
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0	
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$5,598	0.77%	$8,809	
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0	
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$2,399	0.33%	$3,775	

B	MINOR CONSTRUCTION ITEMS	SUBTOTAL (B)	(% of A)	53.74%	$391,000	53.74%	$615,000	
CBI	CONTRUCTION BID ITEMS	SUBTOTAL (A + B)	(% of A)	153.74%	$1,118,000	153.74%	$1,759,000	67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

C-01	F/A - General				6.00%	$67,080	6.00%	$105,540
C-02	F/A - Minor Contract Revisions (MCR's)				3.00%	$33,540	3.00%	$52,770
C-03	F/A - Project Communications	[Level 4	$1,759,000	X 0.12%]	0.12%	$1,287	0.12%	$2,024
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)				0.00%	$0	0.00%	$0
C	F/A's & TSM&O	SUBTOTAL (C)	(% of CBI)		9.12%	$102,000	9.12%	$160,000
CI	CONSTRUCTION ITEMS	SUBTOTAL (A + B + C)	(% of A)		167.81%	$1,220,000	167.74%	$1,919,000

73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

D-01	Construction Engineering	(Default: 10.95%)		10.95%	$133,590	10.95%	$210,131
D-02	Construction Indirects	(Default: 9.5%)		9.50%	$115,900	9.50%	$182,305
D	CONSTRUCTION ENGINEERING & INDIRECTS	SUBTOTAL (D)	(% of CI)	20.45%	$249,000	20.45%	$392,000
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)			$1,469,000		$2,311,000

88.2% of Base Cost

E - PRECONSTRUCTION ITEMS

Indirect % 9.50% (Model Estimate) | Indirect % 9.50% (Region Estimate)

		AVG %	EFFORT		% of CI	Cost (% CI + Indirect %)	% of CI	Cost (% CI + Indirect %)	
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$68,932	2.00%	$42,026	
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0	
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$160,308	12.00%	$252,157	
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$10,019	0.75%	$15,760	
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0	
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0	
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0	
E	PRECONSTRUCTION ITEMS	SUBTOTAL (E)	(% of CI)		19.59%	$239,000	16.15%	$310,000	11.8% of Base Cost
	PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)				$1,708,000		$2,621,000	100.0% of Base Cost
							RE/ME Ratio:	1.53	

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE	DATE: 11/6/2018	RISK RESERVE	10.7% OF BASE COST	$281,000
		TOTAL PROJECT COST (P70)		$2,902,000

110.7% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18	ESCALATION	14.1% OF BASE COST	$409,000
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23	ESCALATED COST		$3,311,000

126.3% of Base Cost

COMMENTS: Please document any key assumptions on unit costs or percentages.

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK	RISK QUANTITY / % PARAMETERS: MIN %	MAX %	MIN	ML	MAX	RISK UNIT COST PARAMETERS: MIN	ML	MAX
	A-01 Cost:	0.0%	$0								

A-02	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0								

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX	
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK
206-00000	0.0	$39.0	$0	*	-15%	40%	-	0	-	$11.0	$36.0	$79.0	OK
206-00100	177.1	$68.8	$12,189	*	-15%	40%	145	170	238	$34.0	$66.0	$115.0	OK
206-00200	0.0	$83.1	$0	*	-15%	40%	-	0	-	$20.4	$77.0	$170.0	OK
403-34841	27.7	$88.9	$2,464	*	-15%	40%	23	27	37	$62.7	$83.5	$137.0	OK
601-03000	27.7	$1,216.7	$33,712	*	-15%	40%	23	27	37	$460.0	$960.0	$3,000.0	OK
602-00020	3515.6	$2.0	$7,107	*	-15%	40%	2,869	3,375	4,725	$0.7	$2.0	$3.4	OK
606-10700	668.8	$33.7	$22,515	*	-15%	40%	546	642	899	$20.0	$33.0	$50.0	OK
621-00411	0.0	$300,000.0	$0	*	0%	0%	-	0	-	$270,000.0	$300,000.0	$330,000.0	OK
621-00412	1.0	$500,000.0	$500,000	*	0%	0%	1	1	1	$450,000.0	$500,000.0	$550,000.0	OK
	A-03_CAT300 Cost:	57.0%	$693,711	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.									
	A-03_REPL Cost:	0.0%	$0										
	A-03_REPA Cost:	0.0%	$0	*MODIFY LS estimate ranges as seem appropriate -->					LUMP SUM COST ESTIMATE RANGES				
	A-03_WALL Cost:	0.0%	$0										
	A-03_CULV Cost:	0.0%	$0										

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX	
	0.0	$358.3	$0	*	-15%	40%	-	0	-	$300.0	$350.0	$450.0	OK
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK
	0.0	$2,000.0	$0	*	-15%	40%	-	0	-	$1,800.0	$2,000.0	$2,200.0	OK
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK
	193.8	$2,700.0	$523,125	*	-15%	40%	158	186	260	$2,430.0	$2,700.0	$2,970.0	OK
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK
	0.0	$3,500.0	$0	*	-15%	40%	-	0	-	$3,150.0	$3,500.0	$3,850.0	OK
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK
	A-03_MISC Cost:	43.0%	$523,125	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.									
	A-03 Cost:	100.0%	$1,216,836										

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.							

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.							
	SUBTOTAL (A)	100.0%	$1,217,000								

B - MINOR ITEMS

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS

	% of (A) RISK	COST RISK	* MIN	ML	MAX
B-01	2.42%	$29,451	0.0%	2.4%	4.8%
B-02	5.95%	$72,412	0.0%	6.0%	11.9%
B-03	0.33%	$4,016	0.0%	0.3%	0.7%
B-04	4.30%	$52,331	0.0%	4.3%	8.6%
B-05	3.08%	$37,484	0.0%	3.1%	6.2%
B-06	16.56%	$201,535	0.0%	16.6%	33.1%
B-07	20.00%	$243,400	0.0%	20.0%	40.0%
B-08	0.00%	$0	0.0%	0.0%	0.0%
B-09	0.77%	$9,371	0.0%	0.8%	1.5%
B-10	0.00%	$0	0.0%	0.0%	0.0%
B-11	0.33%	$4,016	0.0%	0.3%	0.7%
SUBTOTAL (B)	53.7%	$654,000	0.0%	53.7%	107.5%
CBI	153.7% (% of A)	$1,871,000			

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$112,260	6.0%	6.0%	6.0%
C-02	3.00%	$56,130	3.0%	3.0%	3.0%
C-03	0.12%	$2,153	0.1%	0.12%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$171,000			
CI	167.8%	$2,042,000			

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$223,599	10.95%	10.95%	10.95%
D-02	9.50%	$193,990	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$418,000			
CONST		$2,460,000			

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$42,882	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$255,250	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$15,315	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.3%	$313,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	52	$2,773,000
BASE COST	30	$2,621,000
RISK RESERVE	10.7% OF BASE COST	$281,000
P70 VALUE	70	$2,902,000

Probabilistic Ranges:

P10	$2,428,000
P50	$2,761,000
P70	$2,902,000
P90	$3,124,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: 22-Oct-18

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: 22-Oct-18

Project Name	R2 BUNDLE
Project Number	H-13-N
Sub-Account Number	XXXXX
Project Description	H-13-N
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	024A	Begin MP:	271.9	End MP:	278.0	Length:	6.1
CDOT Region:	2	FIPS City:	NONE	FIPS County:	Teller Co		
		FIPS City:	00000	FIPS County:	119		
Segment Mid-point	RefPt 274.950	Latitude:	38.9330	Longitude:	-105.2285	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural	Terrain:	3 Mountainous		
AADT:	5,300	Truck ADT:	160	Tier Class:	Tier 2	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	75.8%	$625,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	80	LS	24.2%	$200,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$825,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$19,965
B-02	Environmental	3 - Average	% OF A	6.0%	$49,088
B-03	Structural	3 - Average	% OF A	0.3%	$2,723
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$35,475
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$25,410
B-06	Mobilization	3 - Average	% OF A	16.6%	$136,620
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$165,000
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$6,353
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$2,723
		SUBTOTAL (B)	% OF A	53.7%	$443,000
	CONTRUCTION BID ITEMS (A + B)	CBI	% OF A	153.7%	$1,268,000

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$76,080
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$38,040
C-03	F/A - Project Communications		% OF CBI	0.1%	$1,406
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$116,000
	CONSTRUCTION ITEMS (A + B + C)	CI	% OF A	167.8%	$1,384,000

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$151,548
D-02	Construction Indirects	% OF CI	9.5%	$131,480
	SUBTOTAL (D)	% OF CI	20.4%	$283,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			$1,667,000

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$30,310
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$181,858
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$11,366
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.2%	$224,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) $1,891,000

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE 11.3% OF BASE COST $214,000

TOTAL PROJECT COST $2,105,000

111.3% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23

ESCALATION 14.1% OF BASE COST $297,000

ESCALATED PROJECT COST $2,402,000

127.0% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	H-13-N
Sub-Account Number	XXXXX
Project Description	H-13-N
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	024A	Begin MP:	271.9	End MP:	278.0	Length:	6.1
CDOT Region:	2	City:	NONE	County:	Teller Co		
		FIPS City:	00000	FIPS County:	119		
Segment Mid-point	RefPt 274.950	Latitude:	38.9330	Longitude:	-105.2285	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	3
AADT:	5,300	Truck ADT:	160	Tier Class:	Tier 2	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

				Model Estimate		Region Estimate	
A-01	EARTHWORK	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-01 Cost:	0.0%	$0	0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-02 Cost:	0.0%	$0	0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)						

A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	0	$21.6	$0	$36.0	$0
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	100	$45.3	$4,530	$66.0	$6,600
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	0	$48.2	$0	$77.0	$0
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	16	$83.5	$1,294	$83.5	$1,294
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	16	$960.0	$14,880	$960.0	$14,880
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	3,920	$1.0	$3,944	$2.0	$7,840
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	604	$95.5	$57,670	$33.0	$19,932
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	0	$65,000.0	$0	$300,000.0	$0
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	1	$50,000.0	$50,000	$500,000.0	$500,000
			A-03_CAT300 Cost:		50.9%	$207,000	75.8%	$625,000

A-03_repl	BRIDGE REPLACEMENT							
			A-03_REPL Cost:		0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR							
			A-03_REPA Cost:		0.0%	$0	0.0%	$0
A-03_wall	WALLS							
			A-03_WALL Cost:		0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS				R2			
			A-03_CULV Cost:		0.0%	$0	0.0%	$0

A-03_misc	MISCELLANEOUS STRUCTURES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_misc	60 Inch Reinforced Concrete Pipe	LF	0	$350.0	$0	$350.0	$0
A-03_misc	72 Inch Reinforced Concrete Pipe	LF	0	$400.0	$0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)	LF	0	$2,000.0	$0	$2,000.0	$0
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)	LF	80	$2,500.0	$200,000	$2,500.0	$200,000
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)	LF	0	$2,700.0	$0	$2,700.0	$0
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*	LF	0	$2,900.0	$0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,100.0	$0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)	LF	0	$3,500.0	$0	$3,500.0	$0
A-03_misc	0	LF	0	$0.0	$0	$0.0	$0
			A-03_MISC Cost:	49.1%	$200,000	24.2%	$200,000
			A-03 Cost:	100.0%	$407,000	100.0%	$825,000

A-04	TRAFFIC/ITS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-04 Cost:	0.0%	$0	0.0%	$0

A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
				A-05 Cost:	0.0%	$0	0.0%	$0

A	MAJOR CONSTRUCTION ITEMS	SUBTOTAL (A)	(% of A)	100.0%	$407,000	100.0%	$825,000	43.6% of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		% of (A)	Cost	% of (A)	Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$9,849	2.42%	$19,965
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$24,217	5.95%	$49,088
B-03	Structural	0.0%	0.3%	2.3%	3 - Average	Adjusted—>	0.33%	$1,343	0.33%	$2,723
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$17,501	4.30%	$35,475
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$12,536	3.08%	$25,410
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$67,399	16.56%	$136,620
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$81,400	20.00%	$165,000
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$3,134	0.77%	$6,353
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$1,343	0.33%	$2,723

B	MINOR CONSTRUCTION ITEMS	SUBTOTAL (B)	(% of A)	53.74%	$219,000	53.74%	$443,000	
CBI	CONTRUCTION BID ITEMS	SUBTOTAL (A + B)	(% of A)	153.74%	$626,000	153.74%	$1,268,000	67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

C-01	F/A - General					6.00%	$37,560	6.00%	$76,080	
C-02	F/A - Minor Contract Revisions (MCR's)					3.00%	$18,780	3.00%	$38,040	
C-03	F/A - Project Communications	[Level 4	$1,268,000	X	0.11%]	0.11%	$694	0.11%	$1,406	
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)					0.00%	$0	0.00%	$0	
C	F/A's & TSM&O	SUBTOTAL (C)	(% of CBI)	9.11%	$57,000	9.11%	$116,000	
CI	CONSTRUCTION ITEMS	SUBTOTAL (A + B + C)	(% of A)	167.81%	$683,000	167.76%	$1,384,000	73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

D-01	Construction Engineering	(Default: 10.95%)	10.95%	$74,789	10.95%	$151,548	
D-02	Construction Indirects	(Default: 9.5%)	9.50%	$64,885	9.50%	$131,480	
D	CONSTRUCTION ENGINEERING & INDIRECTS	SUBTOTAL (D)	(% of CI)	20.45%	$140,000	20.45%	$283,000	
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)			$823,000		$1,667,000	88.2% of Base Cost

E - PRECONSTRUCTION ITEMS

Indirect % 9.50% (Model Estimate) | Indirect % 9.50% (Region Estimate)

		AVG %	EFFORT		% of CI	Cost (% CI + Indirect %)	% of CI	Cost (% CI + Indirect %)
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$38,591	2.00%	$30,310
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$89,746	12.00%	$181,858
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$5,609	0.75%	$11,366
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0

E	PRECONSTRUCTION ITEMS	SUBTOTAL (E)	(% of CI)	19.62%	$134,000	16.18%	$224,000	11.8% of Base Cost
	PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)			$957,000		$1,891,000	100.0% of Base Cost
						RE/ME Ratio:	1.98	

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE	11.3% OF BASE COST	$214,000	
TOTAL PROJECT COST (P70)		$2,105,000	111.3% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23

ESCALATION	14.1% OF BASE COST	$297,000	
ESCALATED COST		$2,402,000	127.0% of Base Cost

COMMENTS: ***Please document any key assumptions on unit costs or percentages.***

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0								

A-02	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0								

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK	
206-00000	0.0	$39.0	$0	*	-15%	40%	-	0	-	$11.0	$36.0	$79.0	OK	
206-00100	104.2	$68.8	$7,170	*	-15%	40%	85	100	140	$34.0	$66.0	$115.0	OK	
206-00200	0.0	$83.1	$0	*	-15%	40%	-	0	-	$20.4	$77.0	$170.0	OK	
403-34841	16.1	$88.9	$1,436	*	-15%	40%	13	16	22	$62.7	$83.5	$137.0	OK	
601-03000	16.1	$1,216.7	$19,644	*	-15%	40%	13	16	22	$460.0	$960.0	$3,000.0	OK	
602-00020	4083.3	$2.0	$8,255	*	-15%	40%	3,332	3,920	5,488	$0.7	$2.0	$3.4	OK	
606-10700	629.2	$33.7	$21,182	*	-15%	40%	513	604	846	$20.0	$33.0	$50.0	OK	
621-00411	0.0	$300,000.0	$0	*	0%	0%	-	0	-	$270,000.0	$300,000.0	$330,000.0	OK	
621-00412	1.0	$500,000.0	$500,000	*	0%	0%	1	1	1	$450,000.0	$500,000.0	$550,000.0	OK	
	A-03_CAT300 Cost:	76.4%	$673,411											

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-03_REPL Cost: 0.0% $0

*MODIFY LS estimate ranges as seem appropriate --> LUMP SUM COST ESTIMATE RANGES

A-03_REPA Cost: 0.0% $0

A-03_WALL Cost: 0.0% $0

A-03_CULV Cost: 0.0% $0

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
	0.0	$358.3	$0	*	-15%	40%	-	0	-	$300.0	$350.0	$450.0	OK	
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK	
	0.0	$2,000.0	$0	*	-15%	40%	-	0	-	$1,800.0	$2,000.0	$2,200.0	OK	
	83.3	$2,500.0	$208,333	*	-15%	40%	68	80	112	$2,250.0	$2,500.0	$2,750.0	OK	
	0.0	$2,700.0	$0	*	-15%	40%	-	0	-	$2,430.0	$2,700.0	$2,970.0	OK	
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK	
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK	
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK	
	0.0	$3,500.0	$0	*	-15%	40%	-	0	-	$3,150.0	$3,500.0	$3,850.0	OK	
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK	
	A-03_MISC Cost:	23.6%	$208,333											
	A-03 Cost:	100.0%	$881,744											

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

SUBTOTAL (A) 100.0% $882,000

B - MINOR ITEMS

	% of (A) RISK	COST RISK		MIN	ML	MAX
B-01	2.42%	$21,344		0.0%	2.4%	4.8%
B-02	5.95%	$52,479		0.0%	6.0%	11.9%
B-03	0.33%	$2,911		0.0%	0.3%	0.7%
B-04	4.30%	$37,926		0.0%	4.3%	8.6%
B-05	3.08%	$27,166		0.0%	3.1%	6.2%
B-06	16.56%	$146,059		0.0%	16.6%	33.1%
B-07	20.00%	$176,400		0.0%	20.0%	40.0%
B-08	0.00%	$0		0.0%	0.0%	0.0%
B-09	0.77%	$6,791		0.0%	0.8%	1.5%
B-10	0.00%	$0		0.0%	0.0%	0.0%
B-11	0.33%	$2,911		0.0%	0.3%	0.7%
SUBTOTAL (B)	53.7%	$474,000		0.0%	53.7%	107.5%

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

CBI 153.7% (% of A) $1,356,000

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$81,360	6.0%	6.0%	6.0%
C-02	3.00%	$40,680	3.0%	3.0%	3.0%
C-03	0.11%	$1,503	0.1%	0.11%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$124,000			

CI 167.7% $1,480,000

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$162,060	10.95%	10.95%	10.95%
D-02	9.50%	$140,600	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$303,000			

CONST $1,783,000

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$31,080	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$185,000	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$11,100	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.3%	$227,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	53	$2,010,000
BASE COST	30	$1,891,000
RISK RESERVE	11.3% OF BASE COST	$214,000
P70 VALUE	70	$2,105,000

Probabilistic Ranges:

P10	$1,751,000
P50	$1,998,000
P70	$2,105,000
P90	$2,280,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: **22-Oct-18**

Project Name	**R2 BUNDLE**
Project Number	**M-21-B**
Sub-Account Number	**XXXXX**
Project Description	**M-21-B**
Project Work Type	**BRIDGE REPLACEMENT**
Estimator:	**E.A.**
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	**Begin MP:**	47.1	**End MP:**	69.8	**Length:**	22.7
CDOT Region:	2	**FIPS City:**	NONE	**FIPS County:**	Otero Co		
		FIPS City:	00000	**FIPS County:**	089		
Segment Mid-point	**RefPt** 58.450	**Latitude:**	37.8382	**Longitude:**	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	**Urban-Rural Class:**	1 Rural	**Terrain:**	2 Rolling		
AADT:	340	**Truck ADT:**	10	**Tier Class:**	Tier 4	**Primary Surface:**	1 Asphalt

Design Maturity:	0 - Conceptual	**NEPA Action:**	Cat/Ex	**NEPA Status:**	In Progress
Project Delivery Method:	Design-Bid-Build	**Construction Start (MMM-YY)**	Sep-22	**Construction Duration (mo)**	24.0

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	33.0%	$482,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	280	LS	67.0%	$980,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$1,462,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$35,380
B-02	Environmental	3 - Average	% OF A	6.0%	$86,989
B-03	Structural	3 - Average	% OF A	0.3%	$4,825
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$62,866
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$45,030
B-06	Mobilization	3 - Average	% OF A	16.6%	$242,107
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$292,400
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$11,257
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$4,825
		SUBTOTAL (B)	% OF A	53.7%	$786,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**153.8%**	**$2,248,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$134,880
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$67,440
C-03	F/A - Project Communications		% OF CBI	0.1%	$2,681
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$205,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**167.8%**	**$2,453,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$268,604
D-02	Construction Indirects	% OF CI	9.5%	$233,035
	SUBTOTAL (D)	% OF CI	20.5%	$502,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$2,955,000**

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$53,721
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$322,324
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$20,145
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.1%	$396,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) **$3,351,000**

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE DATE: **11/6/2018**

RISK RESERVE 11.5% OF BASE COST **$387,000**

TOTAL PROJECT COST **$3,738,000**

111.5% of Base Cost

ESCALATION

Construction Start	Sep-22	**Escalation from Estimate Date:**	Nov-18	**ESCALATION**	14.1% OF BASE COST **$527,000**
Duration (mo)	24.0	**to Construction Mid-Point Date:**	Sep-23	**ESCALATED PROJECT COST**	**$4,265,000**

127.3% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	M-21-B
Sub-Account Number	XXXXX
Project Description	M-21-B
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	Begin MP:	47.1	End MP:	69.8	Length:	22.7
CDOT Region:	2	City:	NONE	County:	Otero Co		
		FIPS City:	00000	FIPS County:	089		
Segment Mid-point	RefPt 58.450	Latitude:	37.8382	Longitude:	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	2
AADT:	340	Truck ADT:	10	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

				Model Estimate		Region Estimate	
A-01	EARTHWORK	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-01 Cost:	0.0%	$0	0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-02 Cost:	0.0%	$0	0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)						

A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	0	$21.6	$0	$36.0	$0
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	315	$45.3	$14,268	$66.0	$20,790
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	0	$48.2	$0	$77.0	$0
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	47	$83.5	$3,906	$83.5	$3,906
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	47	$960.0	$44,928	$960.0	$44,928
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	6,950	$1.0	$6,993	$2.0	$13,900
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	722	$95.5	$68,936	$33.0	$23,826
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	1	$65,000.0	$65,000	$300,000.0	$300,000
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	0	$50,000.0	$0	$500,000.0	$0
			A-03_CAT300 Cost:		22.2%	$279,000	33.0%	$482,000

A-03_repl	BRIDGE REPLACEMENT							
			A-03_REPL Cost:		0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR							
			A-03_REPA Cost:		0.0%	$0	0.0%	$0
A-03_wall	WALLS							
			A-03_WALL Cost:		0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS				R2			
			A-03_CULV Cost:		0.0%	$0	0.0%	$0

A-03_misc	MISCELLANEOUS STRUCTURES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_misc	60 Inch Reinforced Concrete Pipe	LF	0	$350.0	$0	$350.0	$0
A-03_misc	72 Inch Reinforced Concrete Pipe	LF	0	$400.0	$0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)	LF	0	$2,000.0	$0	$2,000.0	$0
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)	LF	0	$2,500.0	$0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)	LF	0	$2,700.0	$0	$2,700.0	$0
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*	LF	0	$2,900.0	$0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,100.0	$0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)	LF	280	$3,500.0	$980,000	$3,500.0	$980,000
A-03_misc	0	LF	0	$0.0	$0	$0.0	$0
		A-03_MISC Cost:		77.8%	$980,000	67.0%	$980,000
		A-03 Cost:		100.0%	$1,259,000	100.0%	$1,462,000

A-04	TRAFFIC/ITS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-04 Cost:	0.0%	$0	0.0%	$0

A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
				A-05 Cost:	0.0%	$0	0.0%	$0

A	MAJOR CONSTRUCTION ITEMS	SUBTOTAL (A)	(% of A)	100.0%	$1,259,000	100.0%	$1,462,000	43.6% of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		% of (A)	Cost	% of (A)	Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$30,468	2.42%	$35,380
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$74,911	5.95%	$86,989
B-03	Structural	0.0%	0.3%	2.3%	3 - Average	Adjusted—>	0.33%	$4,155	0.33%	$4,825
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$54,137	4.30%	$62,866
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$38,777	3.08%	$45,030
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$208,490	16.56%	$242,107
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$251,800	20.00%	$292,400
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$9,694	0.77%	$11,257
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$4,155	0.33%	$4,825

B	MINOR CONSTRUCTION ITEMS	SUBTOTAL (B)	(% of A)	53.74%	$677,000	53.74%	$786,000	
CBI	CONTRUCTION BID ITEMS	SUBTOTAL (A + B)	(% of A)	153.74%	$1,936,000	153.74%	$2,248,000	67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

C-01	F/A - General					6.00%	$116,160	6.00%	$134,880
C-02	F/A - Minor Contract Revisions (MCR's)					3.00%	$58,080	3.00%	$67,440
C-03	F/A - Project Communications	[Level 4	$2,248,000	X	0.12%]	0.12%	$2,309	0.12%	$2,681
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)					0.00%	$0	0.00%	$0
C	F/A's & TSM&O	SUBTOTAL (C)	(% of CBI)			9.12%	$177,000	9.12%	$205,000
CI	CONSTRUCTION ITEMS	SUBTOTAL (A + B + C)	(% of A)			167.83%	$2,113,000	167.78%	$2,453,000	73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

D-01	Construction Engineering	(Default: 10.95%)		10.95%	$231,374	10.95%	$268,604
D-02	Construction Indirects	(Default: 9.5%)		9.50%	$200,735	9.50%	$233,035
D	CONSTRUCTION ENGINEERING & INDIRECTS	SUBTOTAL (D)	(% of CI)	20.45%	$432,000	20.45%	$502,000
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)			$2,545,000		$2,955,000	88.2% of Base Cost

E - PRECONSTRUCTION ITEMS

Indirect % 9.50% | Indirect % 9.50%

		AVG %	EFFORT		% of CI	Cost (% CI + Indirect %)	% of CI	Cost (% CI + Indirect %)
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$119,389	2.00%	$53,721
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$277,648	12.00%	$322,324
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$17,353	0.75%	$20,145
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0

E	PRECONSTRUCTION ITEMS	SUBTOTAL (E)	(% of CI)	19.59%	$414,000	16.14%	$396,000	11.8% of Base Cost
	PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)			$2,959,000		$3,351,000	100.0% of Base Cost
						RE/ME Ratio:	1.13	

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE	DATE: 11/6/2018	RISK RESERVE 11.5% OF BASE COST	$387,000
		TOTAL PROJECT COST (P70)	$3,738,000 (111.5% of Base Cost)

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18	ESCALATION 14.1% OF BASE COST	$527,000
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23	ESCALATED COST	$4,265,000 (127.3% of Base Cost)

COMMENTS: ***Please document any key assumptions on unit costs or percentages.***

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0								

A-02	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0								

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK	
206-00000	0.0	$39.0	$0	*	-15%	40%	-	0	-	$11.0	$36.0	$79.0	OK	
206-00100	328.1	$68.8	$22,586	*	-15%	40%	268	315	441	$34.0	$66.0	$115.0	OK	
206-00200	0.0	$83.1	$0	*	-15%	40%	-	0	-	$20.4	$77.0	$170.0	OK	
403-34841	48.8	$88.9	$4,334	*	-15%	40%	40	47	66	$62.7	$83.5	$137.0	OK	
601-03000	48.8	$1,216.7	$59,313	*	-15%	40%	40	47	66	$460.0	$960.0	$3,000.0	OK	
602-00020	7239.6	$2.0	$14,636	*	-15%	40%	5,908	6,950	9,730	$0.7	$2.0	$3.4	OK	
606-10700	752.1	$33.7	$25,320	*	-15%	40%	614	722	1,011	$20.0	$33.0	$50.0	OK	
621-00411	1.0	$300,000.0	$300,000	*	0%	0%	1	1	1	$270,000.0	$300,000.0	$330,000.0	OK	
621-00412	0.0	$500,000.0	$0	*	0%	0%	-	0	-	$450,000.0	$500,000.0	$550,000.0	OK	
	A-03_CAT300 Cost:	34.7%	$541,913	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.										
	A-03_REPL Cost:	0.0%	$0											
	A-03_REPA Cost:	0.0%	$0	*MODIFY LS estimate ranges as seem appropriate -->						LUMP SUM COST ESTIMATE RANGES				
	A-03_WALL Cost:	0.0%	$0											
	A-03_CULV Cost:	0.0%	$0											

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
	0.0	$358.3	$0	*	-15%	40%	-	0	-	$300.0	$350.0	$450.0	OK	
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK	
	0.0	$2,000.0	$0	*	-15%	40%	-	0	-	$1,800.0	$2,000.0	$2,200.0	OK	
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK	
	0.0	$2,700.0	$0	*	-15%	40%	-	0	-	$2,430.0	$2,700.0	$2,970.0	OK	
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK	
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK	
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK	
	291.7	$3,500.0	$1,020,833	*	-15%	40%	238	280	392	$3,150.0	$3,500.0	$3,850.0	OK	
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK	
	A-03_MISC Cost:	65.3%	$1,020,833	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.										
	A-03 Cost:	100.0%	$1,562,747											

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.							

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.							
	SUBTOTAL (A)	100.0%	$1,563,000								

B - MINOR ITEMS

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS

	% of (A) RISK	COST RISK	* MIN	ML	MAX
B-01	2.42%	$37,825	0.0%	2.4%	4.8%
B-02	5.95%	$92,999	0.0%	6.0%	11.9%
B-03	0.33%	$5,158	0.0%	0.3%	0.7%
B-04	4.30%	$67,209	0.0%	4.3%	8.6%
B-05	3.08%	$48,140	0.0%	3.1%	6.2%
B-06	16.56%	$258,833	0.0%	16.6%	33.1%
B-07	20.00%	$312,600	0.0%	20.0%	40.0%
B-08	0.00%	$0	0.0%	0.0%	0.0%
B-09	0.77%	$12,035	0.0%	0.8%	1.5%
B-10	0.00%	$0	0.0%	0.0%	0.0%
B-11	0.33%	$5,158	0.0%	0.3%	0.7%
SUBTOTAL (B)	53.7%	$840,000	0.0%	53.7%	107.5%

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

CBI	153.7% (% of A)	$2,403,000

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$144,180	6.0%	6.0%	6.0%
C-02	3.00%	$72,090	3.0%	3.0%	3.0%
C-03	0.12%	$2,866	0.1%	0.12%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$219,000			

CI	167.8%	$2,622,000

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$287,109	10.95%	10.95%	10.95%
D-02	9.50%	$249,090	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$536,000			

CONST	$3,158,000

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$55,062	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$327,750	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$19,665	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.3%	$402,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	52	$3,560,000
BASE COST	30	$3,351,000
RISK RESERVE	11.5% OF BASE COST	$387,000
P70 VALUE	70	$3,738,000

Probabilistic Ranges:

P10	$3,098,000
P50	$3,540,000
P70	$3,738,000
P90	$4,048,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: **22-Oct-18**

Project Name	**R2 BUNDLE**
Project Number	**M-22-U**
Sub-Account Number	**XXXXX**
Project Description	**M-22-U**
Project Work Type	**BRIDGE REPLACEMENT**
Estimator:	**E.A.**
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	**Begin MP:**	47.1	**End MP:**	69.8	**Length:**	22.7
CDOT Region:	2	**FIPS City:**	NONE	**FIPS County:**	Otero Co		
		FIPS City:	00000	**FIPS County:**	089		
Segment Mid-point	**RefPt** 58.450	**Latitude:**	37.8382	**Longitude:**	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	**Urban-Rural Class:**	1 Rural	**Terrain:**	2 Rolling		
AADT:	340	**Truck ADT:**	10	**Tier Class:**	Tier 4	**Primary Surface:**	1 Asphalt
Design Maturity:	0 - Conceptual	**NEPA Action:**	Cat/Ex	**NEPA Status:**	In Progress		
Project Delivery Method:	Design-Bid-Build	**Construction Start (MMM-YY)**	Sep-22	**Construction Duration (mo)**	24.0		

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	25.5%	$149,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	150	LS	74.5%	$435,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$584,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$14,133
B-02	Environmental	3 - Average	% OF A	6.0%	$34,748
B-03	Structural	3 - Average	% OF A	0.3%	$1,927
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$25,112
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$17,987
B-06	Mobilization	3 - Average	% OF A	16.6%	$96,710
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$116,800
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$4,497
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$1,927
		SUBTOTAL (B)	% OF A	53.7%	$314,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**153.8%**	**$898,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$53,880
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$26,940
C-03	F/A - Project Communications		% OF CBI	0.1%	$967
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$82,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**167.8%**	**$980,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$107,310
D-02	Construction Indirects	% OF CI	9.5%	$93,100
	SUBTOTAL (D)	% OF CI	20.4%	$200,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$1,180,000**

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$21,462
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$128,772
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$8,048
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.1%	$158,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) **$1,338,000**

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE DATE: **11/6/2018**

RISK RESERVE 18.8% OF BASE COST **$252,000**

TOTAL PROJECT COST **$1,590,000**

118.8% of Base Cost

ESCALATION

Construction Start	Sep-22	**Escalation from Estimate Date:**	Nov-18	**ESCALATION**	14.1% OF BASE COST	**$224,000**
Duration (mo)	24.0	**to Construction Mid-Point Date:**	Sep-23			

ESCALATED PROJECT COST **$1,814,000**

135.6% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	M-22-U
Sub-Account Number	XXXXX
Project Description	M-22-U
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	Begin MP:	47.1	End MP:	69.8	Length:	22.7
CDOT Region:	2	City:	NONE	County:	Otero Co		
		FIPS City:	00000	FIPS County:	089		
Segment Mid-point	RefPt 58.450	Latitude:	37.8382	Longitude:	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	2
AADT:	340	Truck ADT:	10	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

					Model Estimate		Region Estimate	
A-01	EARTHWORK	Unit	Qty	Unit Cost	Cost		Unit Cost	Cost
			A-01 Cost:	0.0%	$0		0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty	Unit Cost	Cost		Unit Cost	Cost
			A-02 Cost:	0.0%	$0		0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)							

A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	0	$21.6	$0	$36.0	$0
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	195	$45.3	$8,833	$66.0	$12,870
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	0	$48.2	$0	$77.0	$0
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	29	$83.5	$2,378	$83.5	$2,378
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	29	$960.0	$27,360	$960.0	$27,360
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	5,155	$1.0	$5,187	$2.0	$10,310
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	638	$95.5	$60,916	$33.0	$21,054
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	0	$65,000.0	$0	$300,000.0	$0
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	0	$50,000.0	$0	$500,000.0	$0
			A-03_CAT300 Cost:		29.3%	$180,000	25.5%	$149,000
A-03_repl	BRIDGE REPLACEMENT							
			A-03_REPL Cost:		0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR							
			A-03_REPA Cost:		0.0%	$0	0.0%	$0
A-03_wall	WALLS							
			A-03_WALL Cost:		0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS				R2			
			A-03_CULV Cost:		0.0%	$0	0.0%	$0

A-03_misc	MISCELLANEOUS STRUCTURES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_misc	60 Inch Reinforced Concrete Pipe	LF	0	$350.0	$0	$350.0	$0
A-03_misc	72 Inch Reinforced Concrete Pipe	LF	0	$400.0	$0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)	LF	0	$2,000.0	$0	$2,000.0	$0
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)	LF	0	$2,500.0	$0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)	LF	0	$2,700.0	$0	$2,700.0	$0
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*	LF	150	$2,900.0	$435,000	$2,900.0	$435,000
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,100.0	$0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)	LF	0	$3,500.0	$0	$3,500.0	$0
A-03_misc	0	LF	0	$0.0	$0	$0.0	$0
			A-03_MISC Cost:	70.7%	$435,000	74.5%	$435,000
			A-03 Cost:	100.0%	$615,000	100.0%	$584,000

A-04	TRAFFIC/ITS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-04 Cost:	0.0%	$0	0.0%	$0

A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
				A-05 Cost:	0.0%	$0	0.0%	$0

A	MAJOR CONSTRUCTION ITEMS	SUBTOTAL (A)	(% of A)	100.0%	$615,000	100.0%	$584,000	43.6% of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		% of (A)	Cost	% of (A)	Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$14,883	2.42%	$14,133
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$36,593	5.95%	$34,748
B-03	Structural	0.0%	0.3%	2.3%	3 - Average	Adjusted—>	0.33%	$2,030	0.33%	$1,927
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$26,445	4.30%	$25,112
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$18,942	3.08%	$17,987
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$101,844	16.56%	$96,710
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$123,000	20.00%	$116,800
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$4,736	0.77%	$4,497
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$2,030	0.33%	$1,927

B	MINOR CONSTRUCTION ITEMS	SUBTOTAL (B)	(% of A)	53.74%	$331,000	53.74%	$314,000	
CBI	CONTRUCTION BID ITEMS	SUBTOTAL (A + B)	(% of A)	153.74%	$946,000	153.74%	$898,000	67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

C-01	F/A - General					6.00%	$56,760	6.00%	$53,880
C-02	F/A - Minor Contract Revisions (MCR's)					3.00%	$28,380	3.00%	$26,940
C-03	F/A - Project Communications	[Level 4	$898,000	X	0.11%]	0.11%	$1,019	0.11%	$967
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)					0.00%	$0	0.00%	$0
C	F/A's & TSM&O	SUBTOTAL (C)	(% of CBI)			9.11%	$86,000	9.11%	$82,000
CI	CONSTRUCTION ITEMS	SUBTOTAL (A + B + C)	(% of A)			167.80%	$1,032,000	167.81%	$980,000	73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

D-01	Construction Engineering	(Default: 10.95%)			10.95%	$113,004	10.95%	$107,310
D-02	Construction Indirects	(Default: 9.5%)			9.50%	$98,040	9.50%	$93,100
D	CONSTRUCTION ENGINEERING & INDIRECTS	SUBTOTAL (D)	(% of CI)		20.45%	$211,000	20.45%	$200,000	
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)				$1,243,000		$1,180,000	88.2% of Base Cost

E - PRECONSTRUCTION ITEMS

					Indirect %	9.50%	Indirect %	9.50%	
		AVG %	EFFORT		% of CI	Cost (% CI + Indirect %)	% of CI	Cost (% CI + Indirect %)	
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$58,310	2.00%	$21,462	
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0	
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$135,605	12.00%	$128,772	
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$8,475	0.75%	$8,048	
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0	
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0	
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0	
E	PRECONSTRUCTION ITEMS	SUBTOTAL (E)	(% of CI)		19.57%	$202,000	16.12%	$158,000	11.8% of Base Cost
	PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)				$1,445,000		$1,338,000	100.0% of Base Cost
							RE/ME Ratio:	0.93	

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE	18.8% OF BASE COST	$252,000	
TOTAL PROJECT COST (P70)		$1,590,000	118.8% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23

ESCALATION	14.1% OF BASE COST	$224,000	
ESCALATED COST		$1,814,000	135.6% of Base Cost

COMMENTS: ***Please document any key assumptions on unit costs or percentages.***

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0								

A-02	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0								

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK	
206-00000	0.0	$39.0	$0	*	-15%	40%	-	0	-	$11.0	$36.0	$79.0	OK	
206-00100	203.1	$68.8	$13,982	*	-15%	40%	166	195	273	$34.0	$66.0	$115.0	OK	
206-00200	0.0	$83.1	$0	*	-15%	40%	-	0	-	$20.4	$77.0	$170.0	OK	
403-34841	29.7	$88.9	$2,640	*	-15%	40%	24	29	40	$62.7	$83.5	$137.0	OK	
601-03000	29.7	$1,216.7	$36,120	*	-15%	40%	24	29	40	$460.0	$960.0	$3,000.0	OK	
602-00020	5369.8	$2.0	$10,856	*	-15%	40%	4,382	5,155	7,217	$0.7	$2.0	$3.4	OK	
606-10700	664.6	$33.7	$22,374	*	-15%	40%	542	638	893	$20.0	$33.0	$50.0	OK	
621-00411	0.0	$300,000.0	$0	*	0%	0%	-	0	-	$270,000.0	$300,000.0	$330,000.0	OK	
621-00412	0.0	$500,000.0	$0	*	0%	0%	-	0	-	$450,000.0	$500,000.0	$550,000.0	OK	
	A-03_CAT300 Cost:	30.8%	$201,696											

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

	A-03_REPL Cost:	0.0%	$0
	A-03_REPA Cost:	0.0%	$0
	A-03_WALL Cost:	0.0%	$0
	A-03_CULV Cost:	0.0%	$0

*MODIFY LS estimate ranges as seem appropriate -->

LUMP SUM COST ESTIMATE RANGES

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
	0.0	$358.3	$0	*	-15%	40%	-	0	-	$300.0	$350.0	$450.0	OK	
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK	
	0.0	$2,000.0	$0	*	-15%	40%	-	0	-	$1,800.0	$2,000.0	$2,200.0	OK	
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK	
	0.0	$2,700.0	$0	*	-15%	40%	-	0	-	$2,430.0	$2,700.0	$2,970.0	OK	
	156.3	$2,900.0	$453,125	*	-15%	40%	128	150	210	$2,610.0	$2,900.0	$3,190.0	OK	
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK	
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK	
	0.0	$3,500.0	$0	*	-15%	40%	-	0	-	$3,150.0	$3,500.0	$3,850.0	OK	
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK	
	A-03_MISC Cost:	69.2%	$453,125											
	A-03 Cost:	100.0%	$654,821											

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

SUBTOTAL (A)	100.0%	$655,000

B - MINOR ITEMS

	% of (A) RISK	COST RISK		MIN	ML	MAX
B-01	2.42%	$15,851		0.0%	2.4%	4.8%
B-02	5.95%	$38,973		0.0%	6.0%	11.9%
B-03	0.33%	$2,162		0.0%	0.3%	0.7%
B-04	4.30%	$28,165		0.0%	4.3%	8.6%
B-05	3.08%	$20,174		0.0%	3.1%	6.2%
B-06	16.56%	$108,468		0.0%	16.6%	33.1%
B-07	20.00%	$131,000		0.0%	20.0%	40.0%
B-08	0.00%	$0		0.0%	0.0%	0.0%
B-09	0.77%	$5,044		0.0%	0.8%	1.5%
B-10	0.00%	$0		0.0%	0.0%	0.0%
B-11	0.33%	$2,162		0.0%	0.3%	0.7%
SUBTOTAL (B)	53.7%	$352,000		0.0%	53.7%	107.5%
CBI	153.7% (% of A)	$1,007,000				

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$60,420	6.0%	6.0%	6.0%
C-02	3.00%	$30,210	3.0%	3.0%	3.0%
C-03	0.11%	$1,085	0.1%	0.11%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$92,000			
CI	167.7%	$1,099,000			

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$120,341	10.95%	10.95%	10.95%
D-02	9.50%	$104,405	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$225,000			
CONST		$1,324,000			

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$23,079	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$137,375	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$8,243	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.4%	$169,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	53	$1,493,000
BASE COST	24	$1,338,000
RISK RESERVE	18.8% OF BASE COST	$252,000
P70 VALUE	70	$1,590,000

Probabilistic Ranges:

P10	$1,240,000
P50	$1,475,000
P70	$1,590,000
P90	$1,764,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: **22-Oct-18**

Project Name	**R2 BUNDLE**
Project Number	**I-15-T**
Sub-Account Number	**XXXXX**
Project Description	**I-15-T**
Project Work Type	**BRIDGE REPLACEMENT**
Estimator:	**E.A.**
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	024A	**Begin MP:**	271.9	**End MP:**	278.0	**Length:**	6.1
CDOT Region:	2	**FIPS City:**	NONE	**FIPS County:**	Teller Co		
		FIPS City:	00000	**FIPS County:**	119		
Segment Mid-point	**RefPt** 274.950	**Latitude:**	38.9330	**Longitude:**	-105.2285	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	**Urban-Rural Class:**	1 Rural	**Terrain:**	3 Mountainous		
AADT:	5,300	**Truck ADT:**	160	**Tier Class:**	Tier 2	**Primary Surface:**	1 Asphalt
Design Maturity:	0 - Conceptual	**NEPA Action:**	Cat/Ex	**NEPA Status:**	In Progress		
Project Delivery Method:	Design-Bid-Build	**Construction Start (MMM-YY)**	Sep-22	**Construction Duration (mo)**	24.0		

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	76.5%	$652,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	100	LS	23.5%	$200,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$852,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$20,618
B-02	Environmental	3 - Average	% OF A	6.0%	$50,694
B-03	Structural	3 - Average	% OF A	0.3%	$2,812
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$36,636
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$26,242
B-06	Mobilization	3 - Average	% OF A	16.6%	$141,091
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$170,400
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$6,560
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$2,812
		SUBTOTAL (B)	% OF A	53.7%	$458,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**153.8%**	**$1,310,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$78,600
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$39,300
C-03	F/A - Project Communications		% OF CBI	0.1%	$1,457
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$119,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**167.7%**	**$1,429,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$156,476
D-02	Construction Indirects	% OF CI	9.5%	$135,755
	SUBTOTAL (D)	% OF CI	20.4%	$292,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$1,721,000**

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$31,295
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$187,771
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$11,736
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.2%	$231,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) **$1,952,000**

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE DATE: **11/6/2018**

RISK RESERVE 11.9% OF BASE COST **$232,000**

TOTAL PROJECT COST **$2,184,000**

111.9% of Base Cost

ESCALATION

Construction Start	Sep-22	**Escalation from Estimate Date:**	Nov-18
Duration (mo)	24.0	**to Construction Mid-Point Date:**	Sep-23

ESCALATION 14.1% OF BASE COST **$308,000**

ESCALATED PROJECT COST **$2,492,000**

127.7% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	I-15-T
Sub-Account Number	XXXXX
Project Description	I-15-T
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	024A	Begin MP:	271.9	End MP:	278.0	Length:	6.1
CDOT Region:	2	City:	NONE	County:	Teller Co		
		FIPS City:	00000	FIPS County:	119		
Segment Mid-point	RefPt 274.950	Latitude:	38.9330	Longitude:	-105.2285	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	3
AADT:	5,300	Truck ADT:	160	Tier Class:	Tier 2	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

				Model Estimate		Region Estimate	
A-01	EARTHWORK	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-01 Cost:	0.0%	$0	0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-02 Cost:	0.0%	$0	0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)						

A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	500	$21.6	$10,777	$36.0	$18,000
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	105	$45.3	$4,756	$66.0	$6,930
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	0	$48.2	$0	$77.0	$0
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	12	$83.5	$1,035	$83.5	$1,035
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	28	$960.0	$27,168	$960.0	$27,168
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	2,300	$1.0	$2,314	$2.0	$4,600
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	596	$95.5	$56,906	$33.0	$19,668
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	0	$65,000.0	$0	$300,000.0	$0
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	1	$50,000.0	$50,000	$500,000.0	$500,000
			A-03_CAT300 Cost:		53.3%	$228,000	76.5%	$652,000
A-03_repl	BRIDGE REPLACEMENT						
			A-03_REPL Cost:		0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR						
			A-03_REPA Cost:		0.0%	$0	0.0%	$0
A-03_wall	WALLS						
			A-03_WALL Cost:		0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS				R2		
			A-03_CULV Cost:		0.0%	$0	0.0%	$0

A-03_misc	MISCELLANEOUS STRUCTURES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_misc	60 Inch Reinforced Concrete Pipe	LF	0	$350.0	$0	$350.0	$0
A-03_misc	72 Inch Reinforced Concrete Pipe	LF	0	$400.0	$0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)	LF	100	$2,000.0	$200,000	$2,000.0	$200,000
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)	LF	0	$2,500.0	$0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)	LF	0	$2,700.0	$0	$2,700.0	$0
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*	LF	0	$2,900.0	$0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,100.0	$0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)	LF	0	$3,500.0	$0	$3,500.0	$0
A-03_misc	0	LF	0	$0.0	$0	$0.0	$0
			A-03_MISC Cost:	46.7%	$200,000	23.5%	$200,000
			A-03 Cost:	100.0%	$428,000	100.0%	$852,000

A-04	TRAFFIC/ITS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-04 Cost:	0.0%	$0	0.0%	$0

A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
				A-05 Cost:	0.0%	$0	0.0%	$0

A	MAJOR CONSTRUCTION ITEMS	SUBTOTAL (A)	(% of A)	100.0%	$428,000	100.0%	$852,000	43.6% of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		% of (A)	Cost	% of (A)	Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$10,358	2.42%	$20,618
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$25,466	5.95%	$50,694
B-03	Structural	0.0%	0.3%	2.3%	3 - Average	Adjusted—>	0.33%	$1,412	0.33%	$2,812
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$18,404	4.30%	$36,636
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$13,182	3.08%	$26,242
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$70,877	16.56%	$141,091
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$85,600	20.00%	$170,400
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$3,296	0.77%	$6,560
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$1,412	0.33%	$2,812

B	MINOR CONSTRUCTION ITEMS	SUBTOTAL (B)	(% of A)	53.74%	$230,000	53.74%	$458,000	
CBI	CONTRUCTION BID ITEMS	SUBTOTAL (A + B)	(% of A)	153.74%	$658,000	153.74%	$1,310,000	67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

C-01	F/A - General					6.00%	$39,480	6.00%	$78,600	
C-02	F/A - Minor Contract Revisions (MCR's)					3.00%	$19,740	3.00%	$39,300	
C-03	F/A - Project Communications	[Level 4	$1,310,000	X	0.11%]	0.11%	$732	0.11%	$1,457	
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)					0.00%	$0	0.00%	$0	
C	F/A's & TSM&O	SUBTOTAL (C)	(% of CBI)	9.11%	$60,000	9.11%	$119,000	
CI	CONSTRUCTION ITEMS	SUBTOTAL (A + B + C)	(% of A)	167.76%	$718,000	167.72%	$1,429,000	73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

D-01	Construction Engineering	(Default: 10.95%)	10.95%	$78,621	10.95%	$156,476	
D-02	Construction Indirects	(Default: 9.5%)	9.50%	$68,210	9.50%	$135,755	
D	CONSTRUCTION ENGINEERING & INDIRECTS	SUBTOTAL (D)	(% of CI)	20.45%	$147,000	20.45%	$292,000	
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)			$865,000		$1,721,000	88.2% of Base Cost

E - PRECONSTRUCTION ITEMS

Indirect % 9.50% (Model Estimate) | Indirect % 9.50% (Region Estimate)

		AVG %	EFFORT		% of CI	Cost (% CI + Indirect %)	% of CI	Cost (% CI + Indirect %)
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$40,568	2.00%	$31,295
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$94,345	12.00%	$187,771
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$5,897	0.75%	$11,736
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0

E	PRECONSTRUCTION ITEMS	SUBTOTAL (E)	(% of CI)	19.64%	$141,000	16.17%	$231,000	11.8% of Base Cost
	PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)			$1,006,000		$1,952,000	100.0% of Base Cost
						RE/ME Ratio:	1.94	

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE	11.9% OF BASE COST	$232,000	
TOTAL PROJECT COST (P70)		$2,184,000	111.9% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23

ESCALATION	14.1% OF BASE COST	$308,000	
ESCALATED COST		$2,492,000	127.7% of Base Cost

COMMENTS: ***Please document any key assumptions on unit costs or percentages.***

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0								

A-02	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0								

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK	
206-00000	520.8	$39.0	$20,313	*	-15%	40%	425	500	700	$11.0	$36.0	$79.0	OK	
206-00100	109.4	$68.8	$7,529	*	-15%	40%	89	105	147	$34.0	$66.0	$115.0	OK	
206-00200	0.0	$83.1	$0	*	-15%	40%	-	0	-	$20.4	$77.0	$170.0	OK	
403-34841	12.9	$88.9	$1,148	*	-15%	40%	11	12	17	$62.7	$83.5	$137.0	OK	
601-03000	29.5	$1,216.7	$35,866	*	-15%	40%	24	28	40	$460.0	$960.0	$3,000.0	OK	
602-00020	2395.8	$2.0	$4,844	*	-15%	40%	1,955	2,300	3,220	$0.7	$2.0	$3.4	OK	
606-10700	620.8	$33.7	$20,901	*	-15%	40%	507	596	834	$20.0	$33.0	$50.0	OK	
621-00411	0.0	$300,000.0	$0	*	0%	0%	-	0	-	$270,000.0	$300,000.0	$330,000.0	OK	
621-00412	1.0	$500,000.0	$500,000	*	0%	0%	1	1	1	$450,000.0	$500,000.0	$550,000.0	OK	
	A-03_CAT300 Cost:	77.2%	$706,325	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.										
	A-03_REPL Cost:	0.0%	$0											
	A-03_REPA Cost:	0.0%	$0	*MODIFY LS estimate ranges as seem appropriate -->						LUMP SUM COST ESTIMATE RANGES				
	A-03_WALL Cost:	0.0%	$0											
	A-03_CULV Cost:	0.0%	$0											

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
	0.0	$358.3	$0	*	-15%	40%	-	0	-	$300.0	$350.0	$450.0	OK	
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK	
	104.2	$2,000.0	$208,333	*	-15%	40%	85	100	140	$1,800.0	$2,000.0	$2,200.0	OK	
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK	
	0.0	$2,700.0	$0	*	-15%	40%	-	0	-	$2,430.0	$2,700.0	$2,970.0	OK	
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK	
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK	
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK	
	0.0	$3,500.0	$0	*	-15%	40%	-	0	-	$3,150.0	$3,500.0	$3,850.0	OK	
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK	
	A-03_MISC Cost:	22.8%	$208,333	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.										
	A-03 Cost:	100.0%	$914,658											

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.							

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0	*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.							
	SUBTOTAL (A)	100.0%	$915,000								

B - MINOR ITEMS

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS

	% of (A) RISK	COST RISK	* MIN	ML	MAX
B-01	2.42%	$22,143	0.0%	2.4%	4.8%
B-02	5.95%	$54,443	0.0%	6.0%	11.9%
B-03	0.33%	$3,020	0.0%	0.3%	0.7%
B-04	4.30%	$39,345	0.0%	4.3%	8.6%
B-05	3.08%	$28,182	0.0%	3.1%	6.2%
B-06	16.56%	$151,524	0.0%	16.6%	33.1%
B-07	20.00%	$183,000	0.0%	20.0%	40.0%
B-08	0.00%	$0	0.0%	0.0%	0.0%
B-09	0.77%	$7,046	0.0%	0.8%	1.5%
B-10	0.00%	$0	0.0%	0.0%	0.0%
B-11	0.33%	$3,020	0.0%	0.3%	0.7%
SUBTOTAL (B)	53.7%	$492,000	0.0%	53.7%	107.5%

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

CBI	153.7% (% of A)	$1,407,000

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$84,420	6.0%	6.0%	6.0%
C-02	3.00%	$42,210	3.0%	3.0%	3.0%
C-03	0.11%	$1,565	0.1%	0.11%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$128,000			

CI	167.7%	$1,535,000

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$168,083	10.95%	10.95%	10.95%
D-02	9.50%	$145,825	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$314,000			

CONST	$1,849,000

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$32,235	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$191,875	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$11,513	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.4%	$236,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	52	$2,085,000
BASE COST	28	$1,952,000
RISK RESERVE	11.9% OF BASE COST	$232,000
P70 VALUE	70	$2,184,000

Probabilistic Ranges:

P10	$1,815,000
P50	$2,074,000
P70	$2,184,000
P90	$2,362,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: **22-Oct-18**

Project Name	**R2 BUNDLE**
Project Number	**I-15-AO**
Sub-Account Number	**XXXXX**
Project Description	**I-15-AO**
Project Work Type	**BRIDGE REPLACEMENT**
Estimator:	**E.A.**
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	024A	**Begin MP:**	271.9	**End MP:**	278.0	**Length:**	6.1
CDOT Region:	2	**FIPS City:**	NONE	**FIPS County:**	Teller Co		
		FIPS City:	00000	**FIPS County:**	119		
Segment Mid-point	**RefPt** 274.950	**Latitude:**	38.9330	**Longitude:**	-105.2285	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	**Urban-Rural Class:**	1 Rural	**Terrain:**	3 Mountainous		
AADT:	5,300	**Truck ADT:**	160	**Tier Class:**	Tier 2	**Primary Surface:**	1 Asphalt
Design Maturity:	0 - Conceptual	**NEPA Action:**	Cat/Ex	**NEPA Status:**	In Progress		
Project Delivery Method:	Design-Bid-Build	**Construction Start (MMM-YY)**	Sep-22	**Construction Duration (mo)**	24.0		

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	75.1%	$724,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	120	LS	24.9%	$240,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$964,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$23,329
B-02	Environmental	3 - Average	% OF A	6.0%	$57,358
B-03	Structural	3 - Average	% OF A	0.3%	$3,181
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$41,452
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$29,691
B-06	Mobilization	3 - Average	% OF A	16.6%	$159,638
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$192,800
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$7,423
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$3,181
		SUBTOTAL (B)	% OF A	53.7%	$518,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**153.7%**	**$1,482,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$88,920
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$44,460
C-03	F/A - Project Communications		% OF CBI	0.1%	$1,670
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$135,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**167.7%**	**$1,617,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$177,062
D-02	Construction Indirects	% OF CI	9.5%	$153,615
	SUBTOTAL (D)	% OF CI	20.5%	$331,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$1,948,000**

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$35,412
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$212,474
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$13,280
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.1%	$261,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) **$2,209,000**

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE DATE: **11/6/2018**

RISK RESERVE 11.5% OF BASE COST **$253,000**

TOTAL PROJECT COST **$2,462,000**

111.5% of Base Cost

ESCALATION

Construction Start	Sep-22	**Escalation from Estimate Date:**	Nov-18	**ESCALATION**	14.1% OF BASE COST	**$347,000**
Duration (mo)	24.0	**to Construction Mid-Point Date:**	Sep-23			

ESCALATED PROJECT COST **$2,809,000**

127.2% of Base Cost

Key: Auto-Populated — Data Provided in Input Form; Model Estimate — Auto-populated from Pricing Database Uploads; Region Estimate — Region Input; Region Overwrite — Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	I-15-AO
Sub-Account Number	XXXXX
Project Description	I-15-AO
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	024A	Begin MP:	271.9	End MP:	278.0	Length:	6.1
CDOT Region:	2	City:	NONE	County:	Teller Co		
		FIPS City:	00000	FIPS County:	119		
Segment Mid-point	RefPt 274.950	Latitude:	38.9330	Longitude:	-105.2285	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	3
AADT:	5,300	Truck ADT:	160	Tier Class:	Tier 2	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

				Model Estimate Unit Cost	Model Estimate Cost	Region Estimate Unit Cost	Region Estimate Cost
A-01	EARTHWORK	Unit	Qty				
			A-01 Cost:	0.0%	$0	0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty				
			A-02 Cost:	0.0%	$0	0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)						
A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty			
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7 / $74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	610	$21.6 / $13,147	$36.0	$21,960
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	125	$45.3 / $5,662	$66.0	$8,250
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	0	$48.2 / $0	$77.0	$0
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	12	$83.5 / $1,035	$83.5	$1,035
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	28	$960.0 / $27,168	$960.0	$27,168
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	2,300	$1.0 / $2,314	$2.0	$4,600
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	2,596	$95.5 / $247,865	$33.0	$85,668
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	0	$65,000.0 / $0	$300,000.0	$0
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	1	$50,000.0 / $50,000	$500,000.0	$500,000
			A-03_CAT300 Cost:	63.7%	$422,000	75.1%	$724,000
A-03_repl	BRIDGE REPLACEMENT						
			A-03_REPL Cost:	0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR						
			A-03_REPA Cost:	0.0%	$0	0.0%	$0
A-03_wall	WALLS						
			A-03_WALL Cost:	0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS			R2			
			A-03_CULV Cost:	0.0%	$0	0.0%	$0
A-03_misc	MISCELLANEOUS STRUCTURES		Unit	Qty			
A-03_misc	60 Inch Reinforced Concrete Pipe		LF	0	$350.0 / $0	$350.0	$0
A-03_misc	72 Inch Reinforced Concrete Pipe		LF	0	$400.0 / $0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)		LF	120	$2,000.0 / $240,000	$2,000.0	$240,000
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)		LF	0	$2,500.0 / $0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)		LF	0	$2,700.0 / $0	$2,700.0	$0
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*		LF	0	$2,900.0 / $0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)		LF	0	$3,100.0 / $0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)		LF	0	$3,300.0 / $0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)		LF	0	$3,500.0 / $0	$3,500.0	$0
A-03_misc	0		LF	0	$0.0 / $0	$0.0	$0
			A-03_MISC Cost:	36.3%	$240,000	24.9%	$240,000
			A-03 Cost:	100.0%	$662,000	100.0%	$964,000
A-04	TRAFFIC/ITS		Unit	Qty			
			A-04 Cost:	0.0%	$0	0.0%	$0
A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty			
			A-05 Cost:	0.0%	$0	0.0%	$0
A	MAJOR CONSTRUCTION ITEMS		SUBTOTAL (A)	(% of A)	100.0% / $662,000	100.0%	$964,000 (43.6% of Base Cost)

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		Model Estimate % of (A)	Model Estimate Cost	Region Estimate % of (A)	Region Estimate Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$16,020	2.42%	$23,329
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$39,389	5.95%	$57,358
B-03	Structural	0.0%	0.3%	2.3%	3 - Average	Adjusted—>	0.33%	$2,185	0.33%	$3,181
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$28,466	4.30%	$41,452
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$20,390	3.08%	$29,691
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$109,627	16.56%	$159,638
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$132,400	20.00%	$192,800
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$5,097	0.77%	$7,423
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$2,185	0.33%	$3,181
B	MINOR CONSTRUCTION ITEMS				SUBTOTAL (B)	(% of A)	53.74%	$356,000	53.74%	$518,000
CBI	CONTRUCTION BID ITEMS				SUBTOTAL (A + B)	(% of A)	153.74%	$1,018,000	153.74%	$1,482,000 (67.1% of Base Cost)

C - FORCE ACCOUNTS & TSM&O

						Model Estimate % of CBI	Model Estimate Cost	Region Estimate % of CBI	Region Estimate Cost
C-01	F/A - General					6.00%	$61,080	6.00%	$88,920
C-02	F/A - Minor Contract Revisions (MCR's)					3.00%	$30,540	3.00%	$44,460
C-03	F/A - Project Communications	[Level 4	$1,482,000	X	0.11%]	0.11%	$1,147	0.11%	$1,670
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)					0.00%	$0	0.00%	$0
C	F/A's & TSM&O				SUBTOTAL (C)	(% of CBI) 9.11%	$93,000	9.11%	$135,000
CI	CONSTRUCTION ITEMS				SUBTOTAL (A + B + C)	(% of A) 167.82%	$1,111,000	167.74%	$1,617,000 (73.2% of Base Cost)

D - CONSTRUCTION ENGINEERING & INDIRECTS

			Model Estimate % of CI	Model Estimate Cost	Region Estimate % of CI	Region Estimate Cost
D-01	Construction Engineering	(Default: 10.95%)	10.95%	$121,655	10.95%	$177,062
D-02	Construction Indirects	(Default: 9.5%)	9.50%	$105,545	9.50%	$153,615
D	CONSTRUCTION ENGINEERING & INDIRECTS	SUBTOTAL (D) (% of CI)	20.45%	$227,000	20.45%	$331,000
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)		$1,338,000		$1,948,000 (88.2% of Base Cost)

E - PRECONSTRUCTION ITEMS

Indirect % 9.50% (Model Estimate) / Indirect % 9.50% (Region Estimate)

		AVG %	EFFORT		Model Estimate % of CI	Model Estimate Cost (% CI + Indirect %)	Region Estimate % of CI	Region Estimate Cost (% CI + Indirect %)
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$62,774	2.00%	$35,412
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$145,985	12.00%	$212,474
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$9,124	0.75%	$13,280
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0
E	PRECONSTRUCTION ITEMS		SUBTOTAL (E)	(% of CI)	19.62%	$218,000	16.14%	$261,000 (11.8% of Base Cost)
	PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)				$1,556,000		$2,209,000 (100.0% of Base Cost)
							RE/ME Ratio:	1.42

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE	11.5% OF BASE COST	$253,000
TOTAL PROJECT COST (P70)		$2,462,000 (111.5% of Base Cost)

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23

ESCALATION	14.1% OF BASE COST	$347,000
ESCALATED COST		$2,809,000 (127.2% of Base Cost)

COMMENTS: ***Please document any key assumptions on unit costs or percentages.***

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0									

A-02	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0									

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX	
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK
206-00000	635.4	$39.0	$24,781	*	-15%	40%	519	610	854	$11.0	$36.0	$79.0	OK
206-00100	130.2	$68.8	$8,963	*	-15%	40%	106	125	175	$34.0	$66.0	$115.0	OK
206-00200	0.0	$83.1	$0	*	-15%	40%	-	0	-	$20.4	$77.0	$170.0	OK
403-34841	12.9	$88.9	$1,148	*	-15%	40%	11	12	17	$62.7	$83.5	$137.0	OK
601-03000	29.5	$1,216.7	$35,866	*	-15%	40%	24	28	40	$460.0	$960.0	$3,000.0	OK
602-00020	2395.8	$2.0	$4,844	*	-15%	40%	1,955	2,300	3,220	$0.7	$2.0	$3.4	OK
606-10700	2704.2	$33.7	$91,040	*	-15%	40%	2,207	2,596	3,634	$20.0	$33.0	$50.0	OK
621-00411	0.0	$300,000.0	$0	*	0%	0%	-	0	-	$270,000.0	$300,000.0	$330,000.0	OK
621-00412	1.0	$500,000.0	$500,000	*	0%	0%	1	1	1	$450,000.0	$500,000.0	$550,000.0	OK
	A-03_CAT300 Cost:	75.8%	$782,367										

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-03_REPL Cost: 0.0% $0

*MODIFY LS estimate ranges as seem appropriate --> LUMP SUM COST ESTIMATE RANGES

A-03_REPA Cost: 0.0% $0

A-03_WALL Cost: 0.0% $0

A-03_CULV Cost: 0.0% $0

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX	
	0.0	$358.3	$0	*	-15%	40%	-	0	-	$300.0	$350.0	$450.0	OK
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK
	125.0	$2,000.0	$250,000	*	-15%	40%	102	120	168	$1,800.0	$2,000.0	$2,200.0	OK
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK
	0.0	$2,700.0	$0	*	-15%	40%	-	0	-	$2,430.0	$2,700.0	$2,970.0	OK
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK
	0.0	$3,500.0	$0	*	-15%	40%	-	0	-	$3,150.0	$3,500.0	$3,850.0	OK
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK
	A-03_MISC Cost:	24.2%	$250,000										
	A-03 Cost:	100.0%	$1,032,367										

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

SUBTOTAL (A) 100.0% $1,032,000

B - MINOR ITEMS

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS

	% of (A) RISK	COST RISK	* MIN	ML	MAX
B-01	2.42%	$24,974	0.0%	2.4%	4.8%
B-02	5.95%	$61,404	0.0%	6.0%	11.9%
B-03	0.33%	$3,406	0.0%	0.3%	0.7%
B-04	4.30%	$44,376	0.0%	4.3%	8.6%
B-05	3.08%	$31,786	0.0%	3.1%	6.2%
B-06	16.56%	$170,899	0.0%	16.6%	33.1%
B-07	20.00%	$206,400	0.0%	20.0%	40.0%
B-08	0.00%	$0	0.0%	0.0%	0.0%
B-09	0.77%	$7,946	0.0%	0.8%	1.5%
B-10	0.00%	$0	0.0%	0.0%	0.0%
B-11	0.33%	$3,406	0.0%	0.3%	0.7%
SUBTOTAL (B)	53.7%	$555,000	0.0%	53.7%	107.5%

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

CBI 153.7% (% of A) $1,587,000

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$95,220	6.0%	6.0%	6.0%
C-02	3.00%	$47,610	3.0%	3.0%	3.0%
C-03	0.11%	$1,789	0.1%	0.11%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$145,000			

CI 167.7% $1,732,000

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$189,654	10.95%	10.95%	10.95%
D-02	9.50%	$164,540	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$354,000			

CONST $2,086,000

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$36,372	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$216,500	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$12,990	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.4%	$266,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	52	$2,352,000
BASE COST	27	$2,209,000
RISK RESERVE	11.5% OF BASE COST	$253,000
P70 VALUE	70	$2,462,000

Probabilistic Ranges:

P10	$2,060,000
P50	$2,344,000
P70	$2,462,000
P90	$2,651,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: **22-Oct-18**

Project Name	**R2 BUNDLE**
Project Number	**N-21-F**
Sub-Account Number	**XXXXX**
Project Description	**N-21-F**
Project Work Type	**BRIDGE REPLACEMENT**
Estimator:	**E.A.**
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	**Begin MP:**	47.1	**End MP:**	69.8	**Length:**	22.7
CDOT Region:	2	**FIPS City:**	NONE	**FIPS County:**	Otero Co		
		FIPS City:	00000	**FIPS County:**	089		
Segment Mid-point	**RefPt** 58.450	**Latitude:**	37.8382	**Longitude:**	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	**Urban-Rural Class:**	1 Rural	**Terrain:**	2 Rolling		
AADT:	340	**Truck ADT:**	10	**Tier Class:**	Tier 4	**Primary Surface:**	1 Asphalt

Design Maturity:	0 - Conceptual	**NEPA Action:**	Cat/Ex	**NEPA Status:**	In Progress
Project Delivery Method:	Design-Bid-Build	**Construction Start (MMM-YY)**	Sep-22	**Construction Duration (mo)**	24.0

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	34.1%	$490,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	270	LS	65.9%	$945,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$1,435,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$34,727
B-02	Environmental	3 - Average	% OF A	6.0%	$85,383
B-03	Structural	3 - Average	% OF A	0.3%	$4,736
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$61,705
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$44,198
B-06	Mobilization	3 - Average	% OF A	16.6%	$237,636
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$287,000
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$11,050
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$4,736
		SUBTOTAL (B)	% OF A	53.7%	$771,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**153.7%**	**$2,206,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$132,360
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$66,180
C-03	F/A - Project Communications		% OF CBI	0.1%	$2,623
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$201,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**167.7%**	**$2,407,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$263,567
D-02	Construction Indirects	% OF CI	9.5%	$228,665
	SUBTOTAL (D)	% OF CI	20.4%	$492,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$2,899,000**

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$52,713
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$316,280
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$19,767
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.2%	$389,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) **$3,288,000**

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE DATE: **11/6/2018**

RISK RESERVE 11.7% OF BASE COST **$384,000**

TOTAL PROJECT COST **$3,672,000**

111.7% of Base Cost

ESCALATION

Construction Start	Sep-22	**Escalation from Estimate Date:**	Nov-18	**ESCALATION**	14.1% OF BASE COST **$517,000**
Duration (mo)	24.0	**to Construction Mid-Point Date:**	Sep-23	**ESCALATED PROJECT COST**	**$4,189,000**

127.4% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	N-21-F
Sub-Account Number	XXXXX
Project Description	N-21-F
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	Begin MP:	47.1	End MP:	69.8	Length:	22.7
CDOT Region:	2	City:	NONE	County:	Otero Co		
		FIPS City:	00000	FIPS County:	089		
Segment Mid-point	RefPt 58.450	Latitude:	37.8382	Longitude:	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	2
AADT:	340	Truck ADT:	10	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

			Unit	Qty	Model Estimate Unit Cost	Model Estimate Cost	Region Estimate Unit Cost	Region Estimate Cost
A-01	EARTHWORK							
				A-01 Cost:	0.0%	$0	0.0%	$0
A-02	PAVEMENT & BASES							
				A-02 Cost:	0.0%	$0	0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)							
A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	0	$21.6	$0	$36.0	$0
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	335	$45.3	$15,174	$66.0	$22,110
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	0	$48.2	$0	$77.0	$0
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	55	$83.5	$4,590	$83.5	$4,590
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	54	$960.0	$51,552	$960.0	$51,552
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	6,290	$1.0	$6,329	$2.0	$12,580
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	730	$95.5	$69,700	$33.0	$24,090
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	1	$65,000.0	$65,000	$300,000.0	$300,000
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	0	$50,000.0	$0	$500,000.0	$0
				A-03_CAT300 Cost:	23.3%	$287,000	34.1%	$490,000
A-03_repl	BRIDGE REPLACEMENT							
				A-03_REPL Cost:	0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR							
				A-03_REPA Cost:	0.0%	$0	0.0%	$0
A-03_wall	WALLS							
				A-03_WALL Cost:	0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS				R2			
				A-03_CULV Cost:	0.0%	$0	0.0%	$0
A-03_misc	MISCELLANEOUS STRUCTURES		Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_misc	60 Inch Reinforced Concrete Pipe		LF	0	$350.0	$0	$350.0	$0
A-03_misc	72 Inch Reinforced Concrete Pipe		LF	0	$400.0	$0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)		LF	0	$2,000.0	$0	$2,000.0	$0
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)		LF	0	$2,500.0	$0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)		LF	0	$2,700.0	$0	$2,700.0	$0
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*		LF	0	$2,900.0	$0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)		LF	0	$3,100.0	$0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)		LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)		LF	270	$3,500.0	$945,000	$3,500.0	$945,000
A-03_misc	0		LF	0	$0.0	$0	$0.0	$0
				A-03_MISC Cost:	76.7%	$945,000	65.9%	$945,000
				A-03 Cost:	100.0%	$1,232,000	100.0%	$1,435,000
A-04	TRAFFIC/ITS		Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
				A-04 Cost:	0.0%	$0	0.0%	$0
A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
				A-05 Cost:	0.0%	$0	0.0%	$0
A	MAJOR CONSTRUCTION ITEMS		SUBTOTAL (A)	(% of A)	100.0%	$1,232,000	100.0%	$1,435,000

43.6% of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		Model Estimate % of (A)	Model Estimate Cost	Region Estimate % of (A)	Region Estimate Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$29,814	2.42%	$34,727
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$73,304	5.95%	$85,383
B-03	Structural	0.0%	0.3%	2.3%	3 - Average	Adjusted—>	0.33%	$4,066	0.33%	$4,736
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$52,976	4.30%	$61,705
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$37,946	3.08%	$44,198
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$204,019	16.56%	$237,636
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$246,400	20.00%	$287,000
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$9,486	0.77%	$11,050
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$4,066	0.33%	$4,736
B	MINOR CONSTRUCTION ITEMS				SUBTOTAL (B)	(% of A)	53.74%	$662,000	53.74%	$771,000
CBI	CONTRUCTION BID ITEMS				SUBTOTAL (A + B)	(% of A)	153.74%	$1,894,000	153.74%	$2,206,000

67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

							Model Estimate % of CBI	Model Estimate Cost	Region Estimate % of CBI	Region Estimate Cost
C-01	F/A - General						6.00%	$113,640	6.00%	$132,360
C-02	F/A - Minor Contract Revisions (MCR's)						3.00%	$56,820	3.00%	$66,180
C-03	F/A - Project Communications	[Level 4	$2,206,000	X	0.12%	]	0.12%	$2,252	0.12%	$2,623
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)						0.00%	$0	0.00%	$0
C	F/A's & TSM&O				SUBTOTAL (C)	(% of CBI)	9.12%	$173,000	9.12%	$201,000
CI	CONSTRUCTION ITEMS				SUBTOTAL (A + B + C)	(% of A)	167.78%	$2,067,000	167.74%	$2,407,000

73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

			Model Estimate % of CI	Model Estimate Cost	Region Estimate % of CI	Region Estimate Cost
D-01	Construction Engineering	(Default: 10.95%)	10.95%	$226,337	10.95%	$263,567
D-02	Construction Indirects	(Default: 9.5%)	9.50%	$196,365	9.50%	$228,665
D	CONSTRUCTION ENGINEERING & INDIRECTS	SUBTOTAL (D) (% of CI)	20.45%	$423,000	20.45%	$492,000
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)		$2,490,000		$2,899,000

88.2% of Base Cost

E - PRECONSTRUCTION ITEMS

						Model Estimate Indirect %	9.50%	Region Estimate Indirect %	9.50%
		AVG %	EFFORT			Model Estimate % of CI	Model Estimate Cost (% CI + Indirect %)	Region Estimate % of CI	Region Estimate Cost (% CI + Indirect %)
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>		5.16%	$116,790	2.00%	$52,713
E-02	Utilities + Railroad Work [Phase U]					0.00%	$0	0.00%	$0
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual				12.00%	$271,604	12.00%	$316,280
E-03.1	Subsurface Utility Engineering (SUE) Budget					0.75%	$16,975	0.75%	$19,767
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget					0.00%	$0	0.00%	$0
E-04	Environmental (NEPA) [Phase E]					0.00%	$0	0.00%	$0
E-05	Miscellaneous [Phase M]					0.00%	$0	0.00%	$0
E	PRECONSTRUCTION ITEMS			SUBTOTAL (E)	(% of CI)	19.59%	$405,000	16.16%	$389,000

11.8% of Base Cost

	PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)	$2,895,000		$3,288,000
				RE/ME Ratio:	1.14

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE	DATE: 11/6/2018	RISK RESERVE	11.7% OF BASE COST	$384,000
		TOTAL PROJECT COST (P70)		$3,672,000

111.7% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18	ESCALATION	14.1% OF BASE COST	$517,000
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23	ESCALATED COST		$4,189,000

127.4% of Base Cost

COMMENTS: ***Please document any key assumptions on unit costs or percentages.***

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0									

A-02	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0									

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK	
206-00000	0.0	$39.0	$0	*	-15%	40%	-	0	-	$11.0	$36.0	$79.0	OK	
206-00100	349.0	$68.8	$24,020	*	-15%	40%	285	335	469	$34.0	$66.0	$115.0	OK	
206-00200	0.0	$83.1	$0	*	-15%	40%	-	0	-	$20.4	$77.0	$170.0	OK	
403-34841	57.3	$88.9	$5,094	*	-15%	40%	47	55	77	$62.7	$83.5	$137.0	OK	
601-03000	55.9	$1,216.7	$68,057	*	-15%	40%	46	54	75	$460.0	$960.0	$3,000.0	OK	
602-00020	6552.1	$2.0	$13,246	*	-15%	40%	5,347	6,290	8,806	$0.7	$2.0	$3.4	OK	
606-10700	760.4	$33.7	$25,601	*	-15%	40%	621	730	1,022	$20.0	$33.0	$50.0	OK	
621-00411	1.0	$300,000.0	$300,000	*	0%	0%	1	1	1	$270,000.0	$300,000.0	$330,000.0	OK	
621-00412	0.0	$500,000.0	$0	*	0%	0%	-	0	-	$450,000.0	$500,000.0	$550,000.0	OK	
	A-03_CAT300 Cost:	35.9%	$551,742											

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

	A-03_REPL Cost:	0.0%	$0
	A-03_REPA Cost:	0.0%	$0
	A-03_WALL Cost:	0.0%	$0
	A-03_CULV Cost:	0.0%	$0

*MODIFY LS estimate ranges as seem appropriate -->

LUMP SUM COST ESTIMATE RANGES

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX		
	0.0	$358.3	$0	*	-15%	40%	-	0	-	$300.0	$350.0	$450.0	OK	
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK	
	0.0	$2,000.0	$0	*	-15%	40%	-	0	-	$1,800.0	$2,000.0	$2,200.0	OK	
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK	
	0.0	$2,700.0	$0	*	-15%	40%	-	0	-	$2,430.0	$2,700.0	$2,970.0	OK	
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK	
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK	
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK	
	281.3	$3,500.0	$984,375	*	-15%	40%	230	270	378	$3,150.0	$3,500.0	$3,850.0	OK	
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK	
	A-03_MISC Cost:	64.1%	$984,375											
	A-03 Cost:	100.0%	$1,536,117											

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

	SUBTOTAL (A)	100.0%	$1,536,000

B - MINOR ITEMS

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS

	% of (A) RISK	COST RISK	*	MIN	ML	MAX
B-01	2.42%	$37,171		0.0%	2.4%	4.8%
B-02	5.95%	$91,392		0.0%	6.0%	11.9%
B-03	0.33%	$5,069		0.0%	0.3%	0.7%
B-04	4.30%	$66,048		0.0%	4.3%	8.6%
B-05	3.08%	$47,309		0.0%	3.1%	6.2%
B-06	16.56%	$254,362		0.0%	16.6%	33.1%
B-07	20.00%	$307,200		0.0%	20.0%	40.0%
B-08	0.00%	$0		0.0%	0.0%	0.0%
B-09	0.77%	$11,827		0.0%	0.8%	1.5%
B-10	0.00%	$0		0.0%	0.0%	0.0%
B-11	0.33%	$5,069		0.0%	0.3%	0.7%
SUBTOTAL (B)	53.7%	$825,000		0.0%	53.7%	107.5%

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

	CBI	153.7% (% of A)	$2,361,000

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$141,660	6.0%	6.0%	6.0%
C-02	3.00%	$70,830	3.0%	3.0%	3.0%
C-03	0.12%	$2,807	0.1%	0.12%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$215,000			

	CI	167.8%	$2,576,000

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$282,072	10.95%	10.95%	10.95%
D-02	9.50%	$244,720	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$527,000			

	CONST		$3,103,000

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$54,096	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$322,000	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$19,320	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.3%	$395,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	52	$3,498,000
BASE COST	29	$3,288,000
RISK RESERVE	11.7% OF BASE COST	$384,000
P70 VALUE	70	$3,672,000

Probabilistic Ranges:

P10	$3,044,000
P50	$3,481,000
P70	$3,672,000
P90	$3,982,000

Key: Auto-Populated

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - EXECUTIVE SUMMARY SHEET

PROJECT PROFILE

Model Version 3 Rev 04
Last Update: **22-Oct-18**

Project Name	**R2 BUNDLE**
Project Number	**M-21-C**
Sub-Account Number	**XXXXX**
Project Description	**M-21-C**
Project Work Type	**BRIDGE REPLACEMENT**
Estimator:	**E.A.**
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	**Begin MP:**	47.1	**End MP:**	69.8	**Length:**	22.7
CDOT Region:	2	**FIPS City:**	NONE	**FIPS County:**	Otero Co		
		FIPS City:	00000	**FIPS County:**	089		
Segment Mid-point	**RefPt** 58.450	**Latitude:**	37.8382	**Longitude:**	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	**Urban-Rural Class:**	1 Rural	**Terrain:**	2 Rolling		
AADT:	340	**Truck ADT:**	10	**Tier Class:**	Tier 4	**Primary Surface:**	1 Asphalt

Design Maturity:	0 - Conceptual	**NEPA Action:**	Cat/Ex	**NEPA Status:**	In Progress
Project Delivery Method:	Design-Bid-Build	**Construction Start (MMM-YY)**	Sep-22	**Construction Duration (mo)**	24.0

REGION'S ESTIMATE

PROJECT CONSTRUCTION COSTS:

A MAJOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	QTY	UNIT	PERCENTAGE	COST
A-01	Earthwork	0	CY	0.0%	$0
A-02	Pavement & Bases	N/A	SY	0.0%	$0
A-03_CAT300	Itemized Structure	N/A	N/A	36.1%	$475,000
A-03_repl	Bridge Replacement	0	DECK AREA (SF)	0.0%	$0
A-03_repa	Bridge Repair	0	DECK AREA (SF)	0.0%	$0
A-03_wall	Walls	0	SF	0.0%	$0
A-03_culv	Major Culverts	0	LF	0.0%	$0
A-03_misc	Miscellaneous Structures	240	LS	63.9%	$840,000
A-04	Traffic / ITS	N/A	N/A	0.0%	$0
A-05	Other Major Items	N/A	N/A	0.0%	$0
		SUBTOTAL (A)		100.0%	$1,315,000

B MINOR CONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	EFFORT	UNIT	PERCENTAGE	COST
B-01	Removals / Resets	3 - Average	% OF A	2.4%	$31,823
B-02	Environmental	3 - Average	% OF A	6.0%	$78,243
B-03	Structural	3 - Average	% OF A	0.3%	$4,340
B-04	Drainage / Utilities	3 - Average	% OF A	4.3%	$56,545
B-05	Roadway Appurtenances	3 - Average	% OF A	3.1%	$40,502
B-06	Mobilization	3 - Average	% OF A	16.6%	$217,764
B-07	Construction Traffic Control / Detour	3 - Average	% OF A	20.0%	$263,000
B-08	Lighting & Electrical	3 - Average	% OF A	0.0%	$0
B-09	Permanent Signing & Striping	3 - Average	% OF A	0.8%	$10,126
B-10	Traffic Signalization & ITS	3 - Average	% OF A	0.0%	$0
B-11	Miscellaneous	3 - Average	% OF A	0.3%	$4,340
		SUBTOTAL (B)	% OF A	53.7%	$707,000
	CONTRUCTION BID ITEMS (A + B)	**CBI**	**% OF A**	**153.8%**	**$2,022,000**

67.1% of Base Cost

C FORCE ACCOUNTS & TSM&O

PCPT CAT	ITEM DESCRIPTION		UNIT	PERCENTAGE	COST
C-01	F/A - General		% OF CBI	6.0%	$121,320
C-02	F/A - Minor Contract Revisions (MCR's)		% OF CBI	3.0%	$60,660
C-03	F/A - Project Communications		% OF CBI	0.1%	$2,372
C-04	TSM&O Traffic & Operations		% OF CBI	0.0%	$0
		SUBTOTAL (C)	% OF CBI	9.1%	$184,000
	CONSTRUCTION ITEMS (A + B + C)	**CI**	**% OF A**	**167.8%**	**$2,206,000**

73.2% of Base Cost

D CONSTRUCTION ENGINEERING & INDIRECTS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
D-01	Construction Engineering	% OF CI	11.0%	$241,557
D-02	Construction Indirects	% OF CI	9.5%	$209,570
	SUBTOTAL (D)	% OF CI	20.4%	$451,000
	PROJECT CONSTRUCTION BUDGET (A + B + C + D)			**$2,657,000**

88.2% of Base Cost

PROJECT PRECONSTRUCTION COSTS:

E PRECONSTRUCTION ITEMS

PCPT CAT	ITEM DESCRIPTION	UNIT	PERCENTAGE	COST
E-01	Right-of-Way [Phase R]	% OF CI	2.0%	$48,311
E-02	Utilities + Railroad Work [Phase U]	% OF CI	0.0%	$0
E-03	Design & Engineering [Phase D]	% OF CI	12.0%	$289,868
E-03.1	Subsurface Utility Engineering (SUE) Budget	% OF CI	0.8%	$18,117
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget	% OF CI	0.0%	$0
E-04	Environmental (NEPA) [Phase E]	% OF CI	0.0%	$0
E-05	Miscellaneous [Phase M]	% OF CI	0.0%	$0
	SUBTOTAL (E)	% OF CI	16.1%	$356,000

11.8% of Base Cost

PROJECT BASE COST ESTIMATE (CONSTRUCTION + PRECONSTRUCTION) **$3,013,000**

100.0% of Base Cost

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE DATE: **11/6/2018**

RISK RESERVE 11.7% OF BASE COST **$354,000**

TOTAL PROJECT COST **$3,367,000**

111.7% of Base Cost

ESCALATION

Construction Start	Sep-22	**Escalation from Estimate Date:**	Nov-18	**ESCALATION**	14.1% OF BASE COST **$474,000**
Duration (mo)	24.0	**to Construction Mid-Point Date:**	Sep-23	**ESCALATED PROJECT COST**	**$3,841,000**

127.5% of Base Cost

Key:

Auto-Populated	Data Provided in Input Form
Model Estimate	Auto-populated from Pricing Database Uploads
Region Estimate	Region Input
Region Overwrite	Overwritten by Region

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PCPT - MODEL & REGION ESTIMATE FORM

PROJECT PROFILE

Project Name	R2 BUNDLE
Project Number	M-21-C
Sub-Account Number	XXXXX
Project Description	M-21-C
Project Work Type	BRIDGE REPLACEMENT
Estimator:	E.A.
Date:	11/6/2018

PROJECT LOCATION & CHARACTERISTICS

Route:	350A	Begin MP:	47.1	End MP:	69.8	Length:	22.7
CDOT Region:	2	City:	NONE	County:	Otero Co		
		FIPS City:	00000	FIPS County:	089		
Segment Mid-point	RefPt 58.450	Latitude:	37.8382	Longitude:	-103.7489	GOOGLE MAP LINK	
Functional Classification:	4 Minor Arterial	Urban-Rural Class:	1 Rural			Terrain:	2
AADT:	340	Truck ADT:	10	Tier Class:	Tier 4	Primary Surface:	1 Asphalt

Design Maturity:	0 - Conceptual	NEPA Action:	Cat/Ex	NEPA Status:	In Progress
Project Delivery Method:	Design-Bid-Build	Construction Start (MMM-YY)	Sep-22	Construction Duration (mo)	24.0

A - MAJOR CONSTRUCTION ITEMS

				Model Estimate		Region Estimate	
A-01	EARTHWORK	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-01 Cost:	0.0%	$0	0.0%	$0
A-02	PAVEMENT & BASES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-02 Cost:	0.0%	$0	0.0%	$0
A-03	MAJOR STRUCTURES (CAT 300 ITEMS)						

A-03_CAT300	PAYITEM GROUP CATEGORY	CAT 300 STRUCTURAL PAYITEM	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_CAT300	202 - Removal of Structures and Obstructions	202-00400 - Removal of Bridge	EACH	1	$74,923.7	$74,924	$74,923.7	$74,924
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00000 - Structure Excavation	CY	0	$21.6	$0	$36.0	$0
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00100 - Structure Backfill (Class 1)	CY	295	$45.3	$13,362	$66.0	$19,470
A-03_CAT300	206 - Structure Excavation & Backfill, Cofferdam an	206-00200 - Structure Backfill (Class 2)	CY	0	$48.2	$0	$77.0	$0
A-03_CAT300	403 - Hot Bituminous Pavement	403-34841 - Hot Mix Asphalt (Grading SX) (100) (PG	TON	45	$83.5	$3,747	$83.5	$3,747
A-03_CAT300	601 - Structural Concrete	601-03000 - Concrete Class D	CY	44	$960.0	$42,336	$960.0	$42,336
A-03_CAT300	602 - Reinforcing Steel	602-00020 - Reinforcing Steel (Epoxy Coated)	LB	5,855	$1.0	$5,891	$2.0	$11,710
A-03_CAT300	606 - Guardrail and Bridge Rail	606-10700 - Bridge Rail Type 7	LF	698	$95.5	$66,645	$33.0	$23,034
A-03_CAT300	621 - Detour	621-00411 - Structure Temporary Access Road (Loca	L S	1	$65,000.0	$65,000	$300,000.0	$300,000
A-03_CAT300	621 - Detour	621-00412 - Structure Temporary Access Road (Loca	L S	0	$50,000.0	$0	$500,000.0	$0
			A-03_CAT300 Cost:		24.5%	$272,000	36.1%	$475,000

A-03_repl	BRIDGE REPLACEMENT						
			A-03_REPL Cost:		0.0%	$0	0.0%	$0
A-03_repa	BRIDGE REPAIR						
			A-03_REPA Cost:		0.0%	$0	0.0%	$0
A-03_wall	WALLS						
			A-03_WALL Cost:		0.0%	$0	0.0%	$0
A-03_culv	MAJOR CULVERTS				R2			
			A-03_CULV Cost:		0.0%	$0	0.0%	$0

A-03_misc	MISCELLANEOUS STRUCTURES	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
A-03_misc	60 Inch Reinforced Concrete Pipe	LF	0	$350.0	$0	$350.0	$0
A-03_misc	72 Inch Reinforced Concrete Pipe	LF	0	$400.0	$0	$400.0	$0
A-03_misc	10x8 Foot Concrete Box Culvert (Precast)	LF	0	$2,000.0	$0	$2,000.0	$0
A-03_misc	12x10 Foot Concrete Box Culvert (Precast)	LF	0	$2,500.0	$0	$2,500.0	$0
A-03_misc	14x6 Foot Concrete Box Culvert (Precast)	LF	0	$2,700.0	$0	$2,700.0	$0
A-03_misc	14x10 Foot Concrete Box Culvert (Precast)*	LF	0	$2,900.0	$0	$2,900.0	$0
A-03_misc	18x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,100.0	$0	$3,100.0	$0
A-03_misc	20x6 Foot Concrete Box Culvert (Precast)	LF	0	$3,300.0	$0	$3,300.0	$0
A-03_misc	20x8 Foot Concrete Box Culvert (Precast)	LF	240	$3,500.0	$840,000	$3,500.0	$840,000
A-03_misc	0	LF	0	$0.0	$0	$0.0	$0
			A-03_MISC Cost:		75.5%	$840,000	63.9%	$840,000
			A-03 Cost:		100.0%	$1,112,000	100.0%	$1,315,000

A-04	TRAFFIC/ITS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
			A-04 Cost:	0.0%	$0	0.0%	$0

A-05	OTHER CATEGORY	OTHER MAJOR ITEMS	Unit	Qty	Unit Cost	Cost	Unit Cost	Cost
				A-05 Cost:	0.0%	$0	0.0%	$0

A	MAJOR CONSTRUCTION ITEMS	SUBTOTAL (A)	(% of A)	100.0%	$1,112,000	100.0%	$1,315,000	43.6% of Base Cost

B - MINOR CONSTRUCTION ITEMS

Work Type: BRIDGE REPLACEMENT

		MIN %	MEAN %	MAX %	EFFORT		% of (A)	Cost	% of (A)	Cost
B-01	Removals / Resets	0.0%	2.4%	6.0%	3 - Average	Adjusted—>	2.42%	$26,910	2.42%	$31,823
B-02	Environmental	0.0%	6.0%	13.4%	3 - Average	Adjusted—>	5.95%	$66,164	5.95%	$78,243
B-03	Structural	0.0%	0.3%	2.3%	3 - Average	Adjusted—>	0.33%	$3,670	0.33%	$4,340
B-04	Drainage / Utilities	0.0%	4.3%	14.9%	3 - Average	Adjusted—>	4.30%	$47,816	4.30%	$56,545
B-05	Roadway Appurtenances	0.0%	3.1%	5.5%	3 - Average	Adjusted—>	3.08%	$34,250	3.08%	$40,502
B-06	Mobilization	0.0%	16.6%	23.5%	3 - Average	Adjusted—>	16.56%	$184,147	16.56%	$217,764
B-07	Construction Traffic Control / Detour	0.0%	20.0%	26.1%	3 - Average	Adjusted—>	20.00%	$222,400	20.00%	$263,000
B-08	Lighting & Electrical	0.0%	0.0%	3.2%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-09	Permanent Signing & Striping	0.0%	0.8%	1.8%	3 - Average	Adjusted—>	0.77%	$8,562	0.77%	$10,126
B-10	Traffic Signalization & ITS	0.0%	0.0%	3.4%	3 - Average	Adjusted—>	0.00%	$0	0.00%	$0
B-11	Miscellaneous	0.0%	0.3%	1.2%	3 - Average	Adjusted—>	0.33%	$3,670	0.33%	$4,340

B	MINOR CONSTRUCTION ITEMS	SUBTOTAL (B)	(% of A)	53.74%	$598,000	53.74%	$707,000	
CBI	CONTRUCTION BID ITEMS	SUBTOTAL (A + B)	(% of A)	153.74%	$1,710,000	153.74%	$2,022,000	67.1% of Base Cost

C - FORCE ACCOUNTS & TSM&O

C-01	F/A - General							6.00%	$102,600	6.00%	$121,320
C-02	F/A - Minor Contract Revisions (MCR's)							3.00%	$51,300	3.00%	$60,660
C-03	F/A - Project Communications	[Level 4	$2,022,000	X	0.12%	]		0.12%	$2,006	0.12%	$2,372
C-04	TSM&O Traffic & Operations (for Reconstruction/Resurfacing projects only)							0.00%	$0	0.00%	$0
C	F/A's & TSM&O		SUBTOTAL (C)	(% of CBI)			9.12%	$156,000	9.12%	$184,000
CI	CONSTRUCTION ITEMS		SUBTOTAL (A + B + C)	(% of A)			167.81%	$1,866,000	167.76%	$2,206,000	73.2% of Base Cost

D - CONSTRUCTION ENGINEERING & INDIRECTS

D-01	Construction Engineering	(Default: 10.95%)	10.95%	$204,327	10.95%	$241,557	
D-02	Construction Indirects	(Default: 9.5%)	9.50%	$177,270	9.50%	$209,570	
D	CONSTRUCTION ENGINEERING & INDIRECTS	SUBTOTAL (D)	(% of CI)	20.45%	$382,000	20.45%	$451,000	
	PROJECT CONSTRUCTION BUDGET	CONSTRUCTION (A + B + C + D)			$2,248,000		$2,657,000	88.2% of Base Cost

E - PRECONSTRUCTION ITEMS

Indirect % 9.50% (Model Estimate) | Indirect % 9.50% (Region Estimate)

		AVG %	EFFORT		% of CI	Cost (% CI + Indirect %)	% of CI	Cost (% CI + Indirect %)
E-01	Right-of-Way [Phase R]	5.2%	3 - Average	Adjusted—>	5.16%	$105,433	2.00%	$48,311
E-02	Utilities + Railroad Work [Phase U]				0.00%	$0	0.00%	$0
E-03	Design & Engineering [Phase D]	Design Maturity: 0 - Conceptual			12.00%	$245,192	12.00%	$289,868
E-03.1	Subsurface Utility Engineering (SUE) Budget				0.75%	$15,325	0.75%	$18,117
E-03.2	Transportation Systems Management & Operation (TSM&O) Budget				0.00%	$0	0.00%	$0
E-04	Environmental (NEPA) [Phase E]				0.00%	$0	0.00%	$0
E-05	Miscellaneous [Phase M]				0.00%	$0	0.00%	$0

E	PRECONSTRUCTION ITEMS	SUBTOTAL (E)	(% of CI)	19.61%	$366,000	16.14%	$356,000	11.8% of Base Cost
	PROJECT BASE COST ESTIMATE	(CONSTRUCTION + PRECONSTRUCTION)			$2,614,000		$3,013,000	100.0% of Base Cost
						RE/ME Ratio:	1.15	

RISK RESERVE

PROBABILISTIC COST ESTIMATE RISK RESERVE — DATE: 11/6/2018

RISK RESERVE	11.7% OF BASE COST	$354,000	
TOTAL PROJECT COST (P70)		$3,367,000	111.7% of Base Cost

ESCALATION

Construction Start	Sep-22	Escalation from Estimate Date:	Nov-18
Duration (mo)	24.0	to Construction Mid-Point Date:	Sep-23

ESCALATION	14.1% OF BASE COST	$474,000	
ESCALATED COST		$3,841,000	127.5% of Base Cost

COMMENTS: ***Please document any key assumptions on unit costs or percentages.***

SECTION A: Major Construction Items

Key:		
	RISK INPUT FUNCTION	Defined Probabilistic Input Fuction
	INPUT PARAMETER	Input Function Parameter (may be overwritten)
	OVERWRITTEN	Overwritten Input Function Parameter
	RISK OUTPUT FUNCTION	Probabilistic Output (Results)
	RISK STATISTIC FUNCTIO	Probabilistic Statistic Values (i.e. percentile values)

Model Version 3 Rev 04
Last Update: **22-Oct-18**

PROBABILISTIC COST ESTIMATE SHEET

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS | COMMENTS/NOTES

@RISK graph

TORNADO DIAGRAM:

The project's tornado diagram is the graphical output of a comparative sensitivity analysis, focusing on the top 10 critical items. It is meant to give you, the analyst, an idea of which factors are most important to the MOST LIKELY cost estimate output for the project. It is used to give the decision makers some insight into the quantity, unit cost, and/or % range uncertainties found in this project and their potential impact.

A - MAJOR ITEMS

A-01	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-01 Cost:	0.0%	$0								

A-02	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-02 Cost:	0.0%	$0								

A-05	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX	
202-00400	1.0	$115,724.3	$115,724	*	0%	0%	1	1	1	$20,000.0	$74,923.7	$374,650.8	OK
206-00000	0.0	$39.0	$0	*	-15%	40%	-	0	-	$11.0	$36.0	$79.0	OK
206-00100	307.3	$68.8	$21,152	*	-15%	40%	251	295	413	$34.0	$66.0	$115.0	OK
206-00200	0.0	$83.1	$0	*	-15%	40%	-	0	-	$20.4	$77.0	$170.0	OK
403-34841	46.8	$88.9	$4,158	*	-15%	40%	38	45	63	$62.7	$83.5	$137.0	OK
601-03000	45.9	$1,216.7	$55,891	*	-15%	40%	37	44	62	$460.0	$960.0	$3,000.0	OK
602-00020	6099.0	$2.0	$12,330	*	-15%	40%	4,977	5,855	8,197	$0.7	$2.0	$3.4	OK
606-10700	727.1	$33.7	$24,478	*	-15%	40%	593	698	977	$20.0	$33.0	$50.0	OK
621-00411	1.0	$300,000.0	$300,000	*	0%	0%	1	1	1	$270,000.0	$300,000.0	$330,000.0	OK
621-00412	0.0	$500,000.0	$0	*	0%	0%	-	0	-	$450,000.0	$500,000.0	$550,000.0	OK
	A-03_CAT300 Cost:	37.9%	$533,734										

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-03_REPL Cost:	0.0%	$0	
A-03_REPA Cost:	0.0%	$0	
A-03_WALL Cost:	0.0%	$0	
A-03_CULV Cost:	0.0%	$0	

*MODIFY LS estimate ranges as seem appropriate -->

LUMP SUM COST ESTIMATE RANGES

A-03_misc	QTY RISK	UNIT COST RISK	COST RISK		MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX	
	0.0	$358.3	$0	*	-15%	40%	-	0	-	$300.0	$350.0	$450.0	OK
	0.0	$400.0	$0	*	-15%	40%	-	0	-	$300.0	$400.0	$500.0	OK
	0.0	$2,000.0	$0	*	-15%	40%	-	0	-	$1,800.0	$2,000.0	$2,200.0	OK
	0.0	$2,500.0	$0	*	-15%	40%	-	0	-	$2,250.0	$2,500.0	$2,750.0	OK
	0.0	$2,700.0	$0	*	-15%	40%	-	0	-	$2,430.0	$2,700.0	$2,970.0	OK
	0.0	$2,900.0	$0	*	-15%	40%	-	0	-	$2,610.0	$2,900.0	$3,190.0	OK
	0.0	$3,100.0	$0	*	-15%	40%	-	0	-	$2,790.0	$3,100.0	$3,410.0	OK
	0.0	$3,300.0	$0	*	-15%	40%	-	0	-	$2,970.0	$3,300.0	$3,630.0	OK
	250.0	$3,500.0	$875,000	*	-15%	40%	204	240	336	$3,150.0	$3,500.0	$3,850.0	OK
	0.0	$0.0	$0	*	-15%	40%	-	0	-	$0.0	$0.0	$0.0	OK
	A-03_MISC Cost:	62.1%	$875,000										
	A-03 Cost:	100.0%	$1,408,734										

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-04	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-04 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

A-05	QTY RISK	UNIT COST RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
	A-05 Cost:	0.0%	$0								

*If unit type = "L S", "ACRE", or "EACH", no quantity uncertainty applies.

	SUBTOTAL (A)	100.0%	$1,409,000

B - MINOR ITEMS

RISK QUANTITY / % PARAMETERS | RISK UNIT COST PARAMETERS

	% of (A) RISK	COST RISK	* MIN	ML	MAX
B-01	2.42%	$34,098	0.0%	2.4%	4.8%
B-02	5.95%	$83,836	0.0%	6.0%	11.9%
B-03	0.33%	$4,650	0.0%	0.3%	0.7%
B-04	4.30%	$60,587	0.0%	4.3%	8.6%
B-05	3.08%	$43,397	0.0%	3.1%	6.2%
B-06	16.56%	$233,330	0.0%	16.6%	33.1%
B-07	20.00%	$281,800	0.0%	20.0%	40.0%
B-08	0.00%	$0	0.0%	0.0%	0.0%
B-09	0.77%	$10,849	0.0%	0.8%	1.5%
B-10	0.00%	$0	0.0%	0.0%	0.0%
B-11	0.33%	$4,650	0.0%	0.3%	0.7%
SUBTOTAL (B)	53.7%	$757,000	0.0%	53.7%	107.5%
CBI	153.7% (% of A)	$2,166,000			

*If ML value CLOSE TO or GREATER THAN historical max, MAX = ML*1.2
*If ML value WITHIN historical range, MAX = ML*2
(NEED TO ENSURE APPROPRIATE % RANGES)

C - F/A's & TSM&O

	% of CBI RISK	COST RISK	MIN	ML	MAX
C-01	6.00%	$129,960	6.0%	6.0%	6.0%
C-02	3.00%	$64,980	3.0%	3.0%	3.0%
C-03	0.12%	$2,541	0.1%	0.12%	0.1%
C-04	0.00%	$0	0.0%	0.00%	0.0%
SUBTOTAL (C)	9.1%	$197,000			
CI	167.8%	$2,363,000			

D - CE & INDIRECTS

	% of CI RISK	COST RISK	MIN	ML	MAX
D-01	10.95%	$258,749	10.95%	10.95%	10.95%
D-02	9.50%	$224,485	9.50%	9.50%	9.50%
SUBTOTAL (D)	20.5%	$483,000			
CONST		$2,846,000			

E - PRECON ITEMS

	% of CI RISK	COST RISK	MIN %	MAX %	MIN	ML	MAX	MIN	ML	MAX
E-01	2.10%	$49,623	-20%	50%	1.60%	2.00%	3.00%			
E-02	0.0%	$0	-20%	50%				$0	$0	$0
E-03	12.50%	$295,375	-15%	40%	10.20%	12.00%	16.80%			
E-03.1	0.75%	$17,723	0%	0%	0.75%	0.75%	0.75%			
E-03.2	0.00%	$0	0%	0%	0.00%	0.00%	0.00%			
E-04	0.0%	$0	-20%	50%				$0	$0	$0
E-05	0.0%	$0	0%	0%				$0	$0	$0
SUBTOTAL (E)	15.4%	$363,000								

@RISK graph

	P-VALUE	
MOST LIKELY (CONST + PRECON)	52	$3,209,000
BASE COST	29	$3,013,000
RISK RESERVE	11.7% OF BASE COST	$354,000
P70 VALUE	70	$3,367,000

Probabilistic Ranges:

P10	$2,793,000
P50	$3,187,000
P70	$3,367,000
P90	$3,653,000

Appendix D
Benefit-Cost Analysis

Benefit-Cost Analysis Appendix

Department of Transportation's Competitive Highway Bridge Program for Fiscal Year 2018

Prepared for CDOT by AECOM

December 4, 2018

Table of Contents

Exhibits

Executive Summary

A benefit-cost analysis (BCA) was conducted to support the grant application of the Colorado Department of Transportation (CDOT) for the Department of Transportation's Competitive Highway Bridge Program for Fiscal Year 2018. There are 14 bridges in Region 2 that are bundled for the analysis. This analysis was conducted in accordance with the 2018 Benefit-Cost Analysis Guidance for Discretionary Grant Programs. Capital outlays are scheduled to begin in 2021, with the last bridges scheduled for completion in 2022. Project benefits were estimated for a 20-year analysis period following completion (2023 through 2042). All values are in 2018 dollars discounted to 2018 using 7 percent and 3 percent discount rates.

Exhibit 1 presents the Impact Matrix, which describes the baseline, the Project as a whole, and the estimated results.

Exhibit 1 – Impact Matrix

Current Status/Baseline & Problem to be Addressed	Change to Baseline or Alternatives	Types of Impacts	Affected Population	Economic Benefit (Net Present Values, $2018 M)		Page Reference in BCA
				Discounted at 7%	Discounted at 3%	
Fourteen (14) bridges are past their useful life and as a result require frequent maintenance and have the potential for emergency closure. The emergency closures create delays and detours for motorists. These delays and detours result in costs incurred by motorists, CDOT, and trucking businesses.	The project would replace 14 bridges, bringing them up to a state of good repair, and thus reducing maintenance expenditures and VMT incurred by motorists due to detours. The reduced VMT results in travel cost savings for autos, operating cost savings for trucks, emissions savings, safety improvements and crash reductions, and roadway maintenance savings.	Safety:				
		Reduced Roadway Fatalities and Crashes	Drivers who reduce VMT after Project opening	$7.72	$13.04	12
		Safety Improvements at Bridges	Drivers and property owners near the Project bridges	$0.09	$0.15	13
		State of Good Repair:				
		Roadway Maintenance Savings	CDOT Taxpayers	$0.04	$0.07	13
		Environmental Protection:				
		Emissions Savings	All residents and non-residents	$0.60	$1.01	14
		Economic Competitiveness:				
		Travel Time Savings	Drivers who reduce VMT after Project opening	$9.66	$16.28	13
		Auto Travel Cost Savings	Drivers who reduce VMT after Project opening	$10.43	$17.61	14
		Residual Savings	CDOT Taxpayers	$2.14	$7.24	14
		Truck Operating Savings	Freight operators Shippers Customers	$4.54	$7.65	14

Exhibit 2 summarizes long-term outcomes of the Project. Taken in total, the Project provides $56.4 million in benefits - reduced roadway fatalities and crashes, safety improvements at bridges, roadway maintenance savings, travel time savings, congestion savings, travel cost savings, residual savings, freight benefits, and emissions savings — over the analysis period, using a 7 percent discount rate. Compared to a similarly discounted cost estimate, the Benefit-Cost Ratio for the Project is 2.1, a solid return on this critical investment for the region. This ratio rises to 3.1 when benefits and costs are discounted at 3 percent. The net benefits of the Project are $29.35 million using a 7 percent discount rate and $65.26 million using a 3 percent discount rate.

Exhibit 2 – Costs and Key Benefits Delivered by Long-Term Outcomes

All Region 2 Bridges	7% Discount Rate	3% Discount Rate
Costs (2018 $M)		
Capital Cost	$27.09	$30.91
Total Costs	*$27.09*	*$30.91*
Benefits (2018 $M)		
Safety Benefits		
Reduced Roadway Fatalities and Crashes	$7.72	$13.04
Safety Improvements at Bridges	$0.09	$0.15
Sub-Total	$7.81	$13.19
State of Good Repair Benefits		
Roadway Maintenance Savings	$0.04	$0.07
Sub-Total	$0.04	$0.07
Economic Competitiveness Benefits		
Travel Time Savings	$9.66	$16.28
Auto Travel Cost Savings	$10.43	$17.61
Residual Savings	$2.14	$7.24
Truck Operating Savings	$4.54	$7.65
Sub-Total	$26.76	$48.78
Environmental Protection		
Emissions Savings	$0.60	$1.01
Sub-Total	$0.60	$1.01
Net Operating & Maintenance Costs	$21.22	$33.13
Total Benefits	*$56.45*	*$96.17*
Outcome		
Net Benefits (2018 $M)	$29.35	$65.26
Benefit-Cost Ratio	**2.1**	**3.1**

Source: AECOM

1. Introduction

Colorado is one of the fastest growing states in the country, and with that growth comes significant strain on aging transportation systems that has significant and tangible consequences in the form of growing safety and mobility problems. Three rural highway corridors – State Highway (SH) 9, United States Highway (US) 24, and US 350 – considered for the Region 2 Bundle serve as vital transportation routes for rural communities, freight movement, and support for agriculture.

Based on the evaluation, 14 bridges were identified as candidates for replacement and comprise the Region 2 Bundle (Table 2). All of the bridges are decades past their original design life, with 13 of the bridges being at least 80 years old. None of the bridges meet FHWA roadway standard shoulder width or current construction standards. Thirteen (13) of the bridges are rated as “poor” per the FHWA guidelines and three of the bridges are load restricted.

Exhibit 3 – Bridges Included in Region 2 Bundle

National Bridge Structure Number	Highway Corridor	Year Built	Condition Rating	Load Restricted	Current Bridge Type*	Replacement Bridge Type*	Replacement Cost
G-12-C	SH 9	1938	Poor	No	CBC	CBC	$1,795,000
J-14-C	SH 9	1934	Fair	No	TTS	CBC	$2,634,000
J-15-G	SH 9	1971	Poor	No	CMP	RCP	$1,441,000
I-13-G	US 24	1937	Poor	Yes	TTS	CBC	$2,902,000
I-15-AO	US 24	1937	Poor	No	CBC	CBC	$2,462,000
I-15-T	US 24	1937	Poor	No	CBC	CBC	$2,184,000
H-13-N	US 24	1937	Poor	No	TTS	CBC	$2,104,000
M-21-B	US 350	1937	Poor	No	CI	CBC	$3,738,000
M-21-C	US 350	1937	Poor	No	CI	CBC	$3,367,000
M-21-J	US 350	1935	Poor	Yes	TTS	CBC	$1,897,000
M-22-U	US 350	1935	Poor	No	CI	CBC	$1,590,000
M-22-Y	US 350	1935	Poor	Yes	TTS	RCP	$1,177,000
N-21-C	US 350	1936	Poor	No	TTS	CBC	$3,289,000
N-21-F	US 350	1937	Poor	No	CI	CBC	$3,672,000
						Total	**$34,255,000**

Bridge Types:
CBC = concrete box culvert
CMP = corrugated metal pipe
CI = concrete on I-beam
RCP = reinforced concrete pipe
TTS = treated timber stringer

The bridges in the Region 2 Bundle are constructed of timber, concrete, and steel. While CDOT has been actively maintaining the bridges, age and severe seasonal weather have led to wooden supports and girders splitting, wooden piles rotting, support walls cracking, concrete spalling, excessive deflection and movement of substructure units, and bridge decks deteriorating. The frequency and magnitude of maintenance and associated emergency

closures of the bridges has accelerated and will reach the point where replacement is the only reasonable option. This need for replacement of the bridges is evident by the replacement of approximately 40 adjacent bridges that has occurred in the same corridors. The bridges replaced by CDOT were of similar age, similar design, and followed similar construction practices as the bridges in the Bundle. This highlights the increased needs of these corridors as the infrastructure ages and also CDOT's ongoing efforts to maintain a state of good repair for the rural highway system.

The implementation and delivery of the replacement of the Region 2 Bundle of bridges represents an opportunity for the State of Colorado to effectively improve mobility and safety outcomes along several of the state's rural corridors while concurrently ensuring that the economic vitality provided by these crucial corridors is maintained.

2. Benefit Analysis Framework

The benefits analysis was conducted using the Benefit-Cost Analysis Guidance for Discretionary Grant Programs document as a guide for preferred methods and monetized values. The parameters of the benefits analysis follow the protocols set by the Office of Management and Budget (OMB) Circular A-94 as well as the recommended benefit quantification methods by the U.S. Department of Transportation (USDOT), the United States Army Corps of Engineers, the Federal Emergency Management Agency, and U.S. Department of Agriculture, Forest Service. Generally, standard factors and values accepted by federal agencies were used for the benefits calculation except in cases where Project-specific values or prices were available. In all such cases, modifications are noted and references are provided for data sources. The analysis follows a conservative estimation of the benefits and assesses some of the benefits qualitatively. By adhering to a strict standard of what could be included in the benefits analysis, actual total benefits may be greater than depicted in the results.

The baseline assumes that the Project will not be built (i.e., the 14 bridges would not be replaced at this time) and the bridges would continue to deteriorate, requiring increased maintenance activities and potential for emergency closure. Under the baseline, the purpose of and need for the Project would not be met. The Project was compared to the baseline to identify benefits and costs.

A custom model was developed to estimate the future benefits for the Project. Benefits were estimated over a 20-year period of analysis beginning when construction ends and concluding after 20 full years of operations. While the replacement schedule for each bridge varies, the construction period for the bundle of 14 bridges is from 2021 through 2022. The 20-year period of analysis is from 2023 through 2042. The base year is 2018 and all values were discounted to the base year.

The benefits are expressed in constant 2018 dollars, which avoids forecasting future inflation and escalating future values for benefits and costs accordingly. The gross domestic product chained price index from the OMB was used to adjust past cost estimates or price values into 2018 dollar terms (OMB, 2018).

The use of constant dollar values requires the use of a real discount rate for discounting to the present value. Projects expecting to use federal funding are required to use a 7 percent discount rate. The Project was also evaluated using a 3 percent discount rate.

3. Analysis Assumptions

The BCA is based on several assumptions on the differences between the baseline scenario and the Build Alternative (replacement of the bridges). The two most significant assumptions are related to maintenance activities and emergency closure and replacement of a bridge. As the bridges age and their conditions worsen, it is anticipated that maintenance activities will increase under the baseline scenario. Engineers at CDOT estimated the maintenance activities that would be required for each of the bridges, which includes repairs to the superstructure and substructure. If the bridges are replaced, structural issues related to the bridges would be resolved and general maintenance activities would decrease.

Bridges in Colorado are regularly inspected by CDOT to identify required maintenance and issues that could impact the integrity of a bridge. While maintenance activities are scheduled and resolved by CDOT, inspectors occasionally identify issues that could compromise the integrity/safety of a bridge. When these issues are identified, load restrictions may be placed on the bridge, and if the issue is significant, the bridge will be closed. When emergency closure occurs, the bridge/road is fully closed and vehicle traffic is required to detour to other roads. Based on experience with prior emergency closures, it is estimated that vehicle traffic would need to follow the detour route for 30 days until a temporary bypass/bridge can be constructed adjacent to the closed bridge. Following an emergency closure, approximately two weeks are needed to get a contract in-place using emergency contracting procedures, and contractor mobilization and construction of the temporary bypass/bridge typically takes two to three weeks. If acquisition of a temporary easement is required, it will add a minimum of a month to the process for a total of 60 to 90 days. For the purposes of this analysis, the assumption has been made that a temporary bypass/bridge would be in place within 30 days.

Because of the condition of a bridge subject to emergency closure, the only reasonable option is to replace the bridge (as opposed to conducting extensive repairs on old bridge). Based on the conditions of the bridges and the rate that similar bridges have been replaced in the corridors (approximately 40 bridges of similar age and construction have already been replaced in the corridors), it is estimated that there is a 5 percent chance in any given year that a bridge would require emergency closure and replacement. This assumption was derived through the engineering judgement of CDOT Staff Bridge and Colorado Bridge Enterprise program leadership with input from CDOT Region staff. Emergency closure and replacement results in an “all hands on deck” at CDOT until the road is open to traffic. Because of the need to quickly mobilize contractors, procure materials, and obtain approvals, CDOT estimates that emergency replacement of a bridge costs 25 percent more than a planned replacement. The primary drivers for the cost increase are lack of a competitive bid due to the implementation of emergency contracting procedures, contractors needing to divert staff/equipment from other projects, and major changes to scope during construction since construction documents for the replacement structure are typically not available in an emergency situation.

A list of assumptions for the Project is provided in the BCA workbook (see Inputs tab in the file BCA_Workbook_Region_2_Bundle.xlsx) as well as in Exhibit 4.

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Exhibit 4 – BCA Calculation Inputs

Input	Value	Source
General		
Discount Rate	7%	2018 BCA Guidance for Discretionary Grant Programs
Discount Rate	3%	2018 BCA Guidance for Discretionary Grant Programs
Deflator	See "Deflator" Sheet	https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/budget/fy2018/hist10z1.xls
Dollar year	2018	
Discount year	2018	
Analysis period	20	years
Safety		
AIS 0 (2017$) per vehicle	$4,327	2018 BCA Guidance for Discretionary Grant Programs
AIS 1 (2017$)	$28,800	2018 BCA Guidance for Discretionary Grant Programs
AIS 2 (2017$)	$451,200	2018 BCA Guidance for Discretionary Grant Programs
AIS 3 (2017$)	$1,008,000	2018 BCA Guidance for Discretionary Grant Programs
AIS 4 (2017$)	$2,553,600	2018 BCA Guidance for Discretionary Grant Programs
AIS 5 (2017$)	$5,692,800	2018 BCA Guidance for Discretionary Grant Programs
AIS 6 (2017$)	$9,600,000	2018 BCA Guidance for Discretionary Grant Programs
Injury (severity unknown)	$174,000	2018 BCA Guidance for Discretionary Grant Programs
AIS 0 (2018$) per vehicle	$4,395	Adjusted by GDP Deflator
AIS 1 (2018$)	$29,251	Adjusted by GDP Deflator
AIS 2 (2018$)	$458,267	Adjusted by GDP Deflator
AIS 3 (2018$)	$1,023,788	Adjusted by GDP Deflator
AIS 4 (2018$)	$2,593,595	Adjusted by GDP Deflator
AIS 5 (2018$)	$5,781,963	Adjusted by GDP Deflator
AIS 6 (2018$)	$9,750,358	Adjusted by GDP Deflator
Injury (severity unknown)	$176,725	Adjusted by GDP Deflator
Conversion rate for Metric tons to Short Tons	1.1015	2018 BCA Guidance for Discretionary Grant Programs
Emissions Monetization Values		
VOC Value of Emissions (2017$) per short ton	$1,905	https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/284031/benefit-cost-analysis-guidance-2018_0.pdf
NOx Value of Emissions (2017$) per short ton	$7,508	Corporate Average Fuel Economy for MY2017-MY2025 Passenger Cars and Light Trucks (August 2012), page 922, Table VIII16, "Economic Values Used for Benefits Computations (2010 dollars). Inflated to 2017 dollars.
PM Value of Emissions (2017$) per short ton	$343,442	Adjusted by GDP Deflator
VOC Value of Emissions (2018$) per short ton	$1,935	Adjusted by GDP Deflator
NOx Value of Emissions (2018$) per short ton	$7,626	Adjusted by GDP Deflator
PM Value of Emissions (2018$) per short ton	$348,821	Adjusted by GDP Deflator
Emissions Rates		
Passenger Car Emission Rates per Mile, VOC, 2013-	0.6	http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf

2024		
Passenger Car Emission Rates per Mile, NOx, 2013-2024	0.91	http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf
Passenger Car Emission Rates per Mile, PM25, 2013-2024	0.01	http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf
Passenger Car Emission Rates per Mile, CO2, 2013-2024	532	http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf
Passenger Car Emission Rates per Mile, VOC, 2025-2034	0.27	http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf
Passenger Car Emission Rates per Mile, NOx, 2025-2034	0.28	http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf
Passenger Car Emission Rates per Mile, PM25, 2025-2034	0.01	http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf
Passenger Car Emission Rates per Mile, CO2, 2025-2034	434	http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf
Passenger Car Emission Rates per Mile, VOC, 2035-	0.21	http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf
Passenger Car Emission Rates per Mile, NOx, 2035-	0.2	http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf
Passenger Car Emission Rates per Mile, PM25, 2035-	0.01	http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf
Passenger Car Emission Rates per Mile, CO2, 2035-	397	http://www.apta.com/gap/fedreg/Documents/NS-SS_Final_PolicyGuidance_August_2013.pdf
Conversion rate for Metric tons to Short Tons	1.1015	2018 BCA Guidance for Discretionary Grant Programs
Truck Emissions Rate g per hour VOC (average of 8a and 8b trucks)	3.868	https://www3.epa.gov/otaq/consumer/420f08025.pdf, Class 8 trucks include long-haul semi-tractor trailer rigs ranging from 33,001 lbs to >60,000 lbs
Truck Emissions Rate g per hour Nox (average of 8a and 8b trucks)	39.0515	https://www3.epa.gov/otaq/consumer/420f08025.pdf, Class 8 trucks include long-haul semi-tractor trailer rigs ranging from 33,001 lbs to >60,000 lbs
Truck Emissions Rate g per hour PM2.5 (average of 8a and 8b trucks)	1.092	https://www3.epa.gov/otaq/consumer/420f08025.pdf, Class 8 trucks include long-haul semi-tractor trailer rigs ranging from 33,001 lbs to >60,000 lbs
Truck Emissions Rate g per hour PM10 (average of 8a and 8b trucks)	1.187	https://www3.epa.gov/otaq/consumer/420f08025.pdf, Class 8 trucks include long-haul semi-tractor trailer rigs ranging from 33,001 lbs to >60,000 lbs
Truck Emissions Rate g per mile VOC (average of gasoline and diesel)	1.0165	EPA 420-F-08-027, Average In-Use Emissions from Heavy-Duty Trucks, October 2008, nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100EVY6.TXT
Truck Emissions Rate g per mile Nox (average of gasoline and diesel)	5.7635	EPA 420-F-08-027, Average In-Use Emissions from Heavy-Duty Trucks, October 2008, nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100EVY6.TXT
Truck Emissions Rate g per mile PM2.5 (average of gasoline and diesel)	0.123	EPA 420-F-08-027, Average In-Use Emissions from Heavy-Duty Trucks, October 2008, nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100EVY6.TXT
Truck Emissions Rate g per	0.135	EPA 420-F-08-027, Average In-Use Emissions from

mile PM10 (average of gasoline and diesel)		Heavy-Duty Trucks, October 2008, nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100EVY6.TXT
Travel Time Savings		
Value of Time (2017$), private vehicle travel time per person hour, all purposes	$14.20	2018 BCA Guidance for Discretionary Grant Programs
Value of Time (2017$), truck driver per hour	$28.60	2018 BCA Guidance for Discretionary Grant Programs
Value of Time (2018$), private vehicle travel time per person hour, all purposes	$14.42	
Value of Time (2018$), truck driver per hour	$29.05	
Average Marginal Costs per Mile, 2016$ (includes value of driver's time)	$1.59	Table 8 ATRI Operational Cost of Trucking 2017
Average Marginal Costs per Mile, 2018$	$1.64	Adjusted by GDP Deflator
Vehicle Maintenance Cost per Mile, Auto (Gas, maintenance, tires, and depreciation) (2017$/Mile)	$0.39	2018 BCA Guidance for Discretionary Grant Programs
Vehicle Maintenance Cost per Mile, Auto (Gas, maintenance, tires, and depreciation) (2018$/Mile)	$0.40	
Auto Occupancy	1.39	2018 BCA Guidance for Discretionary Grant Programs
Assumed Speed on Road (mph)	55	Engineering judgement
Average Vehicle Delay Time Due to Maintenance (minutes)	5	Engineering judgement
State of Good Repair		
Roadway Maintenance Cost, Rural Interstate (2000$/mi) - Auto	$0.000	FHWA Highway Cost Allocation Study, 2000 Addendum, Table 13
Roadway Maintenance Cost per Mile, Rural Interstate (2018$) - Auto	$0.000	Adjusted by GDP Deflator
Roadway Maintenance Cost, Rural Interstate (2000$/mi) - 40 kip truck	$0.010	FHWA Highway Cost Allocation Study, 2000 Addendum, Table 13
Roadway Maintenance Cost per Mile, Rural Interstate (2018$) - 40 kip truck	$0.014	Adjusted by GDP Deflator
Share of Construction costs that are for bridge structure	75%	Engineering judgement
Useful life for bridge (years)	100	Colorado Bridge Enterprise: Strategies for Enhancing Bridge Service Life, 2015
Maintenance		
Maintenance costs in years 0-5 as percent of CAPEX (inspection)	0.10%	Engineering judgement
Maintenance costs in years 5-20 as percent of CAPEX (inspection and scheduled	0.25%	Engineering judgement

maintenance)		
Estimated Bridge Closure Time in Case of Emergency Bridge Replacement (days)	30	CDOT, CBE
Probability of emergency bridge replacement	5%	CDOT, CBE
Emergency Repair Premium	25%	CDOT, CBE

4. Benefits Methodology

The methodology used to estimate the benefits of the Project are described in the following sections.

Safety

The Project would result in safety benefits by removing auto trips from the region's roads. The methodologies for calculating this benefit are described in this section.

Reduced Roadway Fatalities and Crashes

As bridges age past their intended useful life, they require more frequent repairs to keep them operational. However, as time goes on, the probability of a bridge needing emergency replacement, instead of repairs, increases. Emergency bridge replacement would require closure of the route, leading to detours. Per CDOT guidance, it was assumed that a typical closure for emergency bridge replacement would last 30 days, after which time a bridge bypass would be constructed. Detour length was applied to average annual daily traffic (AADT) and the number of days the bridge would be closed, to obtain the vehicle miles travelled (VMT) incurred by motorists in an emergency bridge replacement scenario. Per CDOT guidance, it was assumed that the likelihood of an emergency bridge closure and replacement happening in any year of the analysis period is 5 percent. This probability was then applied to the VMT incurred in the event of an emergency bridge closure and replacement to obtain annual VMT incurred. As under the baseline, there would be no emergency bridge replacement due to condition, the VMT incurred is VMT avoided.

The rates of crashes that result in fatalities, injuries, and property damage are applied to the net annual VMT to derive the estimated crashes from the change in VMT. To ensure consistency between the types of crashes, the crash rates for fatalities, injuries, and property damage are the national average crash rates. These crash rates are shown in Exhibit 5.

Exhibit 5 - Crashes by Type per 100,000,000 VMT

Fatalities	1.133692236
Injured persons	78.93618107
Crashes	203.3926964

Source: 2015 BTS Motor Vehicle Safety Data Table 2-17, https://www.bts.gov/content/motor-vehicle-safety-data

These crash reduction factors were then converted to the Maximum Abbreviated Injury Score (MAIS) crash types in order to apply US DOT Guidance on the value of avoiding a crash. The conversion is based on the National Highway Safety and Traffic Administration (NHTSA) KABCO-AIS Conversion Table (July 2011) provided on page 12 of the TIGER Benefit-Cost

Analysis Resource Guide (USDOT 2016),1 for Injury (severity unknown), and No Injury crashes. KABCO refers to the letters used to designate five levels of crash severity used by police at a crash scene; AIS refers to the Abbreviated Injury Scale used by hospitals. These factors provide the probability that an injury will range from critical to minor to more accurately capture the total number of different types of injuries associated with the VMT avoided. Estimating the distribution of expected injury types is important because the economic cost of the injury increases as injury severity increases.

The total annual value for crash severity is based on USDOT guidance and the National Highway Safety Council estimates for the value of avoiding a crash. These estimates are applied to the number of crashes avoided to estimate the total value of crashes avoided from auto VMT avoided. ***The total reduction in highway fatalities and crashes results in $7.72 million in benefits, discounted at 7 percent.***

Safety Improvements at Bridges

In addition to the safety benefit from changes to VMT in the state, the reconstruction of the bridges results in safety benefits from bringing the bridges up to current design standards. Installing a new bridge with a 36’ or 40’ width would reduce crashes, and thus fatalities, injuries, and property damage. Crash reduction factors for each of the bridges in the bundle were provided by CDOT. To be conservative, it was assumed that all new bridges would have a width of 36’, which would have a lower crash reduction factor than a bridge with a width of 40’.The reduced fatalities, injuries, and property damage were valued based on USDOT guidance and are listed in Exhibit 4. ***The total safety improvements at bridges results in $0.09 million in benefits when discounted at 7 percent.***

State of Good Repair

The Project would result in state of good repair benefits by removing auto trips from the region’s roads. The methodology for calculating this benefit is described in this section.

Roadway Maintenance Savings

In an event of an emergency bridge replacement, the resulting detours would increase auto and truck VMT during the closure period, incurring additional roadway maintenance costs, such as painting and paving. The roadway maintenance cost savings are negligible per auto VMT on rural highways, as obtained from the FHWA Highway Cost Allocation Study. For trucks, the FHWA Highway Cost Allocation Study values their roadway maintenance cost per mile at $0.014 for a 40-kip truck. Multiplying the auto and truck VMT by the maintenance costs per VMT results in state of good repair benefits. ***Roadway maintenance savings amount to $0.04 million, discounted at 7 percent.***

Economic Competitiveness

The Project would produce economic benefits by allowing trucks and automobiles to avoid detours, resulting in travel time savings, auto travel cost savings, residual value, and truck operating cost savings. The methodologies for calculating these benefits are described in this section.

[1] Benefit-Cost Analysis (BCA) Resource Guide 2016, https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf

Automobile Travel Time Savings

In an event of an emergency bridge replacement, vehicles must travel longer routes, thus incurring travel time delays. Assuming a 55 mile per hour travel speed on both the through-route and the detour route, the average detour travel time savings were estimated for the traffic volumes. In addition to travel time savings due to fewer detours, there would be fewer delays caused by partial closures for scheduled maintenance. It was assumed that vehicles would experience a 5 minute delay during a partial bridge closure (one lane would remain open). The annual delay time was obtained by multiplying the number of partial bridge closures each year by the AADT and the average delay time of 5 minutes. Multiplying the net hours by the average vehicle occupancy (1.39)[2] and the personal value of time ($14.42 in 2018 dollars), as found in Exhibit 4, yields the total travel time savings. ***The total travel time savings for the Project amounts to $9.66 million discounted at 7 percent.***

Auto Travel Cost Savings

Because under the Build Alternative, there won't be an emergency bridge replacement due to condition of the structure, drivers would not have to detour and would thus realize travel cost savings relative to the baseline. Travel cost savings was estimated using cost savings per reduced auto VMT of $0.40, which is based on the vehicle maintenance cost per mile provided by AAA and recommended by guidance, and inflated to 2018 dollars.[3] The marginal savings includes gas, maintenance, and tires. ***Auto travel cost savings amount to $10.43 million discounted at 7 percent.***

Truck Operating Savings

Based on the additional truck VMT incurred in the event of an emergency bridge replacement, the net truck operating savings is calculated. Additionally, truck delays were calculated for partial bridge closures, also assuming a 5 minute average delay, as described for automobile travel time savings. The savings per mile of $1.64 in 2018 dollars is the average marginal cost per mile for truck operations from the American Trucking Research Institute. This cost includes both vehicle-based costs and driver-based costs. ***The total truck operating savings for the Project amounts to $4.54 million discounted at 7 percent.***

Residual Value

Construction of the new bridges results in residual value after the end of the 20-year analysis period, because the useful life of the bridge is 100 years.[4] It was assumed that 75 percent of the construction costs are for bridge infrastructure. The remaining value of the bridge discounted from the last year of the 20-year analysis period. ***The value of the remaining useful life for the Project discounted at 7 percent is $2.14 million.***

Environmental Protection

The Project would result in net environmental protection benefits, as there would not be an emergency bridge replacement due to condition of the structure, resulting in emissions savings relative to the baseline Alternative. The methodology for calculating this net result is described in this section.

[2] 2018 Benefit-Cost Analysis Guidance for Discretionary Grant Programs, https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/284031/benefit-cost-analysis-guidance-2018.pdf
[3] Source: AAA, Your Driving Costs, 2017
[4] Source: CDOT. Colorado Bridge Enterprise: Strategies for Enhancing Bridge Service Life, 2015

Emissions Savings

The decrease in auto and truck VMT in the Build Alternative relative to the baseline results in emissions reductions.

The emissions reductions for autos were estimated using emissions rates from USDOT guidance for volatile organic compounds (VOC), nitrogen oxides (NOx), and particulate matter (PM2.5).5 The rates for autos are shown in Exhibit 4 and vary over time as vehicle efficiencies improve. The emissions rates for trucks for VOC, NOx, PM2.5, and PM10 are shown in Exhibit 4 and are constant over the analysis period.

The tons of emissions reduction were summed and monetized using the recommended value of emissions from 2018 USDOT guidance,6 also shown in Exhibit 4, and inflated to 2018 dollars. ***In total, the Project results in net emissions savings of $0.60 million when discounted at 7 percent.***

In addition to VOC, NOx, and PM reductions, carbon dioxide (CO2) or greenhouse gas emissions would also be reduced. Because there is no official guidance on the value of CO2 emissions reductions, these benefits were not quantified in the analysis.

5. Costs

The Project has two cost components: the initial capital costs and ongoing operating and maintenance (O&M) costs. The components used in this analysis are described in this section.

Capital Costs

The capital costs for the Project include the costs for right of way, utilities, design, and construction (Exhibit 6). The capital costs are applied over the individual project construction periods, beginning in 2021 and ending in 2022. Capital costs were given in 2018 dollars. It is estimated that the individual project costs are expended equally over the construction periods. ***The total capital costs for the Project discounted at 7 percent are $27.09 million.***

[5] USDOT, Federal Transit Administration, New and Small Starts Evaluation and Rating Process Final Policy Guidance, August 2013

[6] 2018 Benefit-Cost Analysis Guidance for Discretionary Grant Programs, https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/284031/benefit-cost-analysis-guidance-2018.pdf

Exhibit 6 – Summary of Project Cost by Bridge

National Bridge Structure ID Number	ROW (including utilities)	Professional Services	Construction	Total
G-12-C	$28,000	$58,000	$1,709,000	$1,795,000
J-14-C	$87,000	$176,000	$2,372,000	$2,634,000
J-15-G	$35,000	$71,000	$1,335,000	$1,441,000
I-13-G	$79,000	$160,000	$2,663,000	$2,902,000
I-15-AO	$72,000	$146,000	$2,244,000	$2,462,000
I-15-T	$46,000	$94,000	$2,043,000	$2,184,000
H-13-N	$44,000	$90,000	$1,970,000	$2,104,000
M-21-B	$137,000	$278,000	$3,323,000	$3,738,000
M-21-C	$121,000	$245,000	$3,002,000	$3,367,000
M-21-J	$56,000	$113,000	$1,728,000	$1,897,000
M-22-U	$67,000	$136,000	$1,388,000	$1,590,000
M-22-Y	$25,000	$50,000	$1,103,000	$1,177,000
N-21-C	$115,000	$234,000	$2,940,000	$3,289,000
N-21-F	$134,000	$272,000	$3,267,000	$3,672,000
Total	**$1,045,000**	**$2,122,000**	**$31,089,000**	**$34,255,000**

Note: Right of way (ROW) includes utility relocation and any temporary easements that may be needed during construction. No permanent acquisition of property will be required for the replacement bridges.

Annual Operating and Maintenance Costs

The Project requires annual and periodic O&M expenditures to maintain the new bridge, but the replacement bridge would result in O&M savings from the baseline. In the baseline, the cost to maintain the bridges was provided by CDOT for a 20-year period (Exhibit 7).

Exhibit 7 – Annual O&M Costs for Existing Bridges by Year

National Bridge Structure ID #	2022	2027	2032	2037	2042	Total
J-15-G	$81,700	$19,092	$27,700	$19,092	$27,700	**$175,284**
J-14-C	$51,800	$41,703	$37,000	$41,703	$37,000	**$209,206**
N-21-C	$456,822	$22,000	$56,122	$22,000	$56,122	**$613,066**
M-21-J	$58,303	$22,000	$42,328	$22,000	$42,328	**$186,959**
M-22-Y	$39,985	$22,000	$32,485	$22,000	$32,485	**$148,955**
G-12-C	$273,500	$14,353	$48,000	$14,353	$48,000	**$398,206**
I-13-G	$23,000	$57,076	$22,000	$57,076	$22,000	**$181,152**
H-13-N	$44,049	$22,000	$34,049	$22,000	$34,049	**$156,147**
M-21-B	$673,536	$0	$64,434	$4,200	$64,434	**$806,604**
M-22-U	$495,609	$0	$36,262	$0	$36,262	**$568,133**
I-15-T	$363,200	$14,172	$196,000	$14,172	$196,000	**$783,544**
I-15-AO	$357,500	$15,555	$180,000	$15,555	$180,000	**$748,610**
N-21-F	$1,042,316	$0	$126,649	$6,300	$126,649	**$1,301,914**
M-21-C	$868,280	$0	$97,478	$9,240	$97,478	**$1,072,476**

Source: CDOT

Additionally, emergency bridge replacement costs were included in the analysis. A probabilistic approach, assuming a 5 percent chance of emergency bridge replacement in any year of the analysis, was applied to the cost of building a new bridge. Because emergency replacement would cost more than a planned replacement, a 25 percent premium was applied to the replacement cost, per CDOT guidance.

Maintenance of the new bridges is assumed to be 0.10 percent of capital costs for the first 5 years, and 0.25 percent of the capital costs thereafter. This is a lower cost than the existing O&M costs, so many years result in O&M savings from the bridge reconstruction. ***The net O&M savings over the analysis period and discounting at 7 percent is $21.22 million.***

6. BCA Results

The analysis results in a total Project BCA ratio of 2.1 when discounted at a rate of 7 percent, and increases to 3.1 when discounted at 3 percent. Exhibit 8 displays a summary of the BCA results for the bundle.

Exhibit 8 – BCA Results

All Region 2 Bridges	7% Discount Rate	3% Discount Rate
Costs (2018 $M)		
Capital Cost	$27.09	$30.91
Total Costs	*$27.09*	*$30.91*
Benefits (2018 $M)		
Safety Benefits		
Reduced Roadway Fatalities and Crashes	$7.72	$13.04
Safety Improvements at Bridges	$0.09	$0.15
Sub-Total	$7.81	$13.19
State of Good Repair Benefits		
Roadway Maintenance Savings	$0.04	$0.07
Sub-Total	$0.04	$0.07
Economic Competitiveness Benefits		
Travel Time Savings	$9.66	$16.28
Auto Travel Cost Savings	$10.43	$17.61
Residual Savings	$2.14	$7.24
Truck Operating Savings	$4.54	$7.65
Sub-Total	$26.76	$48.78
Environmental Protection		
Emissions Savings	$0.60	$1.01
Sub-Total	$0.60	$1.01
Net Operating & Maintenance Costs	$21.22	$33.13
Total Benefits	*$56.45*	*$96.17*
Outcome		
Net Benefits (2018 $M)	$29.35	$65.26
Benefit-Cost Ratio	**2.1**	**3.1**

Source: AECOM

List of Supporting Documents

AAA, Your Driving Costs, 2017, http://exchange.aaa.com/wp-content/uploads/2017/08/17-0013_Your-Driving-Costs-Brochure-2017-FNL-CX-1.pdf

CDOT. Colorado Bridge Enterprise: Strategies for Enhancing Bridge Service Life, 2015

FHWA Highway Cost Allocation Study, 2000 Addendum, Table 13, https://www.fhwa.dot.gov/policy/hcas/addendum.cfm

USDOT 2018 Benefit-Cost Analysis Guidance for Discretionary Grant Programs, https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/284031/benefit-cost-analysis-guidance-2018.pdf

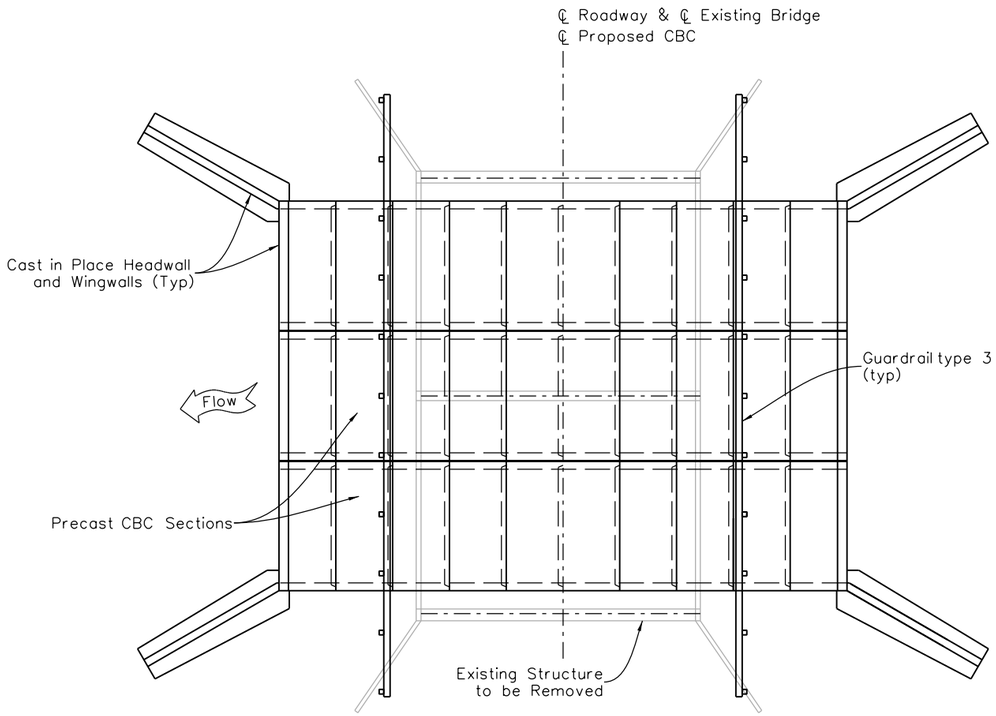
USDOT Benefit-Cost Analysis (BCA) Resource Guide, March 1, 2016, https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf

USDOT, Federal Transit Administration, New and Small Starts Evaluation and Rating Process Final Policy Guidance, August 2013

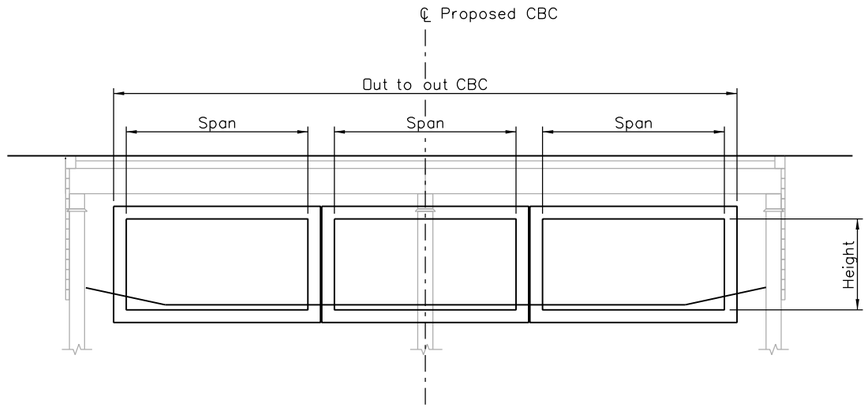
White House Office of Management and Budget. Historical Tables, Table 10.1 – Gross Domestic Product and Deflators Used in the Historical Tables 1940-2021. https://www.whitehouse.gov/omb/budget/Historicals

BCA_Workbook_Region_2_Bundle excel workbook

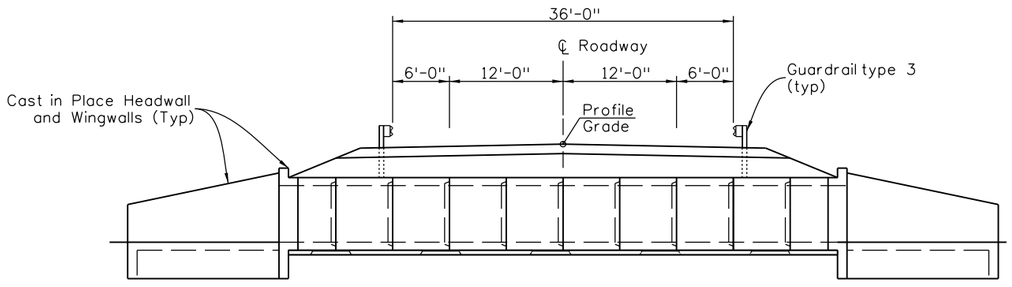
Appendix E
Design Examples



PLAN



SECTION



SECTION

STRUCTURES WITH 2 LANE DETOUR

Bridge	Facility Carried	Feature Intersected	Mile Marker	Replacement Structure
G-12-C	SH 9 ML	PLATTE GULCH	71.445	3 cell CBC - 14'x6'
I-13-G	US 24 ML	DRAW	227.095	3 cell CBC - 14'x6'
H-13-N	US 24 ML	DRAW	240.686	2 cell CBC - 12'x10'
I-15-T	US 24 ML	DRAW	271.691	2 cell CBC - 10'x8'
I-15-AO	US 24 ML	DRAW	271.900	2 cell CBC - 10'x8'

Print Date: 11/30/2018
File Name: Typical General Layout.dgn
Horiz. Scale: NTS Vert. Scale: As Noted
Staff Bridge Branch

Sheet Revisions

Date:	Comments	Init.

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Staff Bridge Branch

As Constructed
No Revisions:
Revised:
Void:

TYPICAL LAYOUT - CBC

Designer: CDOT
Detailer:
Sheet Subset: CBC
Structure Numbers: VARIOUS
Subset Sheets:

Project No./Code
FHWA NOTICE OF
FUNDING OPPORTUNITY

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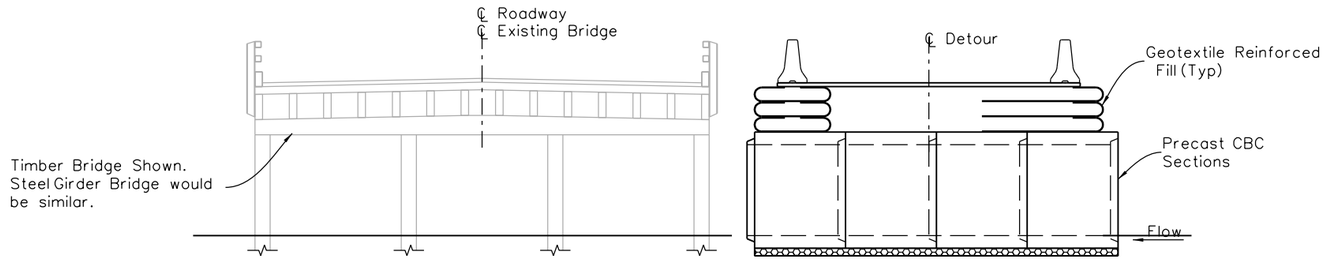
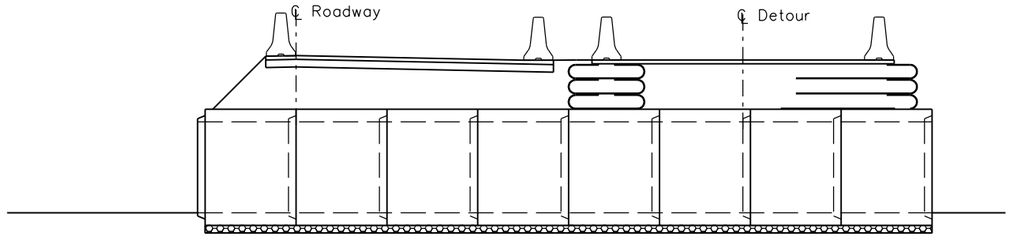


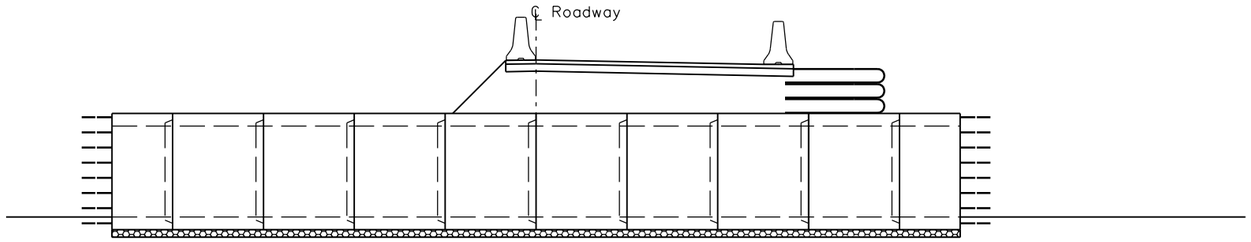
PHASE 1

1a. Level ground and prepare aggregate basecourse subgrade. Place CBC sections. Construction activity should be conducted entirely within the existing ROW, avoiding the time required to obtain temporary easements.
1b. Place geotextile reinforced backfill material and construct a single lane detour. Use temporary signals and shift traffic onto the single lane detour.



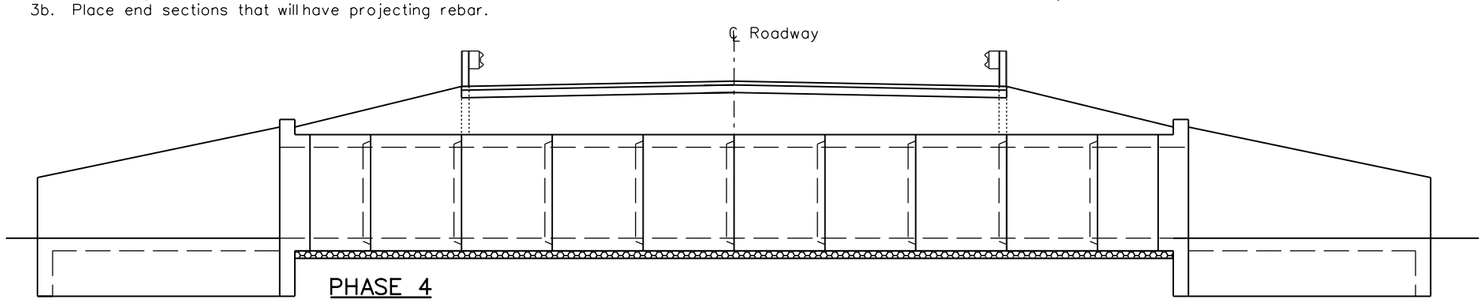
PHASE 2

2a. Demolish the existing bridge.
2b. Grade, prepare subgrade, and place additional CBC sections.
2c. Place additional backfill material. Place pavement section which can be to final grade. Shift the location of the single lane detour.



PHASE 3

3a. Remove portions of the Phase I detour. Some of the CBC sections that will not be needed for the ultimate width may be removed and used to extend the other end.
3b. Place end sections that will have projecting rebar.



PHASE 4

4a. Construct cast in place ends of CBC with headwall and cutoff wall. Construct cast in place wingwalls.
4b. Backfill, place pavement and guardrail. Open completed structure to traffic.

STRUCTURES WITH ONE LANE DETOUR

Bridge	Facility Carried	Feature Intersected	Mile Marker	Replacement Structure
J-15-G	SH 9 ML	MACK GULCH	15.970	3 - 6' RCP
J-14-C	SH 9 ML	LOUIS GULCH	20.107	3 cell CBC - 20'x8'
N-21-C	US 350 ML	DRAW	47.131	3 cell CBC - 14'x6'
N-21-F	US 350 ML	SHEEP CANYON ARROYO	48.744	3 cell CBC 20'x8'
M-21-C	US 350 ML	HOE RANCH ARROYO	50.582	3 cell CBC 20'x8'
M-21-B	US 350 ML	TREE ARROYO	51.682	4 cell CBC 20'x8'
M-21-J	US 350 ML	DRAW	57.069	2 cell CBC 18'x6'
M-22-Y	US 350 ML	DRAW	57.474	5' RCP
M-22-U	US 350 ML	OTERO DITCH	69.817	2 cell CBC 14'x10'

Print Date: 11/30/2018
File Name: One Lane Detour Phasing.dgn
Horiz. Scale: NTS Vert. Scale: As Noted
Staff Bridge Branch

Sheet Revisions

Date:	Comments	Init.

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As Constructed
No Revisions:
Revised:
Void:

PHASING - CONSTRUCTION WITHIN EXISTING ROW

Designer: CDOT
Detailer:
Sheet Subset: CDOT
Structure Numbers: VARIOUS
Subset Sheets:

Project No./Code
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