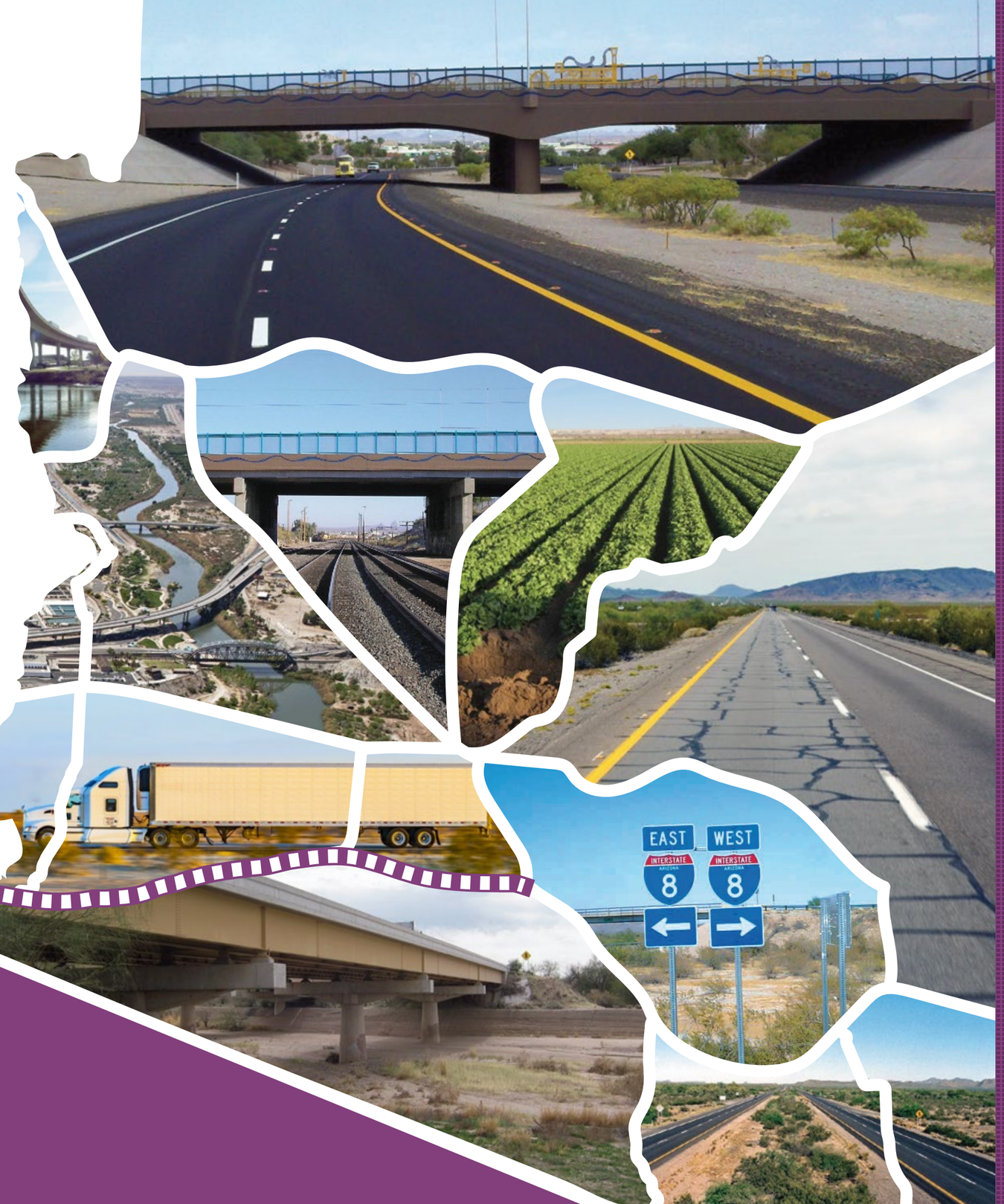
FINAL REPORT

I-8 Corridor Profile Study

Arizona/California State Line to Junction I-10

PREPARED FOR ADOT

MARCH 2017



ADOT WORK TASK NO.
MPD 042-15

ADOT CONTRACT NO.
11-013154

Prepared by

WSP | PARSONS BRINCKERHOFF

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ACRONYMS & ABBREVIATIONS

AADT	Average Annual Daily Traffic
ABISS	Arizona Bridge Information and Storage System
ADOT	Arizona Department of Transportation
AGFD	Arizona Game and Fish Department
ASLD	Arizona State Land Department
AZTDM	Arizona Travel Demand Model
BLM	Bureau of Land Management
BQAZ	Building a Quality Arizona
CAG	Central Arizona Governments
CCTV	Closed Circuit Television
CPS	Corridor Profile Study
CR	Cracking Rating
DCR	Design Concept Report
DMS	Dynamic Message Sign
EB	Eastbound
FHWA	Federal Highway Administration
FY	Fiscal Year
HCRS	Highway Condition Reporting System
HERE	Real time traffic conditions database produced by American Digital Cartography Inc.
HPMS	Highway Performance Monitoring System
I	Interstate
IRI	International Roughness Index
ITS	Intelligent Transportation System
LCCA	Life-Cycle Cost Analysis
LOS	Level of Service
LPOE	Land Point of Entry
LRTP	Long Range Transportation Plan
MAG	Maricopa Association of Governments
MAP-21	Moving Ahead for Progress in the 21st Century
MP	Milepost
MPD	Multimodal Planning Division
NPV	Net Present Value
OP	Overpass
P2P	Planning to Programming
PA	Project Assessment
PARA	Planning Assistance for Rural Areas
PDI	Pavement Distress Index
PES	Performance Effectiveness Score
PSR	Pavement Serviceability Rating
PTI	Planning Time Index
RTP	Regional Transportation Plan
RWIS	Road Weather Information System
SATS	Small Area Transportation Study
SHSP	Strategic Highway Safety Plan
SOV	Single Occupancy Vehicle
SR	State Route
SWAP	State Wildlife Action Plan
TAC	Technical Advisory Committee
TI	Traffic Interchange
TIP	Transportation Improvement Plan
TPTI	Truck Planning Time Index
TTI	Travel Time Index
TTTI	Truck Travel Time Index
UP	Underpass
UPRR	Union Pacific Railroad
USDOT	United States Department of Transportation
V/C	Volume to Capacity Ratio
VMT	Vehicle-Miles Travelled
VPD	Vehicles Per Day
WB	Westbound
WIM	Weigh-in-Motion
YCAT	Yuma County Area Transit
YMPO	Yuma Metropolitan Planning Organization

EXECUTIVE SUMMARY

INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study (CPS) of Interstate 8 (I-8) between the California Border and the Interstate 10 (I-10) Junction. This study examines key performance measures relative to the I-8 corridor, and the results of this performance evaluation are used to identify potential strategic improvements. The intent of the corridor profile program, and of ADOT's Planning-to-Programming (P2P) process, is to conduct performance-based planning to identify areas of need and make the most efficient use of available funding to provide an efficient transportation network.

ADOT is conducting eleven corridor profile studies within three separate groupings. The I-8 corridor, depicted in **Figure ES-1**, is one of the strategic statewide corridors identified and the subject of this CPS.

Corridor Study Purpose, Goals, and Objectives

The purpose of the CPS is to measure corridor performance to inform the development of strategic solutions that are cost-effective and account for potential risks. It is accomplished by following the process described below:

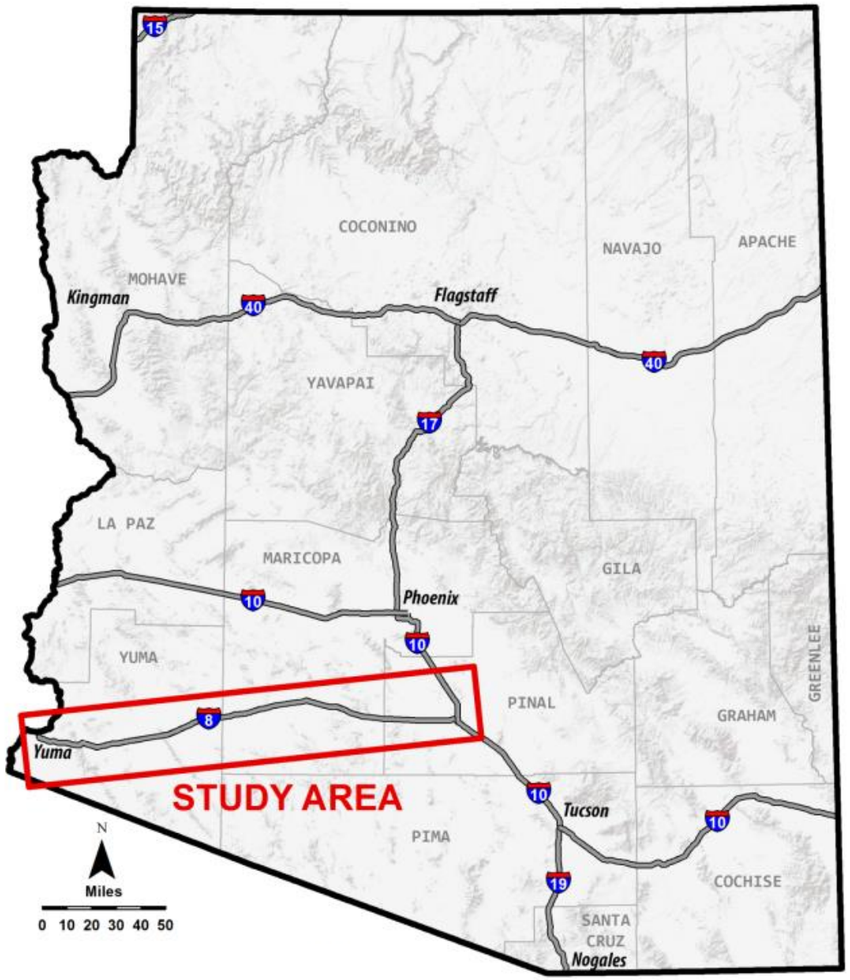
- Inventory past improvement recommendations
- Define corridor goals and objectives
- Assess existing performance based on quantifiable performance measures
- Propose various solutions to improve corridor performance
- Identify specific solutions that can provide quantifiable benefits relative to the performance measures
- Prioritize solutions for future implementation, accounting for performance effectiveness, and risk analysis findings

The objective of the I-8 CPS is to identify a recommended set of prioritized potential solutions for consideration in future construction programs, derived from a transparent, defensible, logical, and replicable process. The I-8 CPS defines solutions and improvements for the corridor that are evaluated and ranked to determine which investments offer the greatest benefit to the corridor in terms of enhancing performance.

The following goals are identified as the outcome of this study:

- Link project decision-making and investments on key corridors to strategic goals
- Develop solutions that address identified corridor needs based on measured performance
- Prioritize improvements that cost-effectively preserve, modernize, and expand transportation infrastructure

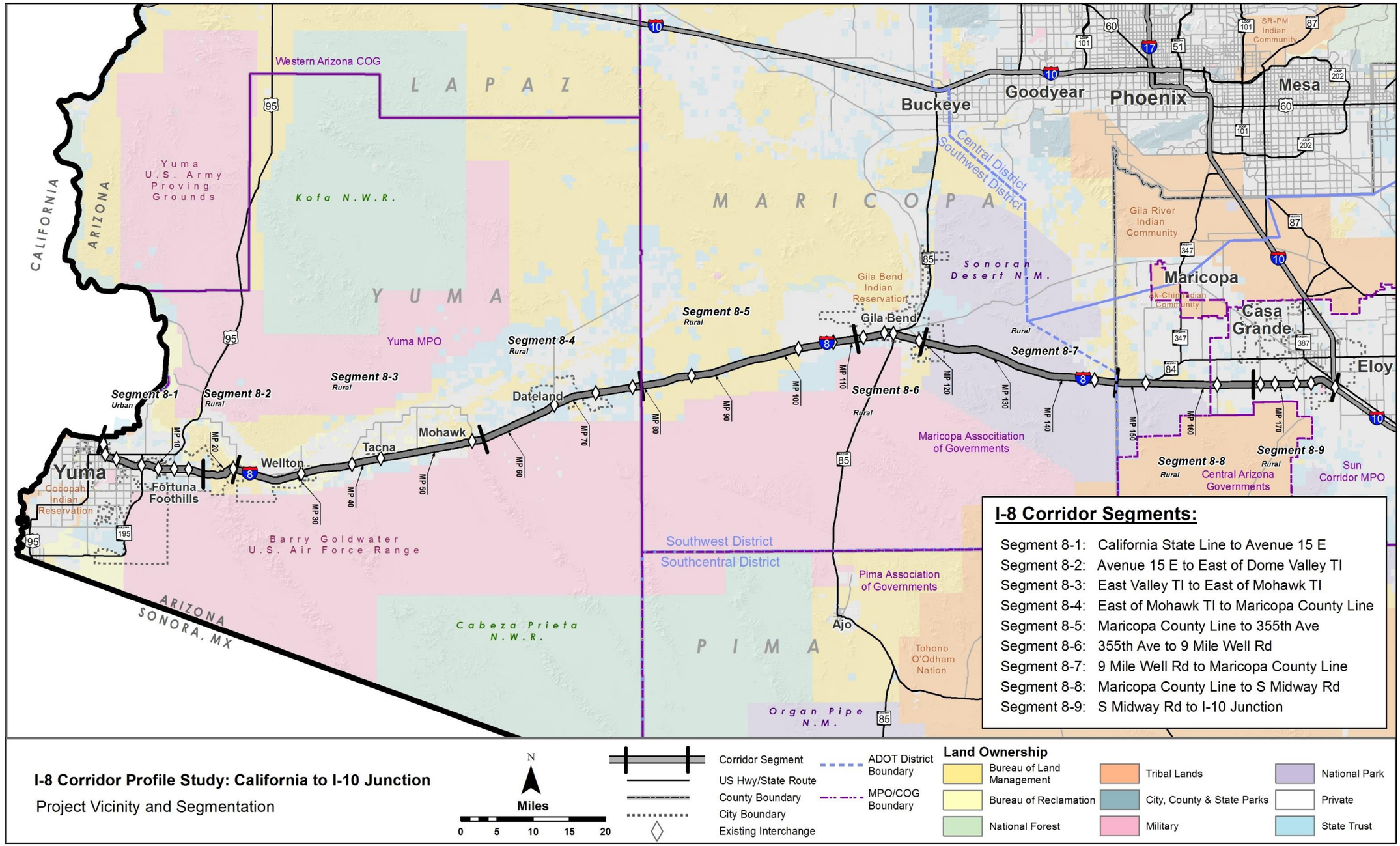
Figure ES-1: Corridor Study Area



Study Location and Corridor Segments

The I-8 CPS utilizes nine planning segments to facilitate analysis and evaluation. The corridor is segmented at logical breaks where the context changes due to differences in characteristics such as terrain, daily traffic volumes, or roadway typical sections. Corridor segments are shown in **Figure ES-2**.

Figure ES-2: Corridor Location and Segments



CORRIDOR PERFORMANCE

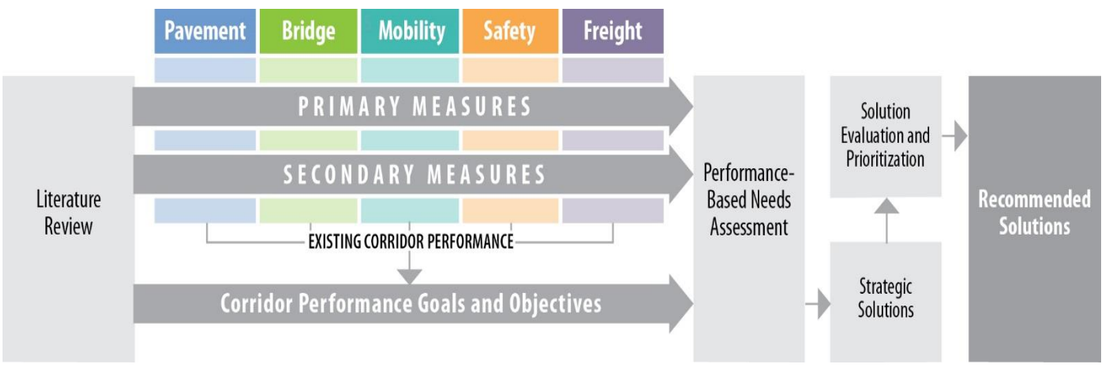
A series of performance measures are used to assess the I-8 corridor. The results of the performance evaluation are used to define corridor needs relative to the long-term goals and objectives for the corridor.

Corridor Performance Framework

This study uses a performance-based process to define baseline corridor performance, diagnose corridor needs, develop corridor solutions, and prioritize strategic corridor investments. In support of this objective, a framework for the performance-based process was developed through a collaborative process involving ADOT and the CPS consultant teams.

Figure ES-3 illustrates the performance framework, which includes a two-tiered system of performance measures (primary and secondary) to evaluate baseline performance.

Figure ES-3: Corridor Profile Performance Framework



The following five performance areas guide the performance-based corridor analyses:

- Pavement
- Bridge
- Mobility
- Safety
- Freight

The performance measures include five primary measures: Pavement Index, Bridge Index, Mobility Index, Safety Index, and Freight Index. Additionally, a set of secondary performance measures provides for a more detailed analysis of corridor performance. **Table ES-1** provides the complete list of primary and secondary performance measures for each of the five performance areas.

Table ES-1: Corridor Performance Measures

Performance Area	Primary Measure	Secondary Measures
Pavement	**Pavement Index** Based on a combination of International Roughness Index and cracking	• Directional Pavement Serviceability • Pavement Failure • Pavement Hot Spots
Bridge	**Bridge Index** Based on lowest of deck, substructure, superstructure and structural evaluation rating	• Bridge Sufficiency • Functionally Obsolete Bridges • Bridge Rating • Bridge Hot Spots
Mobility	**Mobility Index** Based on combination of existing and future daily volume-to-capacity ratios	• Future Congestion • Peak Congestion • Travel Time Reliability • Multimodal Opportunities
Safety	**Safety Index** Based on frequency of fatal and incapacitating injury crashes	• Directional Safety Index • Strategic Highway Safety Plan Emphasis Areas • Crash Unit Types • Safety Hot Spots
Freight	**Freight Index** Based on bi-directional truck planning time index	• Recurring Delay • Non-Recurring Delay • Closure Duration • Bridge Vertical Clearance • Bridge Vertical Clearance Hot Spots

Each of the primary and secondary performance measures identified in the table above is comprised of one or more quantifiable indicators. A three-level scale was developed to standardize the performance scale across the five performance areas, with numerical thresholds specific to each performance measure:

Good/Above Average Performance	Rating is above the identified desirable/average range
Fair/Average Performance	Rating is within the identified desirable/average range
Poor/Below Average Performance	Rating is below the identified desirable/average range

The terms “good”, “fair”, and “poor” apply to the Pavement, Bridge, Mobility, and Freight performance measures, which have defined thresholds. The terms “above average”, “average”, and “below average” apply to the Safety performance measures, which have thresholds referenced to statewide averages.

Corridor Performance Summary

Table ES-2 shows a summary of corridor performance for all primary measures and secondary measure indicators for the I-8 corridor. A weighted corridor average rating (based on the length of the segment) was calculated for each primary and secondary measure as shown in **Table ES-2**.

All segments on the I-8 corridor are performing in the Fair/Average or Good/Above Average range in each of the performance areas, with the exception of one segment with a Poor rating for pavement performance.

The following general observations were made related to the performance of the I-8 corridor.

- **Pavement Performance:** Pavement performance ranges from Fair to Good throughout the corridor, with the exception of Segment 8-2, which has a Poor rating for the data set analyzed. A pavement preservation project has been completed in this segment subsequent to the data period.
- **Bridge Performance:** A total of 115 bridges were included in the evaluation. Bridge performance is Fair throughout the corridor. Two bridges are considered structurally deficient. These include the Eastbound Colorado River Viaduct (MP 0.01) and the Thornton Road TI Underpass (MP 172.55).
- **Mobility Performance:** Mobility performance is Good throughout the corridor. I-8 is considered to have two operating environments for evaluating Mobility. These include Urban 4-Lane Freeway and Rural 4-Lane Freeway with less than 25,000 ADT. Both the current and future capacity is considered “Good”.
- **Safety Performance:** Safety performance is Above Average except for Segment 8-3 that rates as Average. Examining a five-year time period, there were two fatal crashes and seven incapacitating injury crashes in the urban area. In the rural area, there were 20 fatal crashes and 68 incapacitating injury crashes.
- **Freight Performance:** Freight performance is Good throughout the corridor, except for a Fair rating in the urbanized area of Yuma (Segment 8-1). Segment 8-2 experiences some delay associated with the US Customs Border Patrol Checkpoint.
- **Overall performance** within all five areas evaluated is predominantly “Good” to “Fair”

Table ES-2: Corridor Performance Summary by Segment and Performance Measure

Segment #	Segment Length (miles)	Pavement Performance Area				Bridge Performance Area				Mobility Performance Area											
		Pavement Index	Directional PSR		% Area Failure	Bridge Index	Sufficiency Rating	% of Deck Area on Functionally Obsolete Bridges	Lowest Bridge Rating	Mobility Index	Future Daily V/C	Existing Peak Hour V/C		Closure Extent (instances/milepost /year/mile)		Directional TTI (all vehicles)		Directional PTI (all vehicles)		% Bicycle Accommodation	% Non-Single Occupancy Vehicle (SOV) Trips
			EB	WB								EB	WB	EB	WB	EB	WB	EB	WB		
8-1[1]	16.30	4.20	4.28	4.30	15.6%	5.69	87.36	6.6%	4	0.44	0.50	0.32	0.31	0.16	0.24	1.09	1.07	1.42	1.39	100%	12.5%
8-2[2]	5.10	2.31	3.87	4.07	60.0%	5.31	91.38	0%	5	0.32	0.36	0.26	0.23	0.12	0.44	1.05	1.00	1.45	1.12	100%	16.0%
8-3[2]	35.10	3.58	3.74	3.79	12.5%	6.32	95.49	40.8%	6	0.17	0.19	0.09	0.09	0.21	0.19	1.08	1.08	1.23	1.25	100%	9.8%
8-4[2]	23.10	3.68	3.87	3.74	23.9%	6.00	94.00	100.0%	6	0.16	0.17	0.11	0.10	0.03	0.04	1.07	1.06	1.22	1.20	100%	9.3%
8-5[2]	30.80	3.41	3.58	3.55	28.3%	5.90	92.15	58.5%	5	0.21	0.25	0.15	0.15	0.05	0.09	1.07	1.07	1.26	1.22	100%	22.5%
8-6[2]	9.60	4.17	4.01	4.03	0.0%	5.79	93.01	43.8%	5	0.16	0.20	0.13	0.12	0.04	0.08	1.11	1.09	1.41	1.26	100%	19.0%
8-7[2]	27.60	4.11	4.16	4.18	5.4%	6.08	92.59	33.9%	6	0.08	0.09	0.09	0.08	0.04	0.05	1.10	1.09	1.27	1.26	100%	16.8%
8-8[2]	18.90	3.55	3.83	3.75	18.4%	5.90	92.35	38.1%	5	0.09	0.11	0.09	0.08	0.02	0.04	1.08	1.09	1.25	1.24	100%	13.8%
8-9[2]	11.50	3.48	3.40	3.54	37.5%	5.67	88.40	44.4%	4	0.14	0.16	0.13	0.10	0.10	0.02	1.07	1.10	1.27	1.33	100%	12.2%
Weighted Corridor Average		3.69	3.85	3.85	18.8%	5.97	92.48	46.3%	5	0.20	0.23	0.15	0.14	0.08	0.13	1.08	1.07	1.31	1.25	100%	14.7%

SCALE

Performance Level	Interstate		All				Urban Rural	All	Uninterrupted		All	
Good/Above Average	> 3.75	< 5%	> 6.5	> 80	< 12%	> 6	< 0.71 (Urban) < 0.56 (Rural)	< 0.22	< 1.15	<1.30	> 90%	> 17%
Fair/Average	3.2 - 3.75	5% - 20%	5.0 - 6.5	50 - 80	12% - 40%	5 – 6	0.71 - 0.89 (Urban) 0.56 - 0.76 (Rural)	0.22 – 0.62	1.15-1.33	1.30-1.50	60% - 90%	11% - 17%
Poor/Below Average	< 3.2	> 20%	< 5.0	< 50	> 40 %	< 5	> 0.89 (Urban) > 0.76 (Rural)	> 0.62	> 1.33	>1.50	< 60%	< 11%

[1] Urban 4 Lane Freeway / Urban or Fringe Urban Operating Environment
[2] Rural 4 Lane Freeway < 25,000 vpd / Rural Operating Environment

Table ES-2: Corridor Performance Summary by Segment and Performance Measure (continued)

Segment	Segment Length (miles)	Safety Performance Area							Freight Performance Area							
		Safety Index	Directional Safety Index		% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	% of Fatal + Incapacitating Injury Crashes Involving Trucks	% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers	Freight Index	Directional TTI (trucks only)		Directional PTI (trucks only)		Closure Duration (mins/milepost closed/year/mile)		Bridge Vertical Clearance (feet)
			EB	WB						EB	WB	EB	WB	EB	WB	
8-1[1]	16.30	0.23	0.24	0.22	56%	Insufficient Data	Insufficient Data	Insufficient Data	0.71	1.13	1.12	1.40	1.41	28.88	43.90	16.33
8-2[2]	5.10	0.29	0.33	0.25	43%	Insufficient Data	Insufficient Data	Insufficient Data	0.79	1.00	1.06	1.30	1.23	17.23	140.18	16.23
8-3[2]	35.10	0.96	0.95	0.97	59%	Insufficient Data	Insufficient Data	Insufficient Data	0.89	1.04	1.04	1.14	1.11	73.08	28.10	16.20
8-4[2]	23.10	0.61	0.44	0.77	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.90	1.03	1.03	1.12	1.11	5.20	7.68	No Up
8-5[2]	30.80	0.59	0.59	0.59	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.89	1.03	1.04	1.13	1.12	9.07	19.84	No UP
8-6[2]	9.60	0.10	0.06	0.13	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.82	1.06	1.04	1.27	1.17	24.43	21.89	16.63
8-7[2]	27.60	0.68	0.04	1.32	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.89	1.03	1.03	1.13	1.13	13.25	11.42	16.19
8-8[2]	18.90	0.71	0.74	0.68	33%	Insufficient Data	Insufficient Data	Insufficient Data	0.89	1.03	1.03	1.13	1.11	6.29	25.18	16.09
8-9[2]	11.50	0.59	0.21	0.98	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.83	1.04	1.06	1.19	1.23	27.01	1.53	15.86
Weighted Corridor Average		0.53	0.40	0.66	48%				0.86	1.04	1.04	1.17	1.16	25.58	23.73	16.06

SCALE

Performance Level	Urban 4 Lane Freeway Rural 4 Lane Freeway < 25,000 vpd					Uninterrupted			All	
Good/Above Average	< 0.79 < 0.73	< 49.1% < 42.8%	< 6.8% < 13.2%	< 9.3% < 5.0%	< 4.8% < 1.7%	> 0.77	< 1.15	< 1.30	< 44.18	> 16.5
Fair/Average	0.79 – 1.21 0.73 – 1.27	49.1% - 59.4% 42.8% - 52.9%	6.8% - 10.9% 13.2% - 17.0%	9.3% - 11.5% 5.0% - 8.5%	4.8% - 10.3% 1.7% - 2.5%	0.67 - 0.77	1.15 -1.33	1.30 -1.50	44.18 -124.86	16.0-16.5
Poor/Below Average	> 1.21 > 1.27	> 59.4% > 52.9%	> 10.9% > 17.0%	> 11.5% > 8.5%	> 10.3% > 2.5%	< 0.67	> 1.33	>1.50	> 124.86	< 16.0

[1] Urban 4 Lane Freeway / Urban or Fringe Urban Operating Environment
[2] Rural 4 Lane Freeway < 25,000 vpd / Rural Operating Environment

Note: "Insufficient Data" indicates there was not enough data available to generate reliable performance ratings

"No UP" indicates no underpasses are present in the segment

NEEDS ASSESSMENT

Corridor Description

I-8, an important national transportation corridor, spans between San Diego, California and Casa Grande, Arizona. In Arizona, I-8 originates at the Colorado River in the City of Yuma and extends approximately 178 miles east, passing through Yuma County and the Town of Wellton, across Gila Bend in Maricopa County, and terminating at the I-10 junction southeast of Casa Grande in Pinal County. Much of the I-8 corridor is rural and undeveloped.

The entire length of I-8 in Arizona is the subject of this CPS. More than a highway, the corridor is a multimodal facility that moves people and freight and connects communities. The corridor serves the growing Sun Corridor in central Arizona, supports freight movement (e.g., by transporting produce from the "lettuce capital of the US" near Yuma), and carries visitors west to the commercial and recreation centers in Western Arizona, Southern California and Mexico.

Corridor Objectives

Statewide goals and performance measures were established by the ADOT Long-Range Transportation Plan (LRTP), 2010-2035. Statewide performance goals that are relevant to I-8 performance areas were identified and corridor goals were then formulated for each of the five performance areas that aligned with the overall statewide goals established by the LRTP. Based on stakeholder input, corridor goals, corridor objectives, and performance results, three "emphasis areas" were identified for the I-8 corridor: Mobility, Safety and Freight.

Taking into account the corridor goals and identified emphasis areas, performance objectives were developed for each quantifiable performance measure that identify the desired level of performance based on the performance scale levels for the overall corridor and for each segment of the corridor. For the performance emphasis areas, the corridor-wide weighted average performance objectives are identified with a higher standard than for the other performance areas.

Achieving corridor and segment performance objectives will help ensure that investments are targeted toward improvements that support the safe and efficient movement of travelers on the corridor. Corridor performance is measured against corridor and segment objectives to determine needs – the gap between observed performance and the performance objectives.

Needs Assessment Process

The performance-based needs assessment evaluates the difference between the baseline performance and the performance objectives for each of the five performance areas used to characterize the health of the corridor: Pavement, Bridge, Mobility, Safety, and Freight. The performance-based needs assessment process is illustrated in **Figure ES-4**.

The needs assessment compares baseline corridor performance with performance objectives to provide a starting point for the identification of performance needs. This mathematical comparison results in an initial need rating of None, Low, Medium, or High for each primary and secondary performance measure. An illustrative example of this process is shown in **Figure ES-5**.

The initial level of need for each segment is refined to account for hot spots and recently completed or under construction projects, resulting in a final level of need for each segment. The final levels of need for each primary and secondary performance measure are combined to produce a weighted final need rating for each segment. A detailed review of available data helps identify contributing factors to the need and if there is a high level of historical investment.

Figure ES-4: Needs Assessment Process

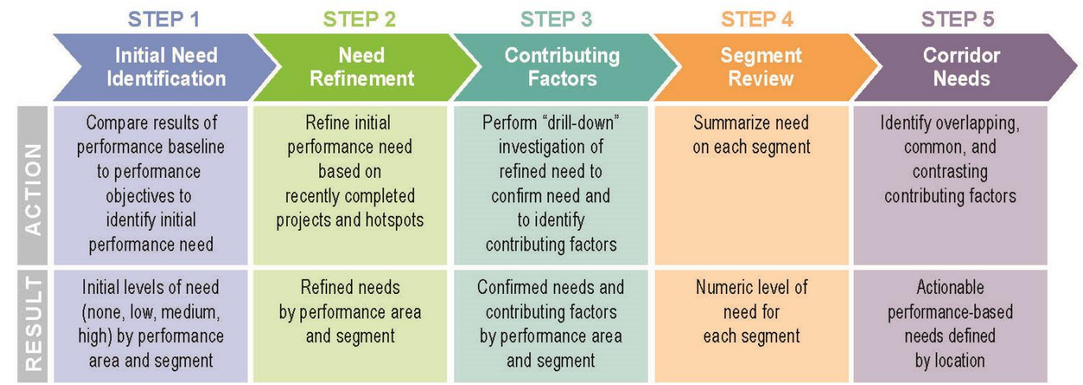


Figure ES-5: Initial Need Ratings in Relation to Baseline Performance (Bridge Example)

Performance Thresholds	Performance Level	Initial Level of Need	Description
6.5	Good	None*	All levels of Good and top 1/3 of Fair (>6.0)
	Good		
	Good		
	Fair		
5.0	Fair	Low	Middle 1/3 of Fair (5.5-6.0)
	Fair	Medium	Lower 1/3 of Fair and top 1/3 of Poor (4.5-5.5)
	Poor		
	Poor	High	Lower 2/3 of Poor (<4.5)
	Poor		

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

Summary of Needs

Table ES-3 provides a summary of needs for each segment across all performance areas, and the average needs for each segment. A weighting factor of 1.5 is applied to the average need scores of the performance areas identified as emphasis areas (Mobility, Safety, and Freight for the I-8 corridor). All nine segments had an overall Low average need. More information on the identified final needs in each performance area is provided as follows.

Pavement Needs

- Overall Final Pavement needs are Low throughout the corridor.
- One Pavement hot spot in Segment 8-1 was addressed, however a hot spot remains from milepost (MP) 0-1, therefore the need was not changed.
- The Pavement hot spot on Segment 8-2 resulting in a High level of need was addressed by a project in 2014.
- Pavement hot spots within Segment 8-9 were identified, but need reduced from Medium to Low due to projects in 2015, addressing all but one hot spot.

Bridge Needs

- A Low Bridge need occurred on six segments, and Medium level of need on three segments (8-2, 8-5, and 8-9).
- Bridge needs (Low, Medium, or High) were identified on 30 of the 115 bridges along the I-8 corridor (26%).
- Eleven bridges have potential repetitive investment issues. Three of these bridges are also hot spots and were candidates for life-cycle cost analysis to evaluate alternative solutions.
- Two bridges have ratings of 4 (Poor condition).
- Thirteen bridges were defined as hot spots since they had ratings of 5 or lower in multiple areas (deck, substructure, or superstructure). A bridge is considered a hot spot when it has a single rating of 4 or lower or multiple ratings of 5.

Mobility Needs

- The Mobility Performance Area is an emphasis area for the I-8 corridor, giving it a heavier weight in the analysis.
- A Low Mobility need was identified on three segments of I-8, the Yuma urbanized area, Telegraph Pass, and Gila Bend; the remaining segments had no Mobility need to meet performance objectives.
- Contributing factors include frequent congestion and overall higher traffic volumes in the urbanized area, the border patrol checkpoint at MP 18 creating eastbound delays, and closures related to incidents/accidents.
- Additionally, I-8 between MP 18 and MP 21 experiences a reduction in shoulder width to accommodate bicycles.

Safety Needs

- The Safety Performance Area is an emphasis area for the I-8 corridor, giving it a heavier weight in the analysis.
- A Medium Safety need was identified for Segment 8-3, while Low Safety needs were identified in Segments 8-1and 8-9. The remaining segments meet performance objectives.
- No crash hot spots were identified.
- In the urbanized Yuma area, most incidents/accidents were related to collisions with other motor vehicles, high speeds, and running off the road to the right.
- Outside the urbanized area, many incidents/accidents were single vehicle crashes, and involved the vehicle overturning or running off the road to the left. In these cases, contributing factors were typically driver inattention/distraction and high speeds.
- It has been noted that guardrail could be upgraded corridor-wide, with some sections having been upgraded already as part of pavement preservation projects.

Freight Needs

- The Freight Performance Area is an emphasis area for the I-8 corridor, giving it a heavier weight in the analysis.
- Final Freight needs are Low or None throughout the corridor. In general, limits on truck travel and planning times are not significant factors.
- Freight needs are generally concentrated between MP 0-57 and MP 120-178, that is, the area between Yuma and Mohawk, including Telegraph Pass, and the area between Gila Bend and Casa Grande. The needs related to freight mobility were dispersed throughout these two segments, with elevated levels of delay caused by congestion in the Yuma urbanized area, closures related to incidents/accidents, and bridge clearance issues.
- Urban congestion in the Yuma area impacts freight movement, including high volumes of freight traffic passing through and originating in Yuma.
- Six bridges on the I-8 corridor have mainline vertical clearance restrictions, consisting of less than 16.25’ clearance and no ramp around ability.

Overlapping Needs

This section identifies overlapping performance needs on the I-8 corridor, which provides guidance to develop strategic solutions that address more than one performance area with elevated levels of need. Completing projects that address multiple needs presents the opportunity to more effectively improve overall performance. A summary of the overlapping needs that relate to locations with elevated levels of need is provided in the following bullets.

- Overlapping Pavement, Freight, and Mobility needs occur in the Yuma urbanized area, milepost 0-16. Many of the issues are due to high traffic volumes and high volumes of trucks. This section also includes hot spot bridges.
- The area of Telegraph Pass, from approximately milepost 18 to 21, has significant grades and therefore suffers from freight and mobility needs related to delay and incidents/accidents associated with the grade. This area also has locations where climbing and passing lanes might improve safety.
- Milepost 21-57 also has Safety, Pavement, and Freight needs. Incidents/accidents and closures in this area, which may be attributable to pavement and guardrail quality, contribute to safety and freight needs.
- Approaching the Casa Grande urbanized area, MP 148 to MP 178 has needs in the Pavement and Freight areas, with bridges having needs as well as height restrictions related to freight. Thornton Road TI (No. 1196, MP 172.55) has both Bridge and Freight needs.

Table ES-3: Summary of Needs by Segment

Performance Area	Segment Number and Mileposts (MP)								
	8-1	8-2	8-3	8-4	8-5	8-6	8-7	8-8	8-9
	MP 0-16.3	MP 16.3-21.4	MP 21.4-56.5	MP 56.5-79.6	MP 79.6-110.4	MP 110.4-120	MP 120-147.6	MP 147.6-166.5	MP 166.5-178
Pavement	Low	None	Low	Low	Medium	None	None	Low	Low
Bridge	Low	Medium	Low	Low	Medium	Low	Low	Low	Medium
Mobility+	Low	Low	None	None	None	Low	None	None	None
Safety+	Low	None	Medium	None	None	None	Low	None	Low
Freight+	Low	Low	Low	None	None	None	Low	Low	Low
Average Need	**1.00**	**0.77**	**1.00**	**0.31**	**0.62**	**0.38**	**0.62**	**0.54**	**0.92**

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study*

+ Identified as an emphasis area for the I-8 corridor

Average Need Scale	
None*	< 0
Low	0.1-1.0
Medium	1.0-2.0
High	> 2.0

STRATEGIC SOLUTIONS

The principal objective of the CPS is to identify strategic solutions (investments) that are performance-based to ensure that available funding resources are used to maximize the performance of the State's key transportation corridors. One of the first steps in the development of strategic solutions is to identify areas of elevated levels of need as addressing these needs will have the greatest effect on corridor performance. Segments with Medium or High needs and specific locations of hot spots are considered strategic investment areas for which strategic solutions should be developed. Segments with lower levels of need or without identified hot spots are not considered candidates for strategic investment and are expected to be addressed through other ADOT programming processes. I-8 strategic investment areas (resulting from the elevated needs) are shown in **Figure ES-6**.

Screening Process

In some cases, needs that are identified do not advance to solutions development and are screened out from further consideration because they have been or will be addressed through other measures including:

- A project is programmed to address this need
- The need is a result of a Pavement or Bridge hot spot that does not show historical investment issues; these hot spots will likely be addressed through other ADOT programming means
- A bridge is not a hot spot but is located within a segment with a Medium or High level of need; this bridge will likely be addressed through current ADOT bridge maintenance and preservation programming processes
- The need is determined to be non-actionable (i.e., cannot be addressed through an ADOT project)
- The conditions/characteristics of the location have changed since the performance data was collected that was used to identify the need

Candidate Solutions

For each elevated need within a strategic investment area that is not screened out, a candidate solution is developed to address the identified need. Each candidate solution is assigned to one of the following three P2P investment categories based on the scope of the solution:

- Preservation
- Modernization
- Expansion

Documented performance needs serve as the foundation for developing candidate solutions for corridor preservation, modernization, and expansion. Candidate solutions are not intended to be a substitute or replacement for traditional ADOT project development processes where various ADOT technical groups and districts develop candidate projects for consideration in the performance-based programming in the P2P process. Rather, these candidate solutions are intended to complement ADOT's traditional project development processes through a performance-based process to address needs in one or more of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Candidate solutions developed for the I-8 corridor will be considered along with other candidate projects in the ADOT statewide programming process.

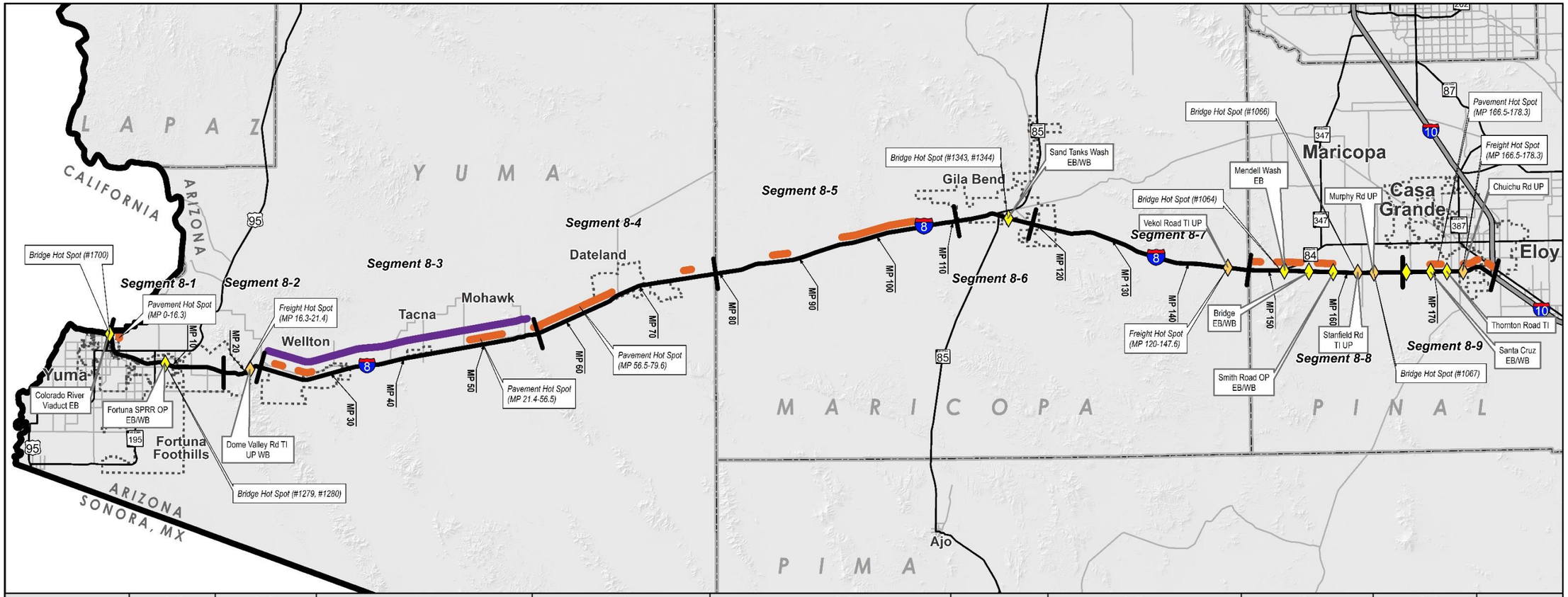
Candidate solutions include some or all of the following characteristics:

- Do not recreate or replace results from normal programming processes
- May include programs or initiatives, areas for further study, and infrastructure projects
- Address elevated levels of need (High or Medium) and hot spots
- Focus on investments in modernization projects (to optimize current infrastructure)
- Address overlapping needs
- Reduce costly repetitive maintenance
- Extend operational life of system and delay expansion
- Leverage programmed projects that can be expanded to address other strategic elements
- Provide measurable benefit

Candidate solutions developed to address an elevated need in the Pavement or Bridge performance areas include two options; rehabilitation or full replacement. These solutions are initially evaluated through a Life-Cycle Cost Analysis (LCCA) to provide insights into the cost-effectiveness of these options so a recommended approach can be identified. Candidate solutions developed to address an elevated need in the Mobility, Safety, or Freight performance areas are advanced directly to the Performance Effectiveness Evaluation. In some cases, there may be multiple solutions identified to address the same area of need.

Candidate solutions that are recommended to expand or modify the scope of an already programmed project are noted and are not advanced to solution evaluation and prioritization. These solutions are directly recommended for programming.

Figure ES-6: Strategic Investment Areas



Performance Area	8-1	8-2	8-3	8-4	8-5	8-6	8-7	8-8	8-9	Perfomance Area
	MP 0-16.3	MP 16.3-21.4	MP 21.4-56.5	MP 56.5-79.6	MP 79.6-110.4	MP 110-4-120	MP 120-147.6	MP 147.6-166.5	MP 166.5-178	
Pavement	Hot Spot	-	Hot Spot	Hot Spot	Medium	-	-	Hot Spot	Hot Spot	Pavement
Bridge	Hot Spot	Medium	-	-	Medium	Hot Spot	-	Hot Spot	Medium	Bridge
Mobility+	-	-	-	-	-	-	-	-	-	Mobility+
Safety+	-	-	Medium	-	-	-	-	-	-	Safety+
Freight+	-	Hot Spot	-	-	-	-	Hot Spot	Hot Spot	Hot Spot	Freight+

+ Identified as Emphasis Area for I-8 Corridor

Note: Figure shows strategic investment areas, which are segments with Medium and High levels of need and locations of hotspots. A"-" symbol indicates a segment level of need of Low or None, which is not considered strategic.

I-8 Corridor Profile Study: California to I-10 Junction

Strategic Investment Areas

N

Miles

0 5 10 15 20

Corridor Segment
US Hwy/State Route
County Boundary
City Boundary

Performance Area Needs

Pavement
Mobility
Safety
Freight
Bridge
Truck Height Restriction Hot Spot

Level of Need
Low
Medium
High

SOLUTION EVALUATION AND PRIORITIZATION

Candidate solutions are evaluated using the following steps: LCCA (where applicable), Performance Effectiveness Evaluation, Solution Risk Analysis, and Candidate Solution Prioritization. The methodology and approach to this evaluation are shown in **Figure ES-7** and described more fully below.

Life-Cycle Cost Analysis

All Pavement and Bridge candidate solutions have two options: rehabilitation/repair or reconstruction. These options are evaluated through an LCCA to determine the best approach for each location where a Pavement or Bridge solution is recommended. The LCCA eliminates options from further consideration and identify which options should be carried forward for further evaluation.

All Mobility, Safety, and Freight strategic investment areas that result in multiple independent candidate solutions are advanced directly to the Performance Effectiveness Evaluation.

Performance Effectiveness Evaluation

After completing the LCCA process, all remaining candidate solutions are evaluated based on their performance effectiveness. This process includes determining a Performance Effectiveness Score (PES) based on how much each solution impacts the existing performance and needs scores for each segment. This evaluation also includes a Performance Area Risk Analysis to help differentiate between similar solutions based on factors that are not directly addressed in the performance system.

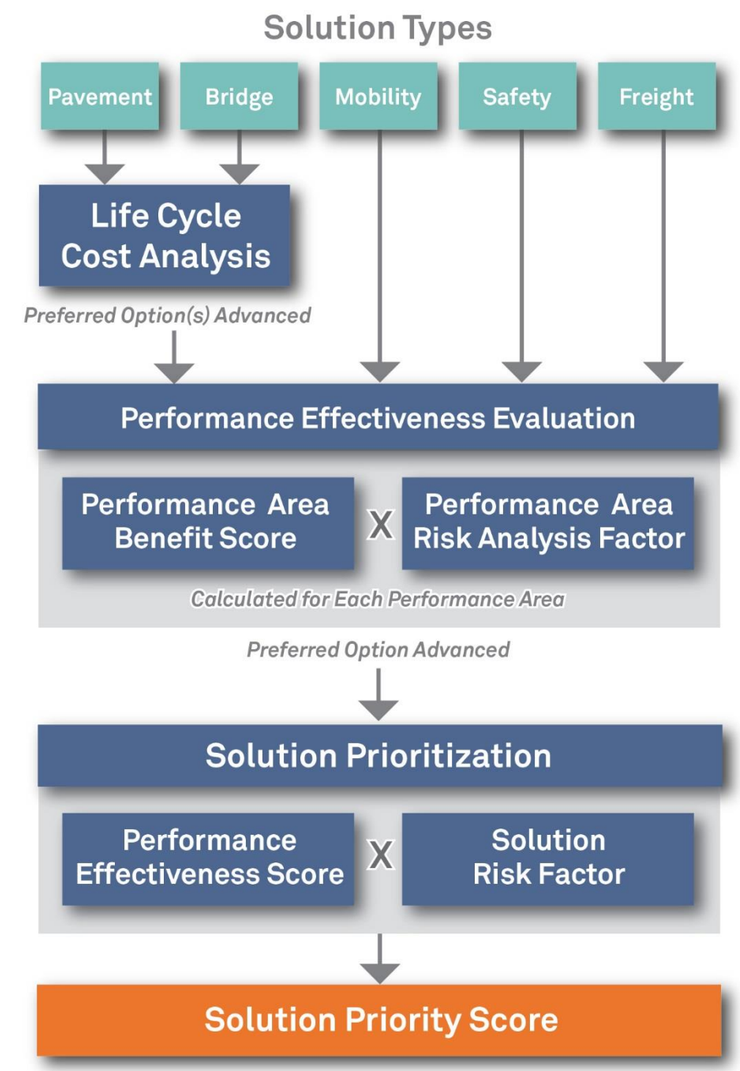
Solution Risk Analysis

All candidate solutions advanced through the Performance Effectiveness Evaluation are also evaluated through a Solution Risk Analysis process. A solution risk probability and consequence analysis is conducted to develop a solution-level risk weighting factor. This risk analysis is a numeric scoring system to help address the risk of not implementing a solution based on the likelihood and severity of the performance failure.

Candidate Solution Prioritization

The PES, weighted risk factor, and segment average need score are combined to create a prioritization score. The candidate solutions are ranked by prioritization score from highest to lowest. The highest prioritization score indicates the candidate solution that is recommended as the highest priority. Solutions that address multiple performance areas tend to score higher in this process.

Figure ES-7: Candidate Solution Evaluation Process



SUMMARY OF CORRIDOR RECOMMENDATIONS

Table ES-4 and **Figure ES-8** show the prioritized candidate solutions recommended for the I-8 corridor. These solutions will increase the performance of the I-8 corridor primarily in the Freight Performance Area. Solutions that address multiple performance areas tend to score higher in this process. Other findings include:

- In the context of the eleven corridors assessed in the corridor profile program, the solutions for I-8 do not score high since the need level is Low in all performance areas.
- Candidate Solution 8.9 Chuichu Rd UP (#1197) Bridge Vertical Clearance Mitigation ranked highest on the corridor due to a reduction in both Freight and Pavement needs at a relatively low cost. Thornton Rd TI UP (#1196) Bridge Vertical Clearance Mitigation also ranked near the top of the corridor list.
- Several sections of I-8 roadway considered pavement hot spots will not be improved by any currently programmed projects. It is anticipated that other preservation programming processes will address these needs in the future.

Other Corridor Recommendations

As part of the investigation of strategic investment areas and candidate solutions, other corridor solutions were also identified that are compatible with the long range vision to support international and inter-regional truck and freight movements:

- Consider a corridor strategy to upgrade all bridges to current standards in anticipation of increased truck/freight traffic over mid to long term.
- Consider corridor-wide ITS solutions to assist truck/freight traffic over the mid to long term.

Policy and Initiative Recommendations

In addition to location-specific needs, general corridor and system-wide needs have also been identified through the CPS process. While these needs are more overarching and cannot be individually evaluated through the CPS process, it is important to document them. A list of recommended policies and initiatives was developed for consideration when programming future projects not only on I-8, but across the entire state highway system where conditions are applicable. The following list, which is in no particular order of priority, was derived from the Round 1, Round 2, and Round 3 CPS:

- Install Intelligent Transportation System (ITS) conduit with all new infrastructure projects
- Prepare strategic plans for Closed Circuit Television (CCTV) camera and Road Weather Information System (RWIS) locations statewide
- Leverage power and communication at existing weigh-in-motion (WIM), dynamic messaging signs (DMS), and call box locations to expand ITS applications across the state
- Consider solar power for lighting and ITS where applicable
- Investigate ice formation prediction technology where applicable
- Conduct highway safety manual evaluation for all future programmed projects
- Develop infrastructure maintenance and preservation plans (including schedule and funding) for all pavement and bridge infrastructure replacement or expansion projects
- Develop standardized bridge maintenance procedures so districts can do routine maintenance work
- Review historical ratings and level of previous investment during scoping of pavement and bridge projects; in pavement locations that warrant further investigation, conduct subsurface investigations during project scoping to determine if full replacement is warranted
- For pavement rehabilitation projects, enhance the amount/level of geotechnical investigations to address issues specific to the varying conditions along the project
- Expand programmed and future pavement projects as necessary to include shoulders
- Expand median cable barrier guidelines to account for safety performance
- Install CCTV cameras with all DMS
- In locations with limited communications, use CCTV cameras to provide still images rather than streaming video
- Develop statewide program for pavement replacement
- Install additional continuous permanent count stations along strategic corridors to enhance traffic count data
- When reconstruction or rehabilitation activities will affect existing bridge vertical clearance, the dimension of the new bridge vertical clearance should be a minimum of 16.25 feet where feasible
- All new or reconstructed roadway/shoulder edges adjacent to an unpaved surface should be constructed with a Safety Edge
- Collision data on tribal lands may be incomplete or inconsistent; additional coordination for data on tribal lands is recommended to ensure adequate reflection of safety issues
- Expand data collection devices statewide to measure freight delay
- Evaluate and accommodate potential changes in freight and goods movement trends that may result from improvements and expansions to the state roadway network

Next Steps

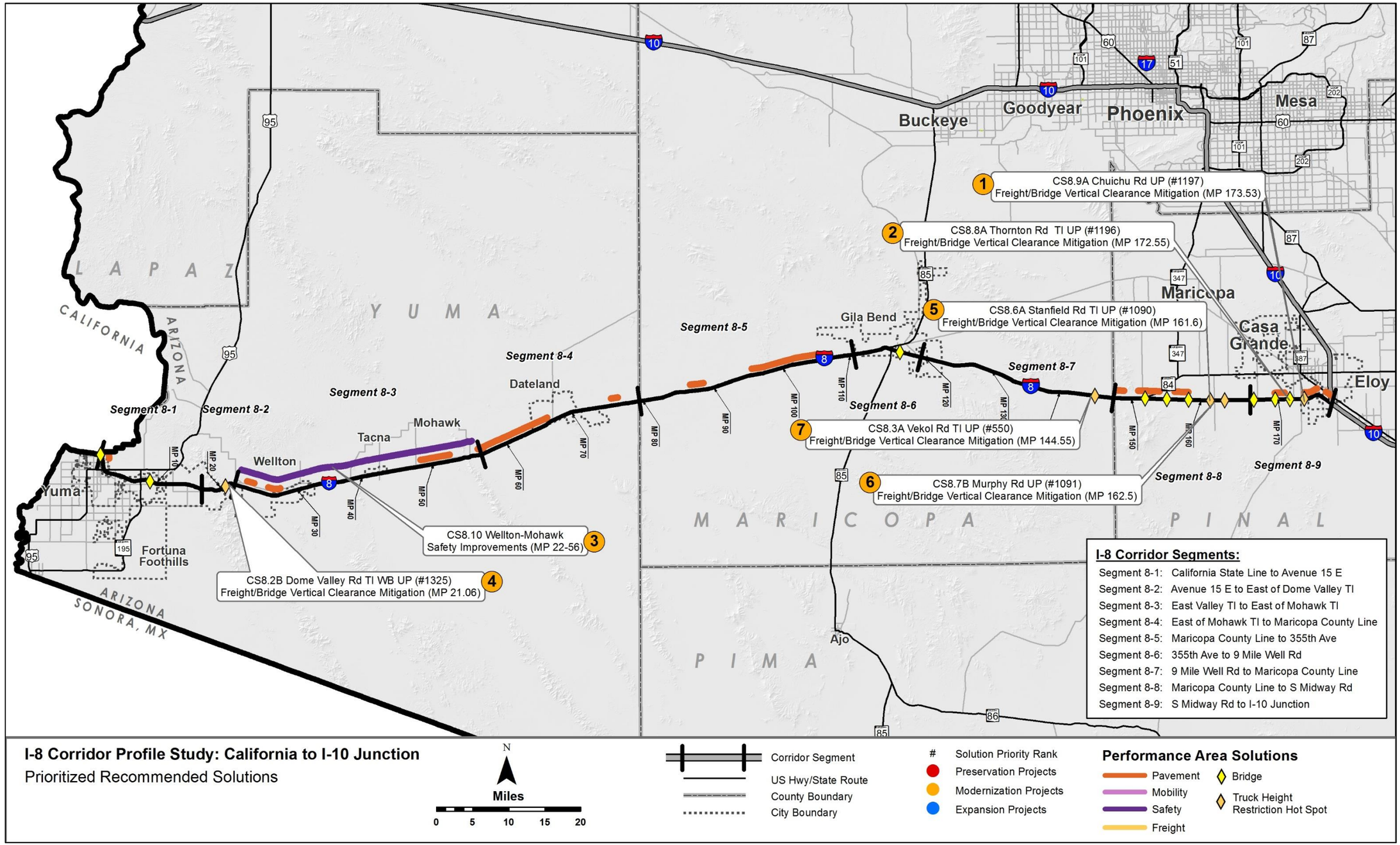
Candidate solutions developed for the I-8 corridor will be considered along with other candidate projects in the ADOT statewide programming process. It is important to note that the candidate solutions are intended to represent strategic solutions to address existing performance needs related to the Pavement, Bridge, Mobility, Safety, and Freight performance areas. Therefore, the strategic solutions are not intended to preclude recommendations related to the ultimate vision for the corridor that may have been defined in the context of prior planning studies and/or design concept reports. Recommendations from such studies are still relevant to addressing the ultimate corridor objectives.

Upon completion of all three CPS rounds, the results will be incorporated into a summary document comparing all corridors that is expected to provide a performance-based review of statewide needs and candidate solutions.

Table ES-4: Prioritized Recommended Solutions

Rank	Candidate Solution #	Option	Candidate Solution Name	Candidate Solution Scope	Estimated Cost ($ million)	Investment Category [P] Preservation [M] Modernization [E]Expansion	Prioritization Score
1	CS8.9	A	Chuichu Rd UP (#1197) Bridge Vertical Clearance Mitigation	Re-profile roadway to achieve 16.5 feet vertical clearance	$0.9	M	12
		B	*Chuichu Rd UP (#1197) Bridge Vertical Clearance Mitigation*	*Replace bridge to achieve 16.5 feet vertical clearance*	*$2.6*	*M*	*3*
2	CS8.8	A	Thornton Rd TI UP (#1196) Bridge Vertical Clearance Mitigation	Rehabilitate the bridge Re-profile roadway to achieve 16.5 feet vertical clearance	$2.9	M	8
		B	*Thornton Rd TI UP (#1196) Bridge Vertical Clearance Mitigation*	*Replace bridge to achieve 16.5 feet vertical clearance*	*$3.4*	*M*	*3*
3	CS8.10	-	Wellton-Mohawk Safety Improvements	Speed Feedback Signs (EB MP 28, EB MP 40, EB MP 45, EB MP 53.75, WB MP 23, WB MP 31.5, WB MP 44, WB MP 56.5) Install Lighting (WB MP 25-25.49, WB MP 27.5-27.99, WB MP 32-33, WB MP 35 - 35.49, EB MP 26 - 26.49, WB MP 45.5-45.99)	$2.8	M	8
4	CS8.2	B	Dome Valley Rd TI WB UP (#1325) Bridge Vertical Clearance Mitigation	Replace bridge to achieve 16.5 feet vertical clearance	$1.8	M	3
		A	*Dome Valley Rd TI WB UP (#1325) Bridge Vertical Clearance Mitigation*	*Re-profile roadway to achieve 16.5 feet vertical clearance*	*$0.3*	*M*	*2*
5	CS8.6	A	Stanfield Rd TI UP (#1090) Bridge Vertical Clearance Mitigation	Re-profile roadway to achieve 16.5 feet vertical clearance	$0.8	M	1
		B	*Stanfield Rd TI UP (#1090) Bridge Vertical Clearance Mitigation*	*Replace bridge to achieve 16.5 feet vertical clearance*	*$2.2*	*M*	*1*
6	CS8.7	A	Murphy Rd UP (#1091) Bridge Vertical Clearance Mitigation	Re-profile roadway to achieve 16.5 feet vertical clearance	$0.6	M	1
		B	*Murphy Rd UP (#1091) Bridge Vertical Clearance Mitigation*	*Replace bridge to achieve 16.5 feet vertical clearance*	*$2.6*	*M*	*1*
7	CS8.3	B	Vekol Road TI UP (#550) Bridge Vertical Clearance Mitigation	Replace bridge to achieve 16.5 feet vertical clearance	$2.2	M	1
		A	*Vekol Road TI UP (#550) Bridge Vertical Clearance Mitigation*	*Re-profile roadway to achieve 16.5 feet vertical clearance*	*$0.6*	*M*	*1*

Figure ES-8: Prioritized Recommended Solutions



1.0 INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study (CPS) of Interstate 8 (I-8) between the California Border in Yuma and the Interstate 10 (I-10) Junction in Casa Grande. The study examines key performance measures relative to the I-8 corridor, and the results of this performance evaluation are used to identify potential strategic improvements. The intent of the corridor profile program, and of ADOT's Planning-to-Programming (P2P) process, is to conduct performance-based planning to identify areas of need and make the most efficient use of available funding to provide an efficient transportation network.

ADOT is conducting eleven CPS within three separate groupings.

The first three studies (**Round 1**) began in Spring 2014, and encompasses:

- I-17: SR 101L to I-40
- I-19: Nogales to I-10
- I-40: California State Line to I-17

The second round (**Round 2**) of studies, initiated in Spring 2015, includes:

- I-8: California State Line to I-10
- I-40: I-17 to the New Mexico State Line
- SR 95: I-8 to I-40

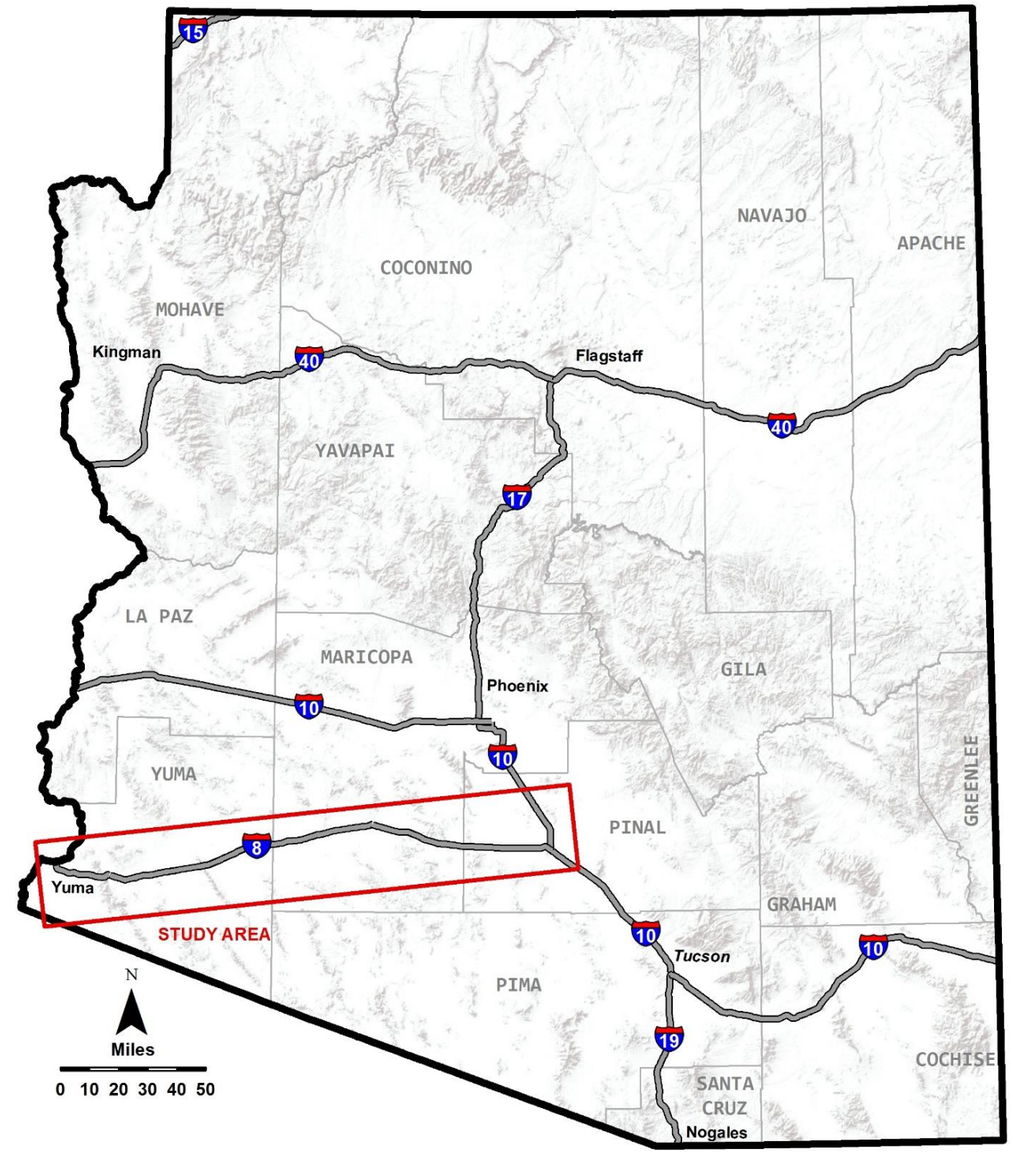
The third round (**Round 3**) of studies, initiated in Fall 2015, includes:

- I-10: California State Line to SR 85 and SR 85: I-10 to I-8
- I-10: SR 202L to the New Mexico State Line
- SR 87/SR 260/SR 377: SR 202L to I-40
- US 60/US 70: SR 79 to US 191 and US 191: US 70 to SR 80
- US 93/US 60: Nevada State Line to SR 303L

The studies under this program assess the overall health, or performance, of the state's strategic highways. The CPS will identify candidate solutions for consideration in the Multimodal Planning Division's (MPD) P2P project prioritization process, providing information to guide corridor-specific project selection and programming decisions.

The I-8 corridor, depicted in **Figure 1,** is one of the strategic statewide corridors identified and the subject of this Round 2 CPS.

Figure 1: Corridor Study Area



1.1 Corridor Study Purpose

The purpose of the CPS is to measure corridor performance to inform the development of strategic solutions that are cost-effective and account for potential risks. It is accomplished by following the process described below:

- Inventory past improvement recommendations
- Define corridor goals and objectives
- Assess existing performance based on quantifiable performance measures
- Propose various solutions to improve corridor performance
- Identify specific solutions that can provide quantifiable benefits relative to the performance measures
- Prioritize solutions for future implementation, accounting for performance effectiveness and risk analysis findings

1.2 Study Goals and Objectives

The objective of this study is to identify a recommended set of prioritized potential solutions for consideration in future construction programs, derived from a transparent, defensible, logical, and replicable process. The I-8 CPS defines solutions and improvements for the corridor that are evaluated and ranked to determine which investments offer the greatest benefit to the corridor in terms of enhancing performance. Corridor benefits can be categorized by the following three investment types:

- Preservation: Activities that protect transportation infrastructure by sustaining asset condition or extending asset service life
- Modernization: Highway improvements that upgrade efficiency, functionality, and safety without adding capacity
- Expansion: Improvements that add transportation capacity through the addition of new facilities and/or services

This study identifies potential actions to improve the performance of the I-8 corridor. Proposed actions are compared based on their likelihood of achieving desired performance levels, life-cycle costs, cost-effectiveness, and risk analysis to produce a prioritized list of solutions that help achieve corridor goals.

The following goals are identified as the desired outcome of this study:

- Link project decision-making and investments on key corridors to strategic goals
- Develop solutions that address identified corridor needs based on measured performance
- Prioritize improvements that cost-effectively preserve, modernize, and expand transportation infrastructure

1.3 Corridor Overview and Location

I-8 is an important national transportation corridor, spanning between San Diego, California and Casa Grande, Arizona. In Arizona, I-8 originates at the Colorado River in the City of Yuma and extends approximately 178 miles east, passing through Yuma County and the Town of Wellton, across Gila Bend in Maricopa County, and terminating at the I-10 junction southeast of Casa Grande in Pinal County. Much of the I-8 corridor is rural and undeveloped.

The entire length of I-8 in Arizona is the subject of this CPS. More than a highway, the corridor is a multimodal facility that moves people and freight and connects communities. The corridor serves the growing Sun Corridor in central Arizona, supports freight movement (e.g., by transporting produce from the “lettuce capital of the US” near Yuma), and carries visitors west to the commercial and recreation centers in San Diego, California.

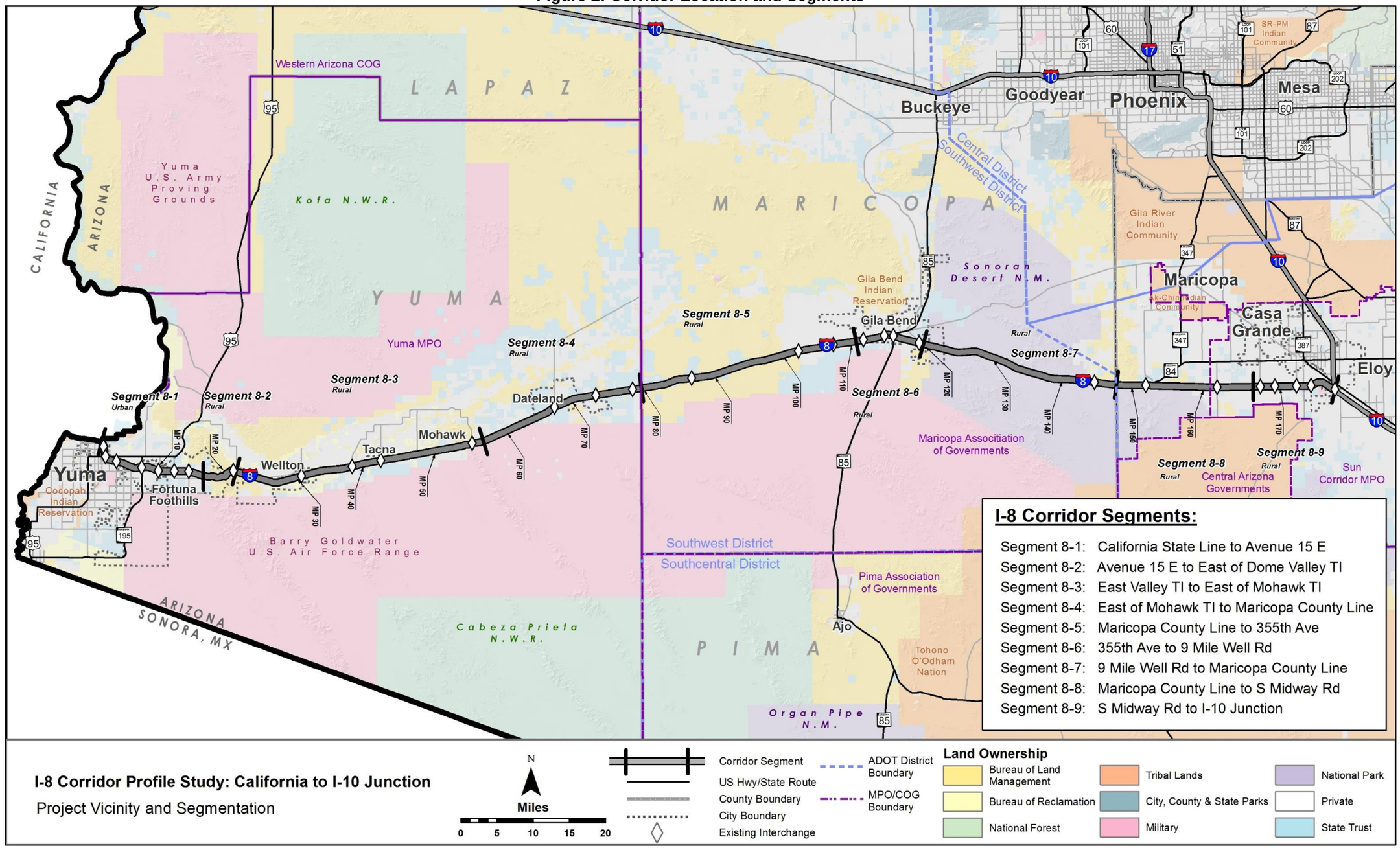
1.4 Corridor Segments

The I-8 corridor is divided into nine planning segments for analysis and evaluation. These planning segments allow the corridor to be analyzed at a detailed level so that location-specific needs can be readily identified and compared to other segments on this or other corridors. Segmentation by similar characteristics (e.g., urban/rural surroundings, road width, traffic volumes) allowed the analysis to highlight anomalies or instances of poor performance within the context of each segment. The corridor is segmented at logical breaks where context changes such as terrain, daily traffic volumes, or roadway typical section indicate. Additional segment breaks may occur at major intersections or junctions, where the corridor transitions from rural to urban environments, other similar operating environments, maintenance sections, and at jurisdictional changes. Corridor segments are described in **Table 1** and are shown in **Figure 2**.

Table 1: I-8 Corridor Segments

Segment #	Begin	End	Approx. Begin Milepost	Approx. End Milepost	Approx. Length (miles)	Typical Through Lanes (EB,WB)	2014 (2035) Average Annual Daily Traffic Volume (vpd)	Character Description
8-1	California State Line	Avenue 15 E	0.0	16.3	16.3	2, 2	28,925 (39,297)	This segment starts at the California Border, traversing the urban area of Yuma and including seven traffic interchanges (TIs) for access. Within the limits, I-8 was constructed on new alignment away from old US 80, now Business 8 (B-8). At Avenue 9E, I-8 returns to the old US 80 alignment utilizing parallel frontage roads. Avenue15E serves as the Yuma city limit, with significant changes in terrain, level of development and traffic volumes.
8-2	Avenue 15 E	East of Dome Valley TI	16.3	21.4	5.1	2, 2	12,848 (16,032)	I-8 crosses through the mountainous terrain of Telegraph Pass, utilizing the old US 80 alignment. The US Border Patrol Station is also located in this section. One TI is located within Segment 8-2.
8-3	East of Dome Valley TI	East of Mohawk TI	21.4	56.5	35.1	2, 2	9,671 (11,673)	I-8 was constructed on a new alignment within this rural segment. Four TIs provide access to the local communities. The terrain is uniform except for the easternmost mile where Mohawk Pass allows a small mountain range to be crossed. There is little fluctuation in traffic numbers across this segment.
8-4	East of Mohawk TI	Maricopa County Line	56.5	79.6	23.1	2, 2	10,719 (13,266)	This segment is considered a rural operating environment and terminates at the Yuma County/Maricopa County line, which is also the break point between the Yuma Metropolitan Planning Organization (YMPO) and Maricopa Association of Governments (MAG). Beginning at the Mohawk TI, I-8 utilizes old US 80 as the eastbound roadway. Additionally, the county line has generally been used as a project limit. Two TIs are inclusive.
8-5	Maricopa County Line	355th Avenue	79.6	110.4	30.8	2, 2	13,265 (18,978)	This segment starts at the county line and ends at approximately the western limits of Gila Bend. This segment is differentiated by jurisdiction rather than any changes in terrain or traffic. Four TIs provide local access.
8-6	355th Avenue	9 Mile Well Road	110.4	120	9.6	2, 2	6,455 (11,959)	I-8 crosses the Gila Bend area between East and West TIs with a total of 4 TIs serving the area. The mainline roadway is on new alignment. Traffic numbers in this segment increase due to the B-8 and SR 85 junctions.
8-7	9 Mile Well Road	Maricopa County Line	120	147.6	27.6	2, 2	5,238 (6,942)	This segment runs from east Gila Bend to the Maricopa / Pinal County Line. One TI falls within the limits of Segment 8-7.
8-8	Maricopa County Line	S Midway Road	147.6	166.5	18.9	2, 2	5,497 (8,230)	This segment is defined by jurisdiction. Midway Road is assumed to be the western limits of Casa Grande development. The jurisdictional boundary between MAG and the Sun Corridor Metropolitan Planning Organization (SCMPO) occurs within this segment at approximately MP 160. Two TIs provide local access.
8-9	S Midway Road	Interstate 10	166.5	178	11.5	2, 2	8,599 (11,731)	This segment is defined as entering into the greater Casa Grande area. This segment terminates at the junction with I-10 and includes 5 TIs.

Figure 2: Corridor Location and Segments



1.5 Corridor Characteristics

The I-8 corridor provides movement for significant freight and recreation needs within Arizona. It serves intrastate, interstate and international commerce linking the agriculturally rich Yuma area with California to the west and all points east. I-8 is a key link in the regional, statewide and national freight network, collecting and distributing goods between Mexico, the west coast, and ports throughout the United States. It also serves as a major connection to recreational opportunities in Western Arizona, Southern California and Mexico.

National Context

I-8 is part of the National Highway System, traversing 345 miles between San Diego, California and Casa Grande, Arizona. It is designated as a national intercity truck route, a hazardous material route, and Key Commerce Corridor within Arizona, connecting west coast ports with Gulf coast ports and eastern markets. This route provides a more direct connection between I-10 east of Casa Grande and San Diego than following I-10 to Los Angeles. Within southern California, I-8 provides connectivity with access to I-5 and I-15, the Port of San Diego and the local military bases. It also runs parallel to the Barry M. Goldwater Air Force Range Complex, the nation's third largest military reservation, covering approximately 1.7 million acres and used primarily for flight training.

Regional Connectivity

I-8 connects to US 95 and SR 195 in the Yuma area, SR 85 in Gila Bend, SR 84 just south of Maricopa which then connects to SR 347, and I-10 in Casa Grande. This connectivity provides regional access to major freight generators in southern and central Arizona with southern California and Mexico. Regional access is also provided for recreational opportunities along the Colorado River and in Southern California.

Commercial Truck Traffic

I-8 serves as a trade route for agricultural products grown in Yuma and the Gila River Valley, as well as for other statewide commerce needs, by providing access to west coast ports, Gulf Coast ports, and eastern markets. A concentration of major agricultural facilities is located in the Yuma area between Avenue 3E and Araby Road. Major distribution centers, such as Walmart, are also located in the Casa Grande area. The high volume of truck traffic on Avenue 3E and Araby Road creates congestion on the southern legs of these intersections. According to ADOT's HPMS Location Report for 2014, the average daily commercial truck volumes along the corridor range from 1,100 – 5,400, with the higher frequencies closer to Yuma. One reason for the higher volume of commercial trucks near Yuma is the proximity to the San Luis Border Crossing. In addition, the Union Pacific Railroad (UPRR) also runs parallel to I-8 for much of the corridor, providing a major freight connection. Potential freight switching opportunities exist in both the Yuma and Casa Grande areas, providing an interface between rail freight, truck freight, and distribution centers.

The San Luis Border Crossing is located less than 25 miles south of Yuma via US 95. In 2014, this crossing was the third busiest in Arizona in terms of total number of loaded truck containers, accounting for approximately 8% of all such truck crossings within the State. The San Luis Border Crossing was also the second busiest crossing for personal vehicles and total pedestrians, accounting for 36% of all personal vehicle crossings (Bureau of Transportation Statistics, 2015). The San Luis Land Port of Entry (LPOE) serves US 95, I-8, SR 195 and Mexico Federal Highway 2. The LPOE consists of two facilities. The primary check point includes six general lanes and two SENTRI Lanes. An additional 80-acre commercial vehicle check point was recently constructed five miles east of the original port of entry and is designed to process 150 trucks per day with the potential to expand to 650 trucks by 2030. Five other border crossings between California and Arizona are also accessible from I-8. Due to its location near the U.S. and Mexico Border, I-8 has a significant impact on the national and regional scale.

One permanent border checkpoint is located just east of Avenue 15E. Another checkpoint that is occasionally used is located just west of the Yuma/Maricopa county line. Both locations require all vehicles to stop for inspection, creating delay with commercial truck traffic.

One weigh-in-motion (WIM) station is located on I-8 just east of the California State Line. A WIM station allows for commercial truck traffic to utilize the scales but with reduced delay. There are four additional weigh-in-motion traffic counters installed along the interstate corridor.

Commuter Traffic

Commuter traffic on I-8 occurs mostly within the urbanized areas of Yuma and Casa Grande, which are the primary economic centers along the corridor. According to ADOT's most recent data, traffic volumes range from approximately 28,000 vehicles per day in the Yuma area to approximately 7,000 vehicles per day in the Casa Grande area. Within the Yuma area, the commuter traffic generally occurs between downtown Yuma and Fortuna Foothills, which lies entirely within Segment 8-1 of this CPS.

According to the 2013 American Community Survey data from the US Census Bureau, 77% of the workforce in the Yuma region relies on a private vehicle to get to work, 82% of the workforce in the Gila Bend region relies on a private vehicle to get to work, and 80% of the workforce in the Casa Grande region relies on a private vehicle to get to work. The average commute travel time for commuters from small rural communities along I-8, such as Wellton, is 20-25 minutes. The smaller communities along I-8 have a high percentage of workers commuting to larger cities, such as Yuma or Casa Grande.

Additionally, there is a significant amount of military related uses in the Yuma region, with the Barry M. Goldwater Air Force Range Complex and the Marine Corps Air Station in the vicinity.

Recreation and Tourism

I-8 provides access to recreational opportunities along the Colorado River and in Southern California. Many recreational users travel I-8 to access the sand dunes just west of Yuma and the Colorado River in several areas along US/SR 95. This creates a mix of vehicles types on I-8, as many recreational vehicles with trailers use the route.

The Sonoran Desert National Monument is also located in the I-8 corridor between Gila Bend and Casa Grande. Motorists utilize I-8 to access SR 85 when traveling south to Organ Pipe National Monument and the border crossing with Mexico at Lukeville, which provides access to the Mexican port city of Puerto Peñasco.

Multimodal Uses

Freight Rail

The UPRR operates the historic Sunset Route connecting Los Angeles California to El Paso Texas. A major platform is located in Yuma, a legendary railroad town, and the railroad travels through Casa Grande. Nearly two-thirds of the Sunset Route is double-tracked to support the growing freight demand in the Southwest region. Moreover, the Sunset Route is a key corridor for North American railroads, carrying about 20 percent of all railroad traffic.

Passenger Rail

Amtrak operates one platform from Yuma. The Sunset Limited Route travels between Louisiana and California, with three trains departing weekly. The Texas Eagle Route, which runs from Chicago to San Antonio, can also be accessed from the Sunset Limited Route.

Bicycles/Pedestrians

Bicycles are permitted to use the shoulders along I-8, which are generally 10 feet wide, although several bridges have a width is less than 4 feet. Pedestrians are prohibited on this route.

Bus/Transit

The largest regional public transportation service provider along the I-8 corridor is the Yuma County Intergovernmental Public Transportation Authority with the Yuma County Area Transit (YCAT). YCAT provides nine fixed routes, a vanpool open to any commuter group in the county, an on-call demand service for individuals living with a disability, and a nighttime shuttle specifically serving colleges in the area. YCAT services connect Yuma to San Luis in the south and to the Town of Wellton to the west via I-8. YCAT also provides connections to and from the Greyhound stops in Yuma.

Greyhound operates two stops in Yuma, one along Castle Done Avenue at the Yuma Palms Regional Center and the other just east at 14th Avenue. These stops service Greyhound Route 580, between El Paso and Los Angeles. The route has additional stops in Gila Bend and Casa Grande.

Aviation

Municipal airports along the corridor are located in Eloy and Gila Bend, with a larger airport located in Yuma, just south of I-8. The predominant use of the Eloy Airfield is for skydiving and regional crop dusting. The Gila Bend Airport has no permanently located aircraft and approximately ten operations per day. The Yuma International Airport is used for military aviation, commercial travel, and medical transport, as well as for general aviation purposes. The Yuma International Airport is currently served by one commercial airline, American Airlines, and provides up to six round-trip flights daily between Yuma and Phoenix Sky Harbor Airport (PHX).

Land Ownership, Land Uses and Jurisdictions

As shown **Table 2**, I-8 crosses multiple jurisdictions and land holdings throughout Yuma, Maricopa, and Pinal Counties. A majority of the land west of Gila Bend is a checkerboard of private and State Trust land, with some Bureau of Land Management (BLM) ownership. East of Gila Bend, the corridor is predominantly National Park land until just west of Casa Grande, where it again traverses a checkerboard of private and State Trust land. In the vicinity of the corridor, but not immediately adjacent to I-8, there are significant military and tribal lands. Much of the military, tribal, and national parks lands are open space. Occurrences where these areas have been utilized by drug traffickers and smugglers have been noted, which can cause abrupt crossings of I-8 at unmarked locations.

Population Centers

The major population centers within the I-8 corridor are centered around the urbanized areas of Yuma and Casa Grande. **Table 2** provides a summary of the US Census population and the state growth forecasts for the communities along I-8. The urbanized area of Yuma is experiencing growth trending to the east, along the I-8 corridor, with increases in the Fortuna Foothills area and beyond into the Wellton region. The small community of Gila Bend is at a major transportation junction and expects sevenfold growth by 2040. Casa Grande serves as a major transportation hub at the junction of I-10 and I-8, and is an important center to Pinal County. It is currently experiencing significant growth in both population and employment opportunities, particularly focused in commercial and industrial development.

Major Traffic Generators

Within the Yuma and Casa Grande areas, major traffic generators are related to freight, including agricultural and industrial traffic, as well as some military-related traffic in the Yuma area. Outside of the study area, major traffic generators are the southern California ports and the San Luis Border Crossing, which generate significant freight traffic on I-8. Additionally, recreational opportunities along the Colorado River, both near Yuma and further north to Parker, generate traffic on I-8.

Table 2: Current and Future Population

Community	2010 Population	2014 Population	Projected 2040 Population	% Change 2010 – 2040	Total Growth
Yuma County	**195,751**	**210,500**	**333,943**	**41%**	**138,192**
Yuma	93,064	96,327	144,302	36%	51,238
Fortuna Foothills	26,265	27,407	36,393	28%	10,128
Wellton	2,882	3,067	5,479	47%	2,597
Tacna	602	610	649	7%	47
Maricopa County	**3,817,117**	**3,990,011**	**6,174,940**	**38%**	**2,357,823**
Gila Bend	1,900	2,000	14,500	87%	12,600
Pinal County	**376,369**	**403,526**	**934,939**	**60%**	**558,570**
Casa Grande	48,664	51,329	106,668	54%	58,004
Eloy	16,657	19,245	72,206	77%	55,549

Source: U.S. Census, Arizona Department of Administration – Employment and Population Statistics

Tribes

Tribal land within the vicinity of the I-8 corridor includes the Tohono O'Odham Nation and the Gila Bend Indian Reservation.

Wildlife Linkages

The Arizona State Wildlife Action Plan (SWAP) provides a 10-year vision for the entire state, identifying wildlife and habitats in need of conservation, insight regarding the stressors to those resources, and suggestive actions that can be taken to alleviate those stressors. Using the Habimap Tool that creates an interactive database of the information included in the SWAP, the following wildlife considerations were identified in relation to the I-8 corridor:

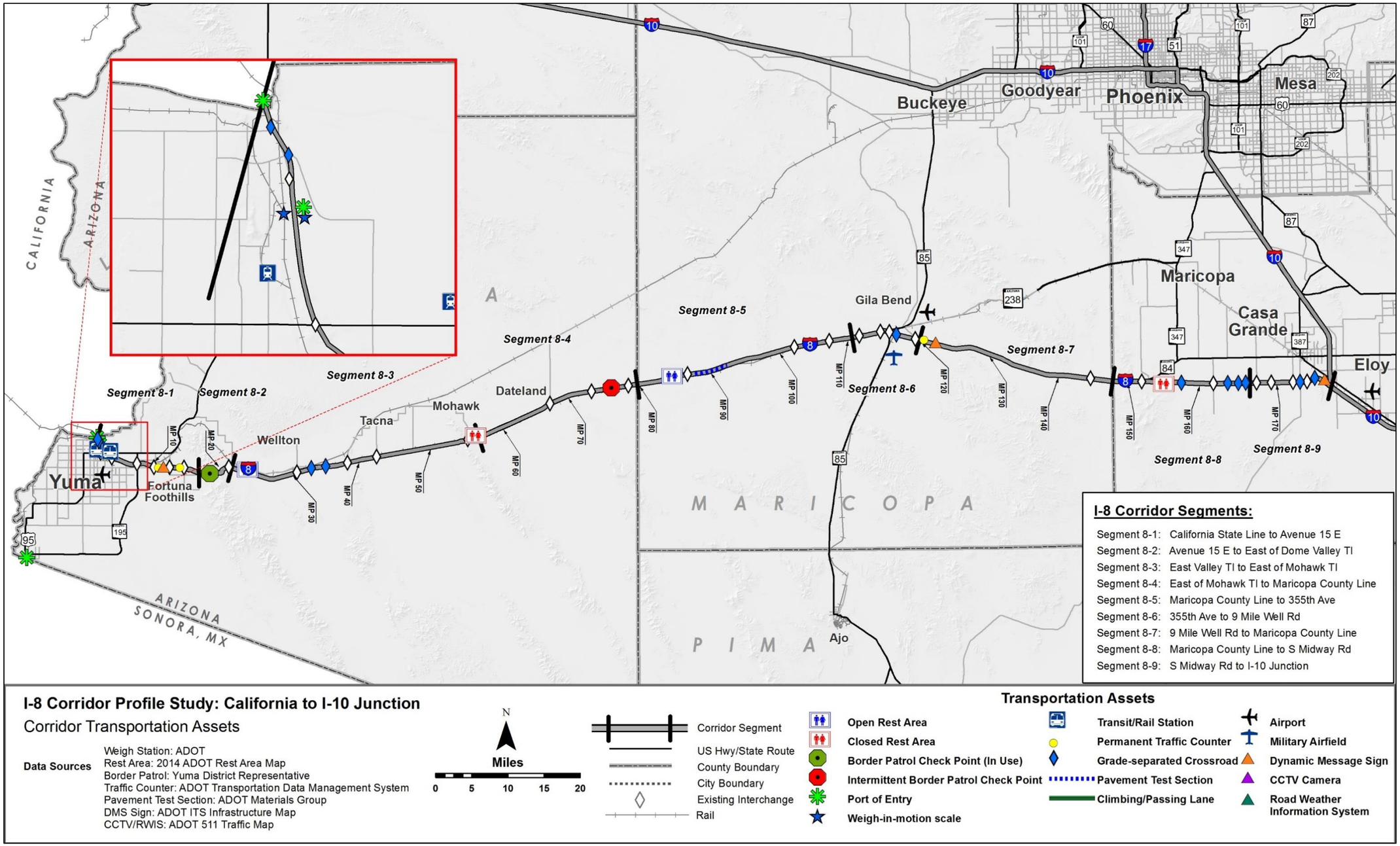
- Wildlife waters exist to the north and south of I-8 between SR 84 and Gila Bend.
- I-8 travels through allotments/pastures from just east of SR 84 to Gila Bend, and periodically from west of Gila Bend to east of Dateland. This roughly corresponds to the area controlled by the BLM.
- Some State Land holdings are present, primarily from just east of Gila Bend to Wellton.
- Arizona Wildlife Linkages – potential linkage zones exist along I-8 between MP 39 and MP 100 (Linkage No. 72), as well as crossing I-8 in the vicinity of MP 8-MP 9 (Linkage No. 70). Habitat fracture zones are identified from the California border to MP 18 (with the exception of MP 8-MP 9), MP 21-MP 39, MP 100-MP 120 and MP 150 to I-10.
- Species and Habitat Conservation Guide – indicates sensitive habitats in the vicinity of South Maricopa Mountains Wilderness, just north of I-8 to the east of Gila Bend, and along the Gila River in the vicinity of Wellton and Tacna.
- Species of greatest conservation need are identified in the vicinity of SR 84 and the Sonoran Desert National Monument.
- A moderate level of "species of economic and recreational importance" are identified along I-8 to the north from Casa Grande to the riparian area west of Gila Bend.

Corridor Assets

Corridor transportation assets are summarized in **Figure 3.** The majority of assets are located along the more densely populated portions of the corridor through Yuma and Casa Grande areas. There are two ports of entry, two weigh-in-motion scales and two transit/rail stations in Yuma, all of which are assets not provided elsewhere along the corridor. Additionally, near the eastern section of the corridor, beginning around MP 160 and continuing to I-10, is one DMS, five grade-separated crossroads and five existing interchanges. This area has a higher concentration of grade-separated crossroads and existing interchanges than any other along the corridor.

The portion of the corridor between Yuma/Fortuna Foothills and MP 160 is generally more rural and the existing assets are predominately grade-separated crossroads and existing interchanges. This stretch of corridor, which is roughly 140 miles, includes one open rest area, two Border Patrol check points, one permanent traffic counter and one DMS. There is also a pavement test section along the eastbound and westbound lanes between MP 88 and MP 92.5.

Figure 3: Corridor Assets



1.6 Corridor Stakeholders and Input Process

A Technical Advisory Committee (TAC) was created with representatives from key stakeholders. TAC meetings were held at key milestones to present results and obtain feedback. In addition, several meetings were also conducted with key stakeholders between October 2015 and October 2016 to present the results and obtain feedback.

Key stakeholders for this study include:

- Yuma Metropolitan Planning Organization (YMPO)
- Sun Corridor Metropolitan Planning Organization (SCMPO)
- Central Arizona Governments (CAG)
- ADOT Southwest District
- ADOT South Central District
- ADOT Technical Groups
- Arizona Game and Fish Department (AGFD)
- Arizona State Land Department (ASLD)
- Federal Highway Administration (FHWA)

Several Working Papers were developed during the course of the CPS. The Working Papers were provided to the TAC for review and comment.

1.7 Prior Studies and Recommendations

This section provides a summary of previous studies and plans and their recommendations that are relevant to the I-8 CPS.

Framework and Statewide Studies

- ADOT 5 Year Transportation Facilities Construction Program 2016 - 2020
- ADOT Statewide Bicycle and Pedestrian Plan Update
- ADOT Climbing and Passing Lane Prioritization Study
- Arizona Key Commerce Corridors
- Arizona Multimodal Freight Analysis Study
- Arizona Port of Entry Study
- Arizona Roadway Departure Safety Implementation Plan
- Arizona State Airport System Plan
- Arizona State Rail Plan
- Arizona Statewide Dynamic Message Master Plan
- Arizona Statewide Rail Framework Study
- Arizona Statewide Rest Area Study
- Arizona Statewide Travel Demand Model (AZTDM)
- Arizona Wildlife Action Plan / Arizona Wildlife Linkages Assessment
- Building a Quality Arizona (BQAZ)
- Bureau of Land Management Travel Management Plan
- What Moves You Arizona? Long-Range Transportation Plan 2010-2035

Regional Planning Studies

- ADOT I-8 Multi Modal Corridor Profile
- ADOT Interstate 11 (I-11) Southern Arizona Future Connectivity Corridor Feasibility Assessment Report
- Arizona – Sonora Border Master Plan
- CAG Regional Transportation Plan (RTP)
- Casa Grande Downtown Circulation Study
- Casa Grande General Plan 2020
- City of Yuma Transportation Master Plan
- FHWA Bi-National Border Transportation Infrastructure Needs Study
- MAG 2035 RTP
- MAG I-8 and I-10/Hidden Valley Transportation Framework Study
- MAG Freight Transportation Framework Plan
- Pinal County Regionally Significant Routes for Safety and Mobility Study
- Pinal County Transit Feasibility Study
- Pinal County Comprehensive Plan
- Pinal County Open Space and Trails Master Plan
- SCMPO 2016 – 2035 Draft RTP
- Short Range Transit Plan
- YMPO RTP (2014-2033)
- Yuma County Rail Corridor Study

Planning Assistance for Rural Areas (PARA) and Small Area Transportation Studies (SATS)

- ADOT Yuma Expressway Study
- ADOT YMPO Transportation Needs for the Foothills and Mesa Del Sol Areas
- Casa Grande SATS
- Pinal County SATS
- Pinal County Transit Element Report
- Southern Pinal County Regional Corridor Study
- Southern Pinal/Northern Pima Corridor Definition Study
- Wellton Transportation Long-Range Plan PARA
- Yuma Regional Transit Study PARA

Design Concept Reports (DCR) and Project Assessments (PA)

- I-10 Jct. I-8 to Tangerine Road DCR
- SR 85 Gila Bend TI DCR
- I-8 at MP 17 Telegraph Pass PA
- I-10 Val Vista – Jct. I-8 PA
- I-8 Araby Road TI DCR
- I-8 Henness Road TI DCR

Table 3: Corridor Recommendations from Previous Studies

Map Key Ref. #	Begin MP	End MP	Length (miles)	Project Description	Investment Category (Preservation [P], Modernization[M], Expansion [E])			Status of Recommendation			Name of Study
					P	M	E	Program Year	Project No.	Environmental Documentation (Y/N)?	
1	0.5	0.5	0	I-8, WB Off Ramp & Giss Parkway (Intersection Improvements)		√		FY17	H8619 01C	Y	ADOT 5 Year Program 2016 - 2020
2	1	1	.5	I-8 Port of Entry facility improvements	√	√				N	AZ Ports of Entry Study
3	2	2	0	Addition of eastbound DMS at CA state line		√				N	Arizona Statewide Dynamic Message Master Plan
4	2	12	10	I-8 Widening, 16th Street to Fortuna (6 lanes)			√	Buildout		N	City of Yuma Transportation Master Plan
5	7	7	0	I-8, Araby Road TI Reconstruction (Roundabouts)		√		FY17	H8102 01C	Y	ADOT 5 Year Program 2016 - 2020
6	7.6	7.6	0	New east-west freeway in Yuma, connecting to I-8			√			N	BQAZ
7	16.2	16.2	0	I-8, Ave 15E (New TI)			√	Buildout		N	Transportation Needs for the Foothills & Mesa Del Sol Areas
8	18	20	2	Addition of eastbound climbing lane			√	Low priority (Tier 3)		N	ADOT Climbing and Passing lane Prioritization Study
9	20	35	15	I-8 Widening (6 lanes)			√	2033		N	Wellton Transportation Long Range Plan
10	21	29	8	I-8, Dome Valley – Wellton (Pavement Preservation)	√			FY16	H8697 01C	Y	ADOT 5 Year Program 2016 - 2020
11	27	27	0	I-8, Ave 25E (New TI)			√	2033		N	Wellton Transportation Long Range Plan
12	30	30	0	I-8, Ave 29E (Reconstruct TI)		√		2033		N	Wellton Transportation Long Range Plan
13	33	33	0	I-8, Ave 31E (New TI)			√	2033		N	Wellton Transportation Long Range Plan
14	36	36	0	Addition of eastbound DMS at S Ave 36 E		√				N	Arizona Statewide Dynamic Message Master Plan
15	36	36	0	Addition of westbound DMS at S Ave 36 E		√				N	Arizona Statewide Dynamic Message Master Plan
16	56	56	0	I-8, Mohawk Rest Area (Rehabilitation)	√	√		FY16	H8707 01C	Y	ADOT 5 Year Program 2016-2020
17	56			Mohawk Rest Area Rehab		√			H8707 01C	Y	Arizona Statewide Rest Area Study
18	84			Sentinel Rest Area Roof and Structure Fixes		√				N	Arizona Statewide Rest Area Study
19	96	106	10	I-8, MP 96 to Paloma Road (Pavement Preservation)	√			FY19	H8922 01C	Y	ADOT 5 Year Program 2016 - 2020
20	115	115	0	Addition of eastbound DMS at SR-85		√				N	Arizona Statewide Dynamic Message Master Plan
21	116	178	62	Widen I-8 from 4 to 6 lanes			√			N	Key Commerce Corridors
22	117	117	0	Upgrade of I-8/SR-85 interchange (to accommodate SR-85 freeway)			√	Beyond 2035		N	Maricopa Association of Governments (MAG) 2035 RTP
23	117	117	0	Upgrade of I-8/SR-85 interchange (to accommodate SR-85 freeway upgrade)			√			N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
24	124			I-8 Accelerate/Decelerate Lane with Cattleguard and sign (southbound)		√				N	Bureau of Land Management Travel Management Plan and EA
25	126	126	0	I-8, Bender Wash (Drainage Improvements)		√		FY16	H8449 01C	Y	ADOT 5 Year Program 2016 - 2020
26	128			I-8 Accelerate/Decelerate Lane with Cattleguard and sign (northbound) (MP 128)		√				N	Bureau of Land Management Travel Management Plan and EA

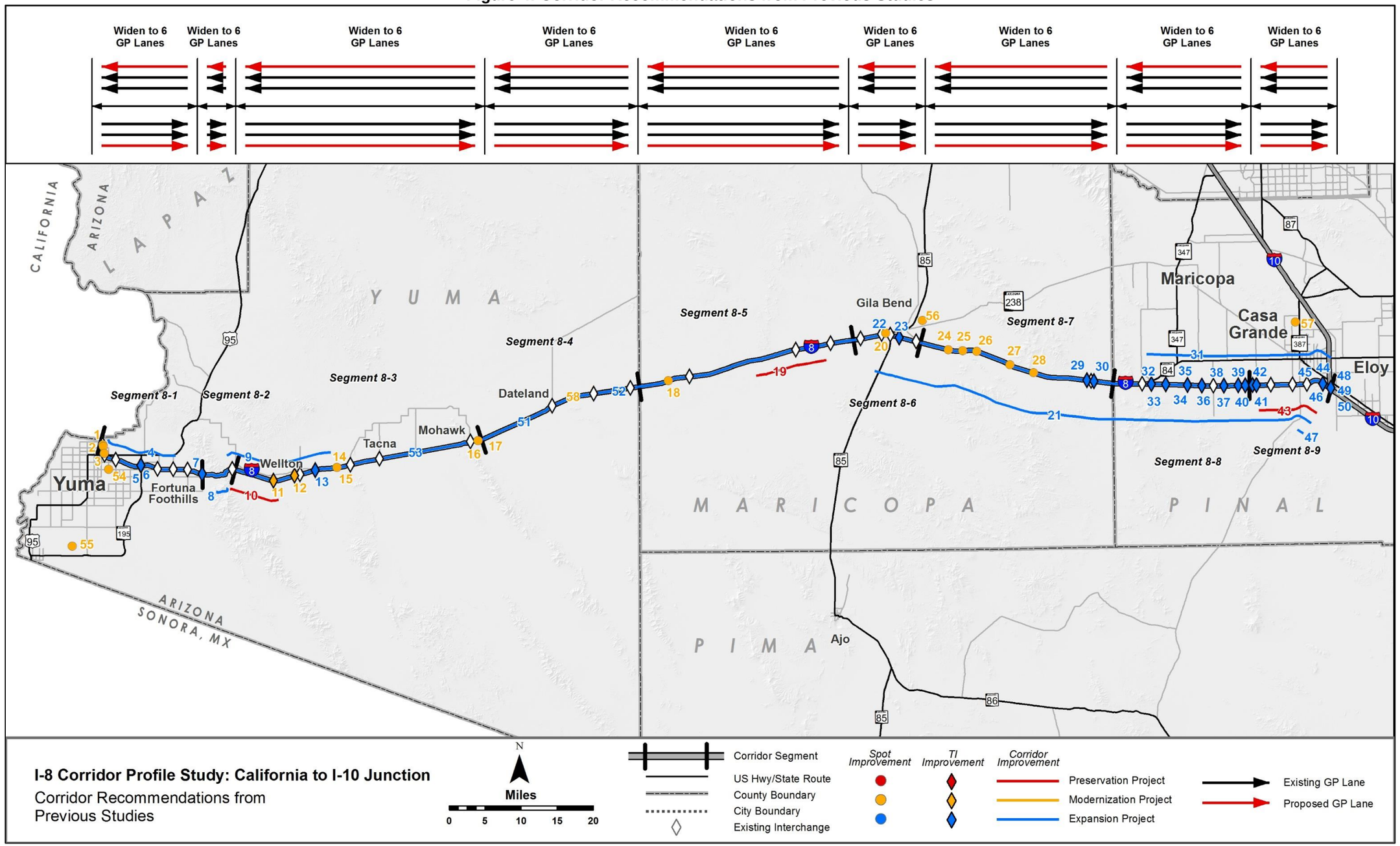
Table 3: Corridor Recommendations from Previous Studies (continued)

Map Key Ref. #	Begin MP	End MP	Length (miles)	Project Description	Investment Category (Preservation [P], Modernization[M], Expansion [E])			Status of Recommendation			Name of Study
					P	M	E	Program Year	Project No.	Environmental Documentation (Y/N)?	
27	133			I-8 Accelerate/Decelerate Lane with Cattleguard and sign (northbound)		√				N	Bureau of Land Management Travel Management Plan and EA
28	136.5			I-8 Accelerate/Decelerate Lane with Cattleguard and Sign		√				N	Bureau of Land Management Travel Management Plan and EA
29	144	144	0	Addition of I-8 interchange at Veko Valley Rd			√			N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
30	145	145	0	Addition of freeway to freeway interchange (to accommodate SR-303L freeway upgrade)			√			N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
31	152	178	26	I-8, widening from SR-347 to I-10 (6 lanes)			√	2030		N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
32	153	153	0	Addition of I-8 interchange at Ratson Rd			√			N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
33	155	155	0	Addition of I-8 interchange at Green Rd			√			N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
34	158	158	0	Addition of I-8 interchange at John Wayne Pkwy (proposed)			√			N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
35	158			Permit for Smith Road under I-8 Overpass (northbound and southbound)		√				N	Bureau of Land Management Travel Management Plan and EA
36	160	160	0	Addition of I-8 interchange at Fuqua Rd			√			N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
37	163	163	0	Addition of I-8 interchange at Anderson Rd			√			N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
38	163	163	.5	New interchange at I-8/Anderson			√			N	Casa Grande SATS/GP
39	165	165	.5	New interchange at I-8/Indian Valley			√			N	Casa Grande GP
40	166	166	0	Addition of I-8 interchange at Russell Rd			√			N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
41	167	167	.5	New system interchange at I-8/Montgomery			√			N	Casa Grande SATS/GP
42	167.5	167.5	0	Addition of freeway to freeway interchange (to accommodate SR-303L freeway upgrade)			√			N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
43	169.5	178	8.5	Pavement preservation from Bianco Rd to I-10	√			2016		N	Sun Corridor MPO Draft Listing of Projects
44	177	177	.5	New interchange of I-8/Henness			√			N	Casa Grande SATS/GP
45	177	177	0	Addition of I-8 interchange at Henness Rd			√			N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
46	177	177	0	Addition of I-8 interchange at Henness Rd			√	2020		N	Sun Corridor MPO Draft Listing of Projects
47	177	178	1	South frontage road from Henness to Cox Rd			√	2030		N	Sun Corridor MPO Draft Listing of Projects
48	178	178	0	Upgrade of I-8/I-10 interchange			√			N	ADOT I-10 Corridor Study, Junction I-8 to Tangerine Rd DCR
49	178	178	0	I-8/I-10 System Interchange		√				N	ADOT Key Commerce Corridors

Table 3: Corridor Recommendations from Previous Studies (continued)

Map Key Ref. #	Begin MP	End MP	Length (miles)	Project Description	Investment Category (Preservation [P], Modernization[M], Expansion [E])			Status of Recommendation			Name of Study
					P	M	E	Program Year	Project No.	Environmental Documentation (Y/N)?	
50	178	178	0	Upgrade of I-8/I-10 interchange			√			N	MAG I-8/I-10 Hidden Valley Transportation Framework Study
51				Widen interstate highways to six lanes in rural Arizona			√			N	BQAZ
52	1	115	115	Intercity bus along I-8 from Gila Bend to Yuma. (2050)			√			N	BQAZ
53	1	115	115	Passenger rail along existing rail line from Gila Bend to Yuma (2050)			√			N	BQAZ
54				Yuma International Airport	√	√	√	FY17-FY20		N	ADOT 5 Year Program 2016 - 2020
55				Yuma Rolle Airfield	√			FY17		N	ADOT 5 Year Program 2016 - 2020
56				Gila Bend Municipal Airport	√	√	√	FY16-FY20		N	ADOT 5 Year Program 2016 - 2020
57				Casa Grande Municipal Airport	√	√	√	FY16-FY20		N	ADOT 5 Year Program 2016 - 2020
58	0	79	79	Various recommendations for improving safety associated with roadway departure incidents		√				N	Arizona Roadway Departure Safety Implementation Plan

Figure 4: Corridor Recommendations from Previous Studies



2.0 CORRIDOR PERFORMANCE

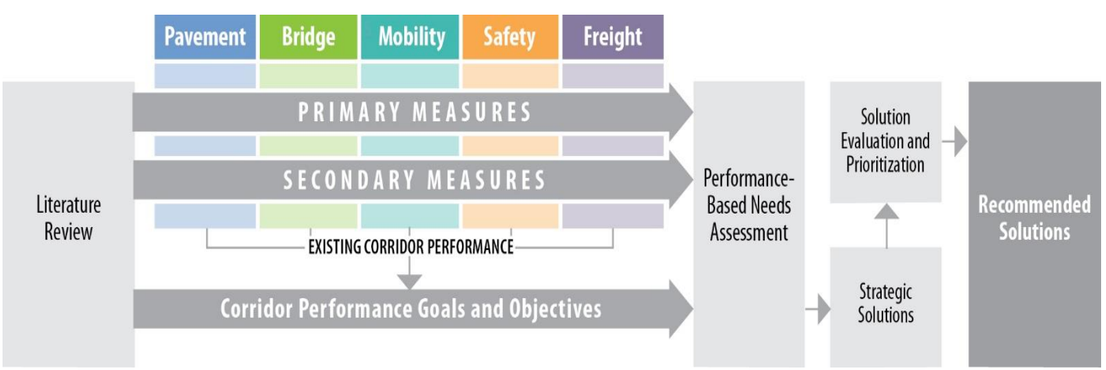
This chapter describes the evaluation of the existing performance of the I-8 corridor. A series of performance measures are used to assess the corridor. The results of the performance evaluation are used to define corridor needs relative to the long-term goals and objectives for the corridor.

2.1 Corridor Performance Framework

This study uses a performance-based process to define baseline corridor performance, diagnose corridor needs, develop corridor solutions, and prioritize strategic corridor investments. In support of this objective, a framework for the performance-based process was developed through a collaborative process involving ADOT and the CPS consultant teams.

Figure 5 illustrates the performance framework, which includes a two-tiered system of performance measures (primary and secondary) to evaluate baseline performance. The primary measures in each of five performance areas are used to define the overall health of the corridor, while the secondary measures identify locations that warrant further diagnostic investigation to delineate needs. Needs are defined as the difference between baseline corridor performance and established performance objectives.

Figure 5: Corridor Profile Performance Framework



The following five performance areas guide the performance-based corridor analyses:

- Pavement
- Bridge
- Mobility
- Safety
- Freight

These performance areas reflect national performance goals stated in Moving Ahead for Progress in the 21st Century (MAP-21):

- Safety: To achieve a significant reduction in traffic fatalities and serious injuries on all public roads
- Infrastructure Condition: To maintain the highway infrastructure asset system in a state of good repair
- Congestion Reduction: To achieve a significant reduction in congestion on the National Highway System
- System Reliability: To improve the efficiency of the surface transportation system
- Freight Movement and Economic Vitality: To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development
- Environmental Sustainability: To enhance the performance of the transportation system while protecting and enhancing the natural environment
- Reduced Project Delivery Delays: To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion

The MAP-21 performance goals were considered in the development of ADOT's P2P process, which integrates transportation planning with capital improvement programming and project delivery. Since the P2P program requires the preparation of annual transportation system performance reports using the five performance areas adopted for the CPS, consistency is achieved in the performance measures used for various ADOT analysis processes.

The performance measures include five primary measures: Pavement Index, Bridge Index, Mobility Index, Safety Index, and Freight Index. Additionally, a set of secondary performance measures provides for a more detailed analysis of corridor performance.

Each of the primary and secondary performance measures is comprised of one or more quantifiable indicators. A three-level scale was developed to standardize the performance scale across the five performance areas, with numerical thresholds specific to each performance measure:

Good/Above Average Performance	Rating is above the identified desirable/average range
Fair/Average Performance	Rating is within the identified desirable/average range
Poor/Below Average Performance	Rating is below the identified desirable/average range

Table 4 provides the complete list of primary and secondary performance measures for each of the five performance areas.

Table 4: Corridor Performance Measures

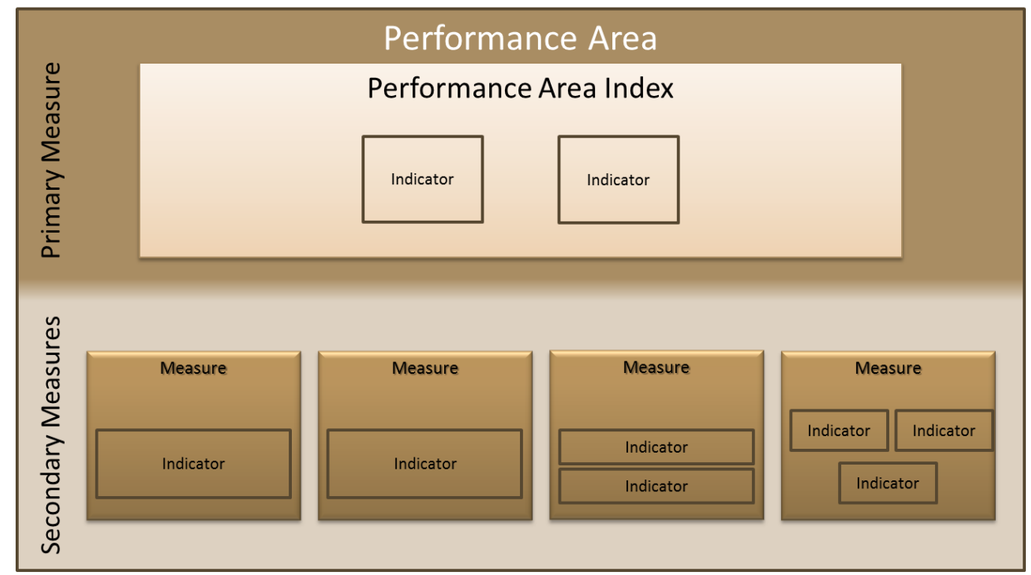
Performance Area	Primary Measure	Secondary Measures
Pavement	**Pavement Index** Based on a combination of International Roughness Index and cracking	• Directional Pavement Serviceability • Pavement Failure • Pavement Hot Spots
Bridge	**Bridge Index** Based on lowest of deck, substructure, superstructure and structural evaluation rating	• Bridge Sufficiency • Functionally Obsolete Bridges • Bridge Rating • Bridge Hot Spots
Mobility	**Mobility Index** Based on combination of existing and future daily volume-to-capacity ratios	• Future Congestion • Peak Congestion • Travel Time Reliability • Multimodal Opportunities
Safety	**Safety Index** Based on frequency of fatal and incapacitating injury crashes	• Directional Safety Index • Strategic Highway Safety Plan Emphasis Areas • Crash Unit Types • Safety Hot Spots
Freight	**Freight Index** Based on bi-directional truck planning time index	• Recurring Delay • Non-Recurring Delay • Closure Duration • Bridge Vertical Clearance • Bridge Vertical Clearance Hot Spots

The general template for each performance area is illustrated in **Figure 6**.

The guidelines for performance measure development are:

- Indicators and performance measures for each performance area should be developed for relatively homogeneous corridor segments
- Performance measures for each performance area should be tiered, consisting of primary measure(s) and secondary measure(s)
- Primary and secondary measures should assist in identifying those corridor segments that warrant in-depth diagnostic analyses to identify performance-based needs and a range of corrective actions known as solution sets
- One or more primary performance measures should be used to develop a Performance Index to communicate the overall health of a corridor and its segments for each performance area; the Performance Index should be a single numerical index that is quantifiable, repeatable, scalable, and capable of being mapped; primary performance measures should be transformed into a Performance Index using mathematical or statistical methods to combine one or more data fields from an available ADOT database
- One or more secondary performance measure indicators should be used to provide additional details to define corridor locations that warrant further diagnostic analysis; secondary performance measures may include the individual indicators used to calculate the Performance Index and/or "hot spot" features

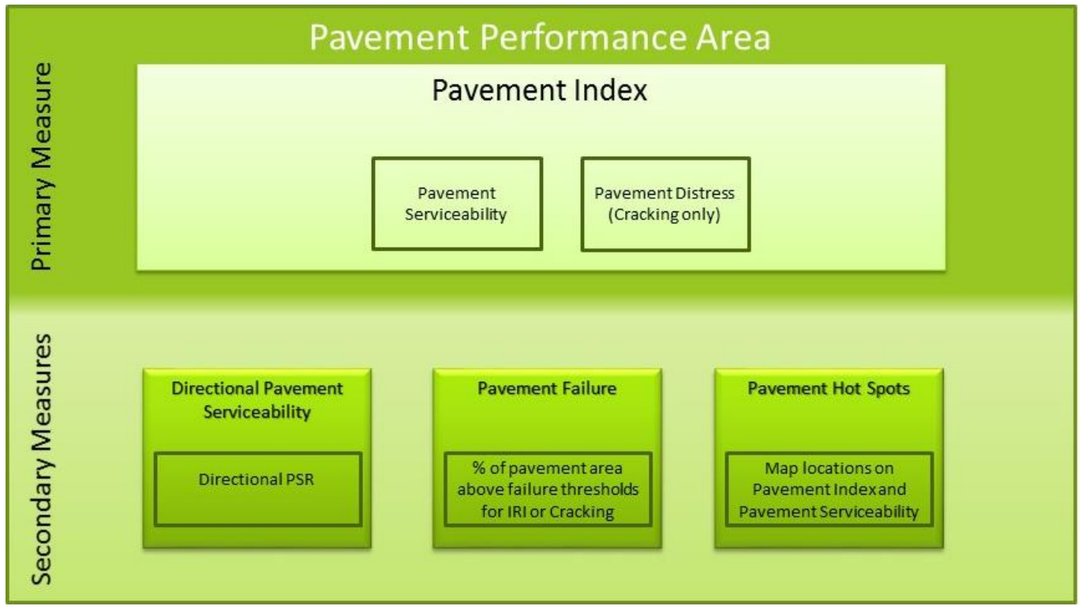
Figure 6: Performance Area Template



2.3 Pavement Performance Area

The Pavement performance area consists of a primary measure (Pavement Index) and three secondary measures, as shown in **Figure 7**. These measures assess the condition of the existing pavement along the I-8 corridor. The detailed calculations and equations developed for each measure are available in **Appendix B** and the performance data for this corridor is contained in **Appendix C.**

Figure 7: Pavement Performance Measures



Primary Pavement Index

The Pavement Index is calculated using two pavement condition ratings: the Pavement Serviceability Rating (PSR) and the Pavement Distress Index (PDI).

The PSR is extracted from the International Roughness Index (IRI), a measurement of pavement roughness based on field-measured longitudinal roadway profiles. The PDI is extracted from the Cracking Rating (CR), a field-measured sample from each mile of highway.

Both the PSR and PDI use a 0 to 5 scale with 0 representing the lowest performance and 5 representing the highest. The Pavement Index for each segment is a weighted average of the directional ratings based on the number of travel lanes. Therefore, the condition of a section with more travel lanes will have a greater influence on the resulting segment Pavement Index than the condition of a section with fewer travel lanes.

Each corridor segment is rated on a scale with other segments in similar operating environments. Within the Pavement performance area, the relevant operating environments are designated as interstate and non-interstate segments. For the I-8 corridor, all segments are considered the interstate operating environment.

Secondary Pavement Measures

Three secondary measures provide an in-depth evaluation of the different characteristics of pavement performance.

Directional Pavement Serviceability

- Weighted average (based on number of lanes) of the PSR for the pavement in each direction of travel

Pavement Failure

- Percentage of pavement area rated above failure thresholds for IRI or Cracking

Pavement Hot Spots

- A Pavement “hot spot” exists where a given one-mile section of roadway rates as being in “poor” condition
- Highlights problem areas that may be under-represented in a segment average; this measure is recorded and mapped, but not included in the Pavement performance area rating calculations

Pavement Performance Results

The Pavement Index provides a high-level assessment of the pavement condition for the corridor and for each segment. The three secondary measures provide more detailed information to assess pavement performance.

Based on the results of the analysis, the following pavement conditions were observed on I-8:

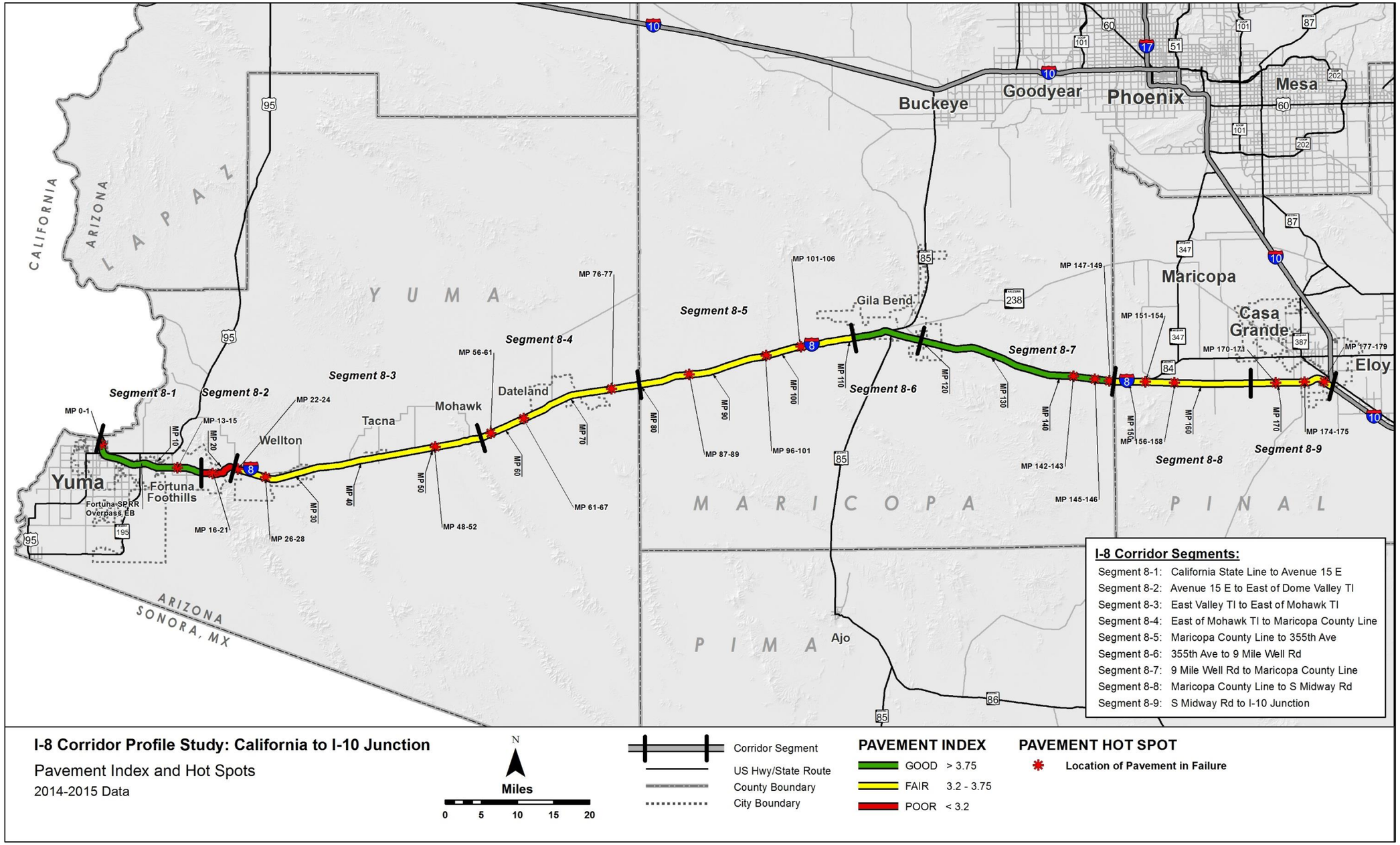
- The I-8 Pavement Performance Index, comprised of the primary measures PSR and PDI, ranges from "Good" to "Poor" throughout the corridor. Approximately 119.7 miles of 178.3 miles rates as "Fair" performance (67% of corridor). The highest performing area is Segment 8-1 in Yuma, which rates as "Good" (4.20 out of 5). The lowest performing area is Segment 8-2 traversing the Telegraph Pass, which rates as "Poor" (2.31 out of 5) for this dataset.
- The Directional Pavement Serviceability Rating ranges in performance from "Good" to "Fair". The condition difference between the Pavement Index rating and the Directional PSR rating is attributed to the exclusion of the cracking rating (PDI). Cracking is most prevalent in Segment 8-2, which caused the Directional PSR to be "Good" even though the Index for this segment is "Poor". Overall, the PSR per segment yields similar results of "Good" and "Fair" in both directions of travel. Examination of the data between mileposts (MP), however, shows the westbound PSR as "Poor" from MP 57 to MP 66 and from MP 97 to MP 106.
- The Pavement Failure evaluation assesses the percentage of lane miles considered in failure throughout the corridor. Four segments exceed the threshold of 20%, indicating worse than average performance. These include Segment 8-2 (60.0%), Segment 8-4 (23.9%), Segment 8-5 (28.3%), and Segment 8-9 (37.5%).

Table 5 summarizes the Pavement performance results for the I-8 corridor. **Figure 8** illustrates the primary Pavement Index performance and locations of pavement hot spots along the I-8 corridor. Maps for each secondary measure can be found in **Appendix A**.

Table 5: Pavement Performance

Segment	Length (miles)	Pavement Index	Directional PSR		% Area Failure
			EB	WB	
8-1	16.30	4.20	4.28	4.30	15.6%
8-2	5.10	2.31	3.87	4.07	60.0%
8-3	35.10	3.58	3.74	3.79	12.5%
8-4	23.10	3.68	3.87	3.74	23.9%
8-5	30.80	3.41	3.58	3.55	28.3%
8-6	9.60	4.17	4.01	4.03	0.0%
8-7	27.60	4.11	4.16	4.18	5.4%
8-8	18.90	3.55	3.83	3.75	18.4%
8-9	11.50	3.48	3.40	3.54	37.5%
Weighted Corridor Average		3.69	3.85	3.85	18.8%
SCALE					
Interstate					
Good		> 3.75			< 5%
Fair		3.2 - 3.75			5% - 20%
Poor		< 3.2			> 20%

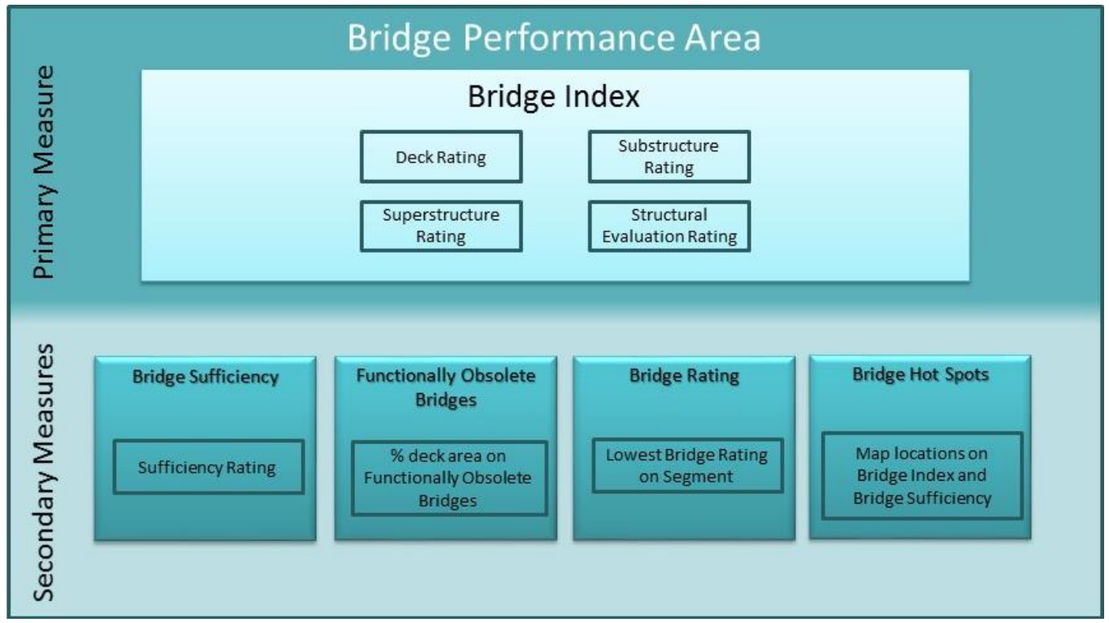
Figure 8: Pavement Performance



2.4 Bridge Performance Area

The Bridge performance area consists of a primary measure (Bridge Index) and four secondary measures, as shown in **Figure 9**. These measures assess the condition of the existing bridges along the I-8 corridor. Only bridges that carry mainline traffic or bridges that cross the mainline are included in the calculation. The detailed calculations and equations developed for each measure are available in **Appendix B** and the performance data for this corridor is contained in **Appendix C.**

Figure 9: Bridge Performance Measures



Primary Bridge Index

The Bridge Index is calculated based on the use of four different bridge condition ratings from the ADOT Bridge Database, also known as the Arizona Bridge Information and Storage System (ABISS). The four ratings are the Deck Rating, Substructure Rating, Superstructure Rating, and Structural Evaluation Rating. These ratings are based on inspection reports and establish the structural adequacy of each bridge. The performance of each individual bridge is established by using the lowest of these four ratings. The use of these ratings, and the use of the lowest rating, is consistent with the approach used by the ADOT Bridge Group to assess the need for bridge rehabilitation. The Bridge Index is calculated as a weighted average for each segment based on deck area.

Secondary Bridge Measures

Four secondary measures provide an in-depth evaluation of the characteristics of each bridge:

Bridge Sufficiency

- Multipart rating includes structural adequacy and safety factors as well as functional aspects such as traffic volume and length of detour
- Rates the structural and functional sufficiency of each bridge on a 100-point scale

Functionally Obsolete Bridges

- Percentage of total deck area in a segment that is on functionally obsolete bridges
- Identifies bridges that no longer meet standards for current traffic volumes, lane width, shoulder width, or bridge rails
- A bridge that is functionally obsolete may still be structurally sound

Bridge Rating

- The lowest rating of the four bridge condition ratings (substructure, superstructure, deck, and structural evaluation) on each segment
- Identifies lowest performing evaluation factor on each bridge

Bridge Hot Spots

- A Bridge “hot spot” is identified where a given bridge has a bridge rating of 4 or lower or multiple ratings of 5 between the deck, superstructure, and substructure ratings
- Identifies particularly low-performing bridges or those that may decline to low performance in the immediate future

Bridge Performance Results

The Bridge Index provides a top-level assessment of the structural condition of bridges on the I-8 corridor, and for each corridor segment. The three secondary measures provide more detailed information to assess the bridge condition for each segment. Overall, based on the Bridge Index, all segments show "fair" performance.

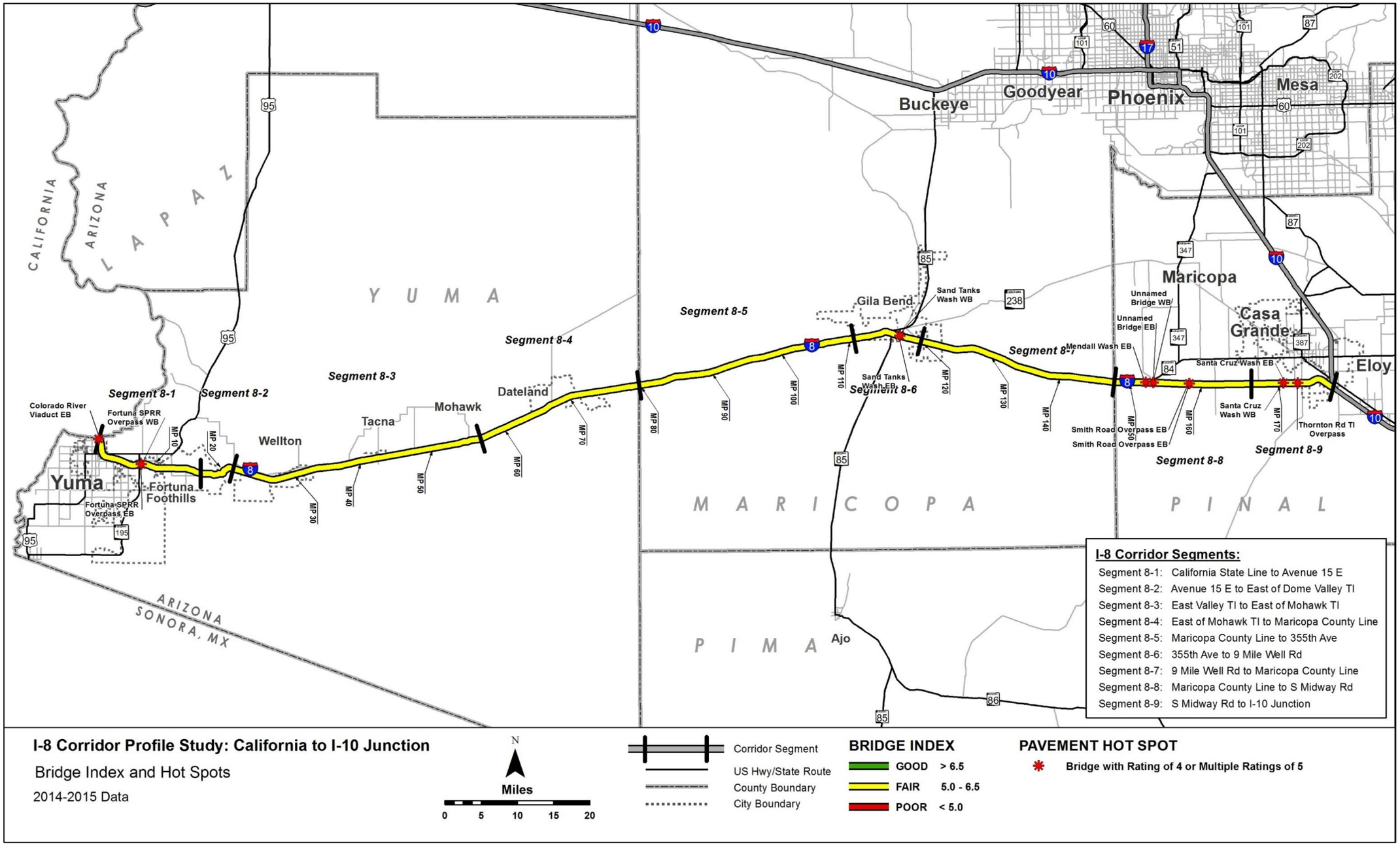
- Every segment on I-8 falls within the "Fair" performance rating for the Bridge Index, which consists of the deck, substructure, superstructure, and structural ratings. The ratings ranged from 5.31 to 6.32 out of 9.
- All segments have a "Good" performance for the Bridge Sufficiency rating, with weighted average values ranging from 87.36 to 95.49 out of 100. The weighted average Sufficiency Rating for the corridor is 92.
- Two bridges have been rated as structurally deficient. At MP 0.01, the Colorado River Viaduct (Eastbound) has a deck rating of 4. At MP 172.55, the Thornton Road TI Underpass has substructure and structural evaluation ratings of 4. In addition, eleven bridges have multiple ratings of 5 for the deck, substructure, superstructure, and structural evaluation. These 13 bridges are shown on **Figure 10**.
- The Eastbound San Cristobal RCBC at MP 59.97 is also classified as a structurally deficient major structure according to ABISS.
- Five of the nine analysis segments on I-8 exceed the threshold for "Poor" performance because they contain a high percentage of bridges that are Functionally Obsolete by current ADOT design standards. These include Segments 8-3 (40.8%), 8-4 (100.0%), 8-5 (58.5%), 8-6 (43.8%) and 8-9 (44.4%).

Table 6 summarizes the bridge performance results for the I-8 Corridor. **Figure 10** illustrates the primary bridge index performance and locations of bridge hot spots along I-8. Maps for each secondary measure can be found in **Appendix A.**

Table 6: Bridge Performance

Segment	Length (miles)	# of Bridges	Bridge Index	Bridge Sufficiency	% Deck Area on Functionally Obsolete Bridges	Lowest Bridge Rating
8-1	16.30	19	5.69	87.36	6.6%	4
8-2	5.10	6	5.31	91.38	0.0%	5
8-3	35.10	19	6.32	95.49	40.8%	6
8-4	23.10	6	6.00	94.00	100.0%	6
8-5	30.80	14	5.90	92.15	58.5%	5
8-6	9.60	18	5.79	93.01	43.8%	5
8-7	27.60	5	6.08	92.59	33.9%	6
8-8	18.90	14	5.90	92.35	38.1%	5
8-9	11.50	14	5.67	88.40	44.4%	4
Weighted Corridor Average			5.97	92.48	46.3%	5
SCALE						
Good			> 6.5	> 80	< 12%	> 6
Fair			5.0 - 6.5	50 - 80	12% - 40%	5 - 6
Poor			< 5.0	< 50	> 40 %	< 5

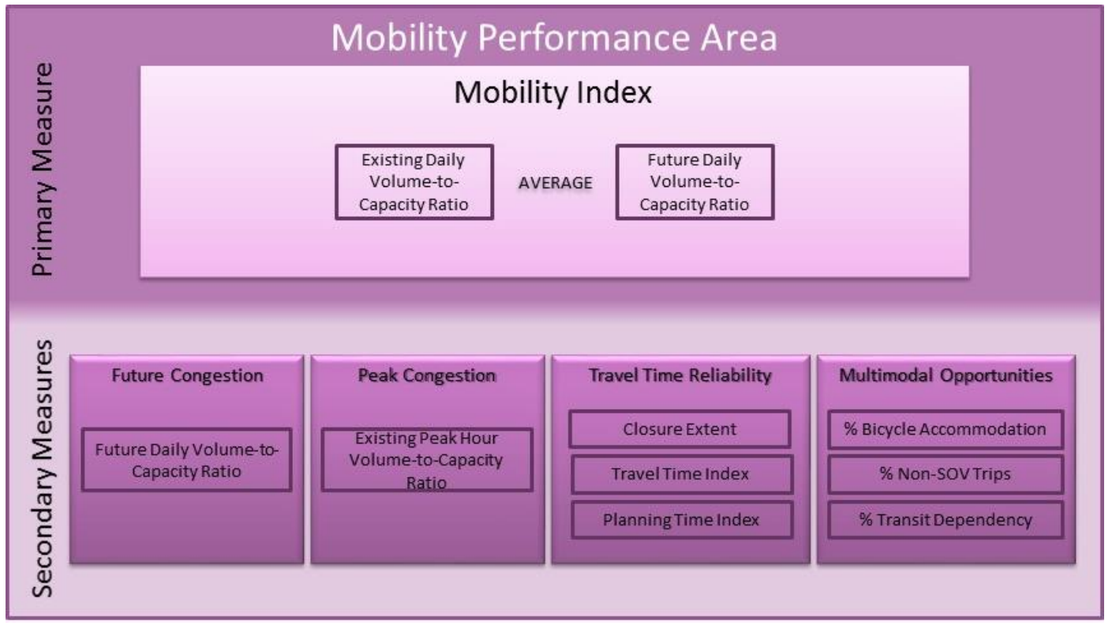
Figure 10: Bridge Performance



2.5 Mobility Performance Area

The Mobility performance area consists of a primary measure (Mobility Index) and four secondary measures, as shown in **Figure 11**. These measures assess the condition of existing mobility along the I-8 corridor. The detailed calculations and equations developed for each measure are available in **Appendix B** and the performance data for this corridor is contained in **Appendix C.**

Figure 11: Mobility Performance Measures



Primary Mobility Index

The Mobility Index is an average of the existing (2014) daily volume-to-capacity (V/C) ratio and the future (2035 AZTDM) daily V/C ratio for each segment of the corridor. The V/C ratio is an indicator of the level of congestion. This measure compares the average annual daily traffic (AADT) volume to the capacity of the corridor segment as defined by the service volume for level of service (LOS) E. By using the average of the existing and future year daily volumes, this index measures the level of daily congestion projected to occur in approximately ten years (2025) if no capacity improvements are made to the corridor.

Each corridor segment is rated on a scale with other segments in similar operating environments. Within the Mobility performance area, the relevant operating environments are urban vs. rural setting and interrupted flow (e.g., signalized at-grade intersections are present) vs. uninterrupted flow (e.g., controlled access grade-separated conditions such as a freeway or interstate highway). For the I-8 corridor, the following operating environments were identified:

- Urban or Urban-Fringe Uninterrupted Flow (Segment 8-1)
- Rural Uninterrupted Flow (Segments 8-2 through 8-9)

Secondary Mobility Measures

Four secondary measures provide and in-depth evaluation of operational characteristics of the corridor:

Future Congestion – Future Daily V/C

- The future (2035 AZTDM) daily V/C ratio; this measure is the same value used in the calculation of the Mobility Index
- Provides a measure of future congestion if no capacity improvements are made to the corridor

Peak Congestion – Existing Peak Hour V/C

- The peak hour V/C ratio for each direction of travel
- Provides a measure of existing peak hour congestion during typical weekdays

Travel Time Reliability– Three separate travel time reliability indicators together provide a comprehensive picture of how much time may be required to travel within the corridor:

- Closure Extent:
  - The average number of instances a particular milepost is closed per year per mile on a given segment of the corridor in a specific direction of travel; a weighted average was applied to each closure that takes into account the distance over which the closure occurs
  - Closures related to crashes, weather, or other incidents are a significant contributor to non-recurring delays; construction-related closures were excluded from the analysis
- Directional Travel Time Index (TTI):
  - The ratio of the average peak period travel time to the free-flow travel time (based on the posted speed limit) in a given direction
  - The TTI recognizes the delay potential from recurring congestion during peak periods; different thresholds are applied to uninterrupted flow (freeways) and interrupted flow (non-freeways) to account for flow characteristics

- Directional Planning Time Index (PTI):
  - The ratio of the 95th percentile travel time to the free-flow travel time (based on the posted speed limit) in a given direction
  - The PTI recognizes the delay potential from non-recurring delays such as traffic crashes, weather, or other incidents; different thresholds are applied to uninterrupted flow (freeways) and interrupted flow (non-freeways) to account for flow characteristics
  - The PTI indicates the amount of time in addition to the typical travel time that should be allocated to make an on-time trip 95% of the time in a given direction

Multimodal Opportunities – Three multimodal opportunity indicators reflect the characteristics of the corridor that promote alternate modes to the single occupancy vehicle (SOV) for trips along the corridor:

- % Bicycle Accommodation:
  - Percentage of the segment that accommodates bicycle travel; bicycle accommodation on the roadway or on shoulders varies depending on traffic volumes, speed limits, and surface type
  - Encouraging bicycle travel has the potential to reduce automobile travel, especially on non-interstate highways
- % Non-SOV Trips:
  - The percentage of trips (less than 50 miles in length) by non-SOVs
  - The percentage of non-SOV trips in a corridor gives an indication of travel patterns along a section of roadway that could benefit from additional multimodal options
- % Transit Dependency:
  - The percentage of households that have zero or one automobile and households where the total income level is below the federally defined poverty level
  - Used to track the level of need among those who are considered transit dependent and more likely to utilize transit if it is available

Mobility Performance Results

The Mobility Index provides a high-level assessment of mobility conditions for the corridor and for each segment. The four secondary measures provide more detailed information to assess mobility performance.

Each corridor segment is rated on a scale with other segments in similar operating environments. Within the mobility performance area, the relevant operating environments included urban or rural locations, as well as interrupted flow (where signalized at-grade intersections are present) and uninterrupted flow (grade-separated). For the mobility performance area, all segments of the I-8 corridor are classified as uninterrupted flow. Segment 8-1 is classified as urban, while all other segments are classified as rural.

Based on the results of this analysis, the following observations were made:

- Every segment along I-8 rates in the "Good" threshold of the Primary Mobility Index. Segment 1 within the Yuma urban area has the highest Mobility Index of all the I-8 segments. The future traffic volumes on I-8 in Segments 8-8 and 8-9 are expected to double with an annual growth rate of more than four percent, but will remain under the capacity of the corridor.
- Every segment is operating within the "Good" threshold of the existing peak hour V/C as indicated in **Table 7**. Segment 8-1 within the Yuma urban area has the highest eastbound and westbound V/C ratios of all the I-8 segments.
- Every segment along I-8 is projected to have future V/C ratios within the "Good" threshold. Segment 8-1 within the Yuma urban area is projected to have the highest future V/C ratios of all the I-8 segments.
- All westbound segments of I-8 rate in the "Good" threshold in terms of the Travel Time Index score for all vehicles traveling within the corridor. However, Segment 8-2 in the eastbound direction rates as "Fair", indicating some level of recurring delay in those areas of the corridor as shown on **Table 7**. The westbound Segment 8-2 score can be attributed to a temporary Border Check Point facility that requires motorists to stop.
- The Directional Planning Time Index rates within the "Good" threshold in the eastbound direction, with the exception of Segments 8-1 ("Fair"), 8-2 ("Poor") and 8-6 ("Fair"). In the westbound direction, Segments 8-1 and 8-9 rate as "Fair". These scores indicate that there is a need to plan for additional travel time when traveling within the Yuma and Casa Grande Urban Areas. **Table 7** shows the corridor directional planning time index for each segment.
- Compared to the statewide average, the extent of closures along the segments of I-8 rate in the "Good" and "Fair" thresholds, indicating that sections of I-8 are not closed as much as other corridors throughout the state. Segment 8-1 is rated as "Fair" while all other segments are rated as "Good". Even the segment that rates in the "Fair" threshold scores in the lower third of the range relatively close to being rated as "Good". **Table 7** illustrates the directional closure scores across I-8 compared to the statewide average.
- Socio-economic characteristics:. Most of the corridor falls within the statewide average for income and vehicle availability. Segments closer to Yuma and the Phoenix metropolitan area indicate a higher concentration of potentially transit dependent households. Greyhound Bus Lines operates intercity bus service the length of the corridor. Non-single occupant vehicle trips (a minimum of a driver and one passenger) for

Segments 8-1, 8-2, 8-3, 8-7 and 8-8 are at approximately the statewide average, falling in a range of 13.1% - 16.7% (with the statewide average at 11% - 17%).

- The analysis examined an additional data source for its potential to provide a more complete understanding of daily and seasonal traffic volume variation on I-8. ADOT's Traffic Data Monitoring System (TDMS) maintains a series of permanent traffic counters that report daily traffic volumes. Three sites are available on the I-8 corridor. These sites are too few and not spaced in a way to provide corridor level analysis; however the counts do provide some information useful to identify traffic patterns. Traffic volumes followed a very similar pattern at all three locations, with no unusual peaks readily identifiable.
- Segments 8-1 and 8-7 experience a 5-18% increase in traffic volumes on Friday compared to the other weekdays and the weekend throughout the year.
- The weekend traffic volumes are lower compared to the weekday traffic volumes. The decrease in weekend traffic volumes range from 8% to 25%.

Table 7 summarizes the Mobility performance results for the I-8 corridor. **Figure 12** illustrates the primary Mobility Index performance along the I-8 corridor. Maps for each secondary measure can be found in **Appendix A**.

Table 7: Mobility Performance

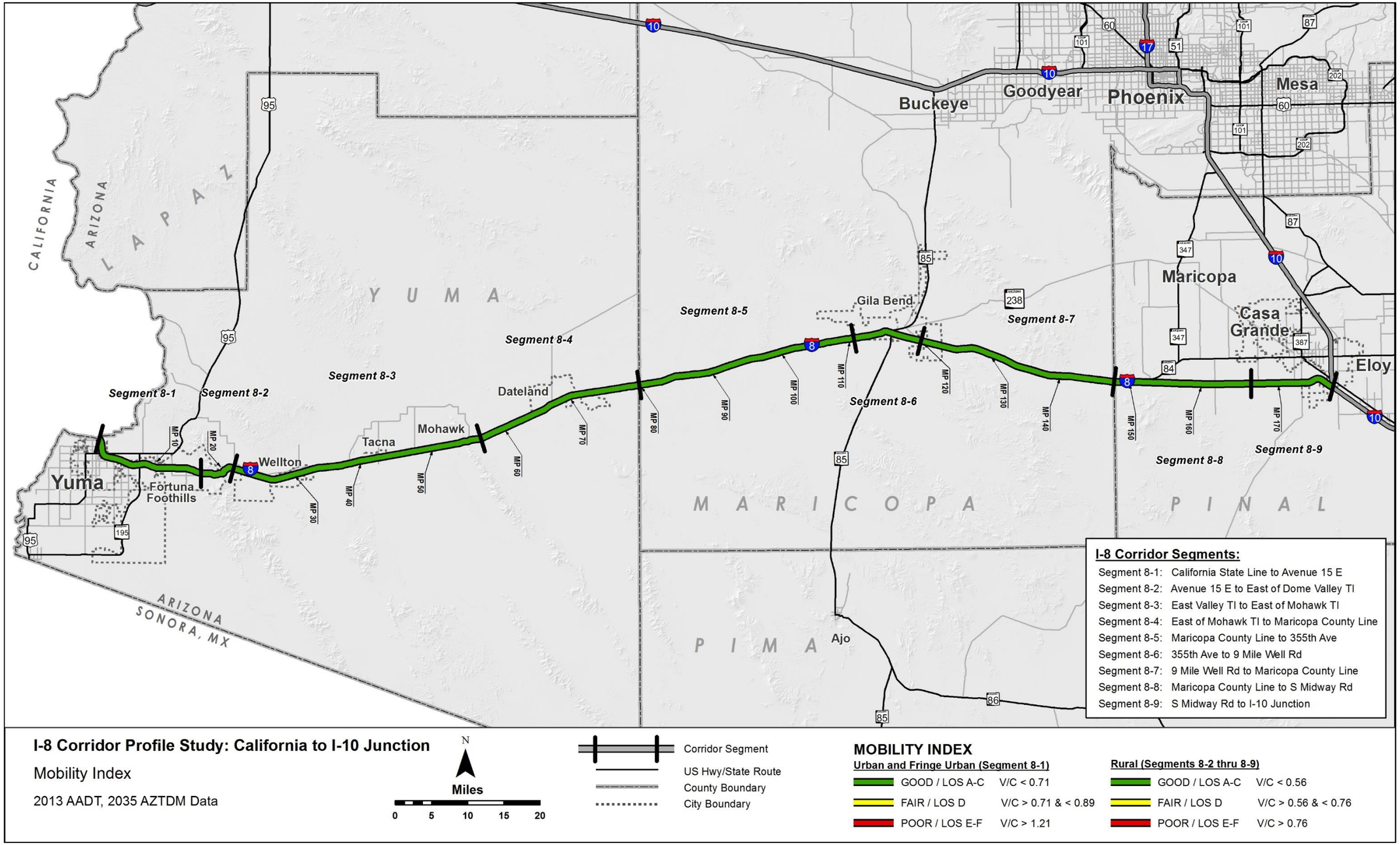
Segment #	Segment Length (miles)	Mobility Index	Future Daily V/C	Existing Peak Hour V/C		Closure Extent (instances/milepost/year/mile)		Directional TTI (all vehicles)		Directional PTI (all vehicles)		% Bicycle Accommodation	% Non-Single Occupancy Vehicle (SOV) Trips
				EB	WB	EB	WB	EB	WB	EB	WB		
8-1[1]^	16.30	0.44	0.50	0.32	0.31	0.16	0.24	1.09	1.07	1.42	1.39	100%	12.5%
8-2 [2]^	5.10	0.32	0.36	0.26	0.23	0.12	0.44	1.05	1.00	1.45	1.12	100%	16.0%
8-3 [2]^	35.10	0.17	0.19	0.09	0.09	0.21	0.19	1.08	1.08	1.23	1.25	100%	9.8%
8-4 [2]^	23.10	0.16	0.17	0.11	0.10	0.03	0.04	1.07	1.06	1.22	1.20	100%	9.3%
8-5 [2]^	30.80	0.21	0.25	0.15	0.15	0.05	0.09	1.07	1.07	1.26	1.22	100%	22.5%
8-6 [2]^	9.60	0.16	0.20	0.13	0.12	0.04	0.08	1.11	1.09	1.41	1.26	100%	19.0%
8-7 [2]^	27.60	0.08	0.09	0.09	0.08	0.04	0.05	1.10	1.09	1.27	1.26	100%	16.8%
8-8 [2]^	18.90	0.09	0.11	0.09	0.08	0.02	0.04	1.08	1.09	1.25	1.24	100%	13.8%
8-9 [2]^	11.50	0.14	0.16	0.13	0.10	0.10	0.02	1.07	1.10	1.27	1.33	100%	12.2%
Weighted Corridor Average		0.20	.23	0.15	0.14	0.08	0.13	1.08	1.07	1.31	1.25	73%	14.7%

SCALE

Performance Level	Urban Rural	All	Uninterrupted Interrupted		All	
Good	< 0.71[1] < 0.56[2]	< 0.22	< 1.15^ < 1.30*	< 1.30^ < 3.00*	> 90%	> 17%
Fair	0.71 - 0.89[1] 0.56 - 0.76[2]	0.22 – 0.62	1.15 - 1.33^ 1.30 - 2.00*	1.30 - 1.50^ 3.00 - 6.00*	60% - 90%	11% - 17%
Poor	> 0.89[1] > 0.76[2]	> 0.62	> 1.33^ > 2.00*	> 1.50^ > 6.00*	< 60%	< 11%

[1]Urban Operating Environment
[2]Rural Operating Environment
^Uninterrupted Flow Facility
*Interrupted Flow Facility

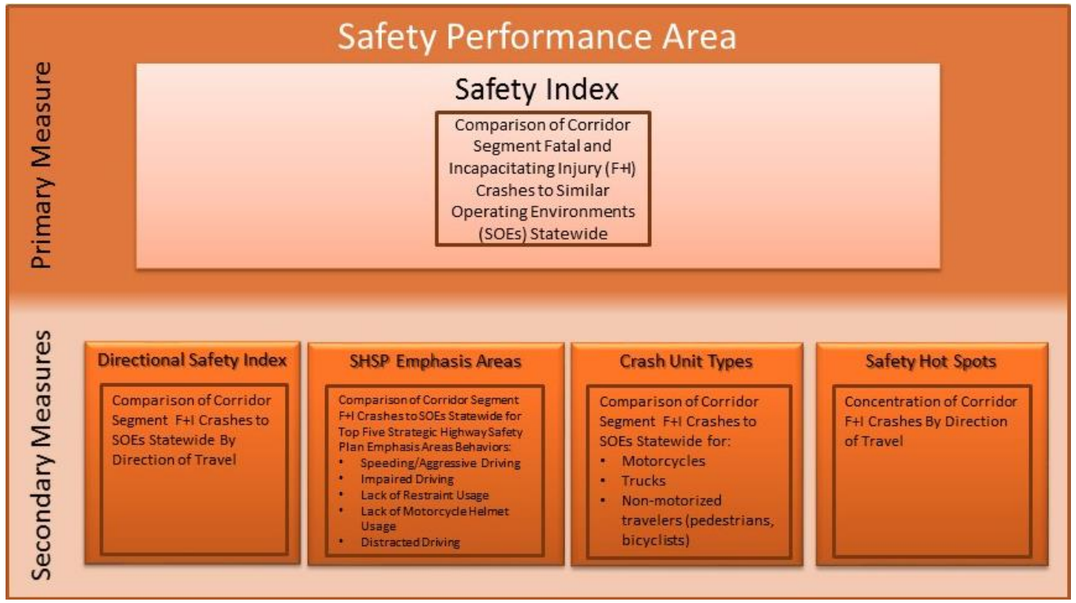
Figure 12: Mobility Performance



2.6 Safety Performance Area

The Safety performance area consists of a primary measure (Safety Index) and four secondary measures, as illustrated in **Figure 13**. All measures relate to crashes that result in fatal and incapacitating injuries, as these types of crashes are the emphasis of the ADOT Strategic Highway Safety Plan (SHSP), FHWA, and MAP-21. The detailed calculations and equations developed for each measure are available in **Appendix B** and the performance data for this corridor is contained in **Appendix C.**

Figure 13: Safety Performance Measures



Primary Safety Index

The Safety Index is based on the bi-directional frequency and rate of fatal and incapacitating injury crashes, the relative cost of those types of crashes, and crash occurrences on similar roadways in Arizona. According to ADOT's 2010 Highway Safety Improvement Program Manual, fatal crashes have an estimated cost that is 14.5 times the estimated cost of incapacitating injury crashes ($5.8 million compared to $400,000).

Each corridor segment is rated on a scale by comparing the segment score with the average statewide score for similar operating environments. Since crash frequencies and rates vary depending on the operating environment of a particular roadway, statewide values were developed for similar operating environments defined by functional classification, urban vs. rural setting, number of travel lanes, and traffic volumes.

For the I-8 corridor, the following operating environments were identified:

- Urban 4-Lane Freeway (Segment 8-1)
- Rural 4-Lane Freeway with Daily Volume < 25,000 (Segments 8-2 through 8-9)

Secondary Safety Measures

Four secondary measures provide an in-depth evaluation of the different characteristics of safety performance:

Directional Safety Index

- This measure is based on the directional frequency and rate of fatal and incapacitating injury crashes

SHSP Emphasis Areas

ADOT's 2014 SHSP identified several emphasis areas for reducing fatal and incapacitating injury crashes. This measure compared rates of crashes in the top five SHSP emphasis areas to other corridors with a similar operating environment. The top five SHSP emphasis areas related to the following driver behaviors:

- Speeding and aggressive driving
- Impaired driving
- Lack of restraint usage
- Lack of motorcycle helmet usage
- Distracted driving

Crash Unit Types

- The percentage of total fatal and incapacitating injury crashes that involves crash unit types of motorcycles, trucks, or non-motorized travelers is compared to the statewide average on roads with similar operating environments

Safety Hot Spots

- The hot spot analysis identifies abnormally high concentrations of fatal and incapacitating injury crashes along the study corridor by direction of travel
- For the Safety Index and the secondary safety measures, any segment that has too small of a sample size to generate statistically reliable performance ratings for a particular performance measure is considered to have "insufficient data" and is excluded from the safety performance evaluation for that particular performance measure.

Safety Performance Results

The Safety Index provides a high-level assessment of safety performance for the corridor and for each segment. The four secondary measures provide more detailed information to assess safety performance.

The scale for ratings for all of the Safety performance measures depend on the crash history on similar statewide operating environments. Based on the results of this analysis, the following observations were made:

- The Safety Index scores of all I-8 segments but one are better than the statewide average within similar operating environments, in terms of fatal and incapacitating injury crashes. The segment index scores therefore fall within the Above Average threshold, regardless of operating environment or terrain. These include the urban four-lane freeway operating environment in Segment 8-1 within the Yuma metropolitan area, as well as all other segments operating in the rural four-lane environment including Segment 8-2, which traverses mountainous terrain. Segment 8-3 rated Average for the Safety Index.
- The secondary measure scores for Directional Safety Index following a similar pattern to the primary measure. All eastbound and westbound segment scores are below the state average within similar operating environments, falling within the Above Average threshold, regardless of urban or rural context or terrain features.
- Segment 8-3 and Segment 8-9 scored worst in terms of the amount of crashes caused by the top five emphasis areas, with over 53% in the rural four-lane freeway environment. Segments 1 and 2 scored within the Average range, with Segments 8-4, 8-5, and 8-8 scoring in the Above Average range. However, both Segment 8-6 and Segment 8-7 did not have a large enough sample size of fatal and incapacitating (F+I) crashes to result in a reliable score calculation.
- The sample size of F+I crashes involving trucks, motorcycles, or non-motorized travelers were all too small to result in reliable segment score calculations.
- As shown in Figure 14, no high concentrations of F+I crashes were observed at any locations on I-8 during the 2010-2014 analysis period.

Table 8 summarizes the Safety performance results for the I-8 corridor. **Figure 14** illustrates the primary Safety Index performance and locations of Safety hot spots along the I-8 corridor. Maps for each secondary measure can be found in **Appendix A**.

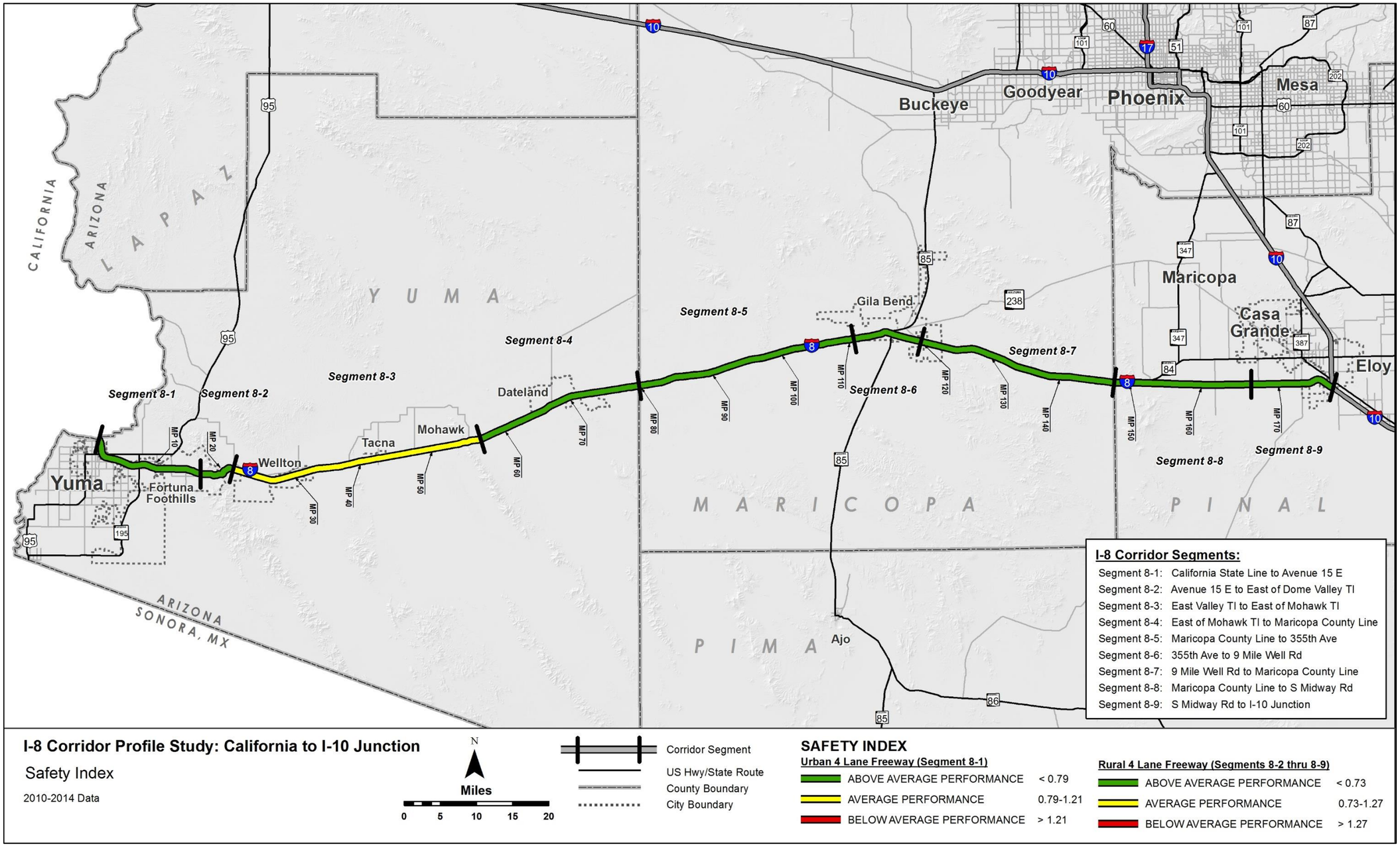
Table 8: Safety Performance

Segment #	Segment Length (miles)	Total Fatal & Incapacitating Injury Crashes (F/I)	Safety Index	Directional Safety Index		% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors
				EB	WB	
8-1 [1]	16.30	2 / 7	0.23	0.24	0.22	56%
8-2 [2]	5.10	0 / 7	0.29	0.33	0.25	43%
8-3 [2]	35.10	8 / 19	0.96	0.95	0.97	59%
8-4 [2]	23.10	3 / 8	0.61	0.44	0.77	Insufficient Data
8-5 [2]	30.80	4 / 18	0.59	0.59	0.59	Insufficient Data
8-6 [2]	9.60	0 / 3	0.10	0.06	0.13	Insufficient Data
8-7 [2]	27.60	2 / 3	0.68	0.04	1.32	Insufficient Data
8-8 [2]	18.90	2 / 4	0.71	0.74	0.68	33%
8-9 [2]	11.50	1 / 6	0.59	0.21	0.98	Insufficient Data
Weighted Corridor Average			0.53	0.40	0.66	48%
SCALE						
Performance Level			**Urban 4-Lane Freeway Rural 4-Lane < 25,000 vpd**			
Above Average			< 0.79 < 0.73			< 49.1% < 42.8%
Average			0.79-1.21 0.73-1.27			49.1%-59.4% 42.8%-52.9%
Below Average			> 1.21 > 1.27			> 59.4% > 52.9%

[1] Urban 4-Lane Freeway / Urban or Fringe Urban Operating Environment
[2] Rural 4-Lane Freeway < 25,000 vpd / Rural Operating Environment

Note: "Insufficient Data" indicates there was not enough data available to generate reliable performance ratings.

Figure 14: Safety Performance



2.7 Freight Performance Area

The Freight performance area consists of a single primary measure (Freight Index) and five secondary measures, as illustrated in **Figure 15**. All measures related to the reliability of truck travel as measured by observed truck travel time speed and delays to truck travel from freeway closures or physical restrictions to truck travel. The detailed calculations and equations developed for each measure are available in **Appendix B** and the performance data for this corridor is contained in **Appendix C.**

Figure 15: Freight Performance Measures

Primary Freight Index

The Freight Index is a reliability performance measure based on the PTI for truck travel. The Truck Planning Time Index (TPTI) is the ratio of the 95th percentile truck travel time to the free-flow truck travel time. The TPTI reflects the extra buffer time needed for on-time delivery while accounting for non-recurring delay. Non-recurring delay refers to unexpected or abnormal delay due to closures or restrictions resulting from circumstances such as crashes, inclement weather, and construction activities.

Each corridor segment is rated on a scale with other segments in similar operating environments. Within the Freight performance area, the relevant operating environments are interrupted flow (e.g., signalized at-grade intersections are present) and uninterrupted flow (e.g., controlled access grade-separated conditions such as a freeway or interstate highway).

For the I-8 corridor, the following operating environments were identified:

- Urban or Urban-Fringe Uninterrupted Flow (Segment 8-1)
- Rural Uninterrupted Flow (Segments 8-2 through 8-9)

Secondary Freight Measures

The Freight performance area includes five secondary measures that provide an in-depth evaluation of the different characteristics of freight performance:

Recurring Delay (Directional Truck Travel Time Index TTTI)

- The ratio of the average peak period truck travel time to the free-flow truck travel time (based on the posted speed limit up to a maximum of 65 miles per hour) in a given direction
- The TTTI recognizes the delay potential from recurring congestion during peak periods; different thresholds are applied to uninterrupted flow (freeways) and interrupted flow (non-freeways) to account for flow characteristics

Non-Recurring Delay (Directional TPTI)

- The ratio of the 95th percentile truck travel time to the free-flow truck travel time (based on the posted speed limit up to a maximum of 65 miles per hour) in a given direction
- The TPTI recognizes the delay potential from non-recurring delays such as traffic crashes, weather, or other incidents; different thresholds are applied to uninterrupted flow (freeways) and interrupted flow (non-freeways) to account for flow characteristics
- The TPTI indicates the amount of time in addition to the typical travel time that should be allocated to make an on-time trip 95% of the time in a given direction

Closure Duration

- The average time (in minutes) a particular milepost is closed per year per mile on a given segment of the corridor in a specific direction of travel; a weighted average is applied to each closure that takes into account the distance over which the closure occurs

Bridge Vertical Clearance

- The minimum vertical clearance (in feet) over the travel lanes for underpass structures on each segment

Bridge Vertical Clearance Hot Spots

- A Bridge vertical clearance "hot spot" exists where the underpass vertical clearance over the mainline travel lanes is less than 16.25 feet and no exit/entrance ramps exist to allow vehicles to bypass the low clearance location
- If a location with a vertical clearance less than 16.25 feet can be avoided by using immediately adjacent exit/entrance ramps rather than the mainline, it is not considered a hot spot

Freight Performance Results

The Freight Index provides a high-level assessment of freight mobility for the corridor and for each segment. The five secondary measures provide more detailed information to assess freight performance.

Each corridor segment is rated on a scale with other segments in similar operating environments. Within the freight performance area, the relevant operating environments included interrupted flow (where signalized at-grade intersections are present) and uninterrupted flow (roads with only controlled access grade-separated conditions such as a freeway or interstate highway). All of the segments along I-8 are classified as uninterrupted flow.

Based on the results of this analysis, the following observations were made:

- All I-8 segments fall within the "Good" threshold for the primary Freight Index measure, with the exception of Segment 8-1 in the Yuma metropolitan area, which falls within the "Fair" scoring threshold.
- All eastbound and westbound segments of I-8 scored within the "Good" range in terms of Directional Truck Travel Time Index, meaning that there is little difference between observed truck free flow speeds and peak period truck speeds.
- All eastbound and westbound segments rated within the "Good" threshold for the Directional Truck Planning Time Index, with the exception of Segment 8-1. This indicates that there is some level of moderate recurring delay in the Yuma area.
- Segment scores for the duration of closures involving trucks vary throughout the I-8 corridor. The mountainous Segment 8-2 has closure durations above the state average. The remainder of segments scored below the state average for closure duration.
- There are multiple locations with truck height restrictions along I-8, with most of the restrictions concentrated in the eastern portion of the corridor near Casa Grande. Among the height restrictions, there are six locations where trucks are not able to ramp around the restriction.

Table 9 summarizes the Freight performance results for the I-8 corridor. **Figure 16** illustrates the primary Freight Index performance and locations of freight hot spots along I-8. Maps for each secondary measure can be found in **Appendix A.**

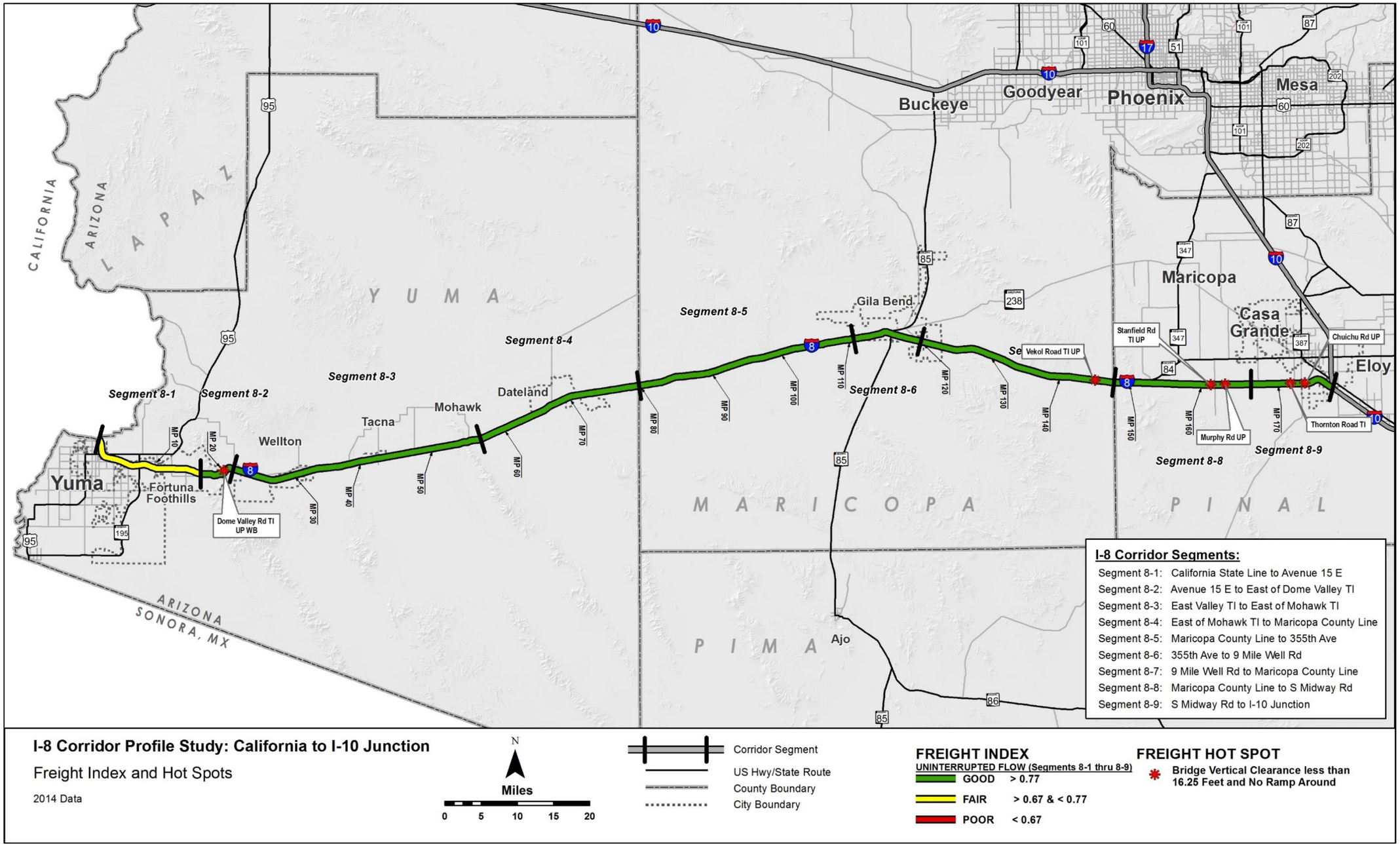
Table 9: Freight Performance

Segment	Length (miles)	Freight Index	Directional Truck TTI		Directional Truck PTI		Closure Duration (minutes/milepost closed/year/mile)		Vertical Bridge Clearance (feet)
			EB	WB	EB	WB	EB	WB	
8-1 [1]^	16.30	0.71	1.13	1.12	1.40	1.41	28.88	43.90	16.33
8-2 [2]^	5.10	0.79	1.00	1.06	1.30	1.23	17.23	140.18	16.23
8-3 [2]^	35.10	0.89	1.04	1.04	1.14	1.11	73.08	28.10	16.20
8-4 [2]^	23.10	0.90	1.03	1.03	1.12	1.11	5.20	7.68	No UP
8-5 [2]^	30.80	0.89	1.03	1.04	1.13	1.12	9.07	19.84	No UP
8-6 [2]^	9.60	0.82	1.06	1.04	1.27	1.17	24.43	21.89	16.63
8-7 [2]^	27.60	0.89	1.03	1.03	1.13	1.13	13.25	11.42	16.19
8-8 [2]^	18.90	0.89	1.03	1.03	1.13	1.11	6.29	25.18	16.09
8-9 [2]^	11.50	0.83	1.04	1.06	1.19	1.23	27.01	1.53	15.86
Weighted Corridor Averages		0.86	1.04	1.04	1.17	1.16	25.58	23.73	16.06

SCALE					
Performance Level	**Uninterrupted Interrupted**			**All**	
Good	> 0.77^ > 0.33*	< 1.15^ < 1.30*	< 1.30^ < 3.00*	< 44.18	> 16.5
Fair	0.67 - 0.77^ 0.17 - 0.33*	1.15 - 1.33^ 1.30 - 2.00*	1.30 - 1.50^ 3.00 - 6.00*	44.18 - 124.86	16.0 - 16.5
Poor	< 0.67^ < 0.17*	> 1.33^ > 2.00*	> 1.50^ > 6.00*	> 124.86	< 16.0

[1]Urban Operating Environment
[2]Rural Operating Environment
^Uninterrupted Flow Facility
*Interrupted Flow Facility

Figure 16: Freight Performance



2.8 Corridor Performance Summary

Based on the results presented in the preceding sections, the following general observations were made related to the performance of the I-8 corridor:

- **Overall performance** within all five areas evaluated is predominantly "Good" to "Fair"
- **Bridge Performance:** A total of 115 bridges were included in the evaluation. Two bridges are considered structurally deficient. These include the Eastbound Colorado River Viaduct (MP 0.01) and the Thornton Road TI Underpass (MP 172.55).
- **Pavement Performance:** 173 of the 178 miles on I-8 rate as "Good" or "Fair" for the overall Pavement Index. Segment 8-2 is the exception with a "Poor" performance. Due to the significant area of pavement cracking, four of the nine segments rate poorly for percentage of area in failure. The westbound direction exhibits more cracking than the eastbound direction.
- **Mobility Performance:** I-8 is considered to have two operating environments for evaluating Mobility. These include Urban 4-Lane Freeway and Rural 4-Lane Freeway with less than 25,000 ADT. Both the current and future capacity is considered "Good".
- **Safety Performance:** The entire corridor has less than the statewide average crash rate for fatal and incapacitating injury crashes. Examining a five-year time period, there were two fatal crashes and seven incapacitating injury crashes in the urban area. In the rural area, there were 20 fatal crashes and 68 incapacitating injury crashes. These result in an average less than half of the statewide average.
- **Freight Performance:** The performance of freight mobility overall is "Good" within the I-8 corridor. Closures in Segment 8-2 were identified as "Poor" performance. There are six locations with vertical clearance less than 16.25 feet and no ramp around capability.
- **Poorest Performing Segment:** Segment 8-2 rated lower in performance than the other segments in the corridor. Approximately 60% of the segment is considered to have pavement failure based on the study dataset. Also, the closure duration was higher in this segment, as revealed by the Mobility and Freight secondary measures.
- **Highest Performing Segments:** Segments 8-6 and 8-7 have "Good" or "Above Average" performance in all areas except for two secondary measures, Obsolete Bridges and % of Non-Single Occupancy Vehicles.

Figure 17 shows the percentage of the I-8 corridor that rates either "good/above average performance", "fair/average performance", or "poor/below average performance" for each primary measure. The lowest performance along the I-8 corridor occurs in the Pavement and Bridge Performance Areas with the Mobility, Safety and Freight Performance Areas showing the highest performance.

Table 10 shows a summary of corridor performance for all primary measures and secondary measure indicators for the I-8 corridor. A weighted corridor average rating (based on the length of the segment) was calculated for each primary and secondary measure. The weighted average ratings are summarized in **Figure 18** which also provides a brief description of each performance measure. **Figure 18** represents the average for the entire corridor and any given segment or location could have a higher or lower rating than the corridor average.

Figure 17: Performance Summary by Primary Measure

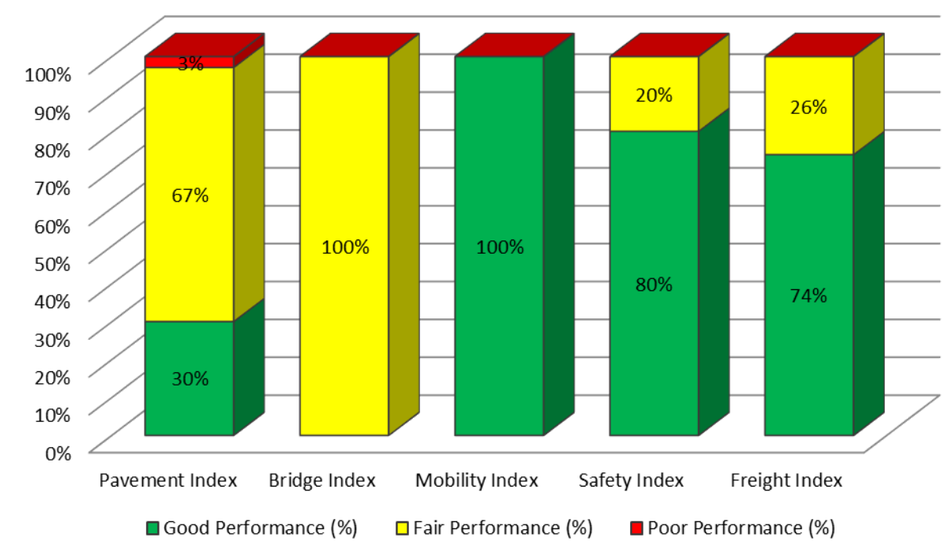


Figure 18: Corridor Performance Summary by Performance Measure

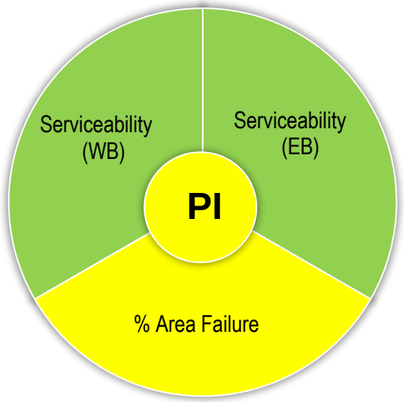
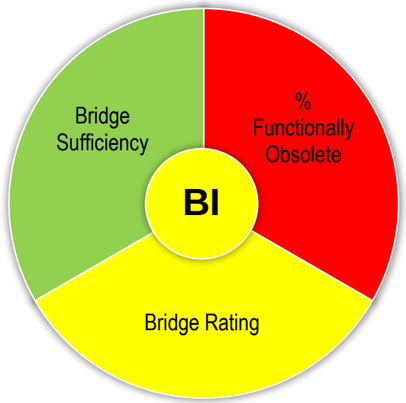
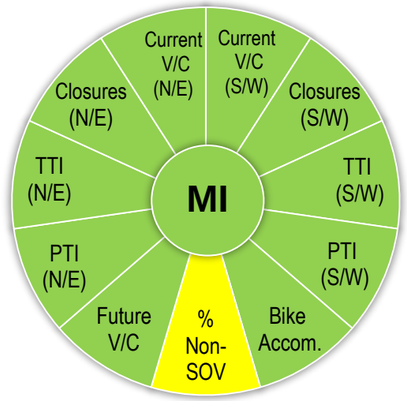
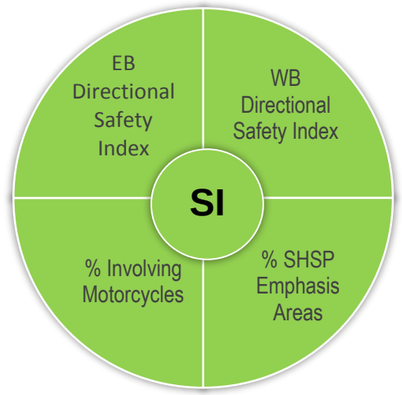
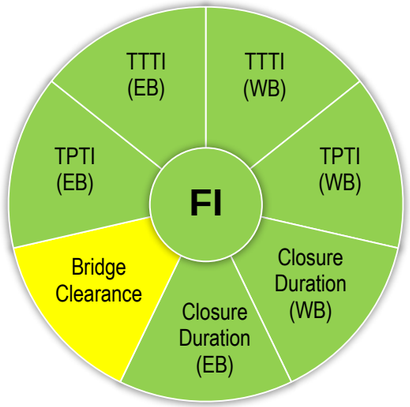
Pavement	Bridge	Mobility	Safety	Freight
				
Pavement Index (PI): based on two pavement condition ratings from the ADOT Pavement Database; the two ratings are the International Roughness Index (IRI) and the Cracking Rating.	**Bridge Index (BI):** based on four bridge condition ratings from the ADOT Bridge Database. The four ratings are the Deck Rating, Substructure Rating, Superstructure Rating, and Structural Evaluation Rating.	**Mobility Index (MI):** an average of the existing daily volume-to-capacity (V/C) ratio and the projected 2035 daily V/C ratio	**Safety Index (SI):** combines the bi-directional frequency and rate of fatal and incapacitating injury crashes, compared to crash occurrences on similar roadways in Arizona	**Freight Index (FI):** a reliability performance measure based on the bi-directional planning time index for truck travel.
➢ **Directional Pavement Serviceability Rating (PSR)** – the weighted average (based on number of lanes) of the PSR for the pavement in each direction of travel ➢ **% Area Failure** – the percentage of pavement area rated above failure thresholds for IRI or Cracking	➢ **Sufficiency Rating**– multipart rating includes structural adequacy and safety factors as well as functional aspects such as traffic volume and length of detour ➢ **% of Deck Area on Functionally Obsolete Bridges**– the percentage of deck area in a segment that is on functionally obsolete bridges; identifies bridges that no longer meet standards for current traffic volumes, lane width, shoulder width, or bridge rails; a bridge that is functionally obsolete may still be structurally sound ➢ **Lowest Bridge Rating** –the lowest rating of the four bridge condition ratings on each segment	➢ **Future Daily V/C** – the future 2035 V/C ratio provides a measure of future congestion if no capacity improvements are made to the corridor ➢ **Existing Peak Hour V/C** – the existing peak hour V/C ratio for each direction of travel provides a measure of existing peak hour congestion during typical weekdays ➢ **Closure Extent** – the average number of instances a particular milepost is closed per year per mile on a given segment of the corridor in a specific direction of travel ➢ **Directional Travel Time Index (TTI)** – the ratio of the average peak period travel time to the free-flow travel time; the TTI represents recurring delay along the corridor ➢ **Directional Planning Time Index (PTI)** – the ratio of the 95th percentile travel time to the free-flow travel time; the PTI represents non-recurring delay along the corridor ➢ **% Bicycle Accommodation** – the percentage of a segment that accommodates bicycle travel ➢ **% Non-single Occupancy Vehicle (Non-SOV) Trips** –the percentage of trips that are taken by vehicles carrying more than one occupant	➢ **Directional Safety Index** – the combination of the directional frequency and rate of fatal and incapacitating injury crashes, compared to crash occurrences on similar roadways in Arizona ➢ **% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors** – the percentage of fatal and incapacitating crashes that involve at least one of the five Strategic Highway Safety Plan (SHSP) emphasis areas on a given segment compared to the statewide average percentage on roads with similar operating environments ➢ **% of Fatal + Incapacitating Crashes Involving SHSP Crash Unit Types** – the percentage of total fatal and incapacitating injury crashes that involves a given crash unit type (motorcycle, truck, non-motorized traveler) compared to the statewide average percentage on roads with similar operating environments	➢ **Directional Truck Travel Time Index (TTTI)** – the ratio of the average peak period truck travel time to the free-flow truck travel time; the TTTI represents recurring delay along the corridor ➢ **Directional Truck Planning Time Index (TPTI)** – the ratio the 95th percentile truck travel time to the free-flow truck travel time; the TPTI represents non-recurring delay along the corridor ➢ **Closure Duration** – the average time a particular milepost is closed per year per mile on a given segment of the corridor in a specific direction of travel ➢ **Bridge Vertical Clearance** – the minimum vertical clearance over the travel lanes for underpass structures on each segment

Table 10: Corridor Performance Summary by Segment and Performance Measure

Segment #	Segment Length (miles)	Pavement Performance Area				Bridge Performance Area				Mobility Performance Area											
		Pavement Index	Directional PSR		% Area Failure	Bridge Index	Sufficiency Rating	% of Deck Area on Functionally Obsolete Bridges	Lowest Bridge Rating	Mobility Index	Future Daily V/C	Existing Peak Hour V/C		Closure Extent (instances/milepos/ year/mile)		Directional TTI (all vehicles)		Directional PTI (all vehicles)		% Bicycle Accommodation	% Non-Single Occupancy Vehicle (SOV) Trips
			EB	WB								EB	WB	EB	WB	EB	WB	EB	WB		
8-1[1]	16.30	4.20	4.28	4.30	15.6%	5.69	87.36	6.6%	4	0.44	0.50	0.32	0.31	0.16	0.24	1.09	1.07	1.42	1.39	100%	12.5%
8-2[2]	5.10	2.31	3.87	4.07	60.0%	5.31	91.38	0%	5	0.32	0.36	0.26	0.23	0.12	0.44	1.05	1.00	1.45	1.12	100%	16.0%
8-3[2]	35.10	3.58	3.74	3.79	12.5%	6.32	95.49	40.8%	6	0.17	0.19	0.09	0.09	0.21	0.19	1.08	1.08	1.23	1.25	100%	9.8%
8-4[2]	23.10	3.68	3.87	3.74	23.9%	6.00	94.00	100.0%	6	0.16	0.17	0.11	0.10	0.03	0.04	1.07	1.06	1.22	1.20	100%	9.3%
8-5[2]	30.80	3.41	3.58	3.55	28.3%	5.90	92.15	58.5%	5	0.21	0.25	0.15	0.15	0.05	0.09	1.07	1.07	1.26	1.22	100%	22.5%
8-6[2]	9.60	4.17	4.01	4.03	0.0%	5.79	93.01	43.8%	5	0.16	0.20	0.13	0.12	0.04	0.08	1.11	1.09	1.41	1.26	100%	19.0%
8-7[2]	27.60	4.11	4.16	4.18	5.4%	6.08	92.59	33.9%	6	0.08	0.09	0.09	0.08	0.04	0.05	1.10	1.09	1.27	1.26	100%	16.8%
8-8[2]	18.90	3.55	3.83	3.75	18.4%	5.90	92.35	38.1%	5	0.09	0.11	0.09	0.08	0.02	0.04	1.08	1.09	1.25	1.24	100%	13.8%
8-9[2]	11.50	3.48	3.40	3.54	37.5%	5.67	88.40	44.4%	4	0.14	0.16	0.13	0.10	0.10	0.02	1.07	1.10	1.27	1.33	100%	12.2%
Weighted Corridor Average		3.69	3.85	3.85	18.8%	5.97	92.48	46.3%	5	0.20	0.23	0.15	0.14	0.08	0.13	1.08	1.07	1.31	1.25	100%	14.7%

SCALE													
Performance Level	Interstate		All				Urban Rural	All	Uninterrupted		All	
Good/Above Average	> 3.75	< 5%	> 6.5	> 80	< 12%	> 6	< 0.71 (Urban) < 0.56 (Rural)	< 0.22	< 1.15	<1.30	> 90%	> 17%
Fair/Average	3.2 - 3.75	5% - 20%	5.0 - 6.5	50 - 80	12% - 40%	5 – 6	0.71 - 0.89 (Urban) 0.56 - 0.76 (Rural)	0.22 – 0.62	1.15-1.33	1.30-1.50	60% - 90%	11% - 17%
Poor/Below Average	< 3.2	> 20%	< 5.0	< 50	> 40 %	< 5	> 0.89 (Urban) > 0.76 (Rural)	> 0.62	> 1.33	>1.50	< 60%	< 11%

[1] Urban 4 Lane Freeway / Urban or Fringe Urban Operating Environment
[2] Rural 4 Lane Freeway < 25,000 vpd / Rural Operating Environment

Table 10: Corridor Performance Summary by Segment and Performance Measure (continued)

Segment	Segment Length (miles)	Safety Performance Area							Freight Performance Area							
		Safety Index	Directional Safety Index		% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	% of Fatal + Incapacitating Injury Crashes Involving Trucks	% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers	Freight Index	Directional TTI (trucks only)		Directional PTI (trucks only)		Closure Duration (mins/milepost closed/year/mile)		Bridge Vertical Clearance (feet)
			EB	WB						EB	WB	EB	WB	EB	WB	
8-1[1]	16.30	0.23	0.24	0.22	56%	Insufficient Data	Insufficient Data	Insufficient Data	0.71	1.13	1.12	1.40	1.41	28.88	43.90	16.33
8-2[2]	5.10	0.29	0.33	0.25	43%	Insufficient Data	Insufficient Data	Insufficient Data	0.79	1.00	1.06	1.30	1.23	17.23	140.18	16.23
8-3[2]	35.10	0.96	0.95	0.97	59%	Insufficient Data	Insufficient Data	Insufficient Data	0.89	1.04	1.04	1.14	1.11	73.08	28.10	16.20
8-4[2]	23.10	0.61	0.44	0.77	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.90	1.03	1.03	1.12	1.11	5.20	7.68	No Up
8-5[2]	30.80	0.59	0.59	0.59	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.89	1.03	1.04	1.13	1.12	9.07	19.84	No UP
8-6[2]	9.60	0.10	0.06	0.13	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.82	1.06	1.04	1.27	1.17	24.43	21.89	16.63
8-7[2]	27.60	0.68	0.04	1.32	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.89	1.03	1.03	1.13	1.13	13.25	11.42	16.19
8-8[2]	18.90	0.71	0.74	0.68	33%	Insufficient Data	Insufficient Data	Insufficient Data	0.89	1.03	1.03	1.13	1.11	6.29	25.18	16.09
8-9[2]	11.50	0.59	0.21	0.98	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.83	1.04	1.06	1.19	1.23	27.01	1.53	15.86
Weighted Corridor Average		0.53	0.40	0.66	48%				0.86	1.04	1.04	1.17	1.16	25.58	23.73	16.06

SCALE										
Performance Level	Urban 4 Lane Freeway Rural 4 Lane Freeway < 25,000 vpd					Uninterrupted			All	
Good/Above Average	< 0.79 < 0.73	< 49.1% < 42.8%	< 6.8% < 13.2%	< 9.3% < 5.0%	< 4.8% < 1.7%	> 0.77	< 1.15	< 1.30	< 44.18	> 16.5
Fair/Average	0.79 – 1.21 0.73 – 1.27	49.1% - 59.4% 42.8% - 52.9%	6.8% - 10.9% 13.2% - 17.0%	9.3% - 11.5% 5.0% - 8.5%	4.8% - 10.3% 1.7% - 2.5%	0.67 - 0.77	1.15 -1.33	1.30 -1.50	44.18 -124.86	16.0-16.5
Poor/Below Average	> 1.21 > 1.27	> 59.4% > 52.9%	> 10.9% > 17.0%	> 11.5% > 8.5%	> 10.3% > 2.5%	< 0.67	> 1.33	>1.50	> 124.86	< 16.0

[1] Urban 4 Lane Freeway / Urban or Fringe Urban Operating Environment
[2] Rural 4 Lane Freeway < 25,000 vpd / Rural Operating Environment

Note: "Insufficient Data" indicates there was not enough data available to generate reliable performance ratings

"No UP" indicates no underpasses are present in the segment

3.0 NEEDS ASSESSMENT

3.1 Corridor Objectives

Statewide goals and performance measures were established by the ADOT Long-Range Transportation Plan (LRTP), 2010-2035. Statewide performance goals that are relevant to I-8 performance areas were identified and corridor goals were then formulated for each of the five performance areas that aligned with the overall statewide goals established by the LRTP. Based on stakeholder input, corridor goals, corridor objectives, and performance results, three "emphasis areas" were identified for the I-8 corridor: Mobility, Safety, and Freight.

Taking into account the corridor goals and identified emphasis areas, performance objectives were developed for each quantifiable performance measure that identify the desired level of performance based on the performance scale levels for the overall corridor and for each segment of the corridor. For the performance emphasis areas, the corridor-wide weighted average performance objectives are identified with a higher standard than for the other performance areas. **Table 11** shows the I-8 corridor goals, corridor objectives, and performance objectives, and how they align with the statewide goals.

It is not reasonable within a financially constrained environment to expect that every performance measure will always be at the highest levels on every corridor segment. Therefore, individual corridor segment objectives have been set as "fair/average" or better and should not fall below that standard.

Achieving corridor and segment performance objectives will help ensure that investments are targeted toward improvements that support the safe and efficient movement of travelers on the corridor. Addressing current and future congestion, thereby improving mobility on congested segments, will also help the corridor fulfill its potential as a significant contributor to the region's economy.

Corridor performance is measured against corridor and segment objectives to determine needs – the gap between observed performance and performance objectives.

Goal achievement will improve or reduce current and future congestion, increase travel time reliability, and reduce fatalities and incapacitating injuries resulting from vehicle crashes. Where performance is currently rated "good", the goal is always to maintain that standard, regardless of whether or not the performance is in an emphasis area.

Table 11: Corridor Performance Goals and Objectives

ADOT Statewide LRTP Goals	I-8 Corridor Goals	I-8 Corridor Objectives	Performance Area	Primary Measure / Secondary Measure Indicators	Performance Objective: Corridor Average	Performance Objective: Segment
Improve Mobility and Accessibility **Support Economic Growth**	Improve mobility and connectivity Provide a safe and reliable route for recreation and tourist travel to/from Mexico, Southern California and Southern Arizona destinations Provide safe, reliable and efficient connection to all communities along the corridor to permit efficient regional travel	Reduce current and future congestion in the urbanized areas Reduce delays from non-recurring events and incidents to improve reliability Improve bicycle accommodation	Mobility (Emphasis Area)	**Mobility Index** Future Daily V/C Existing Peak Hour V/C Closure Extent Directional Travel Time Index Directional Planning Time Index % Bicycle Accommodation % Non-SOV Trips	Good	Fair or Better
	Provide a safe, reliable and efficient freight route between Arizona, California and Mexico	Reduce delays and restrictions to freight movement to improve reliability Improve travel time reliability (including impacts to motorists due to freight traffic)	Freight (Emphasis Area)	**Freight Index** Directional Truck Travel Time Index Directional Truck Planning Time Index Closure Duration Bridge Vertical Clearance	Good	Fair or Better
Preserve and Maintain the State Transportation System	Preserve and modernize highway infrastructure	Maintain structural integrity of bridges	Bridge	**Bridge Index** Sufficiency Rating % of Deck Area on Functionally Obsolete Bridges Lowest Bridge Rating	Fair or Better	Fair or Better
		Improve pavement ride quality	Pavement	**Pavement Index** Directional Pavement Serviceability Rating % Area Failure	Fair or Better	Fair or Better
Enhance Safety and Security	Maintain highway security within the right-of way	Reduce fatal and serious injury crashes	Safety (Emphasis Area)	**Safety Index** Directional Safety Index % of Crashes Involving SHSP Top 5 Emphasis Areas Behaviors % of Crashes Involving Crash Unit Types	Above Average	Average or Better

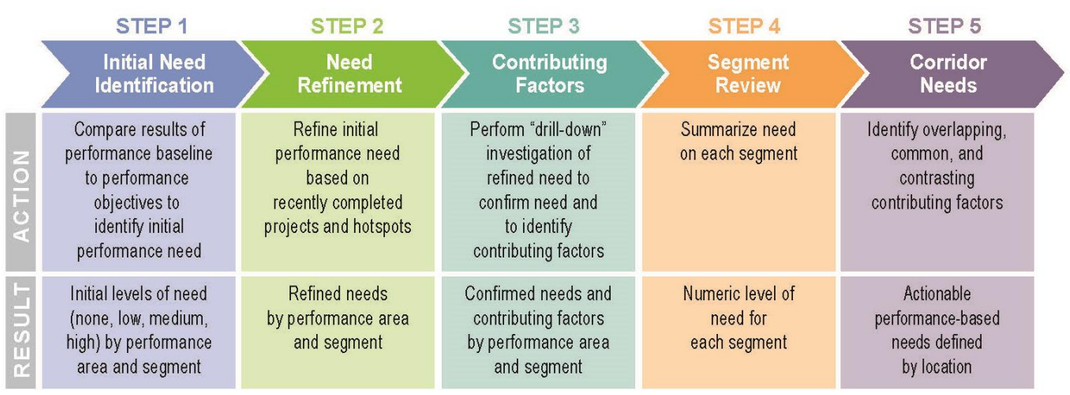
3.2 Needs Assessment Process

The following guiding principles were used as an initial step in developing a framework for the performance-based needs assessment process:

- Corridor needs are defined as the difference between the corridor performance and the performance objectives
- The needs assessment process should be systematic, progressive, and repeatable, but also allow for engineering judgment where needed
- The process should consider all primary and secondary performance measures developed for the study
- The process should develop multiple need levels including programmatic needs for the entire length of the corridor, performance area-specific needs, segment-specific needs, and location-specific needs (defined by MP limits)
- The process should produce actionable needs that can be addressed through strategic investments in corridor preservation, modernization, and expansion

The performance-based needs assessment process is illustrated in **Figure 19** and described in the following sections.

Figure 19: Needs Assessment Process



Step 1: Initial Needs Identification

The first step in the needs assessment process links baseline (existing) corridor performance with performance objectives. In this step, the baseline corridor performance is compared to the performance objectives to provide a starting point for the identification of performance needs. This mathematical comparison results in an initial need rating of None, Low, Medium, or High for each primary and secondary performance measure. An illustrative example of this process is shown below in **Figure 20**.

Figure 20: Initial Need Ratings in Relation to Baseline Performance (Bridge Example)

Performance Thresholds	Performance Level	Initial Level of Need*	Description
6.5	Good	None	All levels of Good and top 1/3 of Fair (>6.0)
	Good		
	Good		
	Fair		
5.0	Fair	Low	Middle 1/3 of Fair (5.5-6.0)
	Fair	Medium	Lower 1/3 of Fair and top 1/3 of Poor (4.5-5.5)
	Poor		
	Poor	High	Lower 2/3 of Poor (<4.5)
	Poor		

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

The initial level of need for each segment is refined to account for hot spots and recently completed or under construction projects, resulting in a final level of need for each segment. The final levels of need for each primary and secondary performance measure are combined to produce a weighted final need rating for each segment. Values of 0, 1, 2, and 3 are assigned to the initial need levels of None, Low, Medium, and High, respectively. A weight of 1.0 is applied to the Performance Index need and equal weights of 0.20 are applied to each need for each secondary performance measure. For directional secondary performance measures, each direction of travel receives a weight of 0.10.

Step 2: Need Refinement

In Step 2, the initial level of need for each segment is refined using the following information and engineering judgment:

- For segments with an initial need of None that contain hot spots, the level of need should be increased from None to Low
- For segments with an initial level of need where recently completed projects or projects under construction are anticipated to partially or fully address the identified need, the level of need should be reduced or eliminated as appropriate
- Programmed projects that are expected to partially or fully address an identified need are not justification to lower the initial need because the programmed projects may not be implemented as planned; in addition, further investigations may suggest that changes in the scope of a programmed project may be warranted

The resulting final needs are carried forward for further evaluation in Step 3.

Step 3: Contributing Factors

In Step 3, a more detailed review of the condition and performance data available from ADOT is conducted to identify contributing factors to the need. Typically, the same databases used to develop the baseline performance serve as the principal sources for the more detailed analysis. However, other supplemental databases may also be useful sources of information. The databases used for diagnostic analysis are listed below:

Pavement Performance Area

- Pavement Rating Database

Bridge Performance Area

- ABISS

Mobility Performance Area

- Highway Performance Monitoring System (HPMS) Database
- AZTDM
- Real-time traffic conditions data produced by American Digital Cartography Inc. (HERE) Database
- Highway Conditions Reporting System (HCRS) Database

Safety Performance Area

- Crash Database

Freight Performance Area

- HERE Database
- HCRS Database

In addition, other sources considered helpful in identifying contributing factors are:

- Maintenance history (from ADOT PeCoS database for pavement), the level of past investments, or trends in historical data that provide context for pavement and bridge history
- Field observations from ADOT district personnel can be used to provide additional information regarding a need that has been identified
- Previous studies can provide additional information regarding a need that has been identified

Step 3 results in the identification of performance-based needs and contributing factors by segment (and MP locations, if appropriate) that can be addressed through investments in preservation, modernization, and expansion projects to improve corridor performance. See **Appendix D** for more information.

Step 4: Segment Review

In this step, the needs identified in Step 2 and refined in Step 3 are quantified for each segment to numerically estimate the level of need for each segment. Values of 0 to 3 are assigned to the final need levels (from Step 3) of None, Low, Medium, and High, respectively. A weighting factor is applied to the performance areas identified as emphasis areas and a weighted average need is calculated for each segment. The resulting average need score can be used to compare levels of need between segments within a corridor and between segments in different corridors.

Step 5: Corridor Needs

In this step, the needs and contributing factors for each performance area are reviewed on a segment-by-segment basis to identify actionable needs and to facilitate the formation of solution sets that address multiple performance areas and contributing factors. The intent of this process is to identify overlapping, common, and contrasting needs to help develop strategic solutions. This step results in the identification of corridor needs by specific location.

3.3 Corridor Needs Assessment

This section documents the results of the needs assessment process described in the prior section. The needs in each performance area were classified as either None, Low, Medium, or High based on how well each segment performed in the existing performance analysis. The needs for each segment were numerically combined to estimate the average level of need for each segment of the corridor

The final needs assessments for each performance measure, along with the scales used in analysis, are shown in **Table 12** through **Table 16**.

Pavement Needs Refinement and Contributing Factors

Of the 178 corridor miles, approximately 76 miles on eastbound I-8 and 79 miles on westbound I-8 have pavement needs. Pavement hot spot failure needs were identified for nine miles on eastbound I-8 and 17 miles on westbound I-8 (discounting those miles that will be addressed by future programmed projects). These areas are dispersed across the corridor. Three future pavement preservation projects are programmed on the corridor.

Key contributing factors are summarized below:

- A High initial need for Segment 8-2 was reduced to no need due to the completion of a recent pavement preservation project along the entire segment.
- A Medium initial need for Segment 8-9 was reduced to a Low need due to the completion of a recent pavement preservation project.

See other contributing factors in **Appendix D**.

Table 12: Final Pavement Needs

Segment #	Performance Score and Level of Need				Initial Segment Need*	Hot Spots	Recently Completed Projects	Final Segment Need*
	Pavement Index	Directional PSR		% Area Failure				
		EB	WB					
8-1	4.20	4.28	4.30	15.63%	0.4	WB MP 0-1, WB MP 13-15	H8158 (MP 13.70 - MP 20.45): Milled and replaced the existing pavement plus ARACFC. The project was completed in 2014.	Low
8-2	2.31	3.87	4.07	60.00%	3.6	EB MP 18-19, WB MP 16-21	H8158 (MP 13.70 - MP 20.45): Milled and replaced the existing pavement plus ARACFC. The project was completed in 2014.	None
8-3	3.58	3.74	3.79	12.50%	0.2	EB MP 23-24, EB MP 26-28, EB MP 48-52, WB MP 56-57	None	Low
8-4	3.68	3.87	3.74	23.91%	0.4	EB MP 76-77, WB MP 57-67	None	Low
8-5	3.41	3.58	3.55	28.33%	1.7	EB MP 87-89, EB MP 96-103, WB MP 97-106	None	Medium
8-6	4.17	4.01	4.03	0.00%	0.0	None	None	None
8-7	4.11	4.16	4.18	5.36%	0.0	EB MP 142-143, WB MP 145-146, WB MP 147-148	H8567 (MP-141.10 - MP-147.60): Crack sealing was completed in 2014.	None
8-8	3.55	3.83	3.75	18.42%	1.4	EB MP 152-154, WB MP 148-149, WB MP 151-153, WB MP 156-158	None	Low
8-9	3.48	3.40	3.54	37.50%	1.8	EB MP 170-171, EB MP 174-176, EB MP 177-179, WB MP 174-176,WB MP178-179	H8171 (MP 170.20 - MP 178.91): Milled and replaced existing AC plus new ARACFC. The project was completed in 2016. H8631 (MP-172.46 - MP-176.65): Repaired slope paving, and other miscellaneous work. Completed in 2015.	Low

Level of Need* (Score)	Performance Score Need Scale		Segment Level Need Scale
None* (0)	> 3.57	< 10%	0
Low (1)	3.38 – 3.57	10% - 15%	< 1.5
Medium (2)	3.02 – 3.38	15% - 25%	1.5 – 2.5
High (3)	< 3.02	> 25%	> 2.5

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

Bridge Needs Refinement and Contributing Factors

Bridge needs were identified on 30 of the 115 bridges along the I-8 corridor. These included all bridges that were documented having a bridge rating of 5 or less in deck, substructure, superstructure, or overall structural evaluation. There are no projects currently programmed that relate to bridge structural improvement on the I-8 corridor.

Key contributing factors are summarized below:

- None of the initial needs required adjustment since no recent bridge work has occurred within the corridor that would change the bridge conditions.
- Three bridges showed a historical rating issue according to the review, including Smith Road OP EB, Smith Road OP WB, and Thornton Rd TI UP.

See other contributing factors in **Appendix D**.

Table 13: Final Bridge Needs

Segment #	Performance Score and Level of Need				Initial Segment Need*	Hot Spots	Recently Completed Projects	Final Segment Need*
	Bridge Index	Sufficiency Rating	Functionally Obsolete Bridges	Bridge Rating				
8-1	5.69	87.4	6.6%	4	1.4	Colorado River Viaduct EB Fortuna SPRR OP EB, Fortuna SPRR OP WB	None	Low
8-2	5.31	91.4	0.0%	5	2.2	None	None	Medium
8-3	6.32	95.5	40.8%	6	0.2	None	None	Low
8-4	6.00	94.0	100.0%	6	0.3	None	None	Low
8-5	5.90	92.2	58.5%	5	1.5	None	None	Medium
8-6	5.79	93.0	43.8%	5	1.4	Sand Tanks Wash Br EB, Sand Tanks Wash Br WB	None	Low
8-7	6.08	92.6	33.9%	6	0.2	None	None	Low
8-8	5.90	92.4	38.1%	5	1.4	Mendell Wash Br EB Bridge EB (MP 153.40), Bridge WB (MP 153.45) Smith Road OP EB, Smith Road OP WB	None	Low
8-9	5.67	88.4	44.4%	4	1.6	Santa Cruz Wash Br EB, Santa Cruz Wash Br WB Thornton Road TI UP MP	Pavement preservation including concrete bridge barrier	Medium

Level of Need* (Score)	Performance Score Need Scale				Segment Level Need Scale
None (0)	> 6.0	> 70	< 21.0%	> 5	0
Low (1)	5.5 – 6.0	60 – 70	21.0% - 31.0%	5	< 1.5
Medium (2)	4.5 – 5.5	40 – 60	31.0% - 49.0%	4	1.5 – 2.5
High (3)	< 4.5	< 40	> 49.0%	< 4	> 2.5

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

Mobility Needs Refinement and Contributing Factors

Mobility was identified as a focus area for the I-8 corridor. A low level of mobility need was identified on 31 miles of I-8, concentrated in the Yuma urbanized area, Telegraph Pass, and Gila Bend. Contributing factors include reoccurring congestion and overall high traffic volumes in the two urbanized areas, with the border patrol checkpoint at MP 18 creating eastbound delays, and closures related to incidents/accidents near Telegraph Pass.

See other contributing factors in **Appendix D**.

Table 14: Final Mobility Needs

Segment	Performance Score and Level of Need											Initial Segment Need*	Recently Completed Projects	Final Segment Need*
	Mobility Index	Future Daily V/C	Existing Peak Hour V/C		Closure Extent		Directional TTI		Directional PTI		% Bicycle Accommodation			
			EB	WB	EB	WB	EB	WB	EB	WB				
8-1 [1]	0.44	0.50	0.32	0.31	0.16	0.24	1.09	1.07	1.42	1.39	100%	0.2	Paving project	Low
8-2 [2]	0.32	0.36	0.26	0.23	0.12	0.44	1.05	1.00	1.45	1.12	100%	0.3	Paving project	Low
8-3 [2]	0.17	0.19	0.09	0.09	0.21	0.19	1.08	1.08	1.23	1.25	100%	0	None	None
8-4 [2]	0.16	0.17	0.11	0.10	0.03	0.04	1.07	1.06	1.22	1.20	100%	0	None	None
8-5 [2]	0.21	0.25	0.15	0.15	0.05	0.09	1.07	1.07	1.26	1.22	100%	0	None	None
8-6 [2]	0.16	0.20	0.13	0.12	0.04	0.08	1.11	1.09	1.41	1.26	100%	0.1	None	Low
8-7 [2]	0.08	0.09	0.09	0.08	0.04	0.05	1.10	1.09	1.27	1.26	100%	0	Paving project	None
8-8 [2]	0.09	0.11	0.09	0.08	0.02	0.04	1.08	1.09	1.25	1.24	100%	0	None	None
8-9 [2]	0.14	0.16	0.13	0.10	0.10	0.02	1.07	1.10	1.27	1.33	100%	0	Paving project	None

Level of Need* (Score)	Performance Score Need Scale					Segment Level Need Scale
None (0)	≤ 0.77 (Urban) ≤ 0.63 (Rural)	< 0.35	< 1.21	< 1.37	> 80%	0
Low (1)	0.77 - 0.83 (Urban) 0.63 - 0.69 (Rural)	0.35 – 0.49	1.21 – 1.27	1.37 – 1.43	70% - 80%	< 1.5
Medium (2)	0.83 - 0.95 (Urban) 0.69 - 0.83 (Rural)	0.49 – 0.75	1.27 – 1.39	1.43 – 1.57	50% - 70%	1.5 - 2.5
High (3)	≥ 0.95 (Urban) ≥ 0.83 (Rural)	> 0.75	> 1.39	> 1.57	< 50%	> 2.5

[1] Urban 4 Lane Freeway / Urban or Fringe Urban Operating Environment
[2] Rural 4 Lane Freeway < 25,000 vpd / Rural Operating Environment

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

Safety Needs Refinements and Contributing Factors

Safety was identified as a focus area for the I-8 corridor. Low safety needs were identified on 78 miles of the corridor and Medium needs on 35 miles. Key contributing factors to the safety needs are summarized below:

- In the urbanized Yuma area, most incidents/accidents were related to collisions with other motor vehicles, high speed, and run off the road to the right.
- Outside the urbanized area, many incidents/accidents involved a single vehicle, frequently with the vehicle overturning or running off the road to the left. In these cases, driver inattention/distraction and high speeds were typical contributing factors.
- It has been noted that guardrail could be upgraded corridor-wide, with some sections having been updated as part of pavement preservation projects. Guardrail can be effective in reducing the severity of crashes.

See other Contributing Factors in **Appendix D**.

Table 15: Final Safety Needs

Segment	Performance Score and Level of Need							Initial Segment Need*	Hot Spots	Recently Completed Projects	Final Segment Need*
	Safety Index	Directional Safety Index		% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Area Behaviors	% of Fatal + Incapacitating Injury Crashes Involving Trucks	% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers				
		EB	WB								
8-1[1]	0.23	0.24	0.22	56%	Insufficient Data	Insufficient Data	Insufficient Data	0.4	None	Paving project including guardrail and concrete barriers	Low
8-2[2]	0.29	0.33	0.25	43%	Insufficient Data	Insufficient Data	Insufficient Data	0.0	None	Paving project including guardrail and concrete barriers	None
8-3[2]	0.96	0.95	0.97	59%	Insufficient Data	Insufficient Data	Insufficient Data	1.8	None	None	Medium
8-4[2]	0.61	0.44	0.77	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.0	None	None	None
8-5[2]	0.59	0.59	0.59	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.0	None	None	None
8-6[2]	0.10	0.06	0.13	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.0	None	Paving project including guardrail	None
8-7[2]	0.68	0.04	1.32	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.2	None	Paving project including guardrail	Low
8-8[2]	0.71	0.74	0.68	33%	Insufficient Data	Insufficient Data	Insufficient Data	0.0	None	None	None
8-9[2]	0.27	0.21	0.98	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.1	None	Paving project including guardrail, concrete barriers, and shoulder improvements	Low

Level of Need* (Score)		Performance Score Needs Scale					Segment Level Need Scale
None (0)	1 2	≤ 0.93 ≤ 0.94	≤ 47% ≤ 42%	≤ 4% ≤ 8%	≤ 15% ≤ 9%	≤ 7% ≤ 2%	0
Low (1)	1 2	0.93 - 1.06 0.94 - 1.06	47% - 51% 42% - 50%	4% - 5% 8% - 10%	15% - 17% 9% - 11%	7% - 9% 2.0% - 2.2%	≤ 1.5
Medium (2)	1 2	1.06 - 1.33 1.06 - 1.30	51% - 59% 50% - 65%	5% - 7% 10% - 13%	17% - 22% 11% - 15%	9% -12% 2.2% - 2.8%	1.5 - 2.5
High (3)	1 2	≥ 1.33 ≥ 1.30	≥ 59% ≥ 65%	≥ 7% ≥ 13%	≥ 22% ≥ 15%	≥ 12% ≥ 2.8%	≥ 2.5

[1] Urban 4 Lane Freeway / Urban or Fringe Urban Operating Environment
[2] Rural 4 Lane Freeway < 25,000 vpd / Rural Operating Environment

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

Freight Needs Refinements and Contributing Factors

Freight was identified as a focus area on the I-8 corridor. A Low level of freight needs were identified on 115 miles of I-8. These are concentrated between MP 0-57 and MP 120-178, which is generally the area between Yuma and Mohawk, including Telegraph Pass, and the area between Gila Bend and Casa Grande. The needs related to freight mobility were dispersed throughout these segments, with elevated levels of delay caused by congestion in the Yuma urbanized area, closures related to incidents/accidents, and bridge clearance issues.

Key contributing factors are summarized below:

- Urban congestion in the Yuma area impacting freight movement including high volumes of freight traffic passing through and originating in Yuma.
- Six bridges have clearance restrictions, consisting of less than 16.25' clearance with no ramp around opportunity.

See other Contributing Factors in **Appendix D**.

Table 16: Final Freight Needs

Segment	Performance Score and Level of Need								Initial Segment Need*	Hot Spots	Recently Completed Projects	Final Segment Need*
	Freight Index	Directional TTTI		Directional TPTI		Closure Duration		Bridge Vertical Clearance				
		EB	WB	EB	WB	EB	WB					
8-1	0.71	1.13	1.12	1.40	1.41	28.88	43.90	16.33	1.4	None	Paving project completed	Low
8-2	0.79	1.00	1.06	1.30	1.23	17.23	140.18	16.23	0.4	Dome Valley Rd TI UP WB - MP 21.06 #1325	Paving project completed	Low
8-3	0.89	1.04	1.04	1.14	1.11	73.08	28.10	16.20	0.3	None	None	Low
8-4	0.90	1.03	1.03	1.12	1.11	5.20	7.68	No UP	0.0	None	None	None
8-5	0.89	1.03	1.04	1.13	1.12	9.07	19.84	No UP	0.0	None	None	None
8-6	0.82	1.06	1.04	1.27	1.17	24.43	21.89	16.63	0.0	None	None	None
8-7	0.89	1.03	1.03	1.13	1.13	13.25	11.42	16.19	0.2	Vekol Road TI UP - MP 144.55 #550	None	Low
8-8	0.89	1.03	1.03	1.13	1.11	6.29	25.18	16.09	0.4	Stanfield Rd TI UP - MP 161.6 #1090 Murphy Rd UP - 162.5 #1091	None	Low
8-9	0.83	1.04	1.06	1.19	1.23	27.01	1.53	15.86	0.4	Thornton Rd TI UP - 172.55 #1096 Chuichu Rd UP - 173.53 #1197	Paving project completed	Low

Level of Need* (Score)	Performance Score Need Scale					Segment Level Need Scale
None (0)	≥ 0.74	≤ 1.21	≤ 1.37	≤ 71.07	≥ 16.33	0
Low (1)	0.70 - 0.74	1.21 - 1.27	1.37 - 1.43	71.07 - 97.97	16.17 - 16.33	≤ 1.5
Medium (2)	0.64 - 0.70	1.27 - 1.39	1.43 - 1.57	97.97 - 151.75	15.83 - 16.17	1.5 - 2.5
High (3)	≤ 0.64	≥ 1.39	≥ 1.57	≥ 151.75	≤ 15.83	≥ 2.5

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

Segment Review

The needs for each segment were combined to numerically estimate the average level of need for each segment of the corridor. **Table 17** provides a summary of needs for each segment across all performance areas, with the overall average need for each segment presented in the last row. All of the segments showed a Low level of average need.

Table 17: Summary of Needs by Segment

Performance Area	Segment Number and Mileposts (MP)								
	8-1	8-2	8-3	8-4	8-5	8-6	8-7	8-8	8-9
	MP 0-16.3	MP 16.3-21.4	MP 21.4-56.5	MP 56.5-79.6	MP 79.6-110.4	MP 110.4-120	MP 120-147.6	MP 147.6-166.5	MP 166.5-178
Pavement	Low	None	Low	Low	Medium	None	None	Low	Low
Bridge	Low	Medium	Low	Low	Medium	Low	Low	Low	Medium
Mobility+	Low	Low	None	None	None	Low	None	None	None
Safety+	Low	None	Medium	None	None	None	Low	None	Low
Freight+	Low	Low	Low	None	None	None	Low	Low	Low
Average Need	**1.00**	**0.77**	**1.00**	**0.31**	**0.62**	**0.38**	**0.62**	**0.54**	**0.92**

Average Need Scale	
None*	< 0.1
Low	0.1 - 1.0
Medium	1.0 - 2.0
High	> 2.0

** A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

+ Identified as an emphasis area for the I-8 corridor.

Summary of Corridor

The needs in each performance area are shown in **Figure 21** and summarized below:

Pavement Needs

- Of the 178 corridor miles, approximately 76 miles on eastbound I-8 and 79 miles on westbound I-8 have been identified to have pavement needs.
- Pavement hot spot failure needs were identified for 9 miles on eastbound I-8 and 17 miles on westbound I-8 (discounting those miles that will be addressed by future programmed projects).
- A high level of historical investment has occurred on Segment 8-1 through the Yuma urbanized area (MP 0-16), which warranted further investigation or alternative solutions.

Bridge Needs

- Bridge needs were identified on 30 of the 115 bridges along the I-8 corridor (26%).
- Eleven bridges have potential repetitive investment issues. Three of these bridges are also hot spots and were candidates for life-cycle cost analysis to evaluate alternative solutions.
- Two bridges have bridge ratings of 4; Colorado River Viaduct EB and Thornton Rd TI UP.
- Thirteen bridges were defined as hot spots since they had multiple bridge ratings of 5 or less.
- Of the 13 hot spot bridges, 3 also showed repetitive investment issues. These included the Smith Road OP EB, Smith Road OP WB and Thornton Rd TI UP.

Mobility Needs

- Mobility Performance is an Emphasis Area for the I-8 corridor, giving it a heavier weight in the analysis.
- A Low level of Mobility need was identified on 31 miles of I-8, concentrated in the Yuma urbanized area, Telegraph Pass, and Gila Bend. Contributing factors include reoccurring congestion and overall high traffic volumes in the urbanized area, the border patrol checkpoint at MP 18 creating eastbound delays, and closures related to incidents/accidents.
- I-8 between MP 18-21 experiences a reduction in shoulder width to accommodate bicycles.

Safety Needs

- Safety Performance is an Emphasis Area for the I-8 corridor, giving it a heavier weight in the analysis.
- In the urbanized Yuma area, most incidents/crashes were related to collisions with other motor vehicles, high speed, and run off the road to the right.
- Outside the urbanized area, many incidents/crashes were involving a single vehicle and involved the vehicle overturning or running off the road to the left. In these cases, driver inattention/distraction and high speeds were typically related, as well as involving a vehicle in transport.

Freight Needs

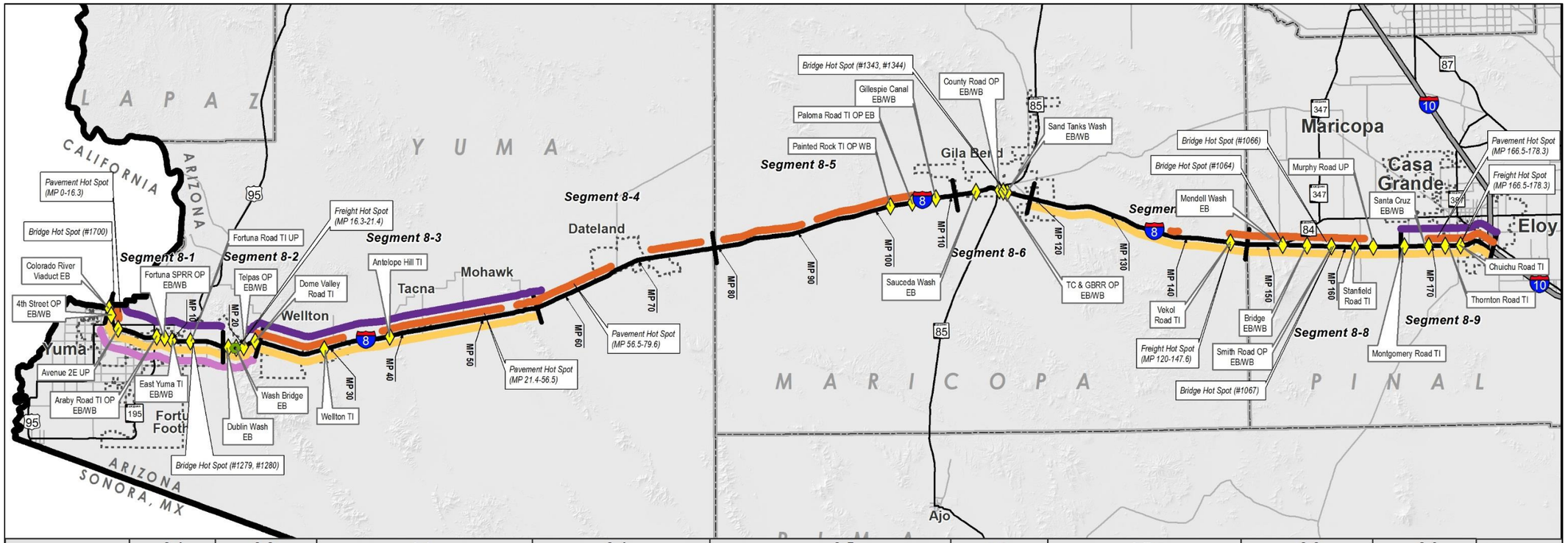
- Freight Performance is an Emphasis Area for the I-8 corridor, giving it a heavier weight in the analysis.
- Low level of Freight needs was identified on 115 miles of I-8. There are no Medium or High level of needs along the corridor. Segments 8-4 through 8-6 meet performance objectives.
- Urban congestion in the Yuma area impacting freight movement including high volumes of freight traffic passing through and originating in Yuma.
- Six bridges have clearance restrictions, consisting of less than 16.25 feet clearance and no ramp. The Thornton Rd TI UP at MP 172.55 has the lowest clearance of 15.87 feet.

Overlapping Needs

This section identifies overlapping performance needs on the I-8 corridor, which provides guidance to develop strategic solutions that address more than one performance area with elevated levels of need. Completing projects that address multiple needs presents the opportunity to more effectively improve overall performance. A summary of the overlapping needs that relate to locations with elevated levels of need is provided below:

- Overlapping Pavement, Freight, and Mobility needs occur in the Yuma urbanized area, from milepost 0-16. This section also includes bridges with needs due to hot spots. Many of the issues are due to the higher traffic volumes, including truck volume. The programmed project at Araby Road may resolve the Bridge needs as well as some of the Pavement needs.
- The area of Telegraph Pass, from approximately milepost 18-21, has significant grades and therefore suffers from Freight and Mobility needs related to delay and incidents/accidents associated with the grade. This area also has narrow shoulders, aged guardrail, and locations where climbing and passing lanes might improve safety. A bridge with a low vertical clearance (Dome Valley Rd TI UP WB) also occurs in this area.
- Milepost 21-57 also has Safety, Pavement, and Freight needs. Incidents/accidents and closures in this area, which may be attributable to pavement and guardrail quality, contribute to safety and freight needs.
- Milepost 57-66 and milepost 72-80 have both Safety and Pavement needs. Pavement and guardrail quality may contribute to safety needs. A recent pavement preservation project has been completed between milepost 66-72
- Approaching the Casa Grande urbanized area, milepost 148-178 has needs in Pavement and Freight, with bridges having needs as well as height restrictions related to freight. A bridge with both Bridge and Freight needs is Thornton Road TI (No. 1196, MP 172.55).

Figure 21: Corridor Needs Summary



Performance Area	8-1	8-2	8-3	8-4	8-5	8-6	8-7	8-8	8-9	Perfomance Area
	MP 0-16.3	MP 16.3-21.4	MP 21.4-56.5	MP 56.5-79.6	MP 79.6-110.4	MP 110-4-120	MP 120-147.6	MP 147.6-166.5	MP 166.5-178	
Pavement	Low	None*	Low	Low	Medium	None*	None*	Low	Low	Pavement
Bridge	Low	Medium	Low	Low	Medium	Low	Low	Low	Medium	Bridge
Mobility+	Low	Low	None*	None*	None*	Low	None*	None*	None*	Mobility+
Safety+	Low	None*	Medium	None*	None*	None*	Low	None*	Low	Safety+
Freight+	Low	Low	Low	None*	None*	None*	Low	Low	Low	Freight+
Average Need (0-3)	1.00	0.77	1.00	0.31	0.62	0.38	0.62	0.54	0.92	Average Need (0-3)

+ Identified as emphasis area for I-8 Corridor

A segment need rating of **'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance scoreexceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

I-8 Corridor Profile Study: California to I-10 Junction
Needs Summary

N
Miles
0 5 10 15 20

Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
Border Patrol Check Point

Performance Area Needs
Pavement
Mobility
Safety
Freight
Bridge

Level of Need
Low
Medium
High

4.0 STRATEGIC SOLUTIONS

The principal objective of the CPS is to identify strategic solutions (investments) that are performance-based to ensure that available funding resources are used to maximize the performance of the State's key transportation corridors. One of the first steps in the development of strategic solutions is to identify areas of elevated levels of need (i.e., Medium or High). Addressing areas of Medium or High need will have the greatest effect on corridor performance and are the focus of the strategic solutions. Segments with Medium or High needs and specific locations of hot spots are considered strategic investment areas for which strategic solutions should be developed. Segments with lower levels of need or without identified hot spots are not considered candidates for strategic investment and are expected to be addressed through other ADOT programming processes. The I-8 strategic investment areas (resulting from the elevated needs) are shown in **Figure 22**.

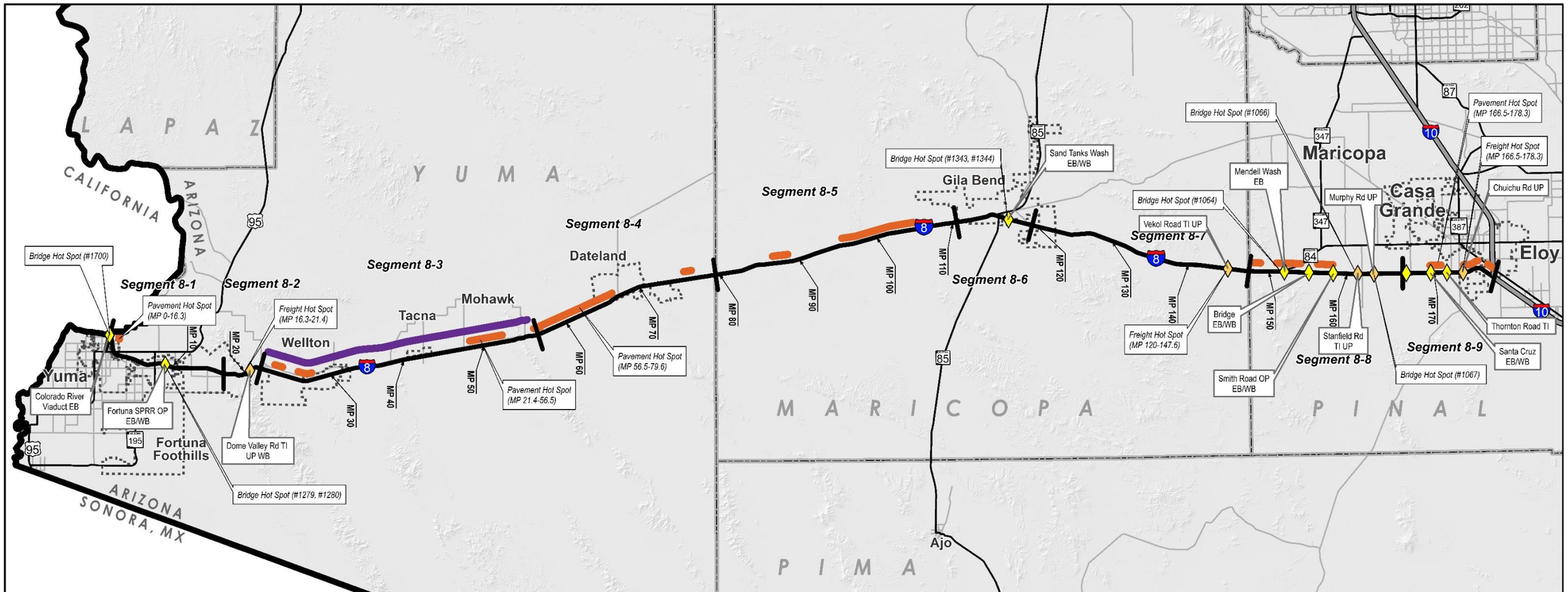
4.1 Screening Process

This section examines qualifying strategic needs and determines if the needs in those locations require action. In some cases, needs that are identified do not advance to solutions development and are screened out from further consideration because they have been or will be addressed through other measures, including:

- A project is programmed to address this need
- The need is a result of a Pavement or Bridge hot spot that does not show historical investment or rating issues; these hot spots will likely be addressed through other ADOT programming means
- A bridge is not a hot spot but is located within a segment with a Medium or High level of need; this bridge will likely be addressed through current ADOT bridge maintenance and preservation programming processes
- The need is determined to be non-actionable (i.e., cannot be addressed through an ADOT project)
- The conditions/characteristics of the location have changed since the performance data was collected that was used to identify the need

Table 18 notes if each potential strategic need advanced to solution development, and if not, the reason for screening the potential strategic need out of the process. Locations advancing to solutions development are marked with Yes (Y); locations not advancing are marked with No (N) and highlighted. This screening table provides specific information about the needs in each segment that will be considered for strategic investment. The table identifies the level of need – either Medium or High segment needs, or segments without Medium or High level of need that have a hot spot. Each area of need is assigned a location number in the screening table to help document and track locations considered for strategic investment.

Figure 22: Strategic Investment Areas



Performance Area	8-1	8-2	8-3	8-4	8-5	8-6	8-7	8-8	8-9	Perfomance Area
	MP 0-16.3	MP 16.3-21.4	MP 21.4-56.5	MP 56.5-79.6	MP 79.6-110.4	MP 110-4-120	MP 120-147.6	MP 147.6-166.5	MP 166.5-178	
Pavement	Hot Spot	-	Hot Spot	Hot Spot	Medium	-	-	Hot Spot	Hot Spot	Pavement
Bridge	Hot Spot	Medium	-	-	Medium	Hot Spot	-	Hot Spot	Medium	Bridge
Mobility+	-	-	-	-	-	-	-	-	-	Mobility+
Safety+	-	-	Medium	-	-	-	-	-	-	Safety+
Freight+	-	Hot Spot	-	-	-	-	Hot Spot	Hot Spot	Hot Spot	Freight+

+ Identified as Emphasis Area for I-8 Corridor

Note: Figure shows strategic investment areas, which are segments with Medium and High levels of need and locations of hotspots. A"-" symbol indicates a segment level of need of Low or None, which is not considered strategic.

I-8 Corridor Profile Study: California to I-10 Junction

Strategic Investment Areas

N

Miles

0 5 10 15 20

Corridor Segment
US Hwy/State Route
County Boundary
City Boundary

Performance Area Needs

Pavement
Mobility
Safety
Freight
Bridge
Truck Height Restriction Hot Spot

Level of Need
Low
Medium
High

Table 18: Strategic Investment Area Screening

Segment # and MP	Level of Strategic Need					Location #	Need Type	Need Description	Advance (Y/N)	Screening Description
	Pavement	Bridge	Mobility	Safety	Freight					
8-1 MP 0.0-16.3	Hot Spot	Hot Spot	-	-	-	L1	Pavement	Hot spot in westbound lanes MP 0-1 (High IRI) and a high level of historical investment has occurred on Segment 8-1	Y	
						L2	Bridge	Hot spot at Colorado River Viaduct EB MP 0.01 (#1700) with Deck Rating 4	N	Structure does not have a historical rating issue according to the historical review, therefore it is not considered for strategic investment. Further, this structure is maintained by Caltrans.
						L3	Bridge	Hot spot at Fortuna SPRR OP EB (MP 8.69, #1279) with Deck Rating 5, Substructure Rating 5, Evaluation Rating 5	N	Structure does not have a historical rating issue according to the historical review, therefore it is not considered for strategic investment.
						L4	Bridge	Hot spot at Fortuna SPRR OP WB (MP 8.70, #1280) with Deck Rating 5, Substructure Rating 5, Evaluation Rating 5	N	Structure does not have a historical rating issue according to the historical review, therefore it is not considered for strategic investment.
8-2 MP 16.3-21.4	-	Medium	-	-	Hot Spot	L5	Bridge	Medium level of need, however none of the following structures within this segment were hot spots: Dublin Wash Br EB (MP 16.85, #1566) Wash Br EB (MP 18.12, #303) Telpas OP WB Over EB (MP 18.80, #971) Telpas OP WB Over EB (MP 20.40, #972) Dome Valley Rd TI UP EB (MP 21.04, #1324) Dome Valley Rd TI UP WB (MP 21.06, #1325)	N	Structures do not have a historical rating issue according to the historical review, therefore it is not considered for strategic investment.
						L6	Freight	Hot spot at Dome Valley Rd TI UP WB (MP 21.06 #1325) has low clearance of 16.23'. Cannot ramp around.	Y	
8-3 MP 21.4-56.5	Hot Spot	-	-	Medium	-	L7	Pavement	Hot spot in EB lanes MP 23-24 (High IRI and Cracking)	N	A medium level of historical investment has occurred on Segment 8-3. A pavement preservation project is currently programmed (MP 21-29) for FY 2016, which will address deficiency.
						L8	Pavement	Hot spot in EB lanes MP 26-28 (High IRI and Cracking)	N	A medium level of historical investment has occurred on Segment 8-3. A pavement preservation project is currently programmed (MP 21-29) for FY 2016, which will address deficiency.
						L9	Pavement	Hot spot in EB lanes MP 48-52 (High IRI and Cracking)	N	A medium level of historical investment has occurred on Segment 8-3. No pavement preservation projects are currently programmed for this portion of the segment. Anticipated to be addressed through current ADOT pavement maintenance and preservation programming processes.
						L10	Pavement	Hot spot in WB lanes MP 56-56.5 (High IRI and Cracking)	N	A medium level of historical investment has occurred on Segment 8-3. No pavement preservation projects are currently programmed for this portion of the segment. Anticipated to be addressed through current ADOT pavement maintenance and preservation programming processes.
						L43	Safety	Crash trends show single vehicle (78%), speed too fast for conditions (41%), ran off the road left (37%), ran off the road right (15%), and daylight conditions (74%).	Y	

Legend: Strategic investment area screened out from further consideration.

Table 18: Strategic Investment Area Screening (continued)

Segment # and MP	Level of Strategic Need					Location #	Need Type	Need Description	Advance (Y/N)	Screening Description
	Pavement	Bridge	Mobility	Safety	Freight					
8-4 MP 56.5-79.6	Hot Spot	-	-	-	-	L11	Pavement	Hot spot in WB lanes MP 56.5-67 (High IRI and Cracking)	N	A medium level of historical investment has occurred on Segment 8-4. No pavement preservation projects are currently programmed for this portion of the segment. Anticipated to be addressed through current ADOT pavement maintenance and preservation programming processes.
						L12	Pavement	Hot spot in EB lanes MP 76-77 (High IRI)	N	A medium level of historical investment has occurred on Segment 8-4. No pavement reservation projects are currently programmed for this portion of the segment. Anticipated to be addressed through current ADOT pavement maintenance and preservation programming processes.
8-5 MP 79.6-110.4	Medium	Medium	-	-	-	L13	Pavement	Hot spot in EB lanes MP 87-89 (High IRI and Cracking)	N	A medium level of historical investment has occurred on Segment 8-5. No pavement preservation projects are currently programmed for this portion of the segment. Anticipated to be addressed through current ADOT pavement maintenance and preservation programming processes.
						L14	Pavement	Hot spot in EB lanes MP 96-99 (High IRI and Cracking)	N	A medium level of historical investment has occurred on Segment 8-4. A pavement preservation project programmed (MP 96-106) for FY 2019, which will address deficiency.
						L15	Pavement	Hot spot in WB lanes MP 97-106 (High IRI and Cracking)	N	A medium level of historical investment has occurred on Segment 8-4. A pavement preservation project programmed (MP 96-106) for FY 2019, which will address deficiency.
						L16	Pavement	Hot spot in EB lanes MP 100-103 (High IRI)	N	A medium level of historical investment has occurred on Segment 8-4. A pavement preservation project programmed (MP 96-106) for FY 2019, which will address deficiency.
						L17	Bridge	Medium level of need related to three functionally obsolete bridges. None of the following bridges were identified as hot spots. Wash Bridge EB (MP 83.14, #317) Sentinel TI OP EB (MP 87.04, #687) Sentinel TI OP WB (MP 87.04, #688) Painted Rock TI OP EB (MP 102.27, #509) Painted Rock TI OP WB (MP 102.27, #510) Paloma Rd TI OP EB (MP 106.54, #566) Paloma Rd TI OP WB (MP 106.54, #567) Gillespie Canal Br EB (MP 107.02, #489) Gillespie Canal Br WB (MP 107.03, #568) Gillespie Canal Br EB (MP 109.55, #490) Gillespie Canal Br WB (MP 109.55, #569) Wash Bridge SFR (MP 110.35, #1505)	N	Structures do not have a historical rating issue according to the review, therefore they are not considered for strategic investment. Anticipated to be addressed through current ADOT bridge maintenance and preservation programming processes.

Legend: Strategic investment area screened out from further consideration.

Table 18: Strategic Investment Area Screening (continued)

Segment # and MP	Level of Strategic Need					Location #	Need Type	Need Description	Advance (Y/N)	Screening Description
	Pavement	Bridge	Mobility	Safety	Freight					
8-6 MP 110.4-120.0	-	Hot Spot	-	-	-	L18	Bridge	Hot spot at Sand Tanks Wash Bridge EB (MP 117.43, #1343) with Deck Rating 5, Substructure Rating 5, Evaluation Rating 5	N	Structure does not have a historical rating issue according to the historical review, therefore it is not considered for strategic investment.
						L19	Bridge	Hot spot at Sand Tanks Wash Bridge WB (MP 117.43, #1344) with Deck Rating 5, Substructure Rating 5, Evaluation Rating 5	N	Structure does not have a historical rating issue according to the historical review, therefore it is not considered for strategic investment.
8-7 MP 120.0-147.6	-	-	-	-	Hot Spot	L20	Freight	Hot spot at Vekol Road TI UP (MP 144.55 #550) has low clearance of 16.19'. Cannot ramp around in eastbound direction.	Y	
8-8 MP 147.6-166.5	Hot Spot	Hot Spot	-	-	Hot Spot	L21	Pavement	Hot spot in WB lanes MP 148-149 (High Cracking)	N	A low level of historical investment has occurred on Segment 8-8. No pavement preservation projects are currently programmed. Anticipated to be addressed through current ADOT pavement maintenance and preservation programming processes.
						L22	Pavement	Hot spot in WB lanes MP 151-153 (High Cracking)	N	A low level of historical investment has occurred on Segment 8-8. No pavement preservation projects are currently programmed. Anticipated to be addressed through current ADOT pavement maintenance and preservation programming processes.
						L23	Pavement	Hot spot in EB lanes MP 152-154 (High IRI and Cracking)	N	A low level of historical investment has occurred on Segment 8-8. No pavement preservation projects are currently programmed. Anticipated to be addressed through current ADOT pavement maintenance and preservation programming processes.
						L24	Pavement	Hot spot in WB lanes MP 156-158 (High IRI and Cracking)	N	A low level of historical investment has occurred on Segment 8-8. No pavement preservation projects are currently programmed. Anticipated to be addressed through current ADOT pavement maintenance and preservation programming processes.
						L25	Bridge	Hot spot at Mendell Wash Bridge EB (MP 151.90, #1064) with Deck Rating 5, Substructure Rating 5, Evaluation Rating 5	N	Structure does not have a historical rating issue according to the historical review, therefore it is not considered for strategic investment.
						L26	Bridge	Hot spot at Bridge EB MP 153.40 (#1066) with Deck Rating 5, Substructure Rating 5, Superstructure Rating 5, Evaluation Rating 5	N	Structure does not have a historical rating issue according to the historical review, therefore it is not considered for strategic investment.
						L27	Bridge	Hot spot at Bridge WB MP 153.46 (#1067) with Deck Rating 5, Substructure Rating 5, Evaluation Rating 5	N	Structure does not have a historical rating issue according to the historical review, therefore it is not considered for strategic investment.
						L28	Bridge	Hot spot at Smith Road OP EB MP 157.55 (#1068) with Deck Rating 5, Substructure Rating 5, Evaluation Rating 5. Structure shows high level of historical rating issues in the historical review.	Y	

Legend: Strategic investment area screened out from further consideration.

Table 18: Strategic Investment Area Screening (continued)

Segment # and MP	Level of Strategic Need					Location #	Need Type	Need Description	Advance (Y/N)	Screening Description
	Pavement	Bridge	Mobility	Safety	Freight					
8-8 MP 147.6-166.5	Hot Spot	Hot Spot	-	-	Hot Spot	L29	Bridge	Hot spot at Smith Road OP WB MP 157.55 (#1069) with Deck Rating 5, Substructure Rating 5, Evaluation Rating 5. Structure shows high level of historical rating issues in the historical review.	Y	
						L30	Freight	Hot spot at Stanfield Rd TI UP (MP 161.6 #1090) has low clearance of 16.09'. Cannot ramp around.	Y	
						L31	Freight	Hot spot at Murphy Rd UP (MP 162.5 #1091) has low clearance of 16.19'. Cannot ramp around.	Y	
8-9 MP 166.5-178.3	Hot Spot	Medium	-	-	Hot Spot	L32	Pavement	Hot spot in EB lanes MP 170-171 (High IRI and High Cracking)	N	A medium level of historical investment has occurred on Segment 8-9, there is a pavement preservation project programmed MP 169.5-178 FY 2016 which will address deficiency.
						L33	Pavement	Hot spot in EB lanes MP 174-176 (High IRI and High Cracking)	N	A medium level of historical investment has occurred on Segment 8-9, there is a pavement preservation project programmed MP 169.5-178 FY 2016 which will address deficiency.
						L34	Pavement	Hot spot in WB lanes MP 174-176 (High IRI)	N	A medium level of historical investment has occurred on Segment 8-9, there is a pavement preservation project programmed MP 169.5-178 FY 2016 which will address deficiency.
						L35	Pavement	Hot spot in EB lanes MP 177-179 (High IRI and High Cracking)	N	A medium level of historical investment has occurred on Segment 8-9, there is a pavement preservation project programmed MP 169.5-178 FY 2016 which will address deficiency.
						L36	Pavement	Hot spot in WB lanes MP 178-179 (High IRI)	N	A medium level of historical investment has occurred on Segment 8-9, there is a pavement preservation project programmed MP 169.5-178 FY 2016 which will address deficiency.
						L37	Bridge	Hot spot at Montgomery Rd TI UP (MP 167.50, #1140) with superstructure rating 5, Evaluation Rating 5	N	Structure does not have a historical rating issue according to the historical review, therefore it is not considered for strategic investment.
						L38	Bridge	Hot spot at Santa Cruz Wash Br EB (MP 170.90, #1142) with Deck Rating 5, Substructure Rating 5, Evaluation Rating 5	N	Structure does not have a historical rating issue according to the historical review, therefore it is not considered for strategic investment.
						L39	Bridge	Hot spot at Santa Cruz Wash Br WB MP 170.90 (#1143) with Deck Rating 5, Substructure Rating 5, Evaluation Rating 5	N	Structure does not have a historical rating issue according to the historical review, therefore it is not considered for strategic investment.
						L40	Bridge	Hot spot at Thornton Rd TI UP MP 172.55 (#1196) with Substructure Rating 4, Evaluation Rating 4. Structure shows high level of historical rating issues in the historical review.	Y	
						L41	Freight	Hot spot at Thornton Rd TI UP (MP 172.55) has low clearance of 15.86'. Cannot ramp around in the eastbound direction.	Y	
						L42	Freight	Hot spot at Chuichu Rd UP (MP 173.53 #1197) has low clearance of 16.04'. Cannot ramp around.	Y	

Legend: Strategic investment area screened out from further consideration.

4.2 Candidate Solutions

For each elevated need within a strategic investment area that is not screened out, a candidate solution is developed to address the identified need. Each candidate solution is assigned to one of the following three P2P investment categories based on the scope of the solution:

- Preservation
- Modernization
- Expansion

Documented performance needs serve as the foundation for developing candidate solutions for corridor preservation, modernization, and expansion. Candidate solutions are not intended to be a substitute or replacement for traditional ADOT project development processes where various ADOT technical groups and districts develop candidate projects for consideration in the performance-based programming in the P2P process. Rather, these candidate solutions are intended to complement ADOT's traditional project development processes through a performance-based process to address needs in one or more of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Candidate solutions developed for the I-8 corridor will be considered along with other candidate projects in the ADOT statewide programming process.

Characteristics of Strategic Solutions

Candidate solutions should include some or all of the following characteristics:

- Do not recreate or replace results from normal programming processes
- May include programs or initiatives, areas for further study, and infrastructure projects
- Address elevated levels of need (High or Medium) and hot spots
- Focus on investments in modernization projects (to optimize current infrastructure)
- Address overlapping needs
- Reduce costly repetitive maintenance
- Extend operational life of system and delay expansion
- Leverage programmed projects that can be expanded to address other strategic elements
- Provide measurable benefit

Candidate Solutions

A set of 9 candidate solutions are proposed to address the identified needs on the I-8 corridor.

Table 19 identifies each strategic location that has been assigned a candidate solution with a number (e.g., CS8.1, CS8.2, etc.). Each candidate solution is comprised of one or more components to address the identified needs. The assigned candidate solution numbers are linked to the location number and provide tracking capability through the rest of the process. The locations of proposed solutions are shown on the map in **Figure 23**.

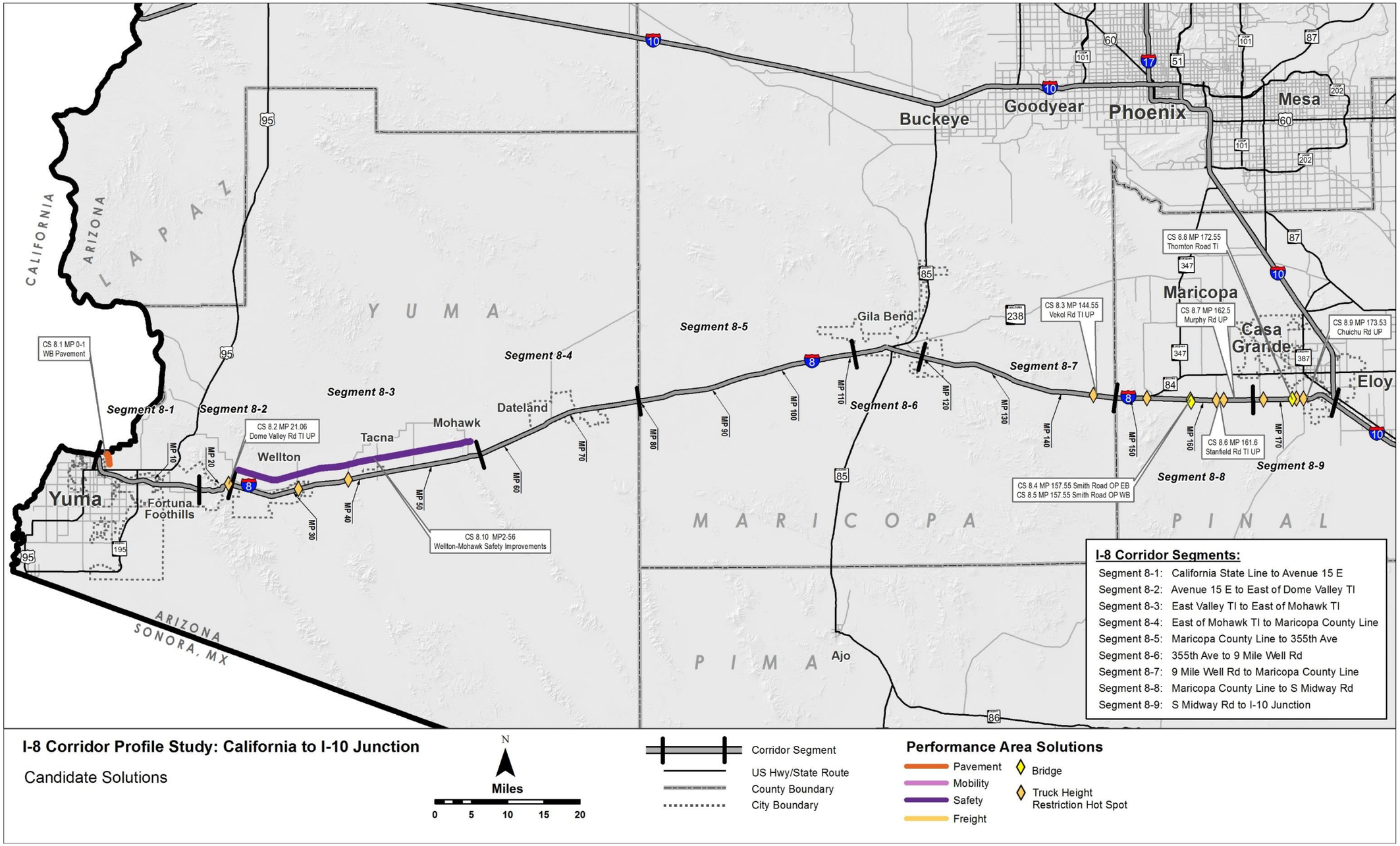
Candidate solutions developed to address an elevated need in the Pavement or Bridge performance area will include two options; rehabilitation or full replacement. These solutions are initially evaluated through a Life-Cycle Cost Analysis (LCCA) to provide insights into the cost-effectiveness of these options so a recommended approach can be identified. Candidate solutions developed to address an elevated need in the Mobility, Safety, or Freight performance areas are advanced directly to the Performance Effectiveness Evaluation. In some cases, there may be multiple solutions identified to address the same area of need.

Candidate solutions that are recommended to expand or modify the scope of an already programmed project are noted and are not advanced to solution evaluation and prioritization. These solutions are directly recommended for programming.

Table 19: Candidate Solutions

Candidate Solution #	Segment #	Location #	Beginning Milepost	Ending Milepost	Candidate Solution Name	Option	Scope	Investment Category Preservation [P] Modernization [M] Expansion [E]
CS8.1	8-1	L1	0	1	CA Border to MP 1 Pavement Project	A B	Rehabilitate pavement Replace pavement	P M
CS8.2	8-2	L6	21.06	21.06	Dome Valley Rd TI UP (#1325) (WB I-8) Freight / Bridge Vertical Clearance Mitigation	A B	Reprofile mainline Replace bridge	M M
CS8.3	8-7	L20	144.55	144.55	Vekol Road TI UP (#550) (WB & EB I-8) Freight / Bridge Vertical Clearance Mitigation	A B	Reprofile mainline Replace bridge	M M
CS8.4	8-8	L28	157.55	157.55	Smith Road OP EB (#1068) Bridge Project	A B	Rehabilitate bridge Replace bridge	P M
CS8.5	8-8	L29	157.55	157.55	Smith Road OP WB (#1069) Bridge Project	A B	Rehabilitate bridge Replace bridge	P M
CS8.6	8-8	L30	161.6	161.6	Stanfield Rd TI UP (#1090) (WB & EB I-8) Freight / Bridge Vertical Clearance Mitigation	A B	Reprofile mainline Replace bridge	M M
CS8.7	8-8	L31	162.5	162.5	Murphy Rd UP (#1091) (WB & EB I-8) Freight / Bridge Vertical Clearance Mitigation	A B	Reprofile mainline Replace bridge	M M
CS8.8	8-9	L40 & L41	172.55	172.55	Thornton Rd TI UP (#1196) (WB & EB I-8) Bridge Project	A B	Rehabilitate bridge and reprofile mainline Replace bridge	M M
CS8.9	8-9	L42	173.53	173.53	Chuichu Rd UP (#1197) (WB & EB I-8) Freight / Bridge Vertical Clearance Mitigation	A B	Reprofile mainline Replace bridge	M M
CS8.10	8-3	L43	22	56	Wellton – Mohawk Safety Improvements	-	Install speed feedback signs (EB MP 28, EB MP 40, EB MP 45, EB MP 53.75, WB MP 23, WB MP 31.5, WB MP 44, WB MP 56.5) Install Lighting WB MP 25-25.49, WB MP 27.5-27.99, WB MP 32-33, WB MP 35 - 35.49, EB MP 26 - 26.49, WB MP 45.5-45.99)	M

Figure 23: Candidate Solutions



5.0 SOLUTION EVALUATION AND PRIORITIZATION

Candidate solutions are evaluated using the following steps: LCCA (where applicable), Performance Effectiveness Evaluation, Solution Risk Analysis, and Candidate Solution Prioritization. The methodology and approach to this evaluation are shown in **Figure 24** and described more fully below.

Life-Cycle Cost Analysis

All Pavement and Bridge candidate solutions have two options: rehabilitation/repair or reconstruction. These options are evaluated through an LCCA to determine the best approach for each location where a Pavement or Bridge solution is recommended. The LCCA can eliminate options from further consideration and identify which options should be carried forward for further evaluation.

When multiple independent candidate solutions are developed for Mobility, Safety, or Freight strategic investment areas, these candidate solution options advance directly to the Performance Effectiveness Evaluation without an LCCA.

Performance Effectiveness Evaluation

After completing the LCCA process, all remaining candidate solutions are evaluated based on their performance effectiveness. This process includes determining a Performance Effectiveness Score (PES) based on how much each solution impacts the existing performance and needs scores for each segment. This evaluation also includes a Performance Area Risk Analysis to help differentiate between similar solutions based on factors that are not directly addressed in the performance system.

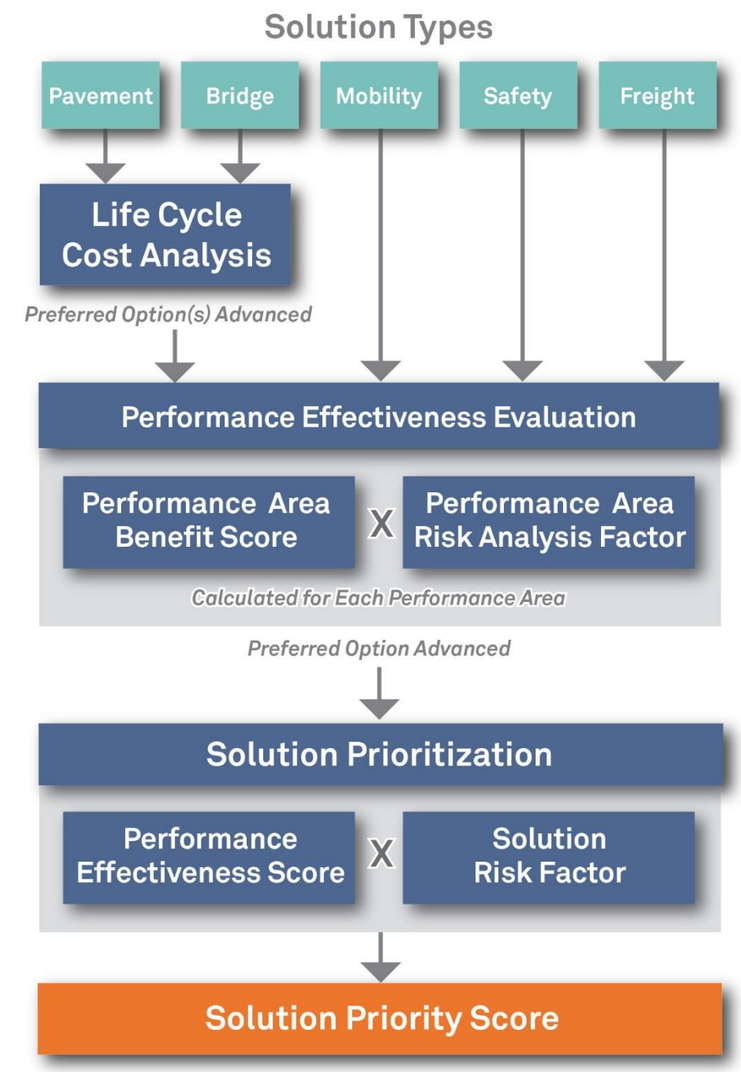
Solution Risk Analysis

All candidate solutions advanced through the Performance Effectiveness Evaluation are also evaluated through a Solution Risk Analysis process. A solution risk probability and consequence analysis is conducted to develop a solution-level risk weighting factor. This risk analysis is a numeric scoring system to help address the risk of not implementing a solution based on the likelihood and severity of performance failure.

Candidate Solution Prioritization

The PES, weighted risk factor, and segment average need score are combined to create a prioritization score. The candidate solutions are ranked by prioritization score from highest to lowest. The highest prioritization score indicates the candidate solution that is recommended as the highest priority. Solutions that address multiple performance areas tend to score higher in this process.

Figure 24: Candidate Solution Evaluation Process



5.1 Life-Cycle Cost Analysis

LCCA is conducted for any candidate solution that is developed as a result of a need in the Pavement or Bridge performance area. The intent of the LCCA is to determine which options warrant further investigation and eliminate options that would not be considered strategic.

LCCA is an economic analysis that compares cost streams over time and presents the results in a common measure, the present value of all future costs. The cost stream occurs over an analysis period that is long enough to provide a reasonably fair comparison among alternatives that may differ significantly in scale of improvement actions over shorter time periods. For both bridge and pavement LCCA, the costs are focused on agency (ADOT) costs for corrective actions to meet the objective of keeping the bridge or pavement serviceable over a long period of time.

LCCA is performed to provide a more complete holistic perspective on asset performance and agency costs over the life of an investment stream. This approach helps ADOT look beyond initial and short-term costs, which often dominate the considerations in transportation investment decision making and programming.

Bridge LCCA

For the bridge LCCA, three basic strategies are analyzed that differ in timing and scale of improvement actions to maintain the selected bridges, as described below:

- Bridge replacement (large upfront cost but small ongoing costs afterwards)
- Bridge rehabilitation until replacement (moderate upfront costs then small to moderate ongoing costs until replacement)
- On-going repairs until replacement (low upfront and ongoing costs until replacement)

The bridge LCCA model developed for the CPS reviews the characteristics of the candidate bridges including bridge ratings and deterioration rates to develop the three improvement strategies (full replacement, rehabilitation until replacement, and repair until replacement). Each strategy consists of a set of corrective actions that contribute to keeping the bridge serviceable over the analysis period. Cost and effect of these improvement actions on the bridge condition are essential parts of the model. Other considerations in the model include bridge age, elevation, pier height, length-to-span ratio, skew angle, and substandard characteristics such as shoulders and vehicle clearance. The following assumptions are included in the bridge LCCA model:

- The bridge LCCA only addresses the structural condition of the bridge and does not address other issues or costs
- The bridge will require replacement at the end of its 75-year service life regardless of current condition
- The bridge elevation, pier height, skew angle, and length-to-span ratio can affect the replacement and rehabilitation costs
- The current and historical ratings are used to estimate a rate of deterioration for each candidate bridge
- Following bridge replacement, repairs will be needed every 20 years
- Different bridge repair and rehabilitation strategies have different costs, expected service life, and benefit to the bridge rating
- The Net Present Value (NPV) of future costs is discounted at 3% and all dollar amounts are in 2015 dollars
- If the LCCA evaluation recommends rehabilitation or repair, the solution is not considered strategic and the rehabilitation or repair will be addressed by normal programming processes
- Since this LCCA is conducted at a planning level, and due to the variabilities in costs and improvement strategies, the LCCA NPV results that are within 15% should be considered equally; in such a case, the solution should be carried forward as a strategic replacement project – more detailed scoping will confirm if replacement or rehabilitation is needed

Based on the candidate solutions presented in **Table 19**, LCCA was conducted for three bridges on the I-8 corridor. A summary of this analysis is shown in **Table 20**. Additional information regarding the bridge LCCA is included in **Appendix E**.

Pavement LCCA

The LCCA approach to pavement is very similar to the process used for bridges. For the pavement LCCA, three basic strategies are analyzed that differ in timing and scale of improvement actions to maintain the selected pavement, as described below:

- Pavement replacement (large upfront cost but small ongoing costs afterwards – could be replacement with asphalt or concrete pavement)
- Pavement major rehabilitation until replacement (moderate upfront costs then small to moderate ongoing costs until replacement)
- Pavement minor rehabilitation until replacement (low upfront and ongoing costs until replacement)

The pavement LCCA model developed for the CPS reviews the characteristics of the candidate paving locations including the historical rehabilitation frequency to develop potential improvement strategies (full replacement, major rehabilitation until replacement, and minor rehabilitation until replacement, for either concrete or asphalt, as applicable). Each strategy consists of a set of corrective actions that contribute to keeping the pavement serviceable over the analysis period. The following assumptions are included in the pavement LCCA model:

- The pavement LCCA only addresses the condition of the pavement and does not address other issues or costs
- The historical pavement rehabilitation frequencies at each location are used to estimate future rehabilitation frequencies

- Different pavement replacement and rehabilitation strategies have different costs and expected service life
- The net present value of future costs is discounted at 3% and all dollar amounts are in 2015 dollars
- If the LCCA evaluation recommends rehabilitation or repair, the solution is not considered strategic and the rehabilitation will be addressed by normal programming processes
- Because this LCCA is conducted at a planning level, and due to the variabilities in costs and improvement strategies, the LCCA net present value results that are within 15% should be considered equally; in such a case, the solution should be carried forward as a strategic replacement project – more detailed scoping will confirm if replacement or rehabilitation is needed

Based on the candidate solutions presented in **Table 19**, LCCA was conducted for one pavement section on the I-8 corridor. A summary of this analysis is shown in **Table 21**. Additional information regarding the pavement LCCA is contained in **Appendix E**.

As shown in **Tables 20** and **21**, the following conclusions were determined based on the LCCA:

- Rehabilitation or repair was determined to be the most effective approach for the candidate solutions listed below and these locations do not have other Needs. Therefore, it is assumed that the identified needs will be addressed by normal programming processes and these candidate solutions will be dropped from further consideration.
    - CA Border to MP 1 Pavement Project (CS8-1)
    - Smith Road OP EB (#1068) Bridge Project (CS8-4)
    - Smith Road OP WB (#1069) Bridge Project (CS8-5)

- Rehabilitation or repair was determined to be the most effective approach for the candidate solution listed below, however, this location had other needs, so it was carried forward for further consideration.
    - Thornton Rd TI UP (#1196) Bridge Project (CS8-8)

Table 20: Bridge Life Cycle Cost Analysis Results

Candidate Solution	Present Value at 3% Discount Rate ($)			Ratio of Present Value Compared to Lowest Present Value			Other Needs	Results
	Replace	Rehab	Repair	Replace	Rehab	Repair		
Smith Road OP EB (CS8-4)	$1,174,758	$1,083,530	**$875,819**	1.34	1.24	1.00	No	Not strategic as a stand-alone solution and no other Needs; no further evaluation
Smith Road OP WB (CS8-5)	$1,174,758	$1,075,380	**$815,250**	1.45	1.32	1.00	No	Not strategic as a stand-alone solution and no other Needs; no further evaluation
Thornton Road TI (CS8-8)	$2,888,512	$2,414,455	**$2,117,179**	1.36	1.14	1.00	Yes	Not strategic as a stand-alone solution; carry forward for further evaluation with other needs

Table 21: Pavement Life Cycle Cost Analysis Results

Candidate Solution	Present Value at 3% Discount Rate ($)				Ratio of Present Value Compared to Lowest Present Value				Other Needs	Results
	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehabilitation	Asphalt Light Rehabilitation	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehabilitation	Asphalt Light Rehabilitation		
CA Border to MP 1 Pavement Project (CS8-1)	$8,795,411	$8,052,390	**$6,307,010**	$6,901,615	1.40	1.28	1.00	1.09	No	Not strategic as a stand-alone solution and no other Needs; no further evaluation

5.2 Performance Effectiveness Evaluation

The results of the Performance Effectiveness Evaluation are combined with the results of a Performance Area Risk Analysis to determine a PES. The objectives of the Performance Effectiveness Evaluation include:

- Measure the benefit to the performance system versus the cost of the solution
- Include risk factors to help differentiate between similar solutions
- Apply to each performance area that is affected by the candidate solution
- Account for emphasis areas identified for the corridor

The Performance Effectiveness Evaluation includes the following steps:

- Estimate the post-solution performance for each of the five performance areas (Pavement, Bridge, Mobility, Safety, and Freight)
- Use the post-solution performance scores to calculate a post-solution level of need for each of the five performance areas
- Compare the pre-solution level of need to the post-solution level of need to determine the reduction in level of need (potential solution benefit) for each of the five performance areas
- Calculate performance area risk weighting factors for each of the five performance areas
- Use the reduction in level of need (benefit) and risk weighting factors to calculate the PES

Post-Solution Performance Estimation

For each performance area, a slightly different approach is used to estimate the post-solution performance. This process is based on the following assumptions:

- Pavement:
  - The IRI rating would decrease (to 30 for replacement or 45 for rehabilitation)
  - The Cracking rating would decrease (to 0 for replacement or rehabilitation)
- Bridge:
  - The structural ratings would increase (+1 for repair, +2 for rehabilitation, or increase to 8 for replacement)
  - The Sufficiency Rating would increase (+10 for repair, +20 for rehabilitation, or increase to 98 for replacement)
- Mobility:
  - Additional lanes would increase the capacity and therefore affect the Mobility Index and associated secondary measures
  - Other improvements (e.g., ramp metering, parallel ramps, variable speed limits) would also increase the capacity (to a lesser extent than additional lanes) and therefore would affect the Mobility Index and associated secondary measures
  - Changes in the Mobility Index (due to increased capacity) would have a direct effect on the TTI secondary measure
  - Changes in the Mobility Index (due to increased capacity) and Safety Index (due to crash reductions) would have a direct effect on the PTI secondary measure
  - Changes in the Safety Index (due to crash reductions) would have a direct effect on the Closure Extent secondary measure
- Safety:
  - Crash modification factors were developed that would be applied to estimate the reduction in crashes (for additional information see **Appendix F**)
- Freight:
  - Changes in the Mobility Index (due to increased capacity) and Safety Index (due to crash reductions) would have a direct effect on the Freight Index and the TPTI secondary measure
  - Changes in the Mobility Index (due to increased capacity) would have a direct effect on the TTTI secondary measure
  - Changes in the Safety Index (due to crash reductions) would have a direct effect on the Closure Duration secondary measure

Performance Area Risk Analysis

The Performance Area Risk Analysis is intended to develop a numeric risk weighting factor for each of the five performance areas (Pavement, Bridge, Mobility, Safety, and Freight). This risk analysis addresses other considerations for each performance area that are not directly included in the performance system. A risk weighting factor is calculated for each candidate solution based on the specific characteristics at the solution location. For example, the Pavement Risk Factor is based on factors such as the elevation, daily traffic volumes, and amount of truck traffic. Additional information regarding the Performance Area Risk Factors is included in **Appendix G**.

Following the calculation of the reduction in level of need (benefit) and the Performance Area Risk Factors, these values are used to calculate the PES. In addition, the reduction in level of Need in each emphasis area is also included in the PES.

Net Present Value Factor

The benefit (reduction in need) is measured as a one-time benefit. However, different types of solutions will have varying service lives during which the benefits will be obtained. For example, a preservation solution would likely have a shorter stream of benefits over time when compared to a modernization or expansion solution. To address the varying lengths of benefit streams, each solution is classified as a 10-year, 20-year, 30-year, or 75-year benefit stream, or the NPV factor (F_{NPV}). A 3% discount rate is used to calculate F_{NPV} for each classification of solution. The service lives and respective factors are described below:

- A 10-year service life is generally reflective of preservation solutions such as pavement and bridge preservation; these solutions would likely have a 10-year stream of benefits; for these solutions, a F_{NPV} of 8.8 is used in the PES calculation
- A 20-year service life is generally reflective of modernization solutions that do not include new infrastructure; these solutions would likely have a 20-year stream of benefits; for these solutions, a F_{NPV} of 15.3 is used in the PES calculation
- A 30-year service life is generally reflective of expansion solutions or modernization solutions that include new infrastructure; these solutions would likely have a 30-year stream of benefits; for these solutions, a F_{NPV} of 20.2 is used in the PES calculation
- A 75-year service life is used for bridge replacement solutions; these solutions would likely have a 75-year stream of benefits; for these solutions, a F_{NPV} of 30.6 is used in the PES calculation

Vehicle-Miles Travelled Factor

Another factor in assessing benefits is the number of travelers who would benefit from the implementation of the candidate solution. This factor varies between candidate solutions depending on the length of the solution and the magnitude of daily traffic volumes. Multiplying the solution length by the daily traffic volume results in vehicle-miles travelled (VMT), which provides a measure of the amount of traffic exposure that would receive the benefit of the proposed solution. The VMT is converted to a VMT factor (known as F_{VMT}), which is on a scale between 0 and 5, using the equation below:

$$F_{VMT} = 5 - (5 \times e^{VMT \times -0.0000139})$$

Performance Effectiveness Score

The PES is calculated using the following equation:

PES = (Sum of all Risk Factored Benefit Scores + Sum of all Risk Factored Emphasis Area Scores) / Cost) x F_{VMT} x F_{NPV}

Where:

Risk Factored Benefit Score = Reduction in Segment-Level Need (benefit) x Performance Area Risk Weighting Factor (calculated for each performance area)

Risk Factored Emphasis Area Score = Reduction in Corridor-Level Need x Performance Area Risk Factors x Emphasis Area Factor (calculated for each emphasis area)

*Cost = estimate cost of candidate solution in millions of dollars (see **Appendix H**)*

F_{VMT} = Factor between 0 and 5 to account for VMT at location of candidate solution based on existing (2014) daily volume and length of solution

F_{NPV} = Factor (ranging from 8.8 to 30.6 as previously described) to address anticipated longevity of service life (and duration of benefits) for each candidate solution

The resulting PES values are shown in **Table 22**. Additional information regarding the calculation of the PES is contained in **Appendix I**.

For candidate solutions with multiple options to address Mobility, Safety, or Freight needs, the PES should be compared to help identify the best performing option. If one option clearly performs better than the other options (e.g., more than twice the PES value and a difference in magnitude of at least 20 points), the other options can be eliminated from further consideration. If multiple options have similar PES values, or there are other factors not accounted for in the performance system that could significantly influence the ultimate selection of an option (e.g., potential environmental concerns, potential adverse economic impacts), those options should all be advanced to the prioritization process.

On the I-8 corridor, six candidate solutions have options to address Freight needs by improving the vertical clearance at bridges that can't be ramped around. In most cases, the most effective option was to reprofile the mainline roadway. Two locations showed more benefit in replacing the bridge due to the poor existing structure performance rating.

As was previously mentioned, rehabilitation or repair was determined to be the most effective approach for the candidate solutions listed below that were subjected to LCCA. Subsequently, these candidate solutions were dropped from further consideration and no PES values were calculated for these solutions:

- CA Border to MP 1 Pavement Project (CS8.1, MP 0-1)
- Smith Road OP EB (#1068) Bridge Project (CS8-4, MP 157.55)
- Smith Road OP WB (#1069) Bridge Project (CS8-5, MP 157.55)

Table 22: Performance Effectiveness Scores

Candidate Solution #	Segment #	Option	Candidate Solution Name	Milepost Location	Estimated Cost ($ million)	Risk Factored Benefit Score					Risk Factored Emphasis Area Scores			Total Factored Benefit Score	F_{VMT}	F_{NPV}	Performance Effectiveness Score
						Pavement	Bridge	Safety	Mobility	Freight	Safety	Mobility	Freight				
CS8.2	8-2	A	Dome Valley Rd TI WB UP (#1325) Reprofile	21.06	$0.3	0.093	0.000	0.003	0.003	0.501	0.001	0.000	0.000	0.600	0.04	20.2	2.2
		B	Dome Valley Rd TI WB UP (#1325) Bridge Replacement	21.06	$1.8	0.000	1.136	0.003	0.003	0.501	0.001	0.000	0.000	1.644	0.09	30.6	2.5
CS8.3	8-7	A	Vekol Road TI UP (#550) Reprofile	144.55	$0.6	0.000	0.000	0.000	0.000	0.302	0.000	0.000	0.000	0.302	0.09	20.2	0.9
		B	Vekol Road TI UP (#550) Bridge Replacement	144.55	$2.2	0.000	1.156	0.000	0.000	0.302	0.000	0.000	0.000	1.457	0.07	30.6	1.5
CS8.6	8-8	A	Stanfield Rd TI UP (#1090) Reprofile	161.6	$0.8	0.203	0.000	0.000	0.000	0.404	0.000	0.000	0.000	0.607	0.12	20.2	1.9
		B	Stanfield Rd TI UP (#1090) Bridge Replacement	161.6	$2.2	0.000	0.462	0.000	0.000	0.404	0.000	0.000	0.000	0.866	0.08	30.6	0.9
CS8.7	8-8	A	Murphy Rd UP (#1091) Reprofile	162.5	$0.6	0.104	0.000	0.000	0.000	0.404	0.000	0.000	0.000	0.508	0.09	20.2	1.6
		B	Murphy Rd UP (#1091) Bridge Replacement	162.5	$2.6	0.000	0.531	0.000	0.000	0.404	0.000	0.000	0.000	0.935	0.08	30.6	0.8
CS8.8	8-9	A	Thornton Rd TI UP (#1196) Bridge Rehab & Reprofile	172.55	$2.9	1.953	0.777	0.001	0.001	0.881	0.001	0.000	0.000	3.614	0.28	20.2	7.0
		B	Thornton Rd TI UP (#1196) Bridge Replacement	172.55	$3.4	0.000	1.072	0.001	0.001	0.881	0.001	0.000	0.000	1.956	0.12	30.6	2.1
CS8.9	8-9	A	Chuichu Rd UP (#1197) Reprofile	173.53	$0.9	1.313	0.000	0.001	0.001	0.881	0.001	0.000	0.000	2.197	0.21	20.2	10.7
		B	Chuichu Rd UP (#1197) Bridge Replacement	173.53	$2.6	0.000	0.892	0.001	0.001	0.881	0.001	0.000	0.000	1.776	0.12	30.6	2.4
CS8-10	8-3		Wellton-Mohawk Safety Improvements	22 - 56	$2.8	0.000	0.000	0.332	0.005	0.024	0.009	0.000	0.061	0.291	4.95	8.8	4.5

5.3 Solution Risk Analysis

Following the calculation of the PES, an additional step is taken to develop the prioritized list of solutions. A solution risk probability and consequence analysis is conducted to develop a solution-level risk weighting factor. This risk analysis is a numeric scoring system to help address the risk of not implementing a solution based on the likelihood and severity of performance failure. **Figure 25** shows the risk matrix used to develop the risk weighting factors.

Figure 25: Risk Matrix

		Severity/Consequence				
		Insignificant	**Minor**	**Significant**	**Major**	**Catastrophic**
Frequency/ Likelihood	**Very Rare**	Low	Low	Low	Moderate	Major
	Rare	Low	Low	Moderate	Major	Major
	Seldom	Low	Moderate	Moderate	Major	Severe
	Common	Moderate	Moderate	Major	Severe	Severe
	Frequent	Moderate	Major	Severe	Severe	Severe

Using the risk matrix in **Figure 25**, numeric values were assigned to each category of frequency and severity. The higher the risk, the higher the numeric factor that was assigned. The risk weight for each area of the matrix was calculated by multiplying the severity factor times the frequency factor. These numeric factors are shown in **Figure 26**.

Figure 26: Numeric Risk Matrix

			Severity/Consequence				
			Insignificant	**Minor**	**Significant**	**Major**	**Catastrophic**
		Weight	1.00	1.10	1.20	1.30	1.40
Frequency/ Likelihood	**Very Rare**	1.00	1.00	1.10	1.20	1.30	1.40
	Rare	1.10	1.10	1.21	1.32	1.43	1.54
	Seldom	1.20	1.20	1.32	1.44	1.56	1.68
	Common	1.30	1.30	1.43	1.56	1.69	1.82
	Frequent	1.40	1.40	1.54	1.68	1.82	1.96

Using the values in **Figure 26**, risk weighting factors were calculated for each of the following four risk categories (low, moderate, major, and severe). These values are simply the average of the values in **Figure 26** that fall within each category. The resulting average risk weighting factors are:

Low	Moderate	Major	Severe
1.14	1.36	1.51	1.78

The risk weighting factors listed above are assigned to the five performance areas as follows:

- Safety = 1.78
  - The Safety performance area quantifies the likelihood of fatal or incapacitating injury crashes; therefore, it is assigned the Severe (1.78) risk weighting factor
- Bridge = 1.51
  - The Bridge performance area focuses on the structural adequacy of bridges; a bridge failure may result in crashes or traffic being detoured for long periods of time resulting in significant travel time increases; therefore, it is assigned the Major (1.51) risk weighting factor
- Mobility and Freight = 1.36
  - The Mobility and Freight performance areas focus on capacity and congestion; failure in either of these performance areas would result in increased travel times but would not have significant effect on safety (crashes) that would not already be addressed in the Safety performance area; therefore, they are assigned the Moderate (1.36) risk weighing factor
- Pavement = 1.14
  - The Pavement performance area focuses on the ride quality of the pavement; failure in this performance area would likely be a spot location that would not dramatically affect drivers beyond what is already captured in the Safety performance area; therefore, it is assigned the Low (1.14) risk weighting factor

The benefit in each performance area is calculated for each candidate solution as part of the Performance Effectiveness Evaluation. Using this information on benefits and the risk factors listed above, a weighted (based on benefit) solution-level numeric risk factor is calculated for each candidate solution. For example, a solution that has 50% of its benefit in Safety and 50% of its benefit in Mobility has a weighted risk factor of 1.57 (0.50 x 1.36 + 0.50 x 1.78 = 1.57).

5.4 Candidate Solution Prioritization

The PES, weighted risk factor, and segment average need score are combined to create a prioritization score as follows:

Prioritization Score = PES x Weighted Risk Factor x Segment Average Need Score

Where:

PES = Performance Effectiveness Score as shown in ***Table 22***

Weighted Risk Factor = Weighted factor to address risk of not implementing a solution based on the likelihood and severity of the performance failure

Segment Average Need Score = Segment average need score as shown in ***Table 17***

Table 23 shows the prioritization scores for the candidate solutions subjected to the solution evaluation and prioritization process. Solutions that address multiple performance areas tend to score higher in this process. A prioritized list of candidate solutions is provided in the subsequent section. See **Appendix J** for additional information on the prioritization process.

Table 23: Prioritization Scores

Candidate Solution #	Segment #	Option	Candidate Solution Name	Milepost Location	Estimated Cost ($ million)	Performance Effectiveness Score	Weighted Risk Factor	Segment Average Need Score	Prioritization Score	Percentage by which Solution Reduces Performance Area Needs				
										Pavement	Bridge	Mobility	Safety	Freight
CS8.2	8-2	A	Dome Valley Rd TI WB UP (#1325) Reprofile	21.06	$0.3	2.2	1.329	0.77	**2**	15.4%		0.7%	0.5%	83.4%
		B	Dome Valley Rd TI WB UP (#1325) Bridge Replacement	21.06	$1.8	2.5	1.465	0.77	**3**		69.1%	0.3%	0.2%	30.4%
CS8.3	8-7	A	Vekol Road TI UP (#550) Reprofile	144.55	$0.6	0.9	1.360	0.38	**1**		0.0%			100.0%
		B	Vekol Road TI UP (#550) Bridge Replacement	144.55	$2.2	1.5	1.479	0.92	**1**		79.3%			20.7%
CS8.6	8-8	A	Stanfield Rd TI UP (#1090) Reprofile	161.6	$0.8	1.9	1.287	0.54	**1**	33.4%				66.6%
		B	Stanfield Rd TI UP (#1090) Bridge Replacement	161.6	$2.2	0.9	1.440	0.54	**1**		53.3%			46.7%
CS8.7	8-8	A	Murphy Rd UP (#1091) Reprofile	162.5	$0.6	1.6	1.315	0.54	**1**	20.5%				79.5%
		B	Murphy Rd UP (#1091) Bridge Replacement	162.5	$2.6	0.8	1.445	0.54	**1**		56.8%			43.2%
CS8.8	8-9	A	Thornton Rd TI UP (#1196) Bridge Rehab & Reprofile	172.55	$2.9	7.0	1.274	0.92	**8**	54.0%	21.5%			24.4%
		B	Thornton Rd TI UP (#1196) Bridge Replacement	172.55	$3.4	2.1	1.443	0.92	**3**		54.8%	0.1%	0.1%	45.0%
CS8.9	8-9	A	Chuichu Rd UP (#1197) Reprofile	173.53	$0.9	10.7	1.229	0.92	**12**	59.8%		0.1%	0.1%	40.1%
		B	Chuichu Rd UP (#1197) Bridge Replacement	173.53	$2.6	2.4	1.436	0.92	**3**		50.2%	0.1%	0.1%	49.6%
CS8.10	8-3		Wellton-Mohawk Safety Improvements	22-56	$2.8	4.5	1.722	1.00	**8**			86.3%	3.1%	10.6%

6.0 SUMMARY OF CORRIDOR RECOMMENDATIONS

6.1 Prioritized Candidate Solution Recommendations

Table 24 and **Figure 27** show the prioritized candidate solutions recommended for the I-8 corridor in ranked order of priority. The highest prioritization score indicates the candidate solution that is recommended as the highest priority. Implementation of these solutions is anticipated to improve performance of the I-8 corridor. The following observations were noted about the prioritized solutions:

- In the context of the eleven corridors assessed in the corridor profile program, the solutions for I-8 do not score high since the need level is Low in all performance areas.
- Candidate Solution 8.9 Chuichu Rd UP (#1197) Bridge Vertical Clearance Mitigation ranked highest on the corridor due to a reduction in both Freight and Pavement needs at a relatively low cost. Thornton Rd TI UP (#1196) Bridge Vertical Clearance Mitigation also ranked near the top of the corridor list.
- Several sections of I-8 roadway considered pavement hot spots will not be improved by any currently programmed projects. It is anticipated that other preservation programming processes will address these needs in the future.

6.2 Other Corridor Recommendations

As part of the investigation of strategic investment areas and candidate solutions, other corridor recommendations can also be identified. These recommendations could include modifications to the existing Statewide Construction Program, areas for further study, or other corridor-specific recommendations that are not related to construction or policy. The list below identifies other corridor recommendations for the I-8 corridor:

- Consider a corridor strategy to upgrade all bridges to current standards in anticipation of increased truck/freight traffic over the medium to long term.
- Consider corridor wide ITS solutions to assist truck/freight traffic over the medium to long term.

6.3 Policy and Initiative Recommendations

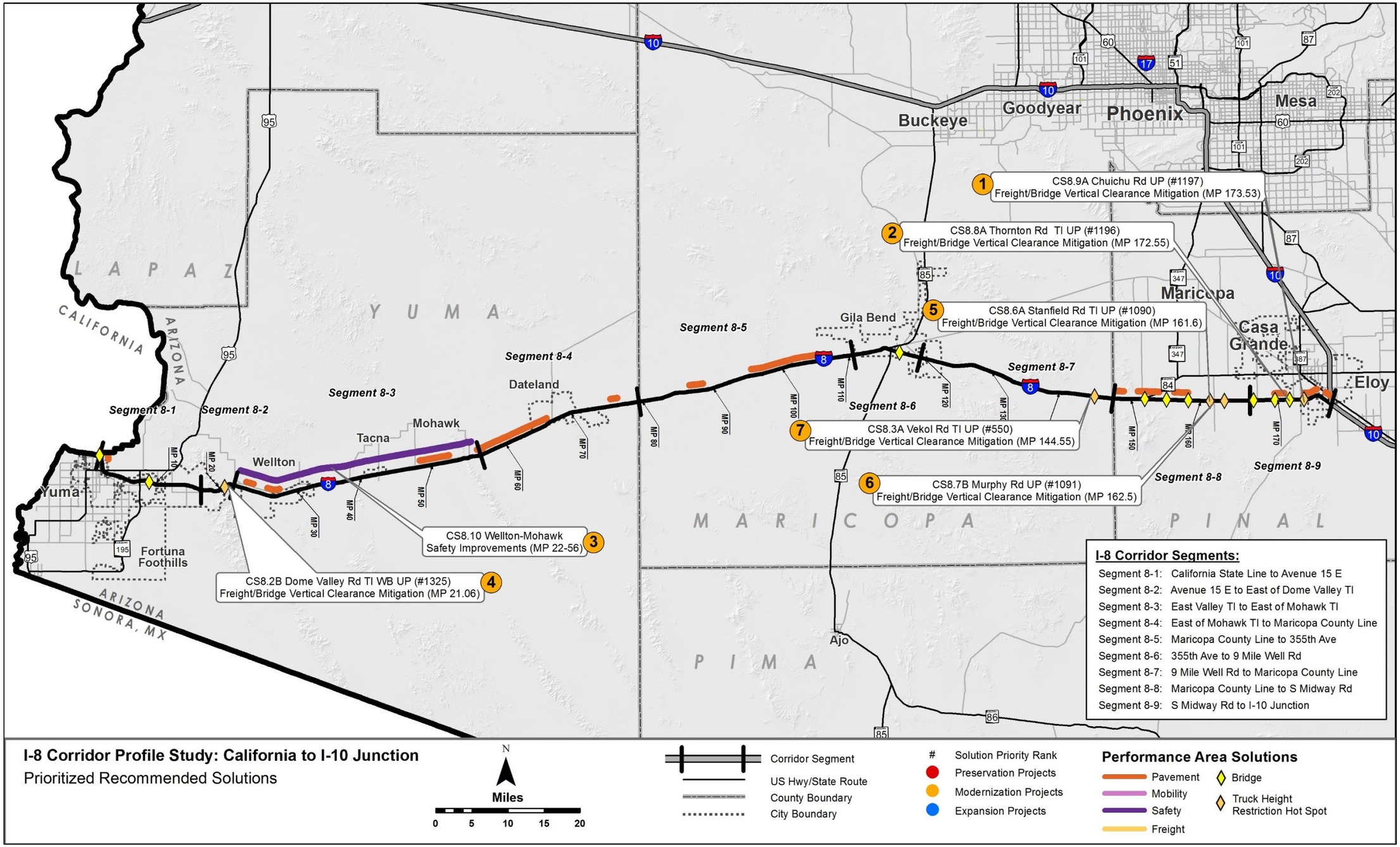
In addition to location-specific needs, general corridor and system-wide needs have also been identified through the CPS process. While these needs are more overarching and cannot be individually evaluated through this process, it is important to document them. A list of recommended policies and initiatives was developed for consideration when programming future projects not only on I-8, but across the entire state highway system where the conditions are applicable. The following list, which is in no particular order of priority, was derived from the Round 1, Round 2, and Round 3 CPS:

- Install Intelligent Transportation System (ITS) conduit with all new infrastructure projects
- Prepare strategic plans for Closed Circuit Television (CCTV) camera and Road Weather Information System (RWIS) locations statewide
- Leverage power and communication at existing weigh-in-motion (WIM), dynamic message signs (DMS), and call box locations to expand ITS applications across the state
- Consider solar power for lighting and ITS where applicable
- Investigate ice formation prediction technology where applicable
- Conduct highway safety manual evaluation for all future programmed projects
- Develop infrastructure maintenance and preservation plans (including schedule and funding) for all pavement and bridge infrastructure replacement or expansion projects
- Develop standardized bridge maintenance procedures so districts can do routine maintenance work
- Review historical ratings and level of previous investment during scoping of pavement and bridge projects. In pavement locations that warrant further investigation, conduct subsurface investigations during project scoping to determine if full replacement is warranted
- For pavement rehabilitation projects, enhance the amount/level of geotechnical investigations to address issues specific to the varying conditions along the project
- Expand programmed and future pavement projects as necessary to include shoulders
- Expand median cable barrier guidelines to account for safety performance
- Install CCTV cameras with all DMS
- In locations with limited communications, use CCTV cameras to provide still images rather than streaming video
- Develop statewide program for pavement replacement
- Install additional continuous permanent count stations along strategic corridors to enhance traffic count data
- When reconstruction or rehabilitation activities will affect existing bridge vertical clearance, the dimension of the new bridge vertical clearance should be a minimum of 16.25 feet where feasible
- All new or reconstructed roadway/shoulder edges adjacent to an unpaved surface should be constructed with a Safety Edge
- Collision data on tribal lands may be incomplete or inconsistent; additional coordination for data on tribal lands is required to ensure adequate reflection of safety issues
- Expand data collection devices statewide to measure freight delay
- Evaluate and accommodate potential changes in freight and goods movement trends that may result from improvements and expansions to the state roadway network

Table 24: Prioritized Recommended Solutions

Rank	Candidate Solution #	Option	Candidate Solution Name	Candidate Solution Scope	Estimated Cost ($ million)	Investment Category [P] Preservation [M] Modernization [E]Expansion	Prioritization Score
1	CS8.9	A	Chuichu Rd UP (#1197) Freight / Bridge Vertical Clearance Mitigation	Re-profile roadway to achieve 16.5 feet vertical clearance	$0.9	M	12
		B	*Chuichu Rd UP (#1197)* *Freight / Bridge Vertical Clearance Mitigation*	*Replace bridge to achieve 16.5 feet vertical clearance*	*$2.6*	*M*	*3*
2	CS8.8	A	Thornton Rd TI UP (#1196) Freight / Bridge Vertical Clearance Mitigation	Rehabilitate the bridge Re-profile roadway to achieve 16.5 feet vertical clearance	$2.9	M	8
		B	*Thornton Rd TI UP (#1196)* *Freight / Bridge Vertical Clearance Mitigation*	*Replace bridge to achieve 16.5 feet vertical clearance*	*$3.4*	*M*	*3*
3	CS8.10	-	Wellton-Mohawk Safety Improvements	Speed Feedback Signs (EB MP 28, EB MP 40, EB MP 45, EB MP 53.75, WB MP 23, WB MP 31.5, WB MP 44, WB MP 56.5) Install Lighting (WB MP 25-25.49, WB MP 27.5-27.99, WB MP 32-33, WB MP 35 - 35.49, EB MP 26 - 26.49, WB MP 45.5-45.99)	$2.8	M	8
4	CS8.2	B	Dome Valley Rd TI WB UP (#1325) Freight / Bridge Vertical Clearance Mitigation	Replace bridge to achieve 16.5 feet vertical clearance	$1.8	M	3
		A	*Dome Valley Rd TI WB UP (#1325)* *Freight / Bridge Vertical Clearance Mitigation*	*Re-profile roadway to achieve 16.5 feet vertical clearance*	*$0.3*	*M*	*2*
5	CS8.6	A	Stanfield Rd TI UP (#1090) Freight / Bridge Vertical Clearance Mitigation	Re-profile roadway to achieve 16.5 feet vertical clearance	$0.8	M	1
		B	*Stanfield Rd TI UP (#1090)* *Freight / Bridge Vertical Clearance Mitigation*	*Replace bridge to achieve 16.5 feet vertical clearance*	*$2.2*	*M*	*1*
6	CS8.7	A	Murphy Rd UP (#1091) Freight / Bridge Vertical Clearance Mitigation	Re-profile roadway to achieve 16.5 feet vertical clearance	$0.6	M	1
		B	*Murphy Rd UP (#1091)* *Freight / Bridge Vertical Clearance Mitigation*	*Replace bridge to achieve 16.5 feet vertical clearance*	*$2.6*	*M*	*1*
7	CS8.3	B	Vekol Road TI UP (#550) Freight / Bridge Vertical Clearance Mitigation	Replace bridge to achieve 16.5 feet vertical clearance	$2.2	M	1
		A	*Vekol Road TI UP (#550)* *Freight / Bridge Vertical Clearance Mitigation*	*Re-profile roadway to achieve 16.5 feet vertical clearance*	*$0.6*	*M*	*1*

Figure 27: Prioritized Recommended Solutions



6.4 Next Steps

The candidate solutions recommended in this study are not intended to be a substitute or replacement for traditional ADOT project development processes where various ADOT technical groups and districts develop candidate projects for consideration in the performance-based programming in the P2P process. Rather, these candidate solutions are intended to complement ADOT's traditional project development processes through a performance-based process to address needs in one or more of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Candidate solutions developed for the I-8 corridor will be considered along with other candidate projects in the ADOT statewide programming process.

It is important to note that the candidate solutions are intended to represent strategic solutions to address existing performance needs related to the Pavement, Bridge, Mobility, Safety, and Freight performance areas. Therefore, the strategic solutions are not intended to preclude recommendations related to the ultimate vision for the corridor that may have been defined in the context of prior planning studies and/or design concept reports. Recommendations from such studies are still relevant to addressing the ultimate corridor objectives.

Upon completion of all three CPS rounds, the results will be incorporated into a summary document comparing all corridors that is expected to provide a performance-based review of statewide needs and candidate solutions.