

Coconino County Roadway  
Alignment  
Final Presentation

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# Project Introduction

- Alternative Access Route in Bellemont, AZ
  - 1.5 mile length
  - Emergency Access
- Client is Coconino County Public Works
- Considerations for future development
  - 20 year traffic growth

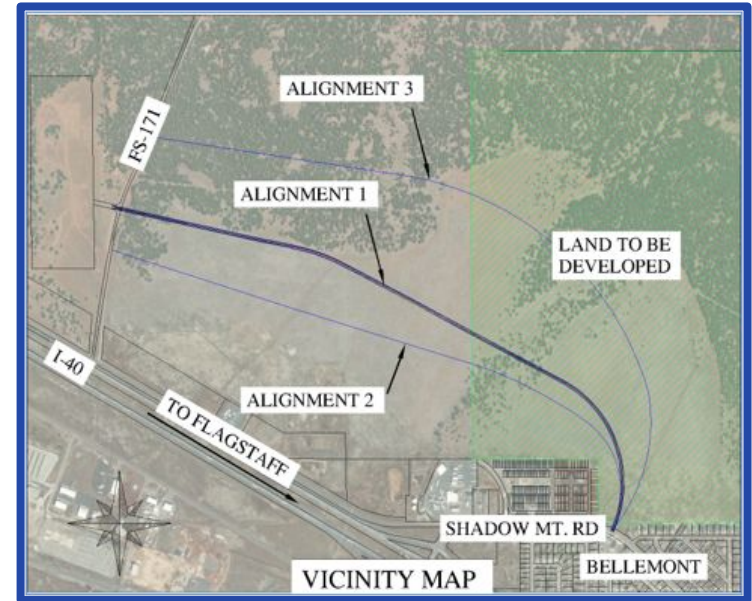


Figure 1: Project Vicinity Map

# Existing Site Information

- Site Visit
- Topographic Data
- FEMA Flood Zone
  - Ardurra report for development near east end of alignment
- Soil Data
- Geotechnical Data
  - Reports from previous projects in Bellemont
- Traffic Counts

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
211	Aridic Argiustolls, Cumulic Haplustolls, rarely flooded, and Aridic Ustifluvents, rarely flooded; cool mesic ustic hills and fans	262.5	100.0%
<b>Totals for Area of Interest</b>		<b>262.5</b>	<b>100.0%</b>

Figure 2: Web Soil Survey Results [1]



Figure 3: Site Visit Photo from East End of Proposed Alignment

# Analysis

- Hydrologic Analysis
  - Watershed delineation
    - StreamStats
    - Topographic maps
  - Rational Method
  - HEC-HMS modeling

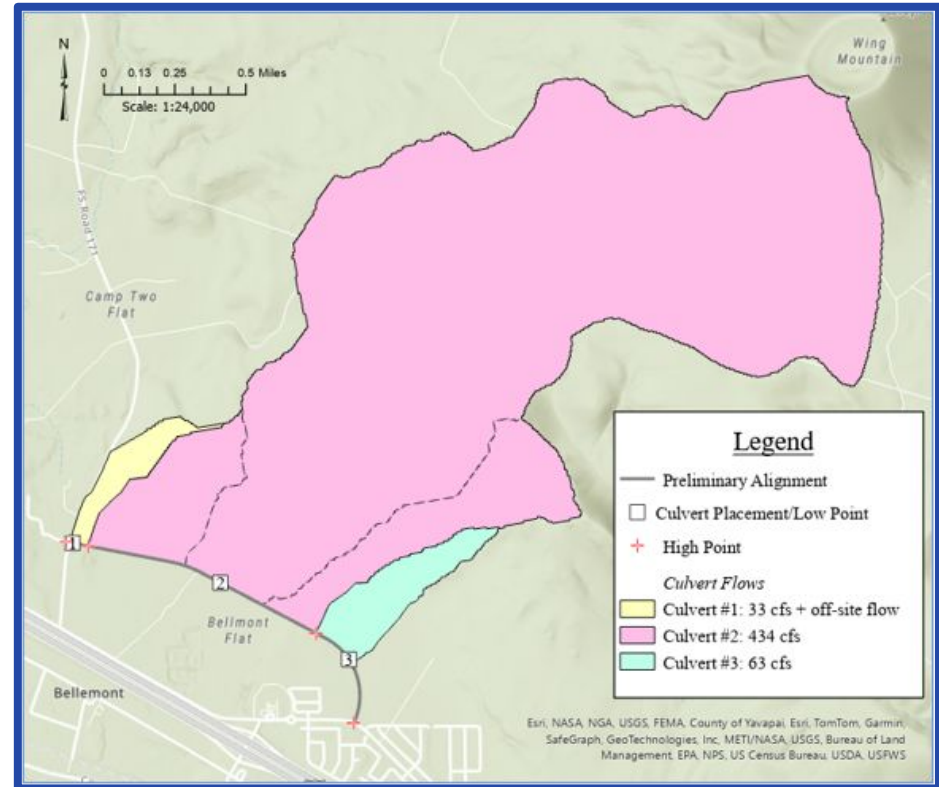


Figure 4: Watershed delineation & flow values

# Analysis cont.

- Hydraulic Analysis
  - Off-site runoff
    - Ardurra report
  - On-site runoff
    - Watershed flows
  - Roadway Drainage
    - Culverts
    - Roadside Ditches

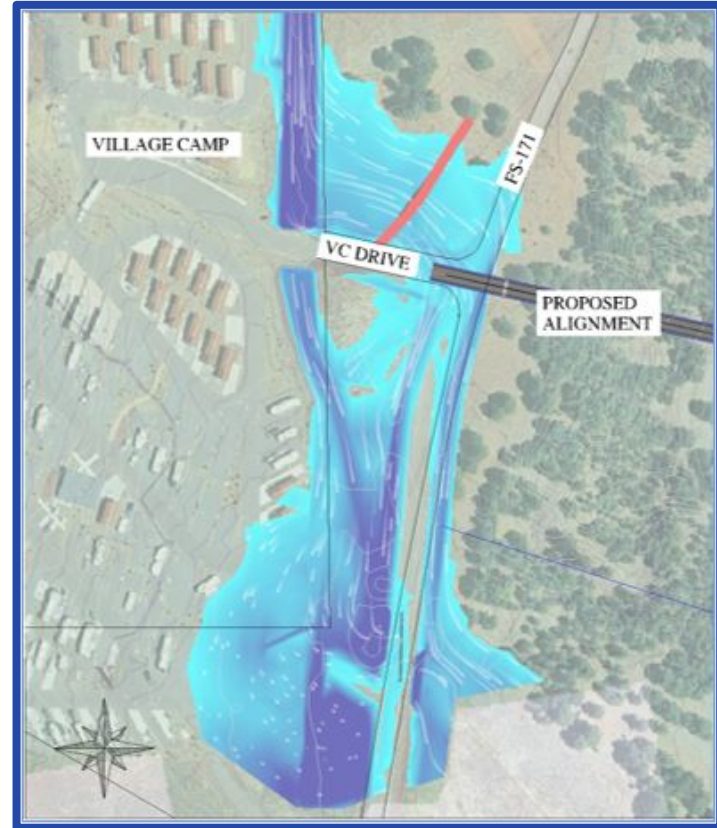


Figure 5: Flow Split Provided by Ardurra [2]

# Analysis cont.

- Traffic Analysis
  - Future traffic
    - Extrapolated per client request
    - ~6,000 average daily trips
  - Connections to Shadow Mtn & FS 171
  - Turn lanes
    - ADOT turn lane warrants
  - Roadway signage
    - MUTCD standards

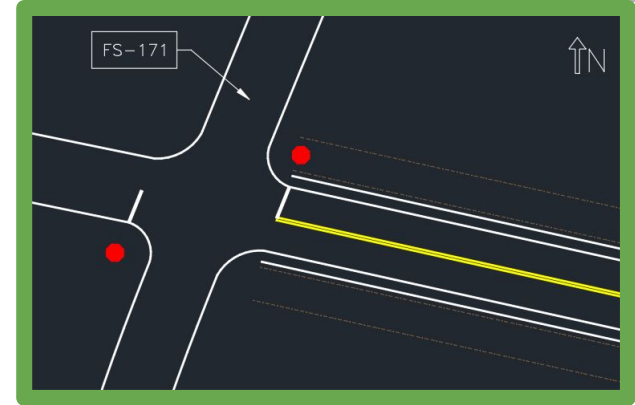


Figure 6: FS 171 Intersection

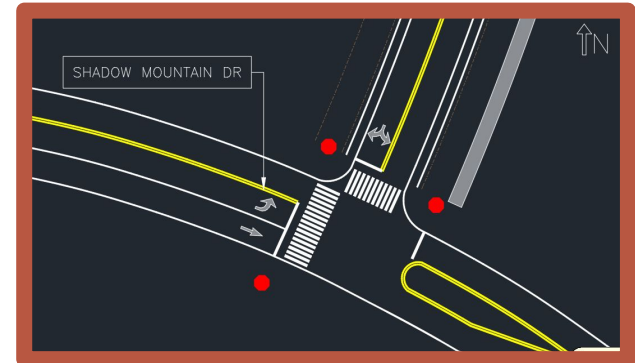


Figure 7: Shadow Mountain Intersection

# Design

- Roadway Design
  - Alignment selection

	Weight	Alternative 1	Alternative 2	Alternative 3
Hydraulic Cost	40%	37	0	37
Cut & Fill Work	20%	9	9	0
Environmental Impact	20%	15	16	0
Alignment Length	20%	3	3	0
<b>Total Score</b>	100%	<b>63</b>	<b>28</b>	<b>37</b>

Figure 8: Alignment Decision Matrix

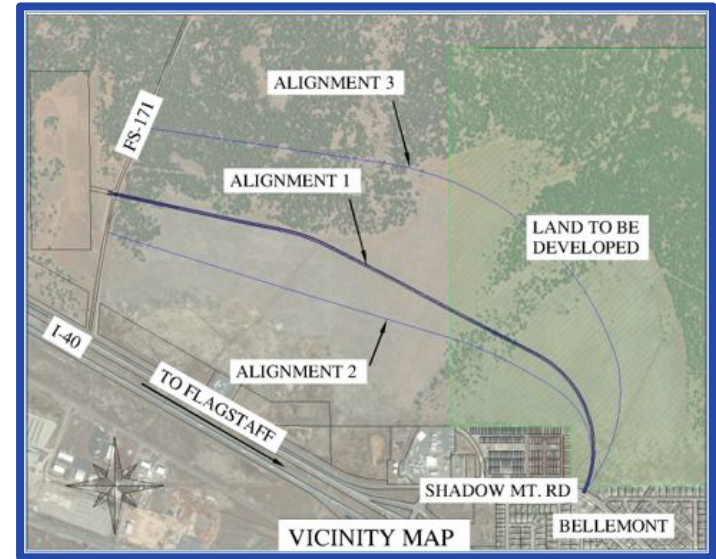
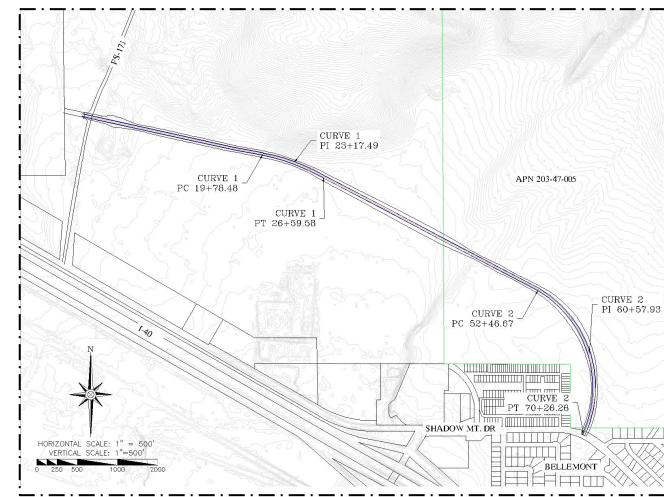
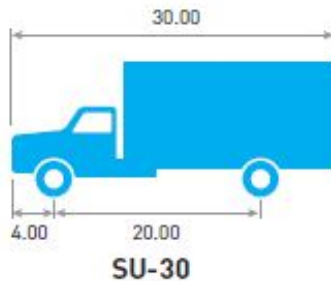


Figure 9: Project Vicinity Map

# Design cont.

- Roadway Design
  - Design vehicle and speed
    - SU-30
    - 45 MPH Design
    - 35 MPH Posted
  - Horizontal alignment



Horizontal Curve Data	Horizontal Curve 1	Horizontal Curve 2
Radius (ft)	2303	1176
PC (station)	19+78.48	52+46.67
PI (station)	23+17.49	60+57.93
PT (station)	26+59.58	70+26.26
Superelevation rate (%)	3.6	5.2
Side-Friction Factor	0.15	0.15
Length of Runoff (ft)	86.4	124.8
Length of Runout (ft)	28.8	41.6

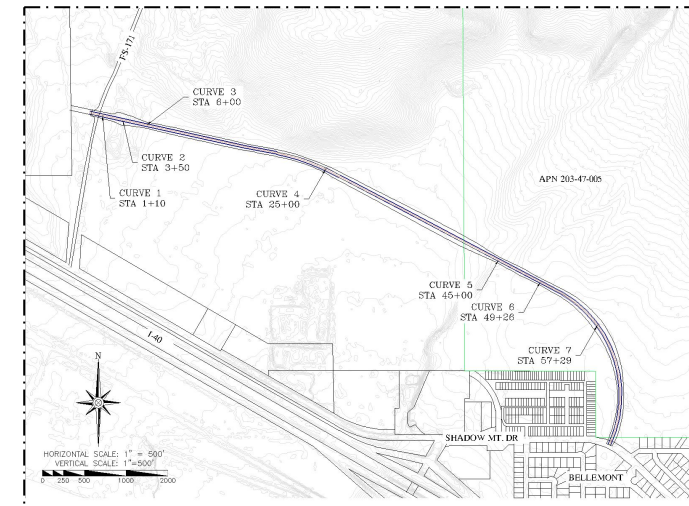
Figure 10. Horizontal Curve Summary

# Design cont.

- Roadway Design
  - Vertical alignment

Curve Number	Curve Description	Curve Type	Foreslope	Design Length (ft)
N/A	Start	Break	0.00%	46
1	Culvert 1	Sag	-0.75%	99
2	Watershed 1-2	Crest	0.50%	163
3	Insert	Sag	-2.18%	211
4	Culvert 2	Sag	-0.50%	79
5	Insert	Sag	0.50%	183
6	Watershed 3-4	Crest	1.82%	236
7	Culvert 3	Sag	-2.05%	162
N/A	End	Break	0.52%	32

Figure 11: Vertical Curve Summary



# Design cont.

- Roadway Design
  - Min. structural number: 4.23
    - 2.8 million ESAL's
  - Structural section
    - Typical aggregate base
      - SN: 4.25
    - Cement treated base
      - SN: 4.29

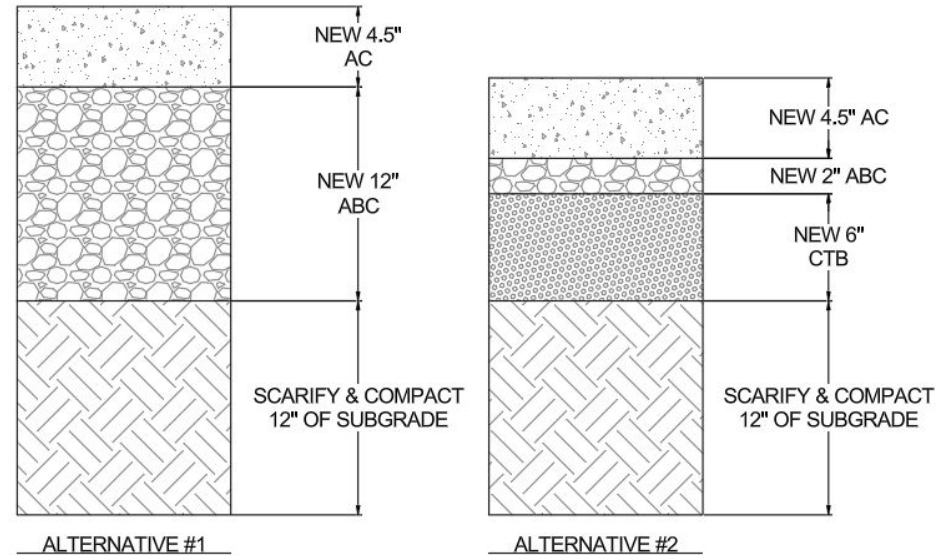


Figure 12: Proposed Structural Sections

# Design cont.

- Roadway Design
  - Typical cross-section

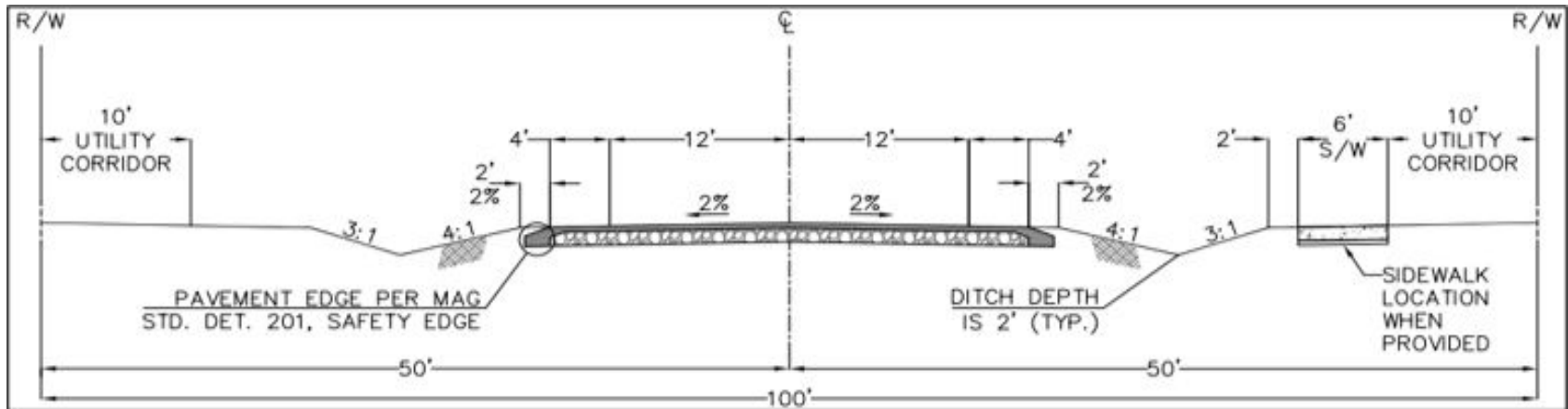


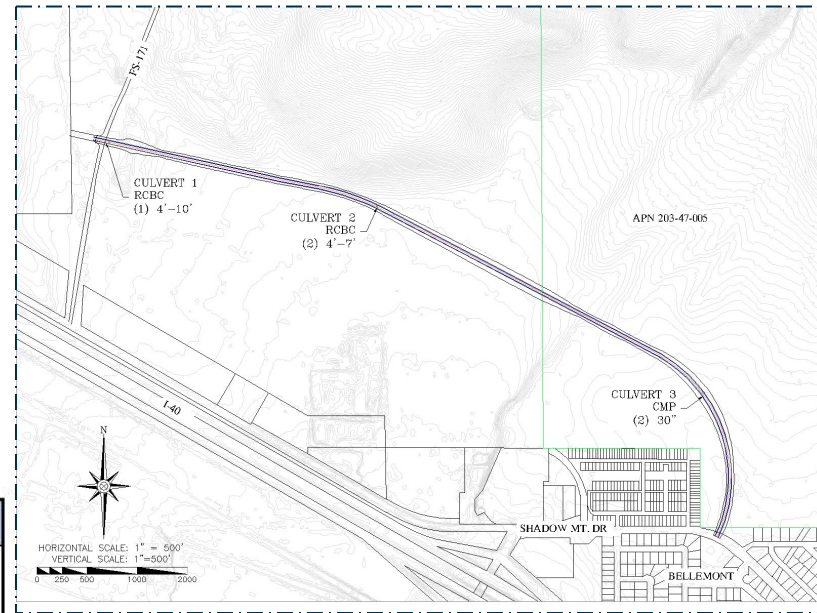
Figure 13: Typical Cross-section

# Design cont.

- Roadway Design
  - Culvert Design
    - Inlet-Controlled Nomographs

Hydraulic Structures						
Culvert ID	Type	Size/Diameter	Flow (cfs)	Velocity (ft/s)	Cover (ft)	Station
1	RCBC	(1) 4' x 10'	353.15	8.8	1.2	1+10
2	RCBC	(2) 4' x 7'	445.16	4.0	1.2	25+00
3	CMP	(2) x 30"	63.85	6.5	1	57+29

Figure 14: Hydraulic Structures Summary

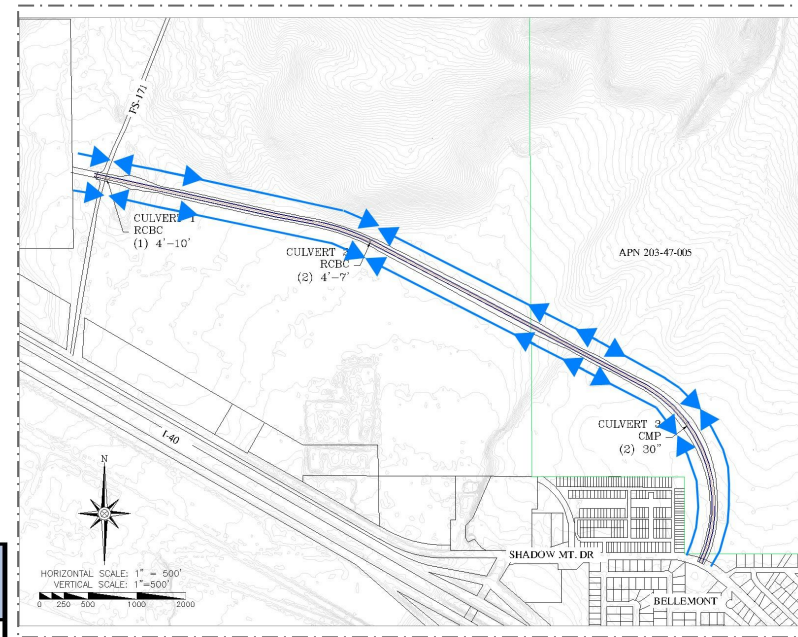


# Design cont.

- Roadway Design
  - Roadside Ditches
    - Manning's Equation

Channel ID	Drain to Culvert	Design Flow (cfs)	Velocity (ft/s)	Slope	Depth (ft)
1	1	0.85	1.72	0.75%	2.00
2	1	0.85	1.48	0.50%	2.00
3	2	11.16	4.89	2.18%	2.00
4	2	11.16	2.81	0.50%	2.15
5	2	11.16	2.81	0.50%	2.15
6	3	5.14	3.93	2.05%	2.00
7	3	5.14	2.35	0.52%	2.00

Figure 15: Roadside V-Ditches Calculations



# Design cont.

- Site Design
  - Cut and fill
    - 12,000 CY Cut
    - 25,000 CY Fill
  - Site grading
  - Utility corridor

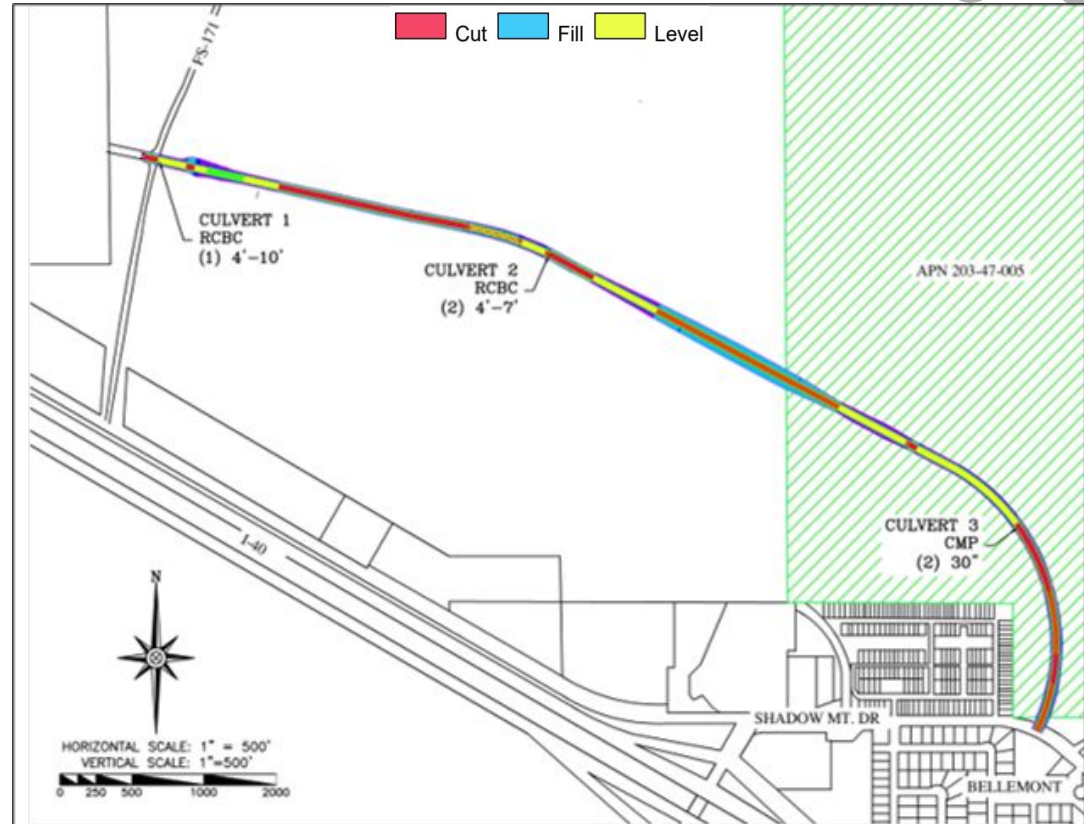


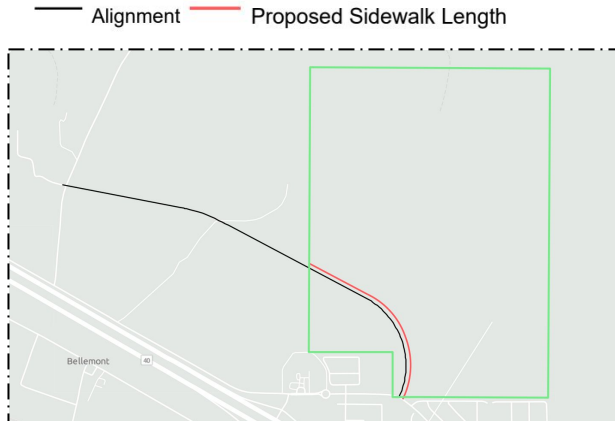
Figure 16: Site Plan with Cut/Fill Exhibit

# Alternatives Considered

- Roadway Alignment
- Structural Section
- Sidewalk Length

	Weight	Alternative 1 - 12" AB & 12" Subgrade		Alternative 2 - 2" AB, 6" CTB, & 12" Subgrade	
		Raw	Weighted	Raw	Weighted
Construction Cost	50%	0	0	9	5
Structural Strength	50%	5	2	14	7
<b>Total Score</b>		5	<b>2</b>	23	<b>12</b>

Figure 18: Structural Section Decision Matrix



	Weight	Reduced Sidewalk Length		Full Sidewalk Length	
		Raw	Weighted	Raw	Weighted
Construction Cost	40%	59	24	0	0
Pedestrian Access	30%	0	0	59	18
Future Costs	30%	100	30	0	0
<b>Total Score</b>		159	<b>54</b>	59	<b>18</b>

Figure 19: Sidewalk Length Decision Matrix

# Final Design Recommendation

- Plan Set
  - Site Plan

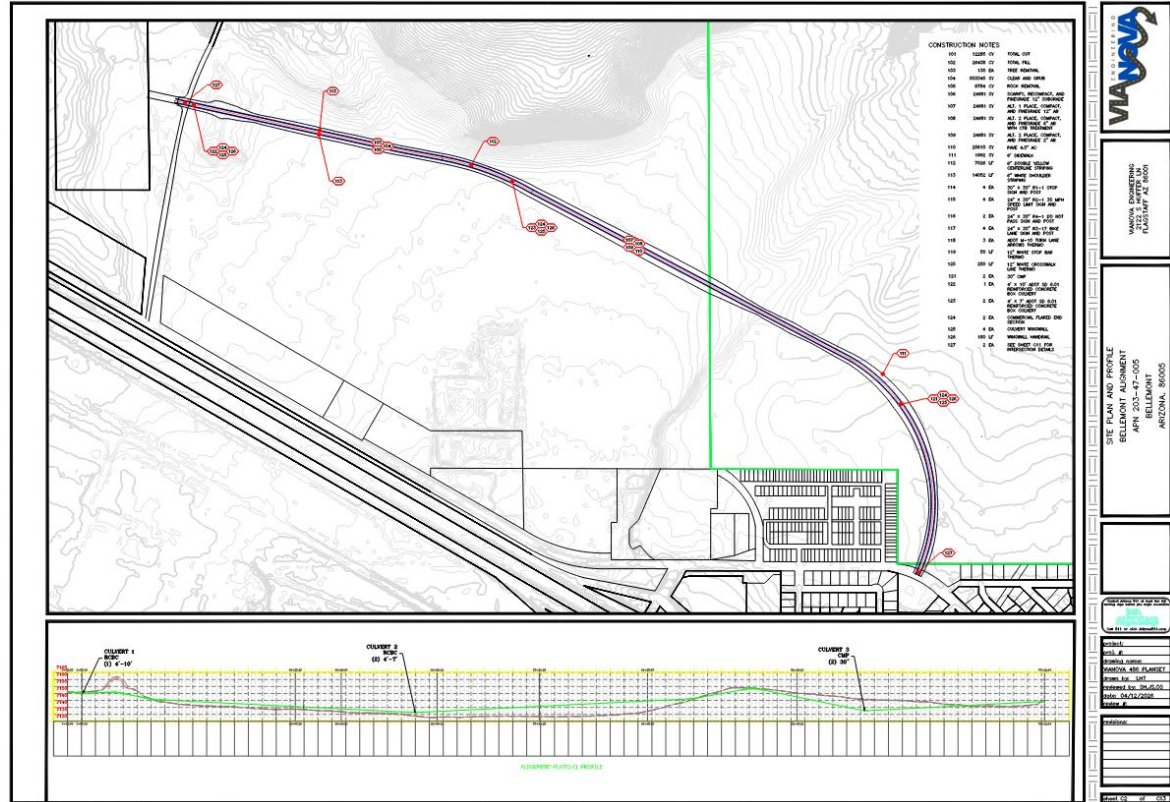
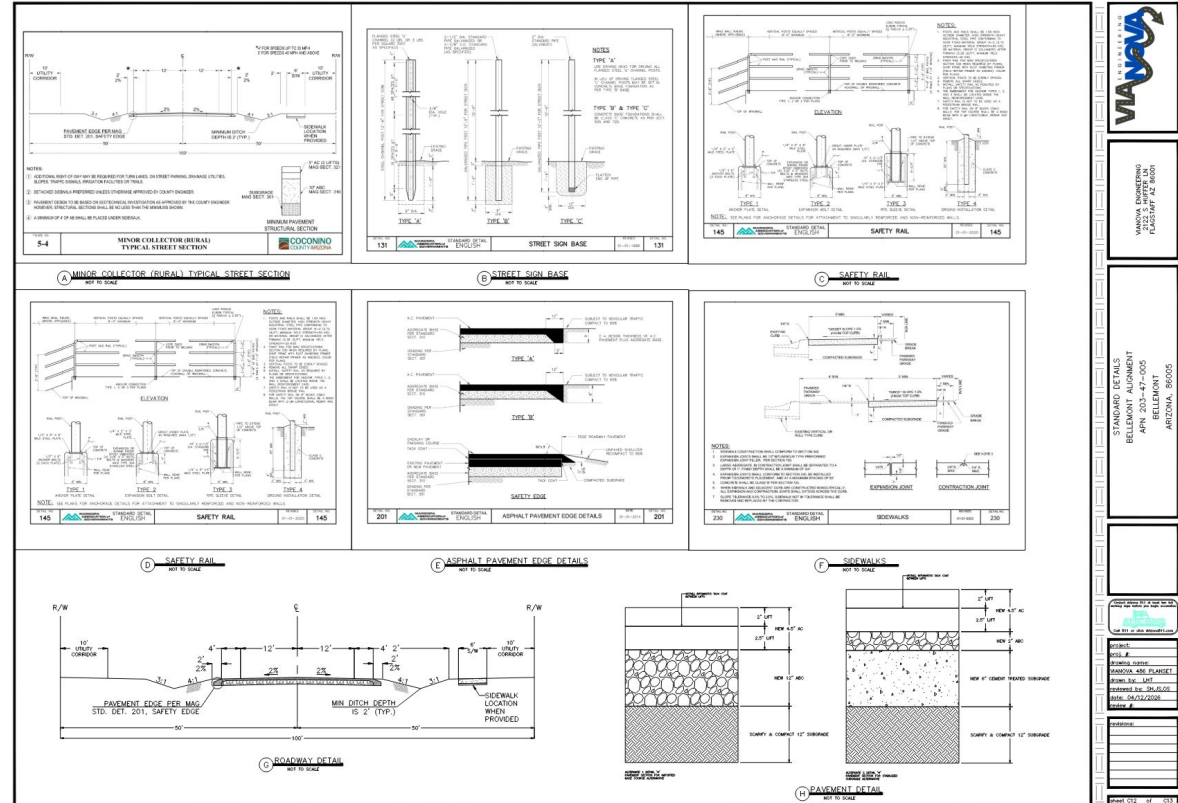


Figure 20: Site Plan



# Final Design Recommendation cont.

- Plan Set
  - Standard Details



VIA ENGINEERING NOVA

STANDARD DETAILS  
 BELLEVUE  
 APRIL 2013-47-000  
 BELLEFONT  
 ARIZONA, BRIDGE

DATE: 04/11/2013  
 TIME: 10:00 AM  
 USER: J. W. BROWN

PROJECT:  
 SHEET NO.:  
 DRAWING NO.:  
 SCALE:  
 DATE:

Figure 22: Standard Details

# Final Design Recommendation cont.

- Engineer’s Opinion of Probable Cost (EOPC)

Engineers Opinion of Probable Cost	
Item	Total Cost
Demo	
Demo Subtotal	\$499,020
Roadway	
Roadway Subtotal Alt 1	\$5,437,529
Roadway Subtotal Alt 2	\$5,233,731
Hydraulic Structures	
Hydraulic Structures Subtotal	\$355,747
Contract	
Contract Subtotal	\$433,328
Alt. 1 Total	\$6,725,624
Alt. 2 Total	\$6,521,827

Figure 23: EOPC

# Conclusion

- Takeaways
  - 20-Year development consideration
  - Provides emergency access
  - Alternative access route
  - Connects community

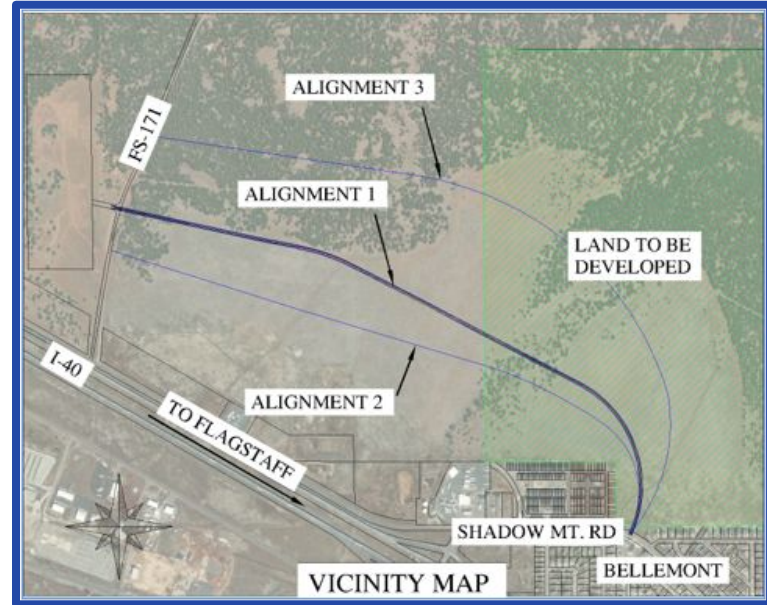


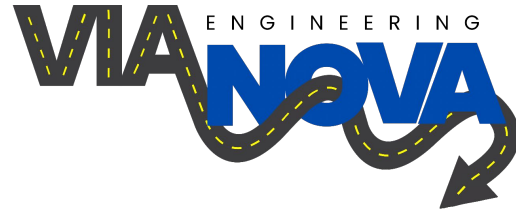
Figure 24: Project Vicinity Map

# References

[1] - USDA, "Web Soil Survey," Usda.gov, 2019.

<https://websoilsurvey.nrcs.usda.gov/app/>

[2] - Shephard - Wesnitzer, Inc. , "Final Drainage Report For Village Camp/Flagstaff," Flagstaff, 2021.



# Questions?

# Plan and Profile

