



[1]

SR 260/SR 89A Intersection Analysis



Final Presentation
CENE 486C



Depict Engineering Group

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Introduction

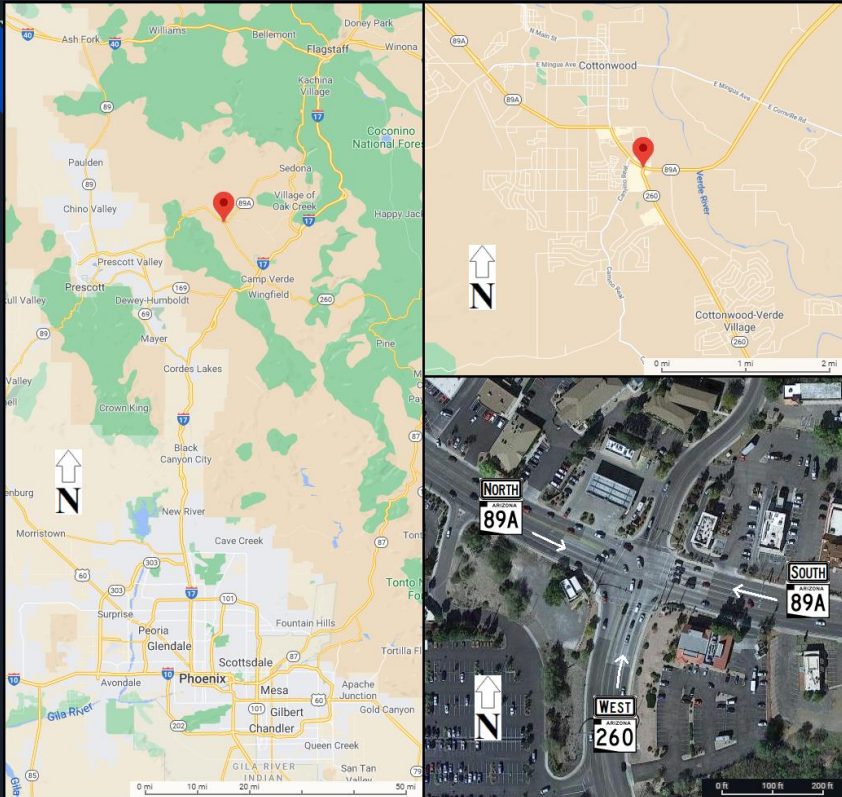




Figure 1: Location of the SR 260/SR 89A intersection Map data © 2021 Google [2]

- **Location:** Intersection of State Route 260 and State Route 89A in Cottonwood, Arizona
 - SR 89A runs east-west, SR 260 runs south, Cove Pkwy runs north
- **Purpose:** Improve mobility and safety at the intersection
- **Background:** Traffic increases at the site, is expected to continue. Facility will fail in 20 years (LOS E or F) without capacity improvements.
- **Client:** Nate Reisner, PE, ADOT District Development Engineering Manager
- **Technical Advisor:** Dr. Edward J. Smaglik, Ph.D., P.E., Professor

Technical Tasks Overview

Completed Tasks

- Task 1.0: Research and Regulatory Considerations
- Task 2.0: Site Investigation  [3]
- Task 3.0: Collection of Traffic Data from ADOT
- Task 4.0: Traffic Counts 
- Task 5.0: Traffic Analysis
- Task 6.0: Alternatives and Final Design

 **Tasks that were modified due to COVID**



Figure 2: State Route 260 in Arizona [4]

Existing Conditions

- PTV VISSIM was used along with ADOT traffic counts
- Level Of Service (LOS)
 - Performance measure
 - A-F
- Peak Hour
 - 3 PM to 4 PM
 - Traffic data used is from Wednesday April 17, 2019

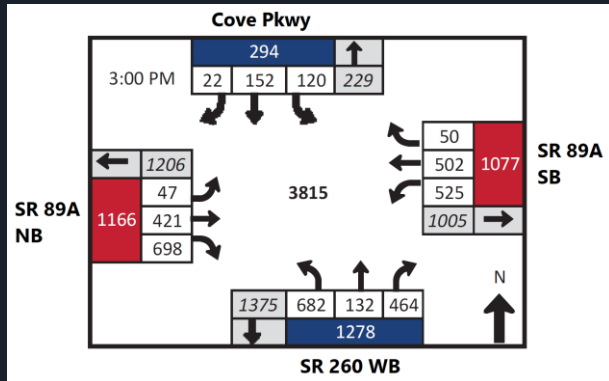


Figure 3: Peak traffic volumes, in vph, for the intersection of SR 260 and SR 89A [5]



Figure 4: Results of present conditions, showing backup

Traffic Analysis

- Compared current conditions to expected 20 year projection.
 - Growth factors
 - 1.25% for high trafficked areas
 - 1% for business entrances and local streets
- Significant LOS degradation
 - Several approaches are already at LOS E.
 - Minimum acceptable is LOS D.
- Biggest issue being 260 WB and SR 89A NB.

Table 1: VISSIM Analysis Results

Road	Move-ment	Level of service			Delay increase (s)	Stop delay increase (s)	Increase in Stops (s)
		Present	20-year	Change (letter)			
SR 89A NB	Left	LOS D	LOS F	2	42.99	37.60	0.70
	Thru	LOS E	LOS F	1	66.05	56.96	1.17
	Right	LOS C	LOS E	2	42.94	27.61	2.10
SR 89A SB	Left	LOS E	LOS E	0	16.07	15.63	0.01
	Thru	LOS E	LOS E	0	18.35	17.43	0.18
	Right	LOS E	LOS E	0	10.84	9.99	0.05
SR 260 WB	Left	LOS E	LOS F	1	13.05	13.41	-0.08
	Thru	LOS E	LOS E	0	3.75	4.26	-0.05
	Right	LOS B	LOS C	1	7.86	1.97	0.60
Cove Pkwy	Left	LOS D	LOS E	1	10.92	9.75	0.07
	Thru	LOS E	LOS E	0	16.66	15.64	0.14
	Right	LOS C	LOS D	1	28.19	27.14	0.21
Overall		LOS D	LOS E	1	24.69	19.94	0.62

Alternative A

Table 2: LOS Changes from Alternative A.

Road	Turn	LOS	Change in delay (s)
SR 89A NB (east appr.)	Left	LOS D	-36.2
	Thru	LOS F	-29.5
	Right	LOS C	-52.8
SR 89A SB (west appr.)	Left	LOS D	-35.4
	Thru	LOS C	-48.1
	Right	LOS C	-48.2
SR 260 WB (north appr.)	Left	LOS C	-49.9
	Thru	LOS C	-36.2
	Right	LOS A	-19.9
Cove Pkwy (south appr.)	Left	LOS D	-11
	Thru	LOS E	-10.6
	Right	LOS E	2.1
Overall		LOS D	-39.1

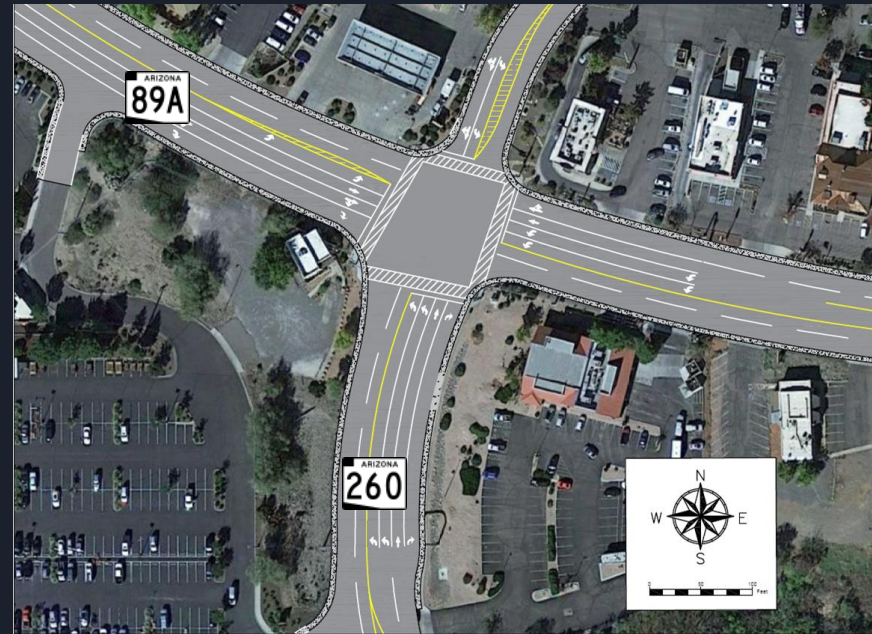


Figure 5: Alternative A.

- No lane additions
- Changes to signal timing
- Reduce delays for SR 260
- Right turn arrows to all right turn movements

Alternative B

Table 3: LOS Changes from Alternative B.

Road	Turn	LOS	Change in delay (s)
SR 89A NB (east appr.)	Left	LOS D	-47.1
	Thru	LOS D	-81.6
	Right	LOS A	-66.5
SR 89A SB (west appr.)	Left	LOS D	-36.3
	Thru	LOS C	-46.3
	Right	LOS C	-43.9
SR 260 WB (north appr.)	Left	LOS C	-52.9
	Thru	LOS C	-36.8
	Right	LOS A	-20.5
Cove Pkwy (south appr.)	Left	LOS D	-14.7
	Thru	LOS F	21.5
	Right	LOS F	39.7
Overall		LOS C	-46.3

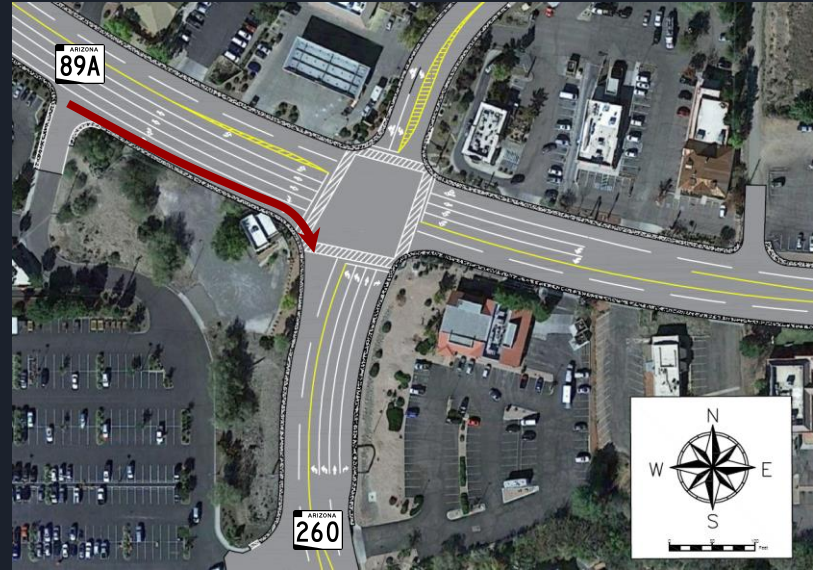


Figure 6: Alternative B.

- Updated timing
- Add a right turn lane to SR 89A NB
- Right of way acquisition

Alternative C

Table 4: LOS Changes from Alternative C.

Road	Turn	LOS	Change in delay (s)
SR 89A NB (east appr.)	Left	LOS D	-47
	Thru	LOS D	-81.4
	Right	LOS A	-67.9
SR 89A SB (west appr.)	Left	LOS D	-34.7
	Thru	LOS C	-46.4
	Right	LOS C	-44.3
SR 260 WB (north appr.)	Left	LOS C	-53
	Thru	LOS C	-36.4
	Right	LOS A	-20.4
Cove Pkwy (south appr.)	Left	LOS D	-23.1
	Thru	LOS D	-36.6
	Right	LOS B	-34.3
Overall		LOS C	-49.4

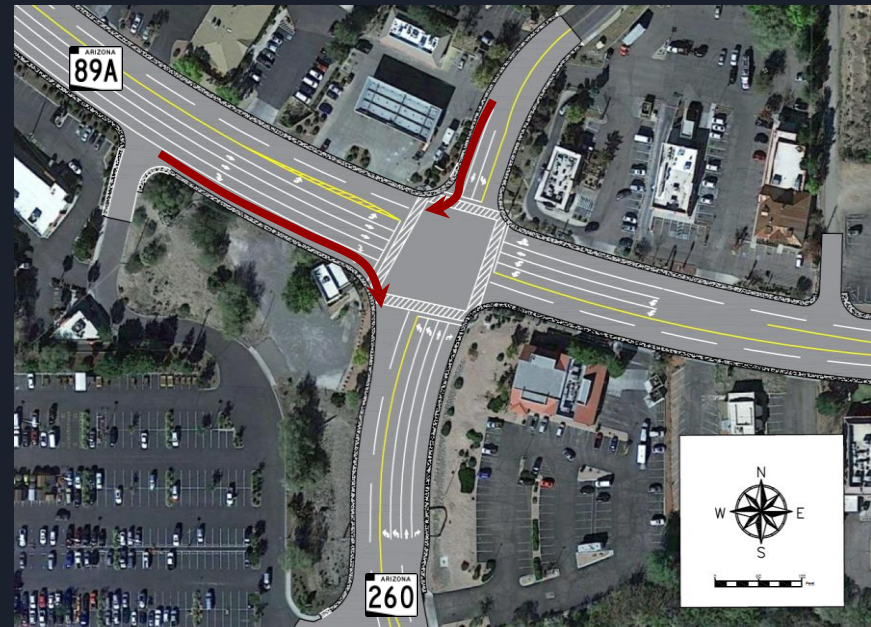


Figure 7: Alternative C.

- Adds right turn lane to Cove Pkwy
- Adds Right turn lane to SR 89A
- Right of way acquisition

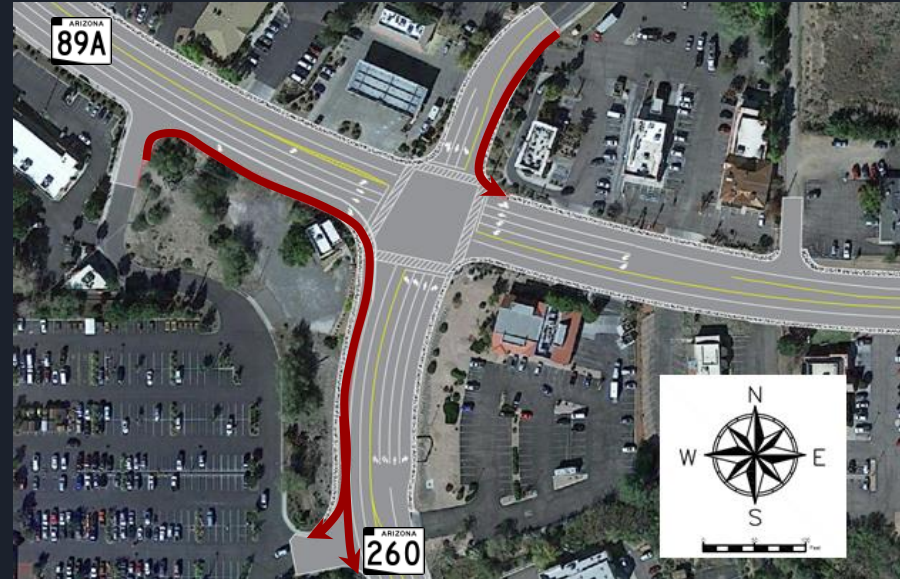
Alternative D

Table 5: LOS Changes from Alternative D.

Road	Turn	D-1	D-2 thru D-4	Change in delay (s)
SR 89A NB (east appr.)	Left	LOS D	LOS D	-48.5
	Thru	LOS D	LOS D	-81.8
	Right	LOS B	LOS A	-69.3
SR 89A SB (west appr.)	Left	LOS D	LOS D	-36.1
	Thru	LOS C	LOS C	-46.3
	Right	LOS C	LOS C	-44.3
SR 260 WB (north appr.)	Left	LOS C	LOS C	-52.4
	Thru	LOS C	LOS C	-36.3
	Right	LOS A	LOS A	-20.2
Cove Pkwy (south appr.)	Left	LOS D	LOS D	-23.1
	Thru	LOS D	LOS D	-36.8
	Right	LOS B	LOS B	-34.3
Overall		LOS C	LOS C	-49.7

- Adds through lane to Cove Pkwy
- Addition of a slip lane to SR 89A EB
- Sub Alternatives
 - Alternative D-1: Short merge distance.
 - Alternative D-2: Slip lane becomes a right-turn only lane at the driveway.
 - Alternative D-3: Slip lane merges before the next signal at Fir Street.
 - Alternative D-4: Slip lane continues until and becomes right-turn only at Fir St.

Figure 8: Alternative D.



Alternative E

Table 6: LOS Changes from Alternative E.

Road	Turn	E-1 thru E-4	Change in delay (s)
SR 89A NB (east appr.)	Left	LOS D	-34.9
	Thru	LOS D	-62.4
	Right	LOS A	-35.3
SR 89A SB (west appr.)	Left	LOS D	-27.8
	Thru	LOS C	-36.3
	Right	LOS C	-35.9
SR 260 WB (north appr.)	Left	LOS C	-51.3
	Thru	LOS C	-27.4
	Right	LOS A	-0.1
Cove Pkwy (south appr.)	Left	LOS D	-16.4
	Thru	LOS D	-28.9
	Right	LOS B	-29.1
Overall		LOS C	-35.463

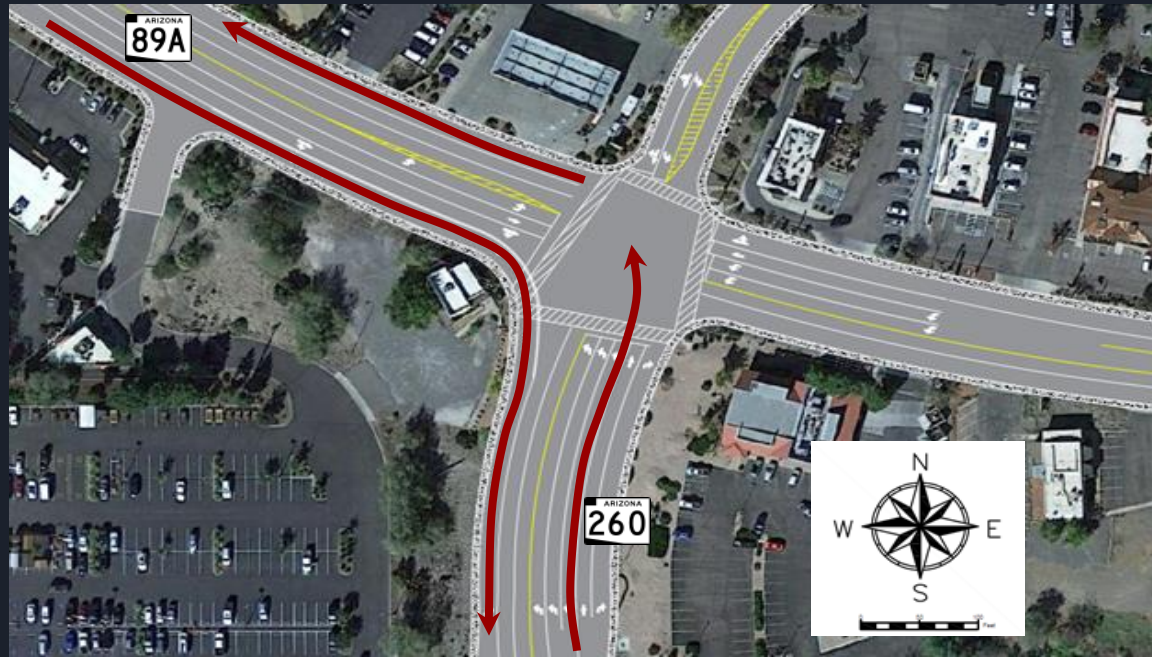


Figure 8: Alternative E.

- Adds through lane to Cove Pkwy
- Also adds slip lane
- Addition of third turn lane (SR 260 WB to SR 89A SB)
- Significant right of way acquisition
- Third lane on SR 89A SB would merge before the next signal

Results of Traffic Analysis

Table 7: Level of service results from VISSIM of each intersection.

Legend
LOS A
LOS B
LOS C
LOS D
LOS E
LOS F

Road	Turn	No-build	A	B	C	D-1	D-2	D-3	D-4	E-1	E-2	E-3	E-4
SR 89A NB (eastbound approach)	Left	LOS F	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D
	Thru	LOS F	LOS F	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D
	Right	LOS F	LOS C	LOS A	LOS A	LOS B	LOS A	LOS A	LOS A	LOS A	LOS A	LOS A	LOS A
SR 89A SB (westbound approach)	Left	LOS F	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D
	Thru	LOS F	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C
	Right	LOS F	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C
SR 260 WB (northbound approach)	Left	LOS F	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C
	Thru	LOS F	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C
	Right	LOS C	LOS A	LOS A	LOS A	LOS A	LOS A	LOS A	LOS A	LOS A	LOS A	LOS A	LOS A
Cove Pkwy (southbound approach)	Left	LOS F	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D
	Thru	LOS F	LOS F	LOS F	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D	LOS D
	Right	LOS D	LOS F	LOS F	LOS B	LOS B	LOS B	LOS B	LOS B	LOS B	LOS B	LOS B	LOS B
Overall		LOS F	LOS D	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C	LOS C

Decision Matrix

- Rated on 1 to 3 scale
 - 0.5 increments to differentiate small differences
- Traffic Improvements
 - Highest weight
 - Based on VISSIM results
- Impacts to Right of Way
 - Land needed to be acquired
- Construction Costs
 - Assumes right of way has already been acquired
 - Construction only
- Maintenance Cost
 - Relative to existing
- Impacts to Pedestrians and Cyclists

Table 8: Scoring matrix categories and weights

Traffic improvements	0.32
Impacts to right-of-way	0.28
Construction cost	0.18
Maintenance cost	0.12
Impacts to pedestrians and cyclists	0.10

Decision Matrix

- Traffic Improvements
 - 1: Negligible improvements to traffic flow
 - 2: Improves traffic flow, but causes issues such as weaving
 - 3: Improves traffic flow with no issues
- Impacts to Right-of-Way (R/W)
 - 1: Requires a lot of R/W, demolishing buildings
 - 2: Requires little new R/W
 - 3: Requires no new R/W
- Construction Costs
 - 1: Design has expensive components, will be very costly to build
 - 2: No expensive components, but relatively expensive to build
 - Minimal construction costs

Table 8: Scoring matrix categories and weights

Traffic improvements	0.32
Impacts to right-of-way	0.28
Construction cost	0.18
Maintenance cost	0.12
Impacts to pedestrians and cyclists	0.1

Decision Matrix

- Maintenance Costs
 - 1: Extensive maintenance which will be costly in the long run
 - 2: Maintenance costs on par with other treatments
 - 3: Negligible maintenance costs
- Impacts to Pedestrians and Cyclists
 - 1: Negligible improvements to ped/bike safety
 - 2: Marginal improvements to ped/bike safety
 - 3: Significant improvements to ped/bike safety

Table 8: Scoring matrix categories and weights

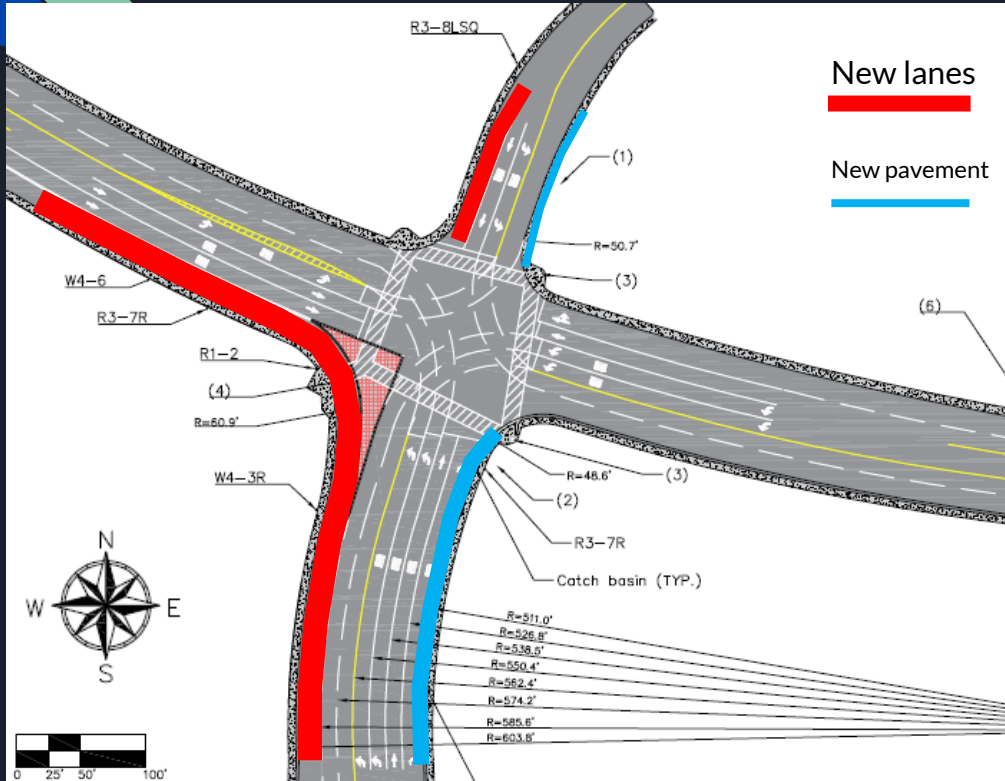
Traffic improvements	0.32
Impacts to right-of-way	0.28
Construction cost	0.18
Maintenance cost	0.12
Impacts to pedestrians and cyclists	0.1

Scores for Each Alternative

Table 9: Decision matrix with scores of each alternative

Alternative	Traffic improvements	Impacts to right-of-way	Construction cost	Maintenance cost	Impacts to pedestrians and cyclists	Score
Weight	0.32	0.28	0.18	0.12	0.1	--
Alt A	0.5	3	3	3	2	2.1
Alt B	1	1	2	2	2	1.4
Alt C	1.5	1	1.5	2	2	1.47
Alt D-1	1.5	3	1.5	2	1.5	1.98
Alt D-2	2	3	1.5	2	2	2.19
Alt D-3	2.5	2.5	1	1.5	2.5	2.11
Alt D-4	3	2.5	1	1.5	2.5	2.27
Alt E-1	2	1	1.5	1.5	1.5	1.52
Alt E-2	2.5	1	1.5	1.5	2	1.73
Alt E-3	3	1	1	1	2.5	1.79
Alt E-4	3	1	1	1	2.5	1.79

Final Alternative



- Adding a slip lane proved most effective
- Alternative D4 was selected
 - Add pedestrian island
 - Slip lane continues on SR 260, becomes right-turn only at Fir St
 - SR 260 approach will shift one lane to the east
 - Add a thru lane onto Cove Pkwy
- Projected level of service: C overall, D at most congested spots

Figure 9: Excerpt from final plan set

Cost to Build

- Right of way needed
- Earthwork
- Remove and replace asphalt
- Concrete sidewalk
- Curb and gutter work
- Lane striping
- Relocation
 - signal masts
 - Controller cabinet
 - Utility cabinet
- Culvert extension
- Pedestrian island
- Temporary Traffic Control (TTC)

Table 10: Summary of estimate of cost.

Item	Quantity	Unit	Unit cost	Total cost
Acquire right-of-way	1	Each	\$750,000.00	\$750,000
Remove Lane striping	3125	LF	\$0.40	\$1,250
Lane striping	5857.5	LF	\$0.40	\$2,343
Pavement markers	5857.5	LF	\$0.83	\$4,881
Remove crosswalks	373.5	LF	\$1.00	\$374
Add crosswalks	457.1	LF	\$1.20	\$549
Paint	1239.1	SF	\$11.00	\$13,630
Remove asphalt	1880.37	SF	\$4.00	\$7,521
New asphaltic concrete	1136.275	Ton	\$110.00	\$124,990
Remove Concrete sidewalk	8398.775	SF	\$4.50	\$37,794
Install Concrete sidewalk	8398.775	SF	\$5.00	\$41,994
Sidewalk ramps	3	Each	\$2,500.00	\$7,500
Install Curb & gutter	1679.755	LF	\$30.00	\$50,393
Earthwork	730	CY	\$30.00	\$21,900
Extend Oak Wash culvert	18	LF	\$2,500.00	\$45,000
Signal mast arm	2	Each	\$700.00	\$1,400
Signal mast foundation	2	Each	\$1,200.00	\$2,400
Move signal cabinet	1	Each	\$500.00	\$500
Move utility box	1	Each	\$500.00	\$500
Replace overhead sign (SR 260)	1	Each	\$10,000.00	\$10,000
Pedestrian island concrete	208.93	SQ YD	\$95.00	\$19,848
Catch basin	4	Each	\$4,000.00	\$16,000
Traffic sign	13	Each	\$25.00	\$325
TTC Cones	20	ea.	\$15.00	\$300
TTC Signs	25	ea.	\$0.75	\$19
TTC Sign trucks	6	ea.-day	\$30.00	\$180
Subtotal				\$1,161,591
Overhead (15%)				\$174,239
Total				\$1,335,830



Impacts

Environmental

- Impervious surface area increased
- Increase in capacity and emissions
- Reduced culvert capacity

Economic

- Reduction in delays will lead to more economic development
- Reduced commute times leads to more productivity
- Capacity increase will increase number of people shopping
- Increase in tax revenue

Social

- Reduced user stress
- Increase in social activity between users of public transportation.

Conclusion

Summary

- Redevelopment of intersection is needed for the 20 year projection
- Final design meets project goals
- The LOS is at an acceptable level per 20 year projection
- Increased capacity has the potential to positively impact the local economy

Final Recommendation

- Add a slip lane to the SR 89A NB (east approach) to SR 260 EB right turn (south exit)
- Add a third lane on SR 260 EB that continues onto Fir Street and becomes a right turn only lane at Fir Street
- Add through lane to the Cove Parkway (southbound) approach
- Shift existing SR 260 approach one lane to the east to accommodate Cove widening



Figure 10: Historic Cottonwood, Arizona [6].



References

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Questions?