

ADOT

Arizona Bottleneck Removal

Alternative Road Safety Audit



Transportation Research Board ACS20 Midyear Meeting

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ARIZONA DEPARTMENT OF TRANSPORTATION



Arizona Facts at a Glance

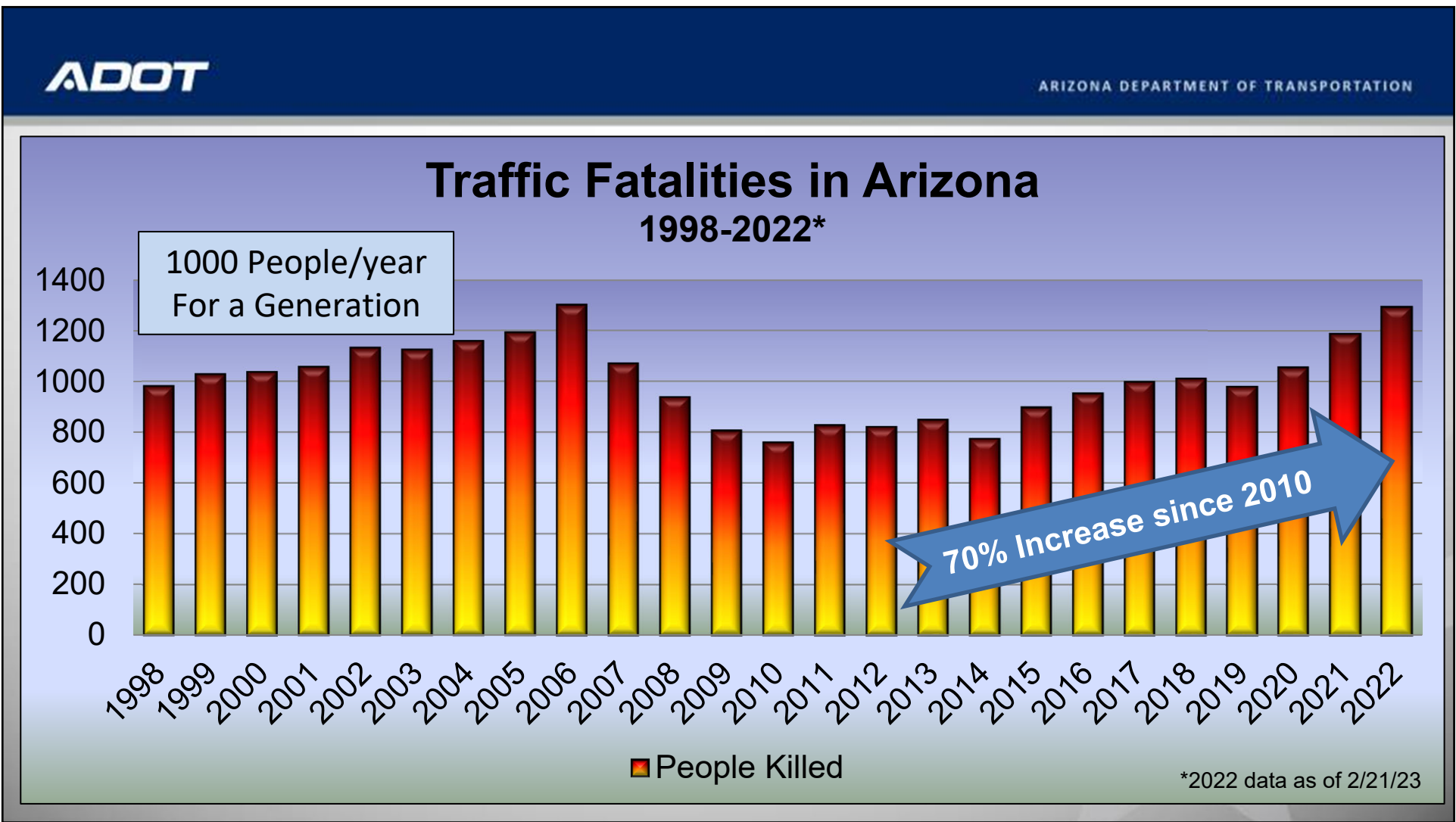
“The Grand Canyon State”

Area: 113,998 mi²
Population: 7,360,000 residents*
Road System:
State – 21,000 miles
Local – 141,000 miles

Road Safety Vision –
Towards Zero Deaths

*USCB est. 7/1/22







2022 Traffic Fatalities

1301 Deaths*

9% Higher than 2021

Highest number since 2006

130,000 crashes Annually

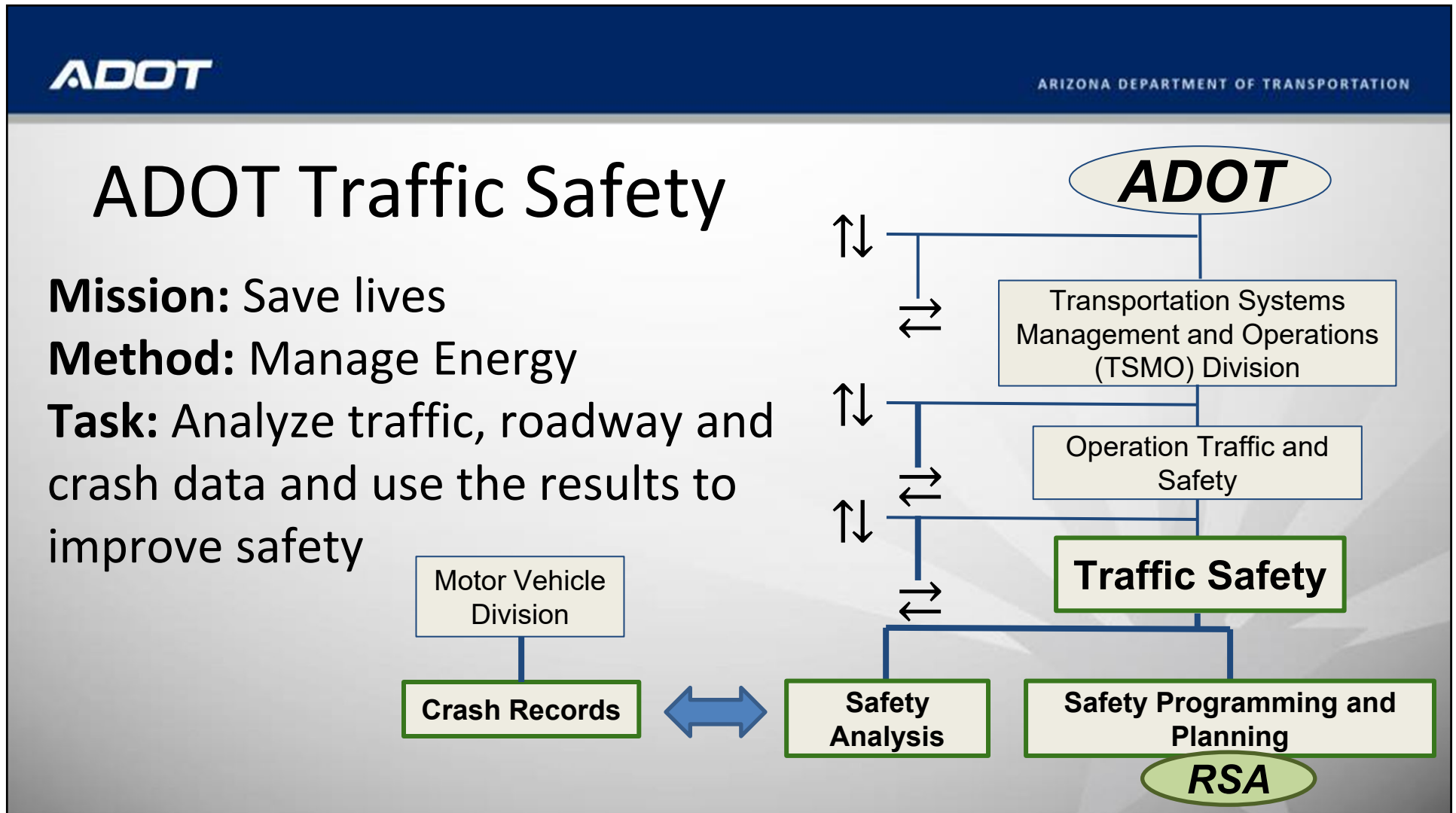
60% within Maricopa County

*2022 data as of 6/26/23



Agenda

- Arizona Road Safety Audit Program
- Bottleneck Removal Project
- Moving Forward
 - Lessons learned
 - Future plans




Road Safety Audits

A formal safety performance of an existing or future road or intersection by an independent, multi-disciplinary team.

- Proactive in nature
- Field observation - day, night, peak, off peak
- Focused on road safety
- Multimodal - peds, bikes, ADA, transit, trucks

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TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS (TSMO) DIVISION
OPERATIONAL AND SAFETY GROUP
TRAFFIC SAFETY

2021 NETWORK SCREENING OPERATIONAL STUDY REPORT

September 2022

Annual Network Screening

Frequency analysis (hot spot) of high fatal & serious injury crash locations based on most recent five years of data

Recommendations:

- No Action
 - Recent change
 - Pending change
- **Conduct Road Safety Audit**

Arizona Department of Transportation
Traffic Safety Section
Network Screening
Pedestrian Crash Type - SHS Intersections

Crash Type 5: Pedestrian
Network: 225
Period: 2016-2020
Query Date: 11/28/2021

#	On Road / Milepost	Intersecting Street / MP	Traffic Control	ADOT District	DPS District	FHWA Region	ADOT Traffic Region	Severity - Pedestrian Crashes Only					Total Crashes	Comments
								K+A Total	Fatal (K)	Serious (A)	Minor/Pass (B/C)	POD (D)		
1	SR-202 (MP 208.75)	Western Dr	Signalized	Northcentral	District 12	A-1	Northern	2	2	0	0	0	2	
2	SR-202 (MP 252.12)	Goodnow Rd	1-way stop	Northcentral	District 11	A-1	Northern	2	1	1	0	0	2	
3	SR-854 (MP 172.48)	Mountain Shadows Dr / Northview Rd	Signalized	Northcentral	District 12	A-1	Northern	2	0	2	0	0	2	
4	1-17 NB Frontage Rd (MP 202.61)	Osborn Rd	1-way stop	Central	Metro Central	A-4	Central	2	0	2	0	0	2	
5	1-17 NB Frontage Rd (MP 202.91)	Indian School Rd	Signalized	Central	Metro Central	A-4	Central	2	0	2	0	0	2	
6	1-17 EB on Ramp / Frontage Rd (MP 129.64)	Elst Ave	Signalized	Central	Metro Central	A-4	Central	2	0	2	0	0	2	

NOTE:
© 2017 Arizona Traffic Crash Manual Definition only without intersection related check box. Any crash within 150 feet of the intersection irrespective of if the intersection related box was checked or not on the report.

What We Look For

Pattern? Yes – No

More than once or twice during study period

Solution? Yes – No

We can prevent future occurrences

Actionable? Yes – No

We can implement solution



Suggest Possible Mitigation: Suggestions Appropriate to Project Stage

Short term solutions

Changing signage pavement markings, rumble strips, barriers, enforcement, etc.

Long term solutions

Flattening a curve modifying a roadway's vertical alignment, intersection re-alignment, etc.



RSA Response Template

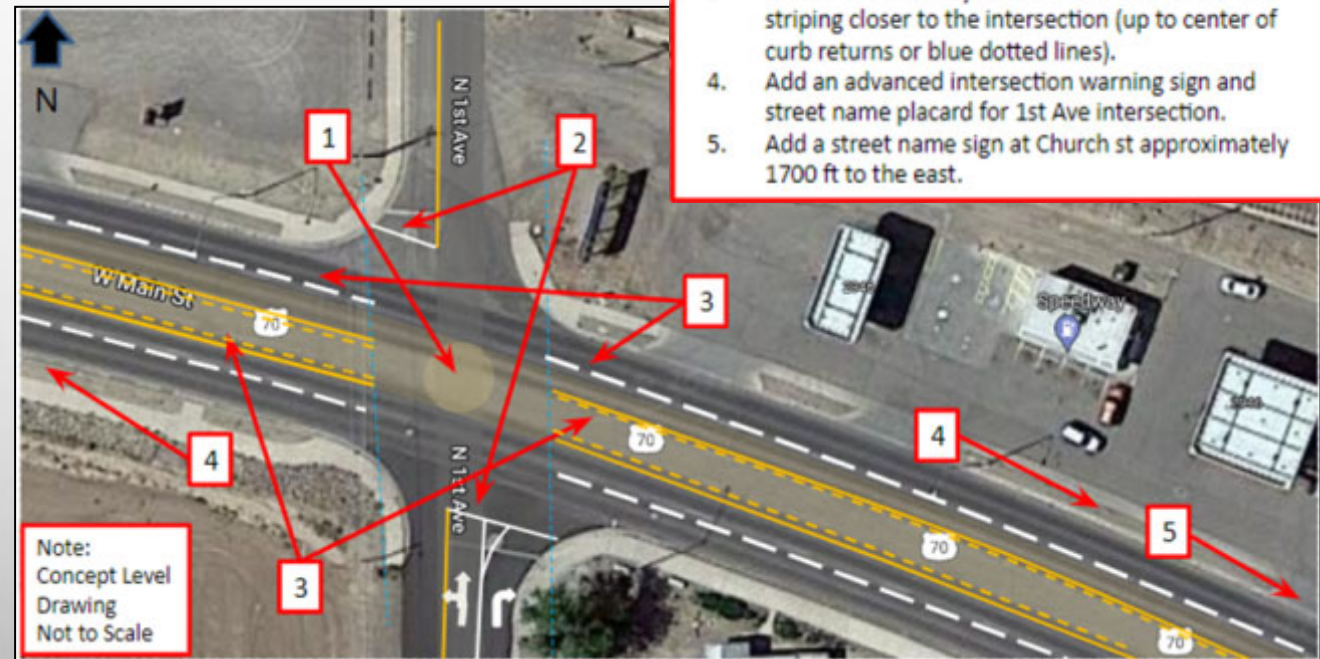
		Owner Response			
		Reject	Concur		
Suggested Countermeasure	Priority (High/Low)	Reason	Action	Partner	Detail/Response

conditions, or railway-highway crossings, pursuant to sections 130, 144, and 148 of this title or for the purpose of developing any highway safety construction improvement project which may be implemented utilizing Federal-aid highway funds shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data

Countermeasure Diagram

All proposed countermeasures

- Appropriate detail
- Approximate distances
- Numbering consistent with report



Program Philosophy

RSA are done for a reason

- Expensive in time and money
- Recommendations need to be taken seriously and responded to

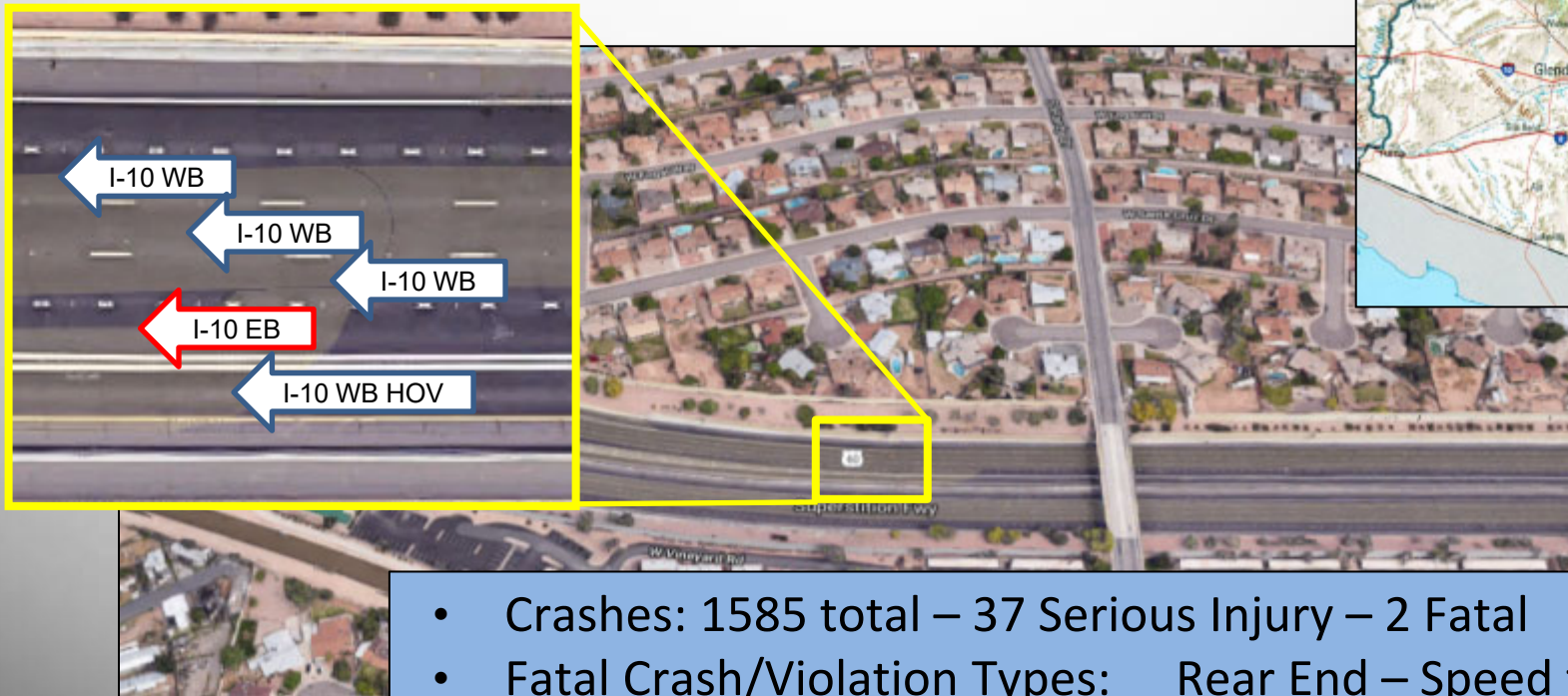
Reports should be directly actionable

- Should contain enough information to move forward
 - Low cost solutions should have enough info for work orders
 - Higher dollar solutions should contain concept level design, cost and B/C estimates



Westbound US-60 MP-173-4

Highest Crash Segment Statewide



- Crashes: 1585 total – 37 Serious Injury – 2 Fatal
- Fatal Crash/Violation Types: Rear End – Speed too Fast



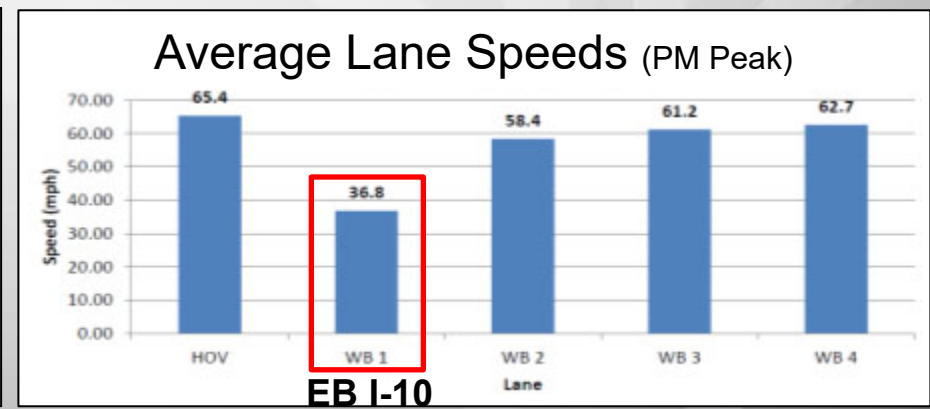
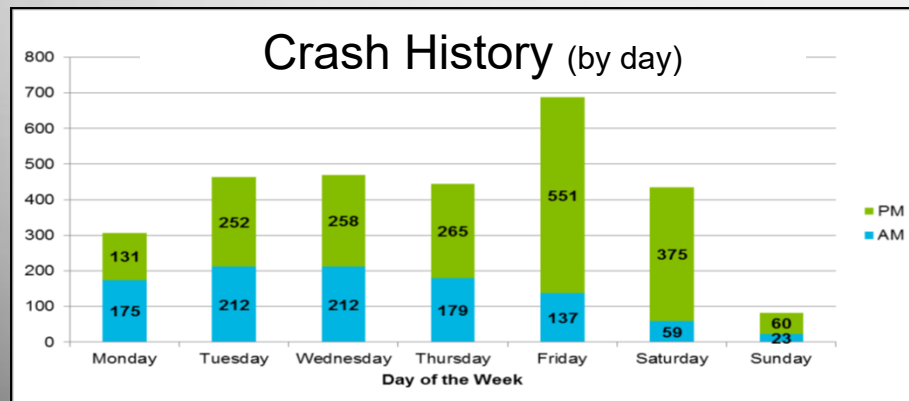
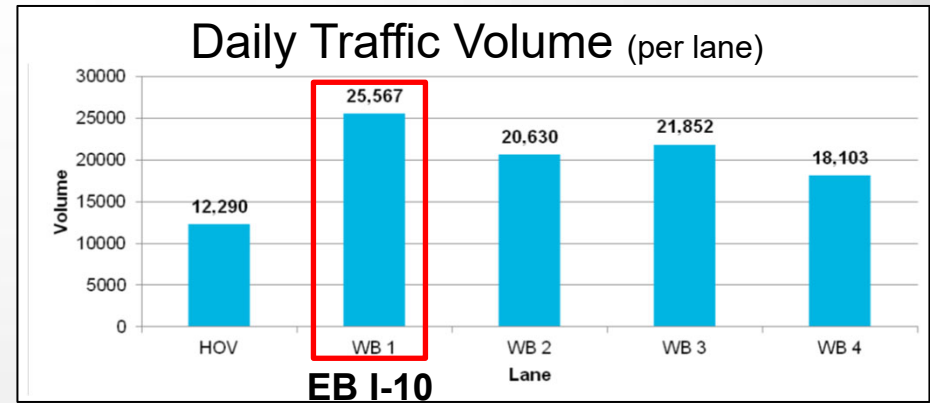
US-60 Analysis

Initial Road Safety Audit Results

Crashes: Between EB I-10 (1) & WB I-10 (HOV & 2) lanes

Lane volume: 4,000-7,000 veh./day

Speed differential: 22-26 mph



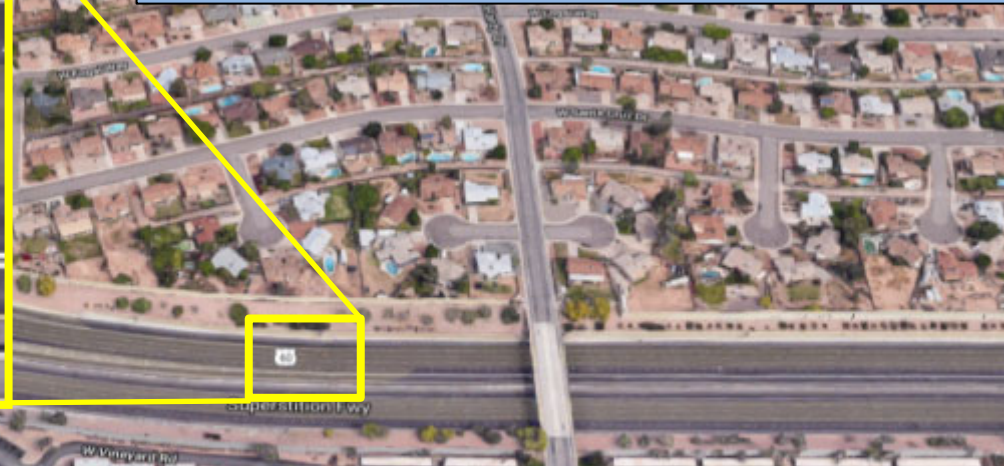
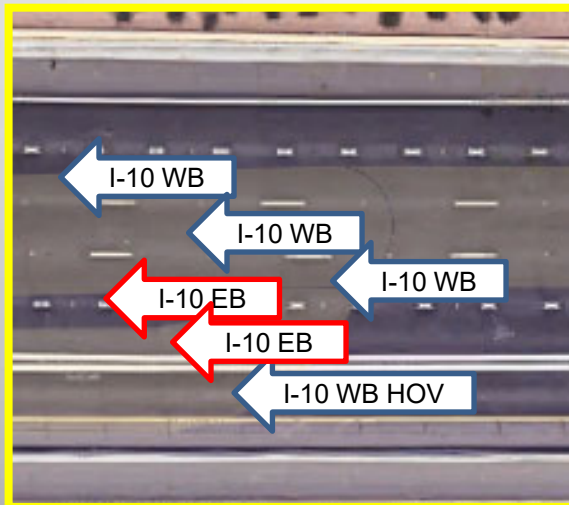


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Westbound US-60 MP-173-4

Solution

- Second Eastbound exit lane added fly-over ramp
 - Ramp Doubling
- Required modeling and design exception



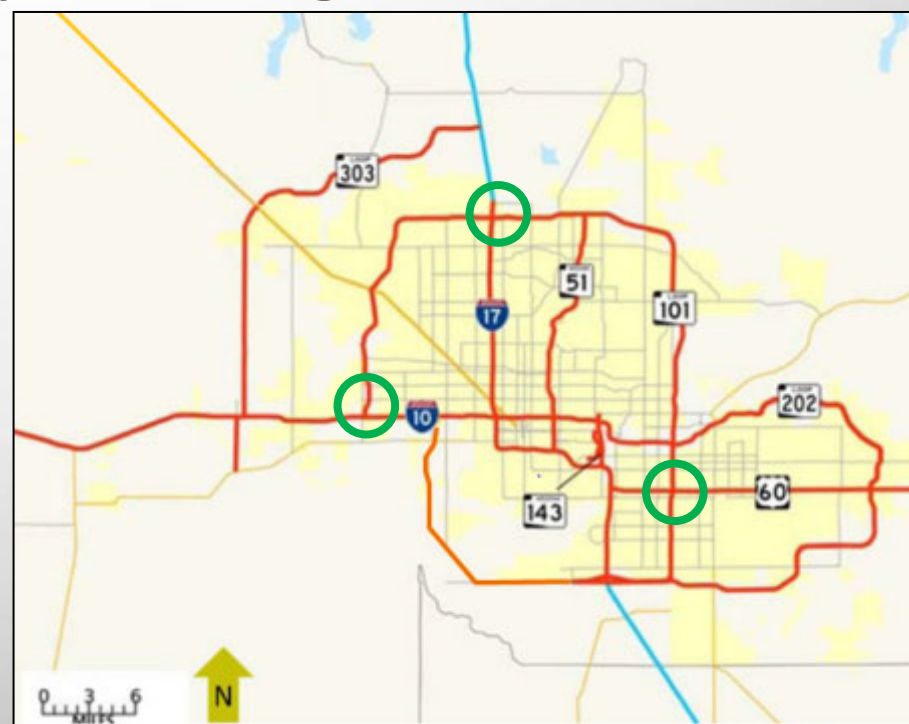
- Installed: July 2018 Cost: \$400,000
- Sustained Results: **Crashes reduced by 2/3**

Ramp Doubling – Duplicating Success

Similar conditions existed at three other valley ramps

- High congestion, lane-lane speed differential and high crashes

All received similar treatments with same resulting sustained crash reduction



Bottleneck Removal RSA Program

Initial Assumptions:

- Locations with high congestion would we also have areas of high crash history or potential
- Eliminating these sources of congestion, would reduce crashes and improve traffic safety
- Many improvements could be made with low cost countermeasures (striping, signing)

Bottleneck Removal RSA

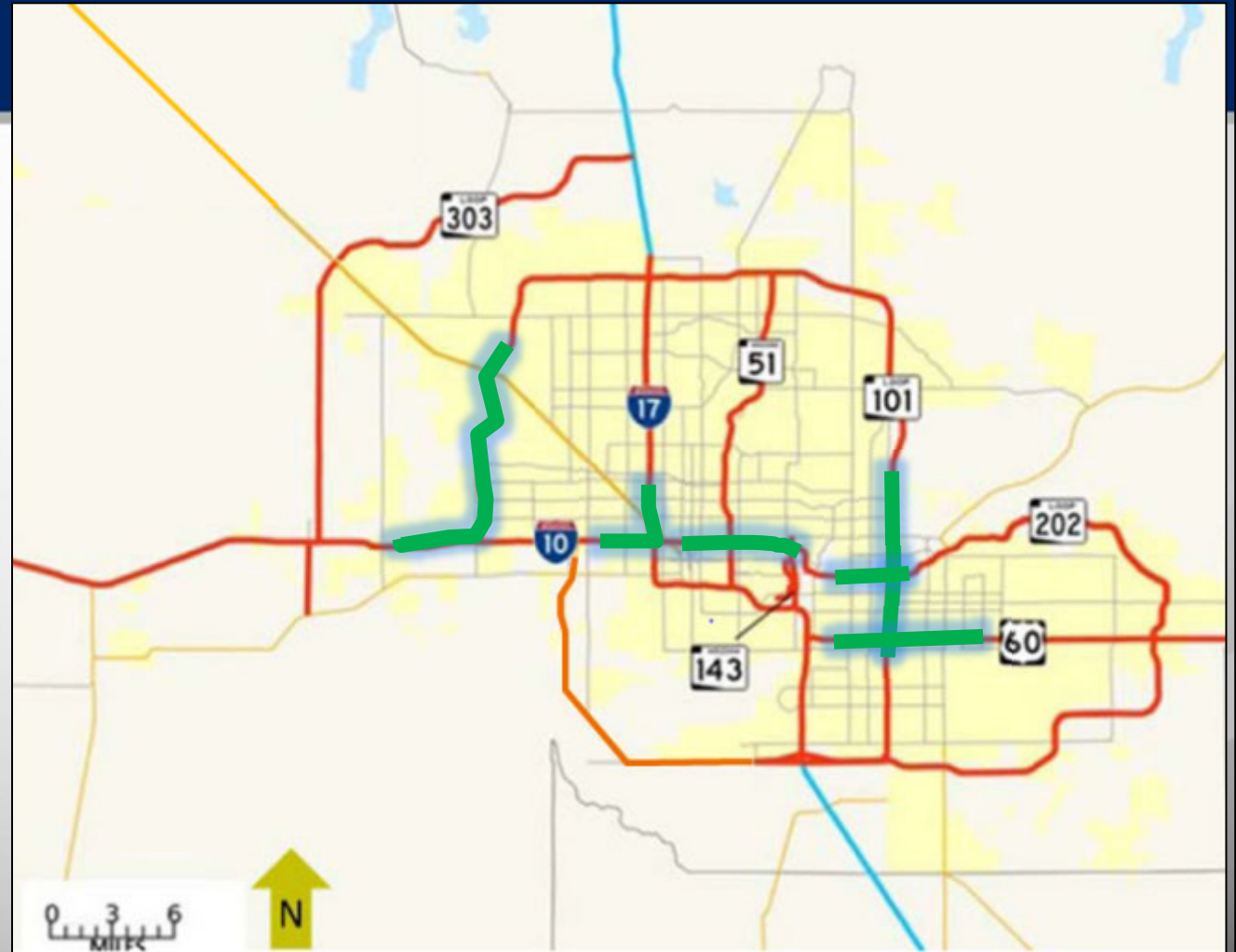
Concerns:

- Changing traffic flow on such high volume segments was risky
- Many portions of the freeways were “land-locked” with no low cost solutions
- Would the improvements to safety be noticeable and sustainable?

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Bottleneck Removal RSA Locations

- 18 locations selected based on delays (speed) either
- Segment wide
 - Lane-to-lane





Bottleneck Removal RSA

Locations split into four groups

Each RSA conducted separately (\$30-45K/ea.)

Constants teams hired for each group

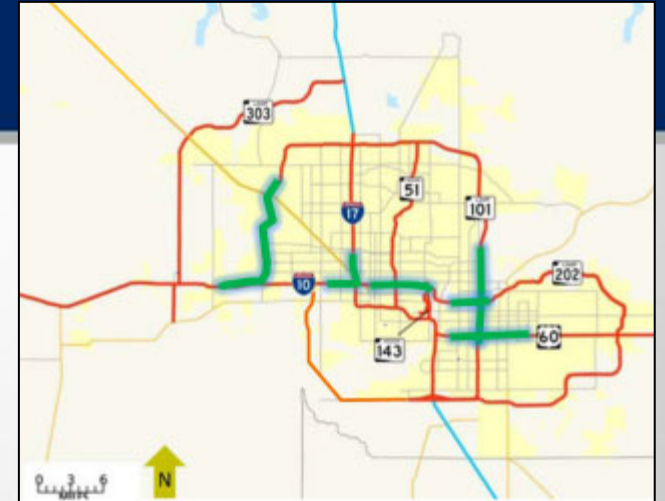
Locations split into four groups based on proximity


Field reviews conducted virtually (TOC cameras) and in person following pandemic protocol

Each bottleneck received separate RSA report

Reports included:


- General recommendations (short, mid and long-term)
- Concept level drawings, CMF and B/C for short-term CMs





Concept Level Estimates

- Design
- CMF
- Estimate



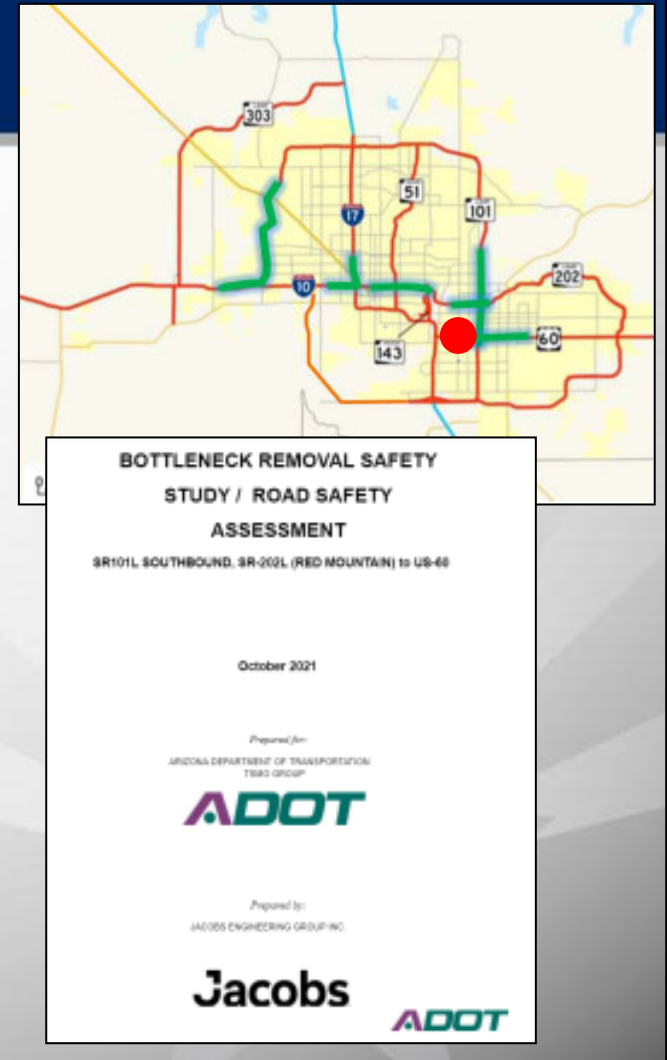
Suggested Countermeasures for Consideration	Priority	Type of Crashes Expected to be Improved	Crash Modification Factor (If available)	Existing Crashes	Crash Reduction
Improve the Scottsdale Rd On-Ramp and Center Parkway Off-ramp conditions. Two options are	High	Lane change and weaving related crashes	0.86 (CMF 5215)	37	5

Location/Countermeasure	Improvements	Estimate of probable Cost
Improve the Scottsdale Rd On-Ramp and Center Parkway Off-ramp conditions. Two options are suggested: Option 1: Use the existing roadway widths to increase the on-ramp acceleration lane lengths at Scottsdale Road	Restripe Scottsdale Rd off-ramp to dual ramps. Needs: 1. Pavement marking modifications on SR 202 and Scottsdale Rd On-Ramp 2. Sign modification 3. Design Exception	\$50,000
		\$120,000



Bottleneck Removal RSA US-60 WB Mesa to I-10

- RSA performed on class of problem area:
 - Segment wide congestion with additional problems as some off ramps
 - High lane departure and rear-end crashes
 - Consultant led but team includes ADOT Traffic Safety
- Countermeasures include concept level striping adjustments, budget and B/C
- Included roadway design standards review



US-60 WB Mesa to I-10

- Multi-lane freeway commuter
- Configuration:
 - 3-5 general purpose lanes + HOV lane
 - 65 mph speed limit
- History:
 - Built to connect eastern suburbs with Phoenix.
 - Metro area has continued expanding east
 - Volume has expanded accordingly





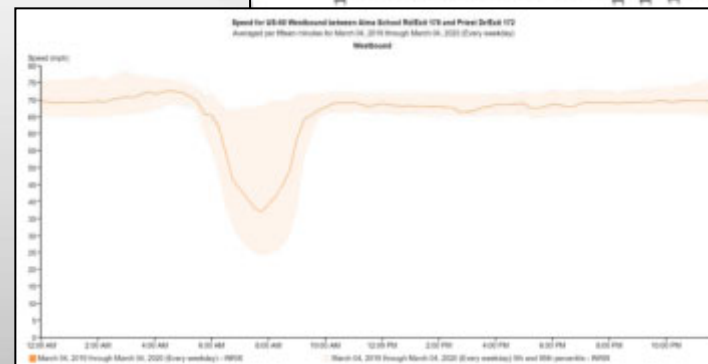
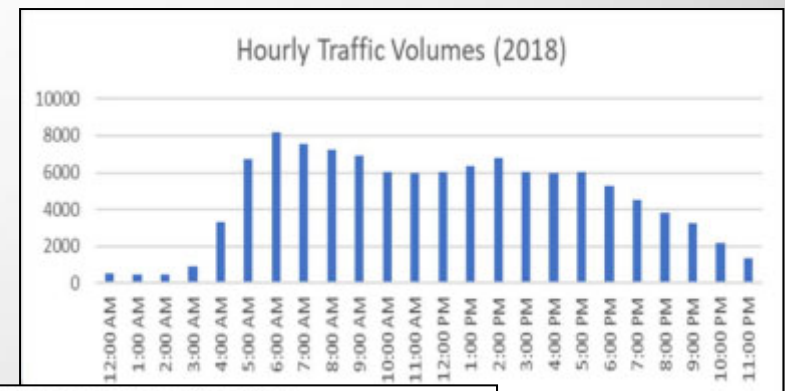
Traffic Volume and Speeds

Volume:

- 102,638 AADT
- AM Peak: 6-7 AM (8,246 vehicles)
- PM Peak: 2-3 PM (6,798 vehicles)

Speed:

- Average: 65-75 mph
- AM Peak: 35-45 mph
- Outside (exit) lanes generally operating slower than inside (thru)

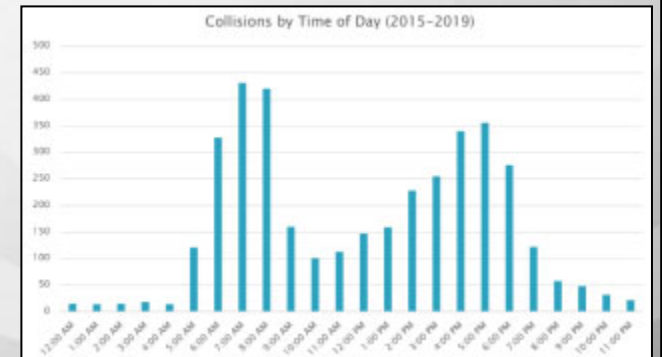
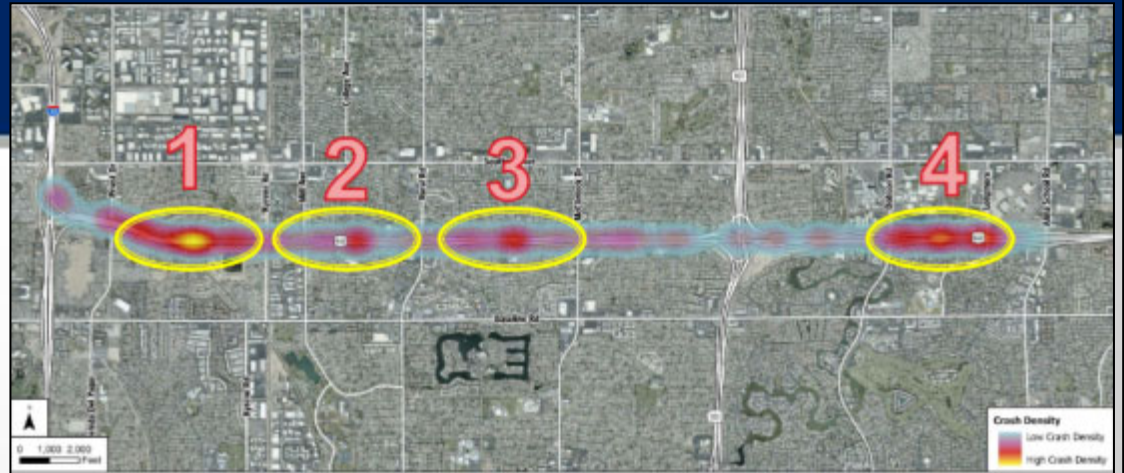




Crash Data

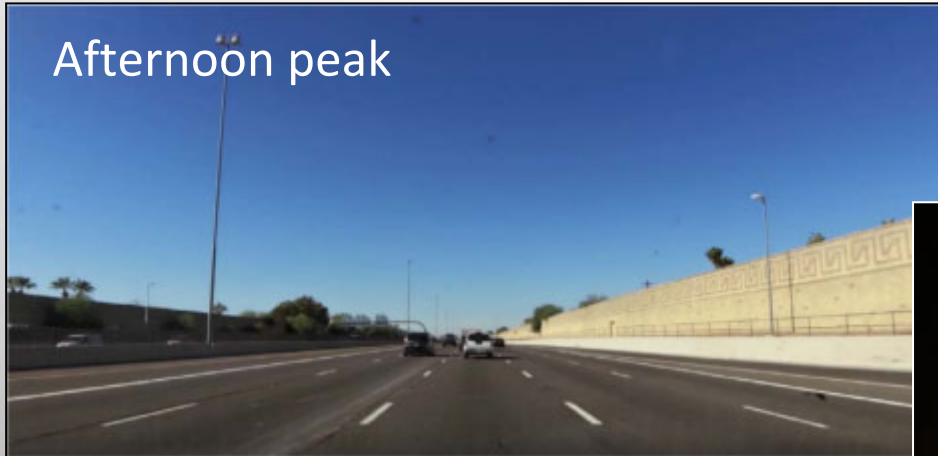
Study (2015-19)

- Total: **3,793**
- Peak Month: **February** Day: **Friday**
- Peak Period: **6-9 AM**
- Fatalities: **7** Serious Injuries: **46**
- Primary Collision Type: **Rear End (2,766)**
- Primary Violation: **Speed Too Fast for Conditions (2,720)**

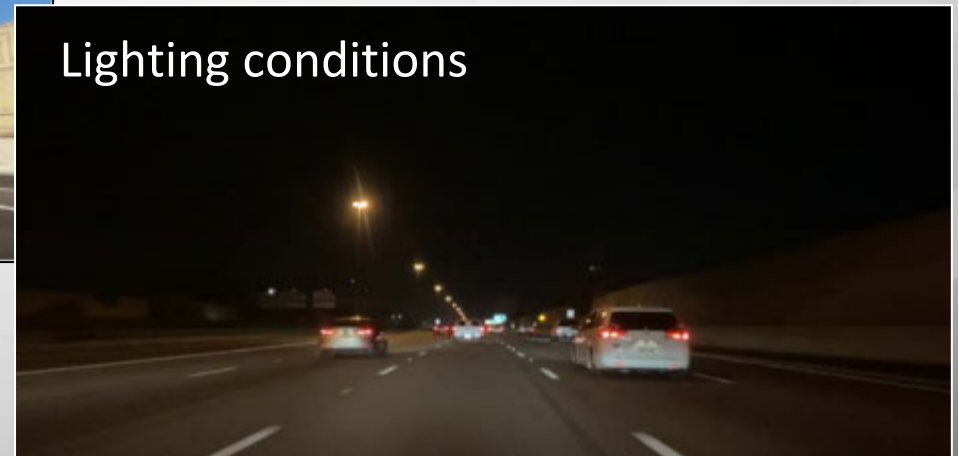


Typical Conditions

Afternoon peak



Lighting conditions



General Findings

- Pavement and signing conditions generally met current or recent standards
- Roadway operating within expectations for urban freeway commuter route (speed, volume, etc.)
- Daily back-ups occur at exit ramps throughout corridor
- Collisions consistent with congestion



Specific Recommendations

Eight total primarily involve signing & striping changes

- Low: 4
- Medium: 3
- Applicable CMF: 4

Response:

- Reject: 2
- Concur: 6

Final Report Recommendations						Owner Response			
Suggested Countermeasure	Priority	Affected Crash Type	CMF	Existing Crashes	Expected Crash Reduction	Reject Reason	Concur Action	Partner	Detail/Response
1a Add additional lane designation signage paired with the existing Dobson Road signage (at the existing location)	Low	Congestion related rear end and sideswipe	n/a			Existing signage and lane designations are consistent with ADOT practices	Include for consideration in Group D HSIP application	TS	TS to add MAG LTP and add to ADOT P2P listing and HSIP application being developed based on concept level dwg. Design FY23, construct FY24
1b Make second exit lane an optional exit with a lane drop after SR-101 NB exit			0.79 (CMF ID 3140)						
2 Add second overhead sign guide between Dobson Road WB on-ramp and SR-101L SB off-ramp	Medium	Congestion related rear end and sideswipe	0.85 (CMF ID 62)			Include for consideration in Group D HSIP application	TS	Include for consideration in HSIP application being developed based on concept level dwg. Design FY23, construct FY24	
3 Add speed reduction sign on the McClintock Road off-ramp, including curve warning signs, chevrons, or supplemental RPMs	Medium	Single vehicle collisions	0.7 (CMF ID 71)			CRTE to evaluate existing advisory speed, striping and curve warning signs, and DE to inspect	CRTE		
4 Trim landscape along McClintock Road off-ramp for better sight distance	Low	Rear ends	n/a			CRTE/TS believe need for this change will be superseded by work accepted for CM6	DE	landscaping at gore point between US-60 WB and SR-101 SB to McClintock Dr exit and trim as needed	
5 Shorten lane drop taper length per MUTCD, and ADOT Signing and Striping Standard Drawings	Low	Sideswipe and rear end collisions	n/a						
6 Remove lane merge at Rural Road and extend lane #6 past Kyrene Road overpass	Medium	Sideswipes and rear end collisions	0.76 (CMF ID 8334)			Include for consideration in Group D HSIP application	TS	TS to add MAG LTP and add to ADOT P2P listing and HSIP application being developed based on concept level dwg. Design FY23, construct FY24	
7 Provide maintenance to non-functioning high pressure sodium lighting and upgrade mainline, underdeck and ramp lighting to LED	Low	Sideswipe and rear end collisions	n/a			Initial maintenance completed in 2021. LED conversion to be forwarded to ITS for inclusion in ITS Master Plan	TS	TS to forward to ITS for inclusion in ITS Master Plan	



Recommendations

ID	Observation	Potential safety issue	Countermeasures for consideration	CMF (CMF ID#)
D4-5	<p>US-60 WB Lane Drop under the Rural Road Overpass:</p> <p>The lane drop taper at Rural Road overpass is approximately 1600 feet which is too long.</p> <p>Per the MUTCD taper length should be 780 feet and the placement of advanced warning sign should be 475 feet for total length of 1255 feet.</p>	<p>This causes aggressive drivers to "fight" for their position resulting in a potential for sideswipe and rear-end collisions.</p>	<p>Shorten lane drop taper length per MUTCD, ADOT Signing and Striping Standard Drawings.</p>	N/A



Add capacity to existing exit lane by extending drop lane

Current status:

- Design plans and Exception approved
- Installed March 2023
- Scheduled overlay

Bottleneck Removal RSA Findings General

- All segments generally designed and operated well but observations conducted during pandemic related reduced volume
- All RSAs included ideas for extensive redesign or redevelopment but also relatively minor adjustments to signing or striping that could have big payoffs
 - Even relatively minor changes were expensive and complex
- Much of the implementation work needed to wait for other road work (overlays, major realignment, etc.)

Bottleneck Removal RSA Bright Spots

- Crashes alone are not always the best or only measure of roadway crash potential and safety performance
 - RSA opened the state thinking to look beyond silos of operation, safety or air quality
- Allowed many near term (low-ish cost) countermeasures to be made to improve safety and operation.
- Opened ADOT and MAG to possibility that changes to the freeway system were possible and that some could be implemented without major roadway work

Bottleneck Removal RSA Problems

- Many of the easier seeming changes ran into unexpected implementation problems leading to delays
- RSA conducted at start of pandemic and reflects pre-pandemic conditions.
- Traffic in region is still growing but patterns in flux
 - Traffic still readjusting after pandemic

Future Plans

ADOT will update our Strategic Highway Safety Plan (SHSP) in 2024. Update to include adoption of the ***Safe System Approach***.

Alternative Road Safety Audits will assume an increasingly important role in reducing fatal and serious injury crashes.

Planned changes include:

- Complete between 50-75 RSA per year
- Evaluate high **conflict** locations

ADOT

Questions?

**TRAFFIC SAFETY STARTS AT AND ENDS AT HOME,
*DRIVE, BIKE AND WALK SAFELY!***

Kerry Wilcoxon, P.E., P.T.O.E., RSP₁

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602-712-2060



ADOT Road Safety Audit Program

<https://azdot.gov/business/transportation-systems-management-and-operations/operational-traffic-safety/road-safety>

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