FINAL REPORT

I-17 Corridor Profile Study

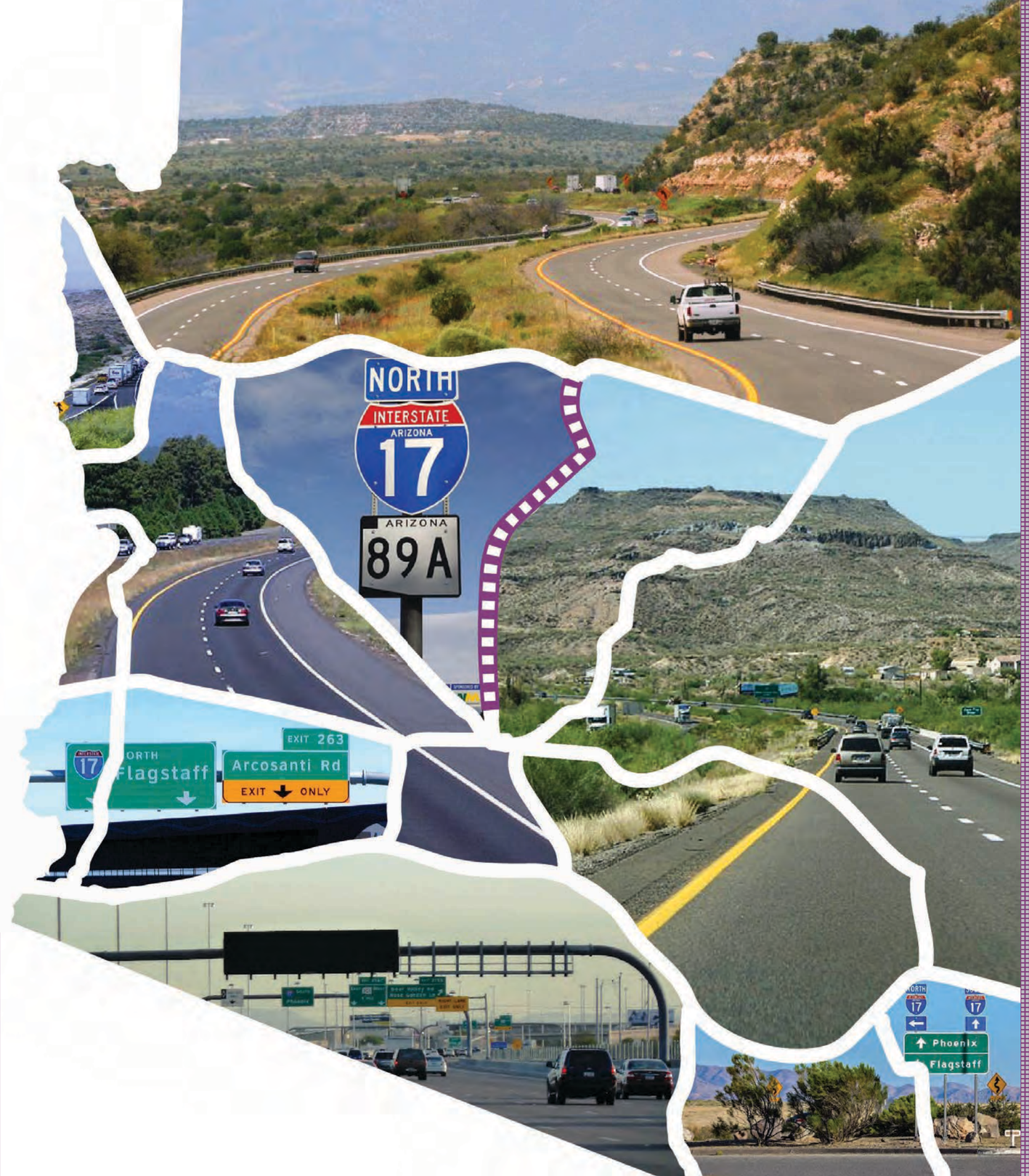
SR 101L to I-40

PREPARED FOR ADOT MARCH 2017

ADOT WORK TASK NO.
MPD 072B-14

ADOT CONTRACT NO.
11-013164

Prepared by



I-17 CORRIDOR PROFILE STUDY

SR 101L TO I-40

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MARCH 2017

PREPARED FOR:

ARIZONA DEPARTMENT OF TRANSPORTATION

PREPARED BY:

AECOM

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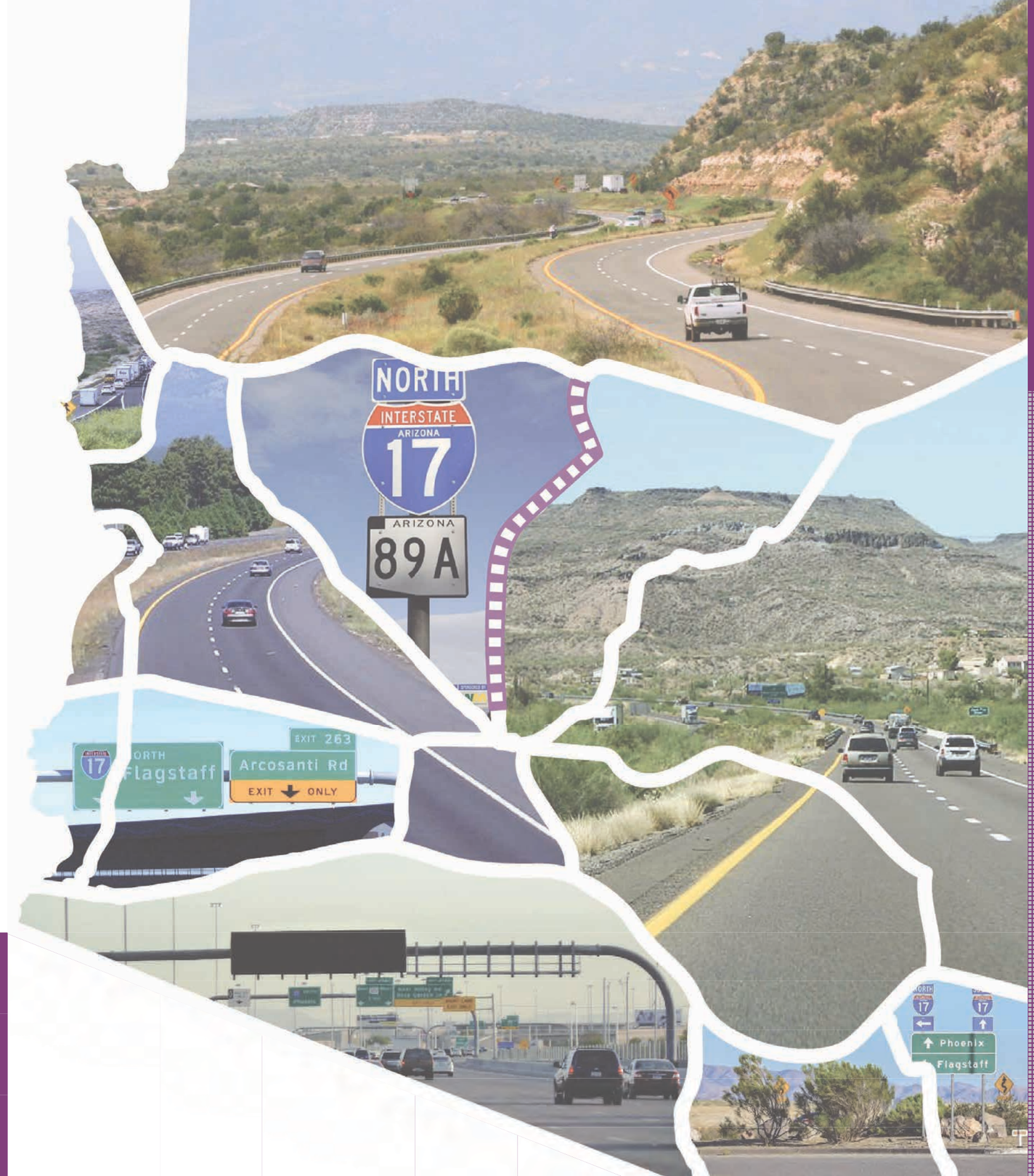
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ACRONYMS & ABBREVIATIONS

AADT	Average Annual Daily Traffic
ADOT	Arizona Department of Transportation
ASLD	Arizona State Land Department
AZTDM	Arizona Travel Demand Model
BCA	Benefit-Cost Analysis
BLM	Bureau of Land Management
BQAZ	Building a Quality Arizona
CCTV	Closed Circuit Television
CDP	Census Designated Places
CR	Cracking Rating
CYMPO	Central Yavapai Metropolitan Planning Organization
DMS	Dynamic Message Sign
DCR	Design Concept Report
FMPO	Flagstaff Metropolitan Planning Organization
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
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
NACOG	Northern Arizona Council of Governments
NB	Northbound
NPV	Net Present Value
OP	Overpass
PES	Performance Effectiveness Score
P2P	Planning to Programming
PDI	Pavement Distress Index
PSR	Pavement Serviceability Rating
PTI	Planning Time Index
RTP	Regional Transportation Plan
SB	Southbound
SHSP	Strategic Highway Safety Plan
SR	State Route
TI	Traffic Interchange
TIP	Transportation Improvement Plan
TPTI	Truck Planning Time Index
TTI	Travel Time Index
TTTI	Truck Travel Time Index
UP	Underpass
USDOT	United States Department of Transportation
V/C	Volume to Capacity Ratio
VMT	Vehicle-Miles Traveled
WIM	Weigh-in-motion



Executive Summary

EXECUTIVE SUMMARY

INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study (CPS) of Interstate 17 (I-17) between the cities of Phoenix (SR 101L) and Flagstaff (I-40). This study examines key performance measures relative to the I-17 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 I-17 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. This purpose can be accomplished by following the process described below:

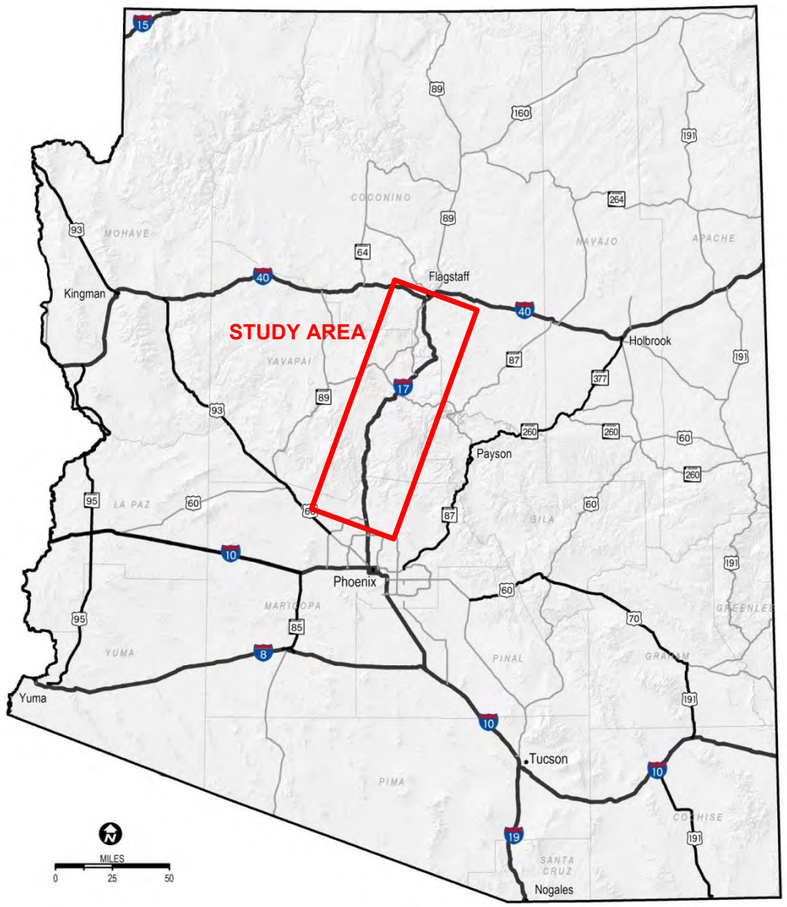
- Inventory past improvement recommendations
- Define corridor goals and objectives
- Assess existing performance based on quantifiable performance measures
- Propose various solutions to improve corridor performance
- Identify specific solutions that can provide quantifiable benefits relative to the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

The objective of 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-17 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

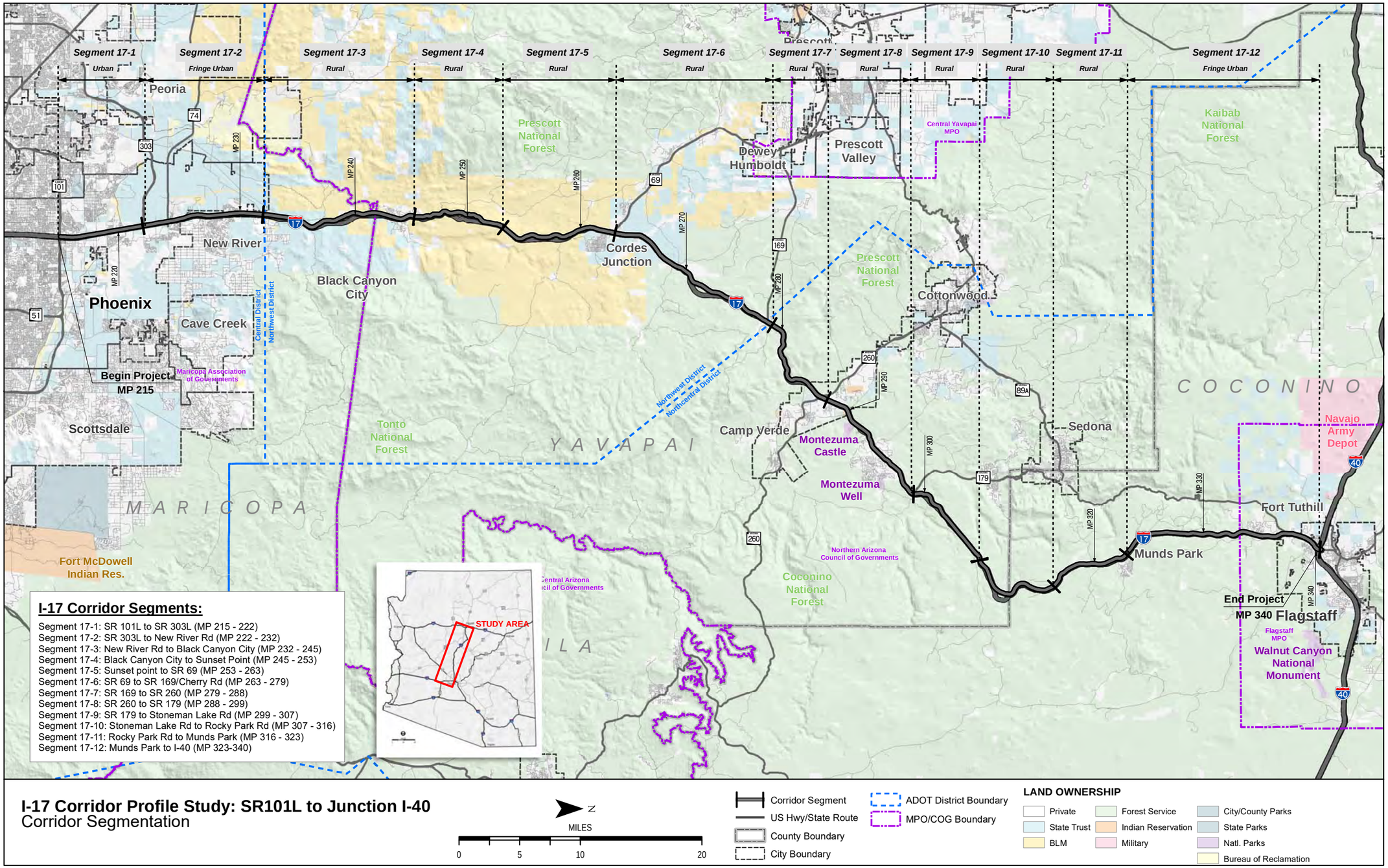
Figure ES-1: Corridor Study Area



Study Location and Corridor Segments

The I-17 Corridor is divided into 12 planning segments for 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 is used to assess the I-17 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 falls 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-17 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**.

Approximately 81% of the corridor shows “good” performance in the Pavement Index. For the Bridge Index, 34% of the corridor shows “good” performance, and 66% shows “fair” performance. Approximately 70% of the corridor shows “good”, 25% “fair” and 5% “poor” performance in Mobility. Over one-third of the corridor (36%) for the Safety Index shows “below average” performance, while the remaining 64% of the corridor shows “fair” performance. For the Freight Index, approximately 60% of the corridor shows “good” performance while 40% shows “fair” performance.

The lowest performance along the I-17 Corridor occurs in the Safety and Bridge Performance Areas while the Pavement and Mobility Performance Areas showing the highest performance.

The following general observations were made related to the I-17 Corridor:

- The bridges and pavement are generally in “good” or “fair” condition with the exception of a few isolated locations
- The McGuireville TI is a structurally deficient bridge, has a low Sufficiency Rating, and has a sub-standard vertical clearance which obstructs freight movement since the southbound exit ramp is a loop ramp and does not allow trucks to by-pass the restriction
- Currently, the general mobility along the corridor is “good” (during a typical weekday) but projected traffic growth is expected to result in “poor” or “fair” performance in approximately 45% of the corridor (at the south end and in the middle of the corridor) by the year 2035
- There are several locations along the corridor where recurring and non-recurring delays show either “fair” or “poor” performance, primarily due to uphill grades, as reflected in both the Mobility and Freight Performance Areas
- Currently, the freight mobility along the corridor is “good” with a few spot locations that show “fair” performance primarily due to uphill grades
- The frequency of closures along the corridor generally match the statewide average with the exception of segments 17-3 and 17-4 which exceed the statewide average
- The duration of closures along the corridor generally match the statewide average with the exception of segments 17-1, 17-3, and 17-4 which exceed the statewide average
- A majority of the segments perform either “average” or “below average” in the Safety Index

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	Lowest Bridge Rating	% of Deck Area on Functionally Obsolete Bridges	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
			NB	SB								NB	SB	NB	SB	NB	SB	NB	SB		
17-11	7	4.19	4.24	4.14	0.0%	6.98	91.52	5	23.8%	0.90	1.09	0.67	0.67	0.41	0.03	1.00	1.00	1.03	1.03	99%	10.7%
17-21	10	4.16	4.13	4.15	0.0%	6.79	92.73	6	14.6%	0.68	0.80	0.51	0.53	0.41	0.00	1.08	1.05	1.15	1.11	100%	12.3%
17-32	13	3.85	3.92	3.86	3.8%	6.39	91.10	5	31.3%	0.58	0.71	0.40	0.40	0.78	0.11	1.09	1.11	1.17	1.20	100%	12.0%
17-42	8	4.25	3.65	4.25	0.0%	5.71	93.97	5	60.9%	0.64	0.78	0.38	0.38	0.75	0.61	1.21	1.00	1.61	1.07	97%	12.3%
17-52	10	4.25	4.09	4.02	0.0%	7.15	96.27	6	16.9%	0.59	0.72	0.38	0.40	0.42	0.28	1.20	1.14	1.34	1.21	100%	15.5%
17-62	16	4.26	4.08	4.02	0.0%	6.19	94.82	5	8.5%	0.37	0.45	0.33	0.33	0.05	0.15	1.13	1.38	1.23	1.69	100%	7.7%
17-72	9	3.92	3.78	3.93	16.7%	6.31	91.41	6	0.0%	0.55	0.68	0.47	0.48	0.27	0.11	1.09	1.15	1.27	1.31	98%	7.7%
17-82	11	4.32	4.01	4.17	4.5%	6.04	89.20	4	13.6%	0.39	0.47	0.35	0.35	0.15	0.22	1.14	1.13	1.27	1.24	100%	14.1%
17-92	8	4.21	3.77	4.18	18.8%	6.00	93.00	6	100.0%	0.41	0.49	0.32	0.32	0.35	0.20	1.30	1.12	1.61	1.22	100%	6.6%
17-102	9	4.19	4.01	4.06	0.0%	6.52	94.00	6	100.0%	0.35	0.41	0.27	0.27	0.20	0.29	1.29	1.13	1.60	1.25	100%	6.3%
17-112	7	3.73	3.50	3.82	21.4%	6.91	96.48	5	3.4%	0.29	0.34	0.23	0.21	0.00	0.29	1.10	1.08	1.18	1.16	100%	6.2%
17-121	17	3.70	3.49	3.82	25.7%	5.80	92.00	5	62.3%	0.29	0.34	0.18	0.18	0.07	0.31	1.06	1.05	1.13	1.11	94%	17.9%
Weighted Corridor Average		4.07	3.88	4.02	7.9%	6.34	92.94	5.28	35.6%	0.48	0.58	0.36	0.36	0.30	0.21	1.13	1.13	1.28	1.24	98.8%	11.3%

SCALES

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

Performance Level	Rural
Good/Above Average	< 0.56
Fair/Average	0.56 - 0.76
Poor/Below Average	> 0.76

1: Urban or Fringe Urban
2: Rural

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 TTTI		Directional TPTI		Closure Duration (mins/milepost/year/mile)		Bridge Vertical Clearance (feet)
			NB	SB						NB	SB	NB	SB	NB	SB	
17-1[a]	7	1.13	1.03	1.24	0%	6%	12%	Insufficient Data	0.94	1.03	1.03	1.07	1.07	134.0	4.5	16.80
17-2[b]	10	1.67	1.51	1.83	31%	11%	9%	Insufficient Data	0.95	1.02	1.00	1.06	1.04	108.5	0.0	16.23
17-3[c]	13	0.75	0.84	0.67	69%	10%	17%	Insufficient Data	0.94	1.01	1.03	1.04	1.09	209.8	19.7	16.01
17-4[c]	8	1.06	0.49	1.64	35%	12%	29%	Insufficient Data	0.67	1.34	1.07	1.81	1.16	194.0	175.3	16.29
17-5[c]	10	1.01	1.36	0.65	35%	10%	15%	Insufficient Data	0.88	1.09	1.02	1.20	1.07	120.0	49.4	18.22
17-6[d]	16	1.32	1.09	1.55	56%	6%	17%	Insufficient Data	0.74	1.03	1.27	1.08	1.61	13.6	24.9	16.85
17-7[c]	9	0.85	0.98	0.72	47%	Insufficient Data	13%	Insufficient Data	0.75	1.07	1.27	1.15	1.52	64.0	20.7	16.91
17-8[d]	11	2.54	3.00	2.08	58%	16%	5%	Insufficient Data	0.88	1.08	1.05	1.15	1.11	32.7	44.2	15.18
17-9[d]	8	2.18	2.39	1.97	48%	10%	0%	Insufficient Data	0.75	1.29	1.06	1.55	1.13	122.5	107.0	No UP
17-10[d]	9	0.86	0.81	0.91	50%	Insufficient Data	Insufficient Data	Insufficient Data	0.74	1.25	1.07	1.57	1.15	41.7	121.2	No UP
17-11[d]	7	1.21	2.19	0.24	29%	7%	7%	Insufficient Data	0.94	1.03	1.02	1.07	1.06	0.0	124.4	16.87
17-12[d]	17	1.04	0.53	1.54	33%	4%	8%	Insufficient Data	0.93	1.05	1.03	1.10	1.06	12.6	122.3	16.51
Weighted Corridor Average		1.29	1.29	1.29	43.1%	8.9%	12.1%	Insufficient Data	0.85	1.09	1.08	1.21	1.19	81.8	65.2	16.56

SCALES										
Performance Level	Urban >6 Lane Freeway					Uninterrupted			All	
Good/Above Average	< 0.80	< 42.6%	< 2.5%	< 12.6%	-	> 0.77	< 1.15	< 1.30	< 44.18	> 16.5
Fair/Average	0.80 – 1.20	42.6% - 54.8%	2.5% - 6.0%	12.6% - 20.0%	-	0.67 - 0.77	1.15 -1.33	1.30 -1.50	44.18 -124.86	16.0-16.5
Poor/Below Average	> 1.20	> 54.8%	> 6.0%	> 20.0%	-	< 0.67	> 1.33	>1.50	> 124.86	< 16.0
Performance Level	Urban or Rural 6 Lane Freeway									
Good/Above Average	< 0.82	< 33.5%	< 6.2%	< 6.7%	-					
Fair/Average	0.82 – 1.18	33.5% - 57.2%	6.2% - 11.0%	6.7% - 12.9%	-					
Poor/Below Average	> 1.18	> 57.2%	> 11.0%	> 12.9%	-					
Performance Level	Rural 4 Lane Freeway > 25,000 vpd									
Good/Above Average	< 0.68	< 40.8%	< 7.2%	< 7.7%	-					
Fair/Average	0.68 – 1.32	40.8% - 57.1%	7.2% - 12.9%	7.7% - 17.1%	-					
Poor/Below Average	> 1.32	> 57.1%	> 12.9%	> 17.1%	-					
Performance Level	Rural 4 Lane Freeway < 25,000 vpd									
Good/Above Average	< 0.73	< 42.8%	< 13.2%	< 5.0%	-					
Fair/Average	0.73 – 1.27	42.8% - 52.9%	13.2% - 17.0%	5.0% - 8.5%	-					
Poor/Below Average	> 1.27	> 52.9%	> 17.0%	> 8.5%	-					

a: Urban >6 Lane Freeway b: Urban or Rural 6 Lane Freeway c: Rural 4 Lane Freeway > 25,000 vpd d: Rural 4 Lane Freeway < 25,000 vpd

Notes: "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

The I-17 Corridor is and will continue to be a major transportation corridor for commuting, commerce, and tourism. I-17 is primarily a 4-lane divided freeway from New River Road through I-40 with 4-8 divided lanes and HOV lanes in the urban segments of the corridor between SR 101L and New River Road. ADOT has designated this section of I-17 as a Key Commerce Corridor and as part of the National Primary Freight Network. I-17 provides the most direct and fastest link between Phoenix (and I-10) and Flagstaff (and I-40) and provides a principal road link for national and international traffic from Phoenix Sky Harbor International Airport to Prescott, the Verde Valley, Sedona, Flagstaff, the Grand Canyon, and the Navajo and Hopi nations.

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-17 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, two "Emphasis Areas" were identified for the I-17 Corridor: Mobility and Safety.

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 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

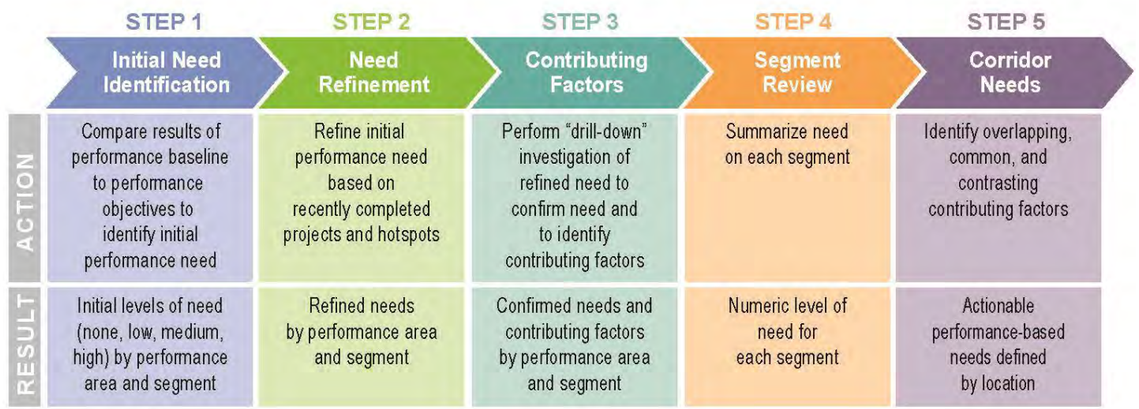


Figure ES-5: Initial Need Ratings in Relation to Baseline Performance (Bridge Example)

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		

Summary of Corridor Needs

Table ES-3 provides a summary of needs for each segment across all performance areas, with the average need score for each segment presented in the last row of the table. A weighting factor of 1.5 is applied to the need scores of the performance areas identified as emphasis areas (Mobility and Safety for the I-17 Corridor). There are no segments with a High average need, nine segments with a Medium average need, and five segments with a Low average need. More information on the identified final needs in each performance area is provided below.

Pavement Needs

- Pavement Needs were identified on three segments (17-3, 17-11, and 17-12).
- Programmed pavement rehabilitation projects will likely mitigate two of these segments.
- A high level of historical investment was identified on approximately 72 miles of the corridor, meaning that some projects have proven to provide only temporary improvements and require frequent attention. These locations may be candidates for life-cycle cost analysis to evaluate alternative solutions.

Bridge Needs

- Bridge Needs occur due to under-performing bridges or hot spots on nine of the twelve segments.
- Bridge Needs were identified at 16 of the total 98 bridges (16%).
- Projects are programmed at two bridges which could address the Needs at Moores Gulch (southbound) and Willard Springs TI.
- Eleven bridges have current ratings of 5, and one bridge has current rating of 4.
- Eight bridges have potential historical rating issues and may be candidates for life-cycle cost analysis to evaluate alternative solutions.

Mobility Needs

- Mobility Needs were identified on nine of the twelve segments (70% of corridor).
- A majority of the Needs are related to future travel demand, directional TTI and PTI issues, and closures.
- “Medium” Mobility Needs were identified on Segment 17-4 primarily due to the grades/terrain and restrictions due to closures.
- The lowest trip reliability is on Segment 17-4 (MP 245-253).

Safety Needs

- Safety Needs were identified on all segments along the I-17 Corridor.
- “High” Safety Needs were identified on six of the twelve segments (47% of corridor).
- Multiple safety hot spots were identified, especially in the southern part of the corridor on segments 17-1 through 17-3.
- At the overall corridor level, 62% of the fatal and incapacitating crashes involve either over-turning or colliding with a fixed object, 52% involve run-off-road crashes, and 30% involve speed too fast for conditions.
- While a “High” level of Need was identified on segments 17-1 and 17-2, both of these segments have recently been reconstructed/widened which has changed the operating conditions of these segments and may have addressed some of the safety issues.

Freight Needs

- Freight Needs were identified on all segments along the I-17 Corridor.
- All segments show “Low” Need, except on segment 17-4. Other than on segment 17-4, impediments to freight mobility and travel times are not significant.
- Elevated values for TTTI and TPTI are generally shown in the uphill directions of mountainous terrain.
- Closure durations are higher than the statewide average on the southern end (segments 17-1 through 17-5) and the northern end (segments 17-9-17-12) of the corridor.
- Two bridges provide less than 16’ vertical clearance and cannot be by-passed by using ramps: Table Mesa Rd TI UP (MP 236 southbound) and McGuireville TI UP (MP 293 southbound)

Overlapping Needs

This section identifies overlapping performance needs on the I-17 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:

- MP 245 to 253 (Segment 17-4) has overlapping needs in the Bridge, Mobility, Safety, and Freight performance areas with Medium or High levels of Need in all four areas. The ADOT Northwest District has indicated that this location is a high crash area and has significant mobility issues. This area has substantial grades and is classified as mountainous terrain which is the primary contributing factor to the freight and mobility issues. Mountainous terrain typically creates speed differentials between vehicles and two travel lanes do not supply ample passing opportunities leading to improper lane changes. The ADOT Climbing and Passing Lane Prioritization Study (2015) indicated that the implementation of a climbing lane on this section of the corridor is ranked number 1 on the prioritized list of climbing lanes on multi-lane highways within the state.

Table ES-3: Summary of Needs by Segment

Performance Area	Segment Number and Mileposts											
	17-1 MP 215-222	17-2 MP 222-232	17-3 MP 232-245	17-4 MP 245-253	17-5 MP 253-263	17-6 MP 263-279	17-7 MP 279-288	17-8 MP 288-299	17-9 MP 299-307	17-10 MP 307-316	17-11 MP 316-323	17-12 MP 323-340
Pavement	None	None	Low	None	None	None	None	None	None	None	Low	Low
Bridge	Low	None	Low	Medium	None	Low	None	Low	Low	Low	Low	Medium
Mobility+	High	Low	Low	Medium	Low	Low	Low	None	Low	Low	None	None
Safety+	High	High	Low	Medium	Medium	High	Low	High	High	Low	High	Medium
Freight	Low	Low	Low	High	Low	Low	Low	Low	Low	Low	Low	Low
Average Need (0-3)	**2.07**	**1.33**	**1.00**	**1.87**	**1.03**	**1.47**	**0.73**	**1.17**	**1.47**	**0.87**	**1.30**	**1.13**

** 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-17 Corridor.

Average Need Scale	
None	< 0.1
Low	0.1 - 1.00
Medium	1.00 - 2.00
High	> 2.00

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. The I-17 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-17 Corridor will be considered along with other candidate projects in the ADOT statewide programming process.

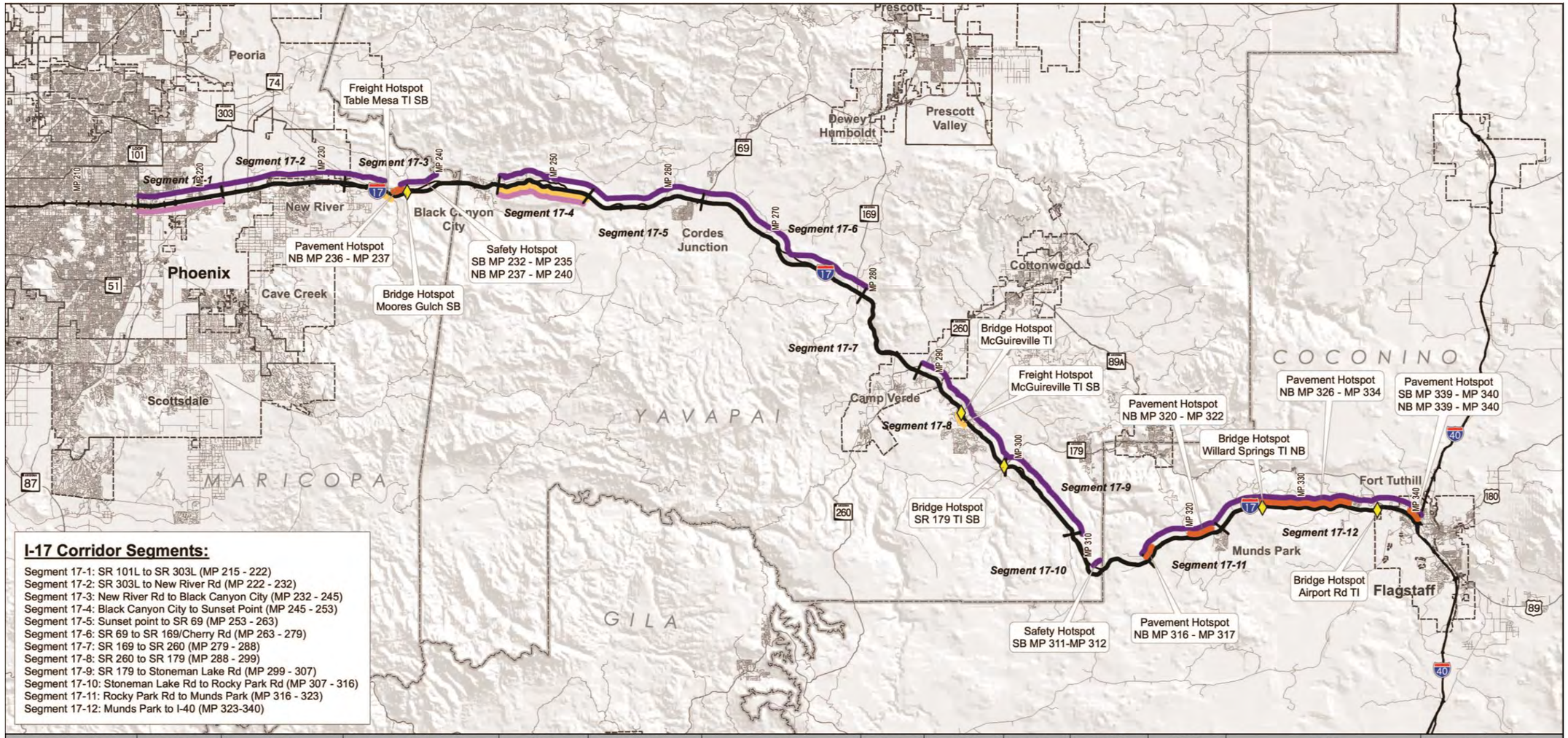
Candidate solutions include some or all of the following characteristics:

- 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



I-17 Corridor Segments:

Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
Segment 17-2: SR 303L to New River Rd (MP 222 - 232)
Segment 17-3: New River Rd to Black Canyon City (MP 232 - 245)
Segment 17-4: Black Canyon City to Sunset Point (MP 245 - 253)
Segment 17-5: Sunset point to SR 69 (MP 253 - 263)
Segment 17-6: SR 69 to SR 169/Cherry Rd (MP 263 - 279)
Segment 17-7: SR 169 to SR 260 (MP 279 - 288)
Segment 17-8: SR 260 to SR 179 (MP 288 - 299)
Segment 17-9: SR 179 to Stoneman Lake Rd (MP 299 - 307)
Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)

Segments	17-1	17-2	17-3	17-4	17-5	17-6	17-7	17-8	17-9	17-10	17-11	17-12	Segments
Pavement	-	-	Hotspot	-	-	-	-	-	-	-	Hotspot	Hotspot	Pavement
Bridge	-	-	Hotspot	Medium	-	-	-	Hotspot	-	-	-	Medium	Bridge
Mobility*	High	-	-	Medium	-	-	-	-	-	-	-	-	Mobility*
Safety*	High	High	Hotspot	Medium	Medium	High	-	High	High	Hotspot	High	Medium	Safety*
Freight	-	-	Hotspot	High	-	-	-	Hotspot		-	-	-	Freight
Average Need (0-3)	2.07	1.33	1.00	1.87	1.03	1.47	0.73	1.17	1.47	0.87	1.30	1.13	Average Need (0-3)

* Identified as Emphasis Area for I-17 corridor

I-17 Corridor Profile Study: SR 101L to Junction I-40
Strategic Investment Areas

0 2.5 5 10 15 20 Miles

Strategic Investment Areas
Safety
Pavement
Freight
Mobility
Bridge

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 is 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 can eliminate 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.

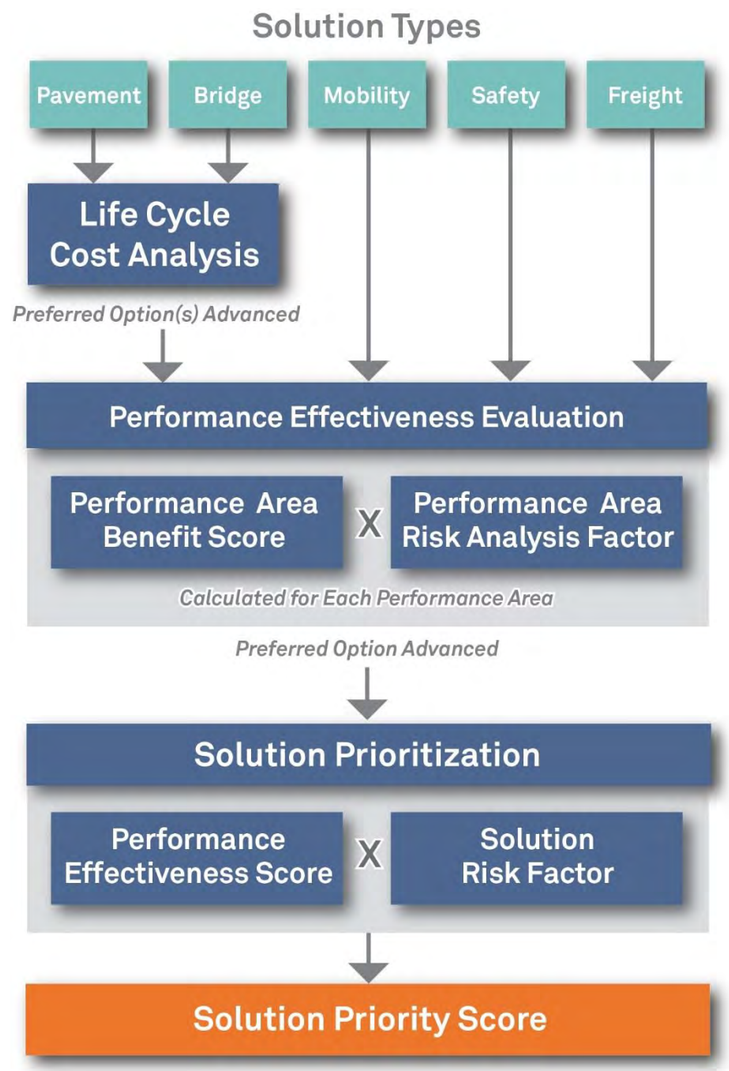
Solution Risk Analysis

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

Prioritized Candidate Solution Recommendations

Table ES-4 and **Figure ES-8** show the prioritized candidate solutions recommended for the I-17 Corridor. Implementation of these solutions is anticipated to improve performance of the I-17 Corridor across a majority of the performance areas.

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-17 Corridor:

- Conduct study to investigate paving roadway along existing dirt roads connecting Bumble Bee Rd (MP 248) to Bloody Basin Rd (MP 259) for use during closures, similar to N20 interim detour for US 89.
- Continue to provide additional driver messaging and emphasis on safety during holiday weekends.
- The scoping and design of project H893401C (Coconino County Line to I-40)(FY 18) should investigate safety improvements such as installing high visibility striping and delineators, raised pavement markers, rumble strips and widening/rehabilitating the inside (median) shoulder in both directions of travel.
- When recommending future projects along I-17, review historical ratings and levels of investment. According to data used for this study, the following pavement and bridge locations have exhibited high historical investment (pavement) or rating fluctuation (bridge) issues:
  - I-17 OP @ Frt Rd SB #2180 (MP 215)
  - Pavement MP 215 – MP 222
  - Pavement MP 222 – MP 232
  - Moores Gulch SB #339 (MP 238.6)
  - Pavement MP 253 – MP 263
  - Dugas Rd TI SB #1080 (MP 268.75)
  - Cienga Creek NB #428 (MP 277.93)
  - Middle Verde Rd TI #1733 (MP 289.97)
  - Pavement MP 288 – MP 299
  - Pavement MP 299 – MP 307
  - Pavement MP 307 – MP 316
  - McGuireville TI #652 (MP 293.26)
  - Pavement MP 323 – MP 340
  - Willard Springs TI NB #1583 (MP 326)
  - Airport Rd TI #632 (MP 337.39)

Policy and Initiatives 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-17, 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-17 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.

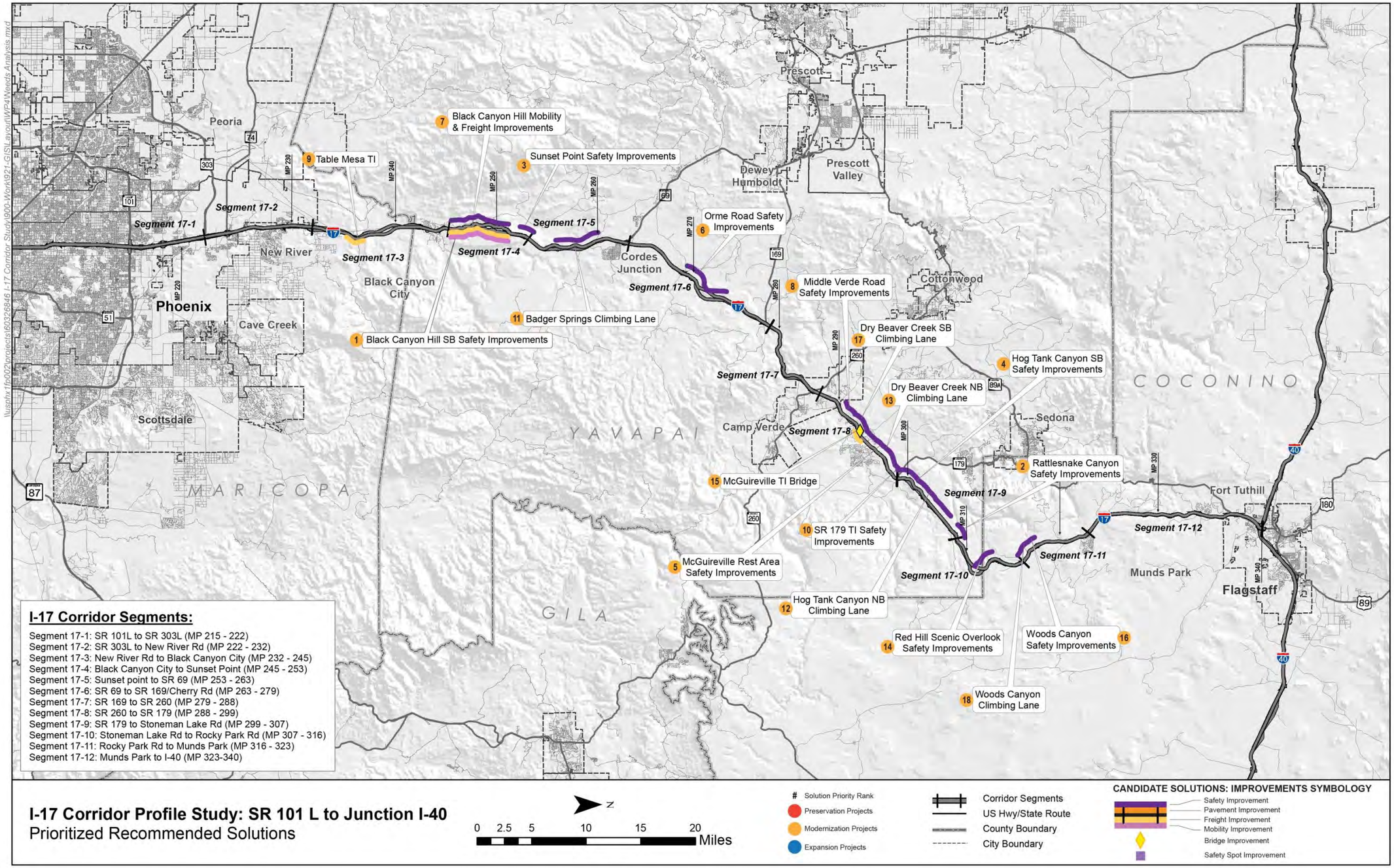
Table ES-4: Prioritized Recommended Solutions

Rank	Candidate Solution #	Option	Solution Name and Location	Description / Scope	Estimated Cost (in millions)	Investment Category Preservation [P] Modernization [M] Expansion [E]	Prioritization Score
1	CS17.03	-	Black Canyon Hill Southbound Safety Improvements (SB MP 245 -251)	Enhance roadside design (replace guardrail). Install high visibility striping and delineators, raised pavement markers, and rumble strips. Install chevrons on curves. Excavate/grade cut slopes to improve sight distance. Install dynamic speed feedback system on southbound roadway (near MP 248 & MP 251).	$3.15	M	176
2	CS17.15	-	Rattlesnake Canyon Northbound Safety Improvements (NB MP 305-307)	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace). Install high visibility striping and delineators, raised pavement markers, and rumble strips. Install chevrons on curves. Install dynamic speed feedback system. Construct/extend northbound parallel entrance ramp at Stoneman Lake TI. Install CCTV near MP 306.5.	$2.25	M	151
3	CS17.04	-	Sunset Point Safety Improvements (MP 252-253)	Construct/ extend parallel northbound and southbound exit ramps at Sunset Point TI. Install roadway weather information systems (RWIS). Install dynamic wind warning system.	$2.47	M	99
4	CS17.14	-	Hog Tank Canyon Southbound SB Safety Improvements (SB MP 300-302)	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace). Install high visibility striping and delineators, raised pavement markers, and rumble strips. Install chevrons on curves. Install dynamic speed feedback system. Excavate/grade cut slopes to improve sight distance.	$4.03	M	74
5	CS17.11	-	McGuireville Rest Area Safety Improvements (SB MP 295-299)	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace). Install high visibility striping and delineators, raised pavement markers, and rumble strips. Install chevrons on curves. Install dynamic speed feedback system near MP 297 and MP 299. Install CCTV on existing DMS located at MP 297.4.	$4.73	M	63
6	CS17.06	-	Orme Rd Southbound Safety Improvements (SB MP 269-274)	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace). Install high visibility striping and delineators, raised pavement markers, and rumble strips. Install chevrons on curves. Install dynamic speed feedback system near MP 272 & 274.	$4.72	M	52
7	CS17.02	A	Black Canyon Hill Mobility & Freight Improvements (MP 245-251)	Construct northbound climbing lane and replace southbound Bumble Bee Rd Bridge.	$47.57	M	41
		B		Construct reversible lanes and replace southbound Bumble Bee Rd Bridge.	$146.22	M	29
8	CS17.08	-	Middle Verde Rd Northbound Safety Improvements (NB MP 290-293)	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace). Install high visibility striping and delineators, raised pavement markers, and rumble strips. Install chevrons on curves. Install dynamic speed feedback system near MP 291 & MP 293. Install CCTV near existing DMS located at MP 289.	$3.83	M	32
9	CS17.01	-	Table Mesa TI Vertical Clearance Mitigation (MP 236)	Re-profile southbound roadway	$2.41	M	18

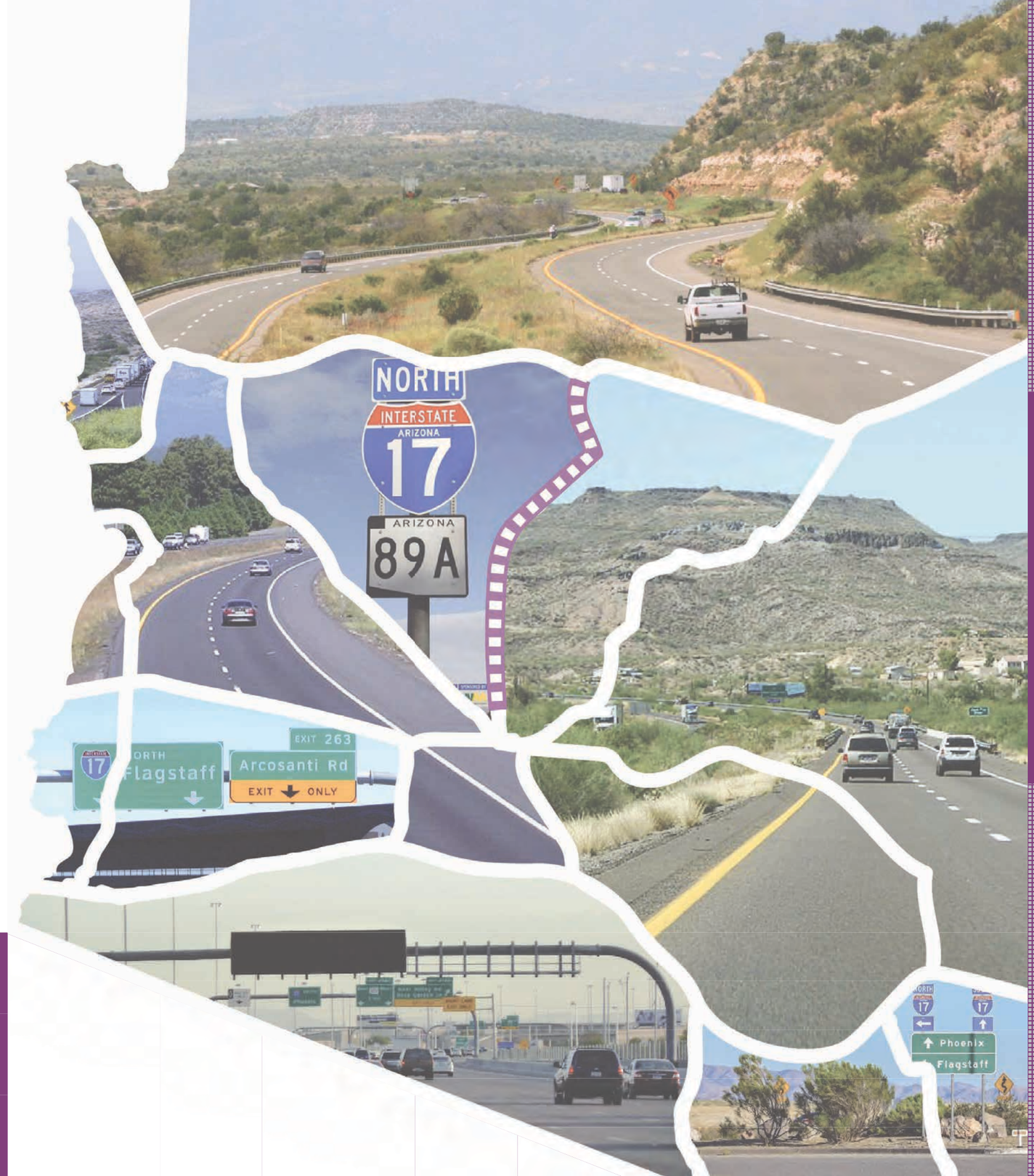
Table ES-4: Prioritized Recommended Solutions (continued)

Rank	Candidate Solution #	Option	Solution Name and Location	Description / Scope	Estimated Cost (in millions)	Investment Category Preservation [P] Modernization [M] Expansion [E]	Prioritization Score
10	CS17.12	-	SR 179 TI Safety Improvements (MP 299)	Construct/extend parallel southbound entrance and northbound exit ramps at SR179 TI.	$2.22	M	12
11	CS17.05	-	Badger Springs Northbound Climbing Lane (NB MP 256-260)	Construct northbound climbing lane.	$14.90	M	12
12	CS17.13	-	Hog Tank Canyon NB Climbing Lane (NB MP 299-305)	Construct northbound climbing lane. Install new DMS at MP 303.4 with CCTV.	$23.06	M	11
13	CS17.10	-	Dry Beaver Creek NB Climbing Lane (NB MP 294-298)	Construct northbound climbing lane	$14.90	M	11
14	CS17.16	-	Red Hill Scenic Overlook Southbound Safety Improvements (SB MP 309-313)	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace). Install chevrons on curves. Install dynamic speed feedback system near MP 311 and MP 313. Install CCTV near MP 312.3.	$7.23	M	9
15	CS17.07	A	McGuireville TI Bridge (MP 293.25-293.75)	Rehabilitate/repair McGuireville TI bridge and construct new southbound exit ramp	$7.79	M	6
		B		Replace McGuireville TI bridge	$18.86	M	5
16	CS17.18	-	Woods Canyon Safety Improvements (MP 316.5-317.5)	Realign roadway and construct new bridges over Woods Canyon with de-icing system. Install roadway weather information system (RWIS) near Rocky Park TI or Woods Canyon.	$36.28	M	5
17	CS17.09	-	Dry Beaver Creek SB Climbing Lane (SB MP 292-294)	Construct southbound climbing lane and widen Dry Beaver Creek Bridge	$9.35	M	1
18	CS17.17	-	Woods Canyon Southbound Climbing Lane (SB MP 316-317)	Construct southbound climbing lane	$5.60	M	1

Figure ES-8: Prioritized Recommended Solutions



Final Report



1.0 INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study (CPS) of Interstate 17 (I-17) between SR 101L and I-40. The study examines key performance measures relative to the I-17 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 encompass:

- 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 New Mexico State Line
- SR 95: I-8 to I-40

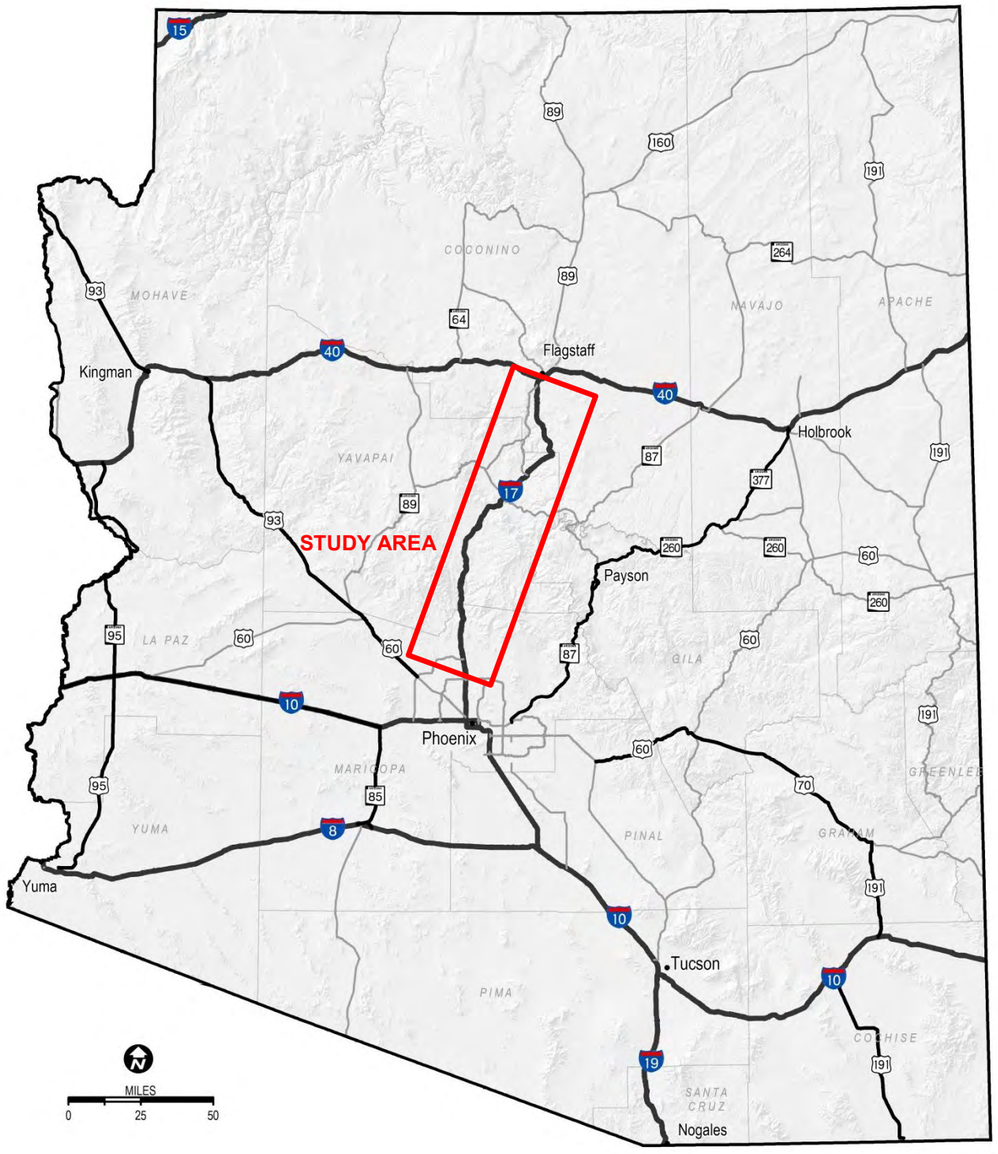
The third round (Round 3) of studies, initiated in Fall 2015, includes:

- I-10: California State Line to SR 85 and SR 85: I-10 to I-8
- I-10: SR 202L to 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-17 Corridor, depicted in **Figure 1,** is one of the strategic statewide corridors identified and the subject of this Round 1 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. This purpose can be 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-17 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-17 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

The Arizona Sun Corridor is one of eleven megapolitan areas in the United States, defined as a conglomeration of two or more intertwined metropolitan areas. The Sun Corridor megapolitan extends from Nogales to Prescott, and is similar to Indiana in area and population. The Sun Corridor is one of the fastest growing areas in the country, with I-17 playing a key role in the transportation infrastructure of its northern portion, contributing to its economic success.

I-17 provides the most direct and fastest link between Phoenix (and I-10) and Flagstaff (and I-40). I-17 provides a principal road link for national and international traffic from Phoenix Sky Harbor International Airport to Prescott, the Verde Valley, Sedona, Flagstaff, the Grand Canyon, and the Navajo and Hopi nations. This study builds on earlier planning efforts in developing and applying a performance-based process for prioritizing improvements to meet present and future needs in the corridor.

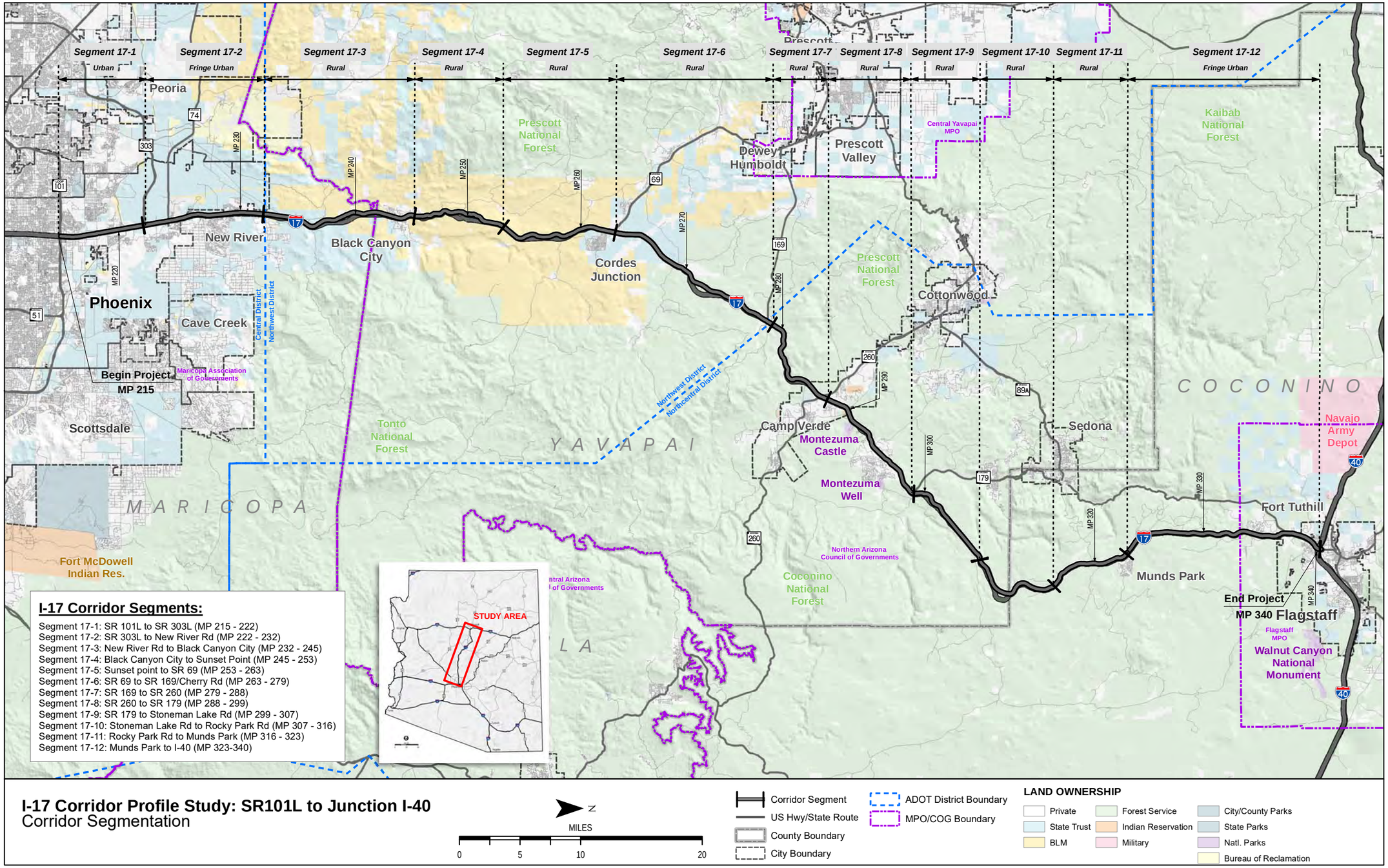
1.4 Corridor Segments

The I-17 Corridor is divided into 12 planning segments to allow for an appropriate level of detailed needs analysis, performance evaluation, and comparison between different segments of the corridor. 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 described in **Table 1** and shown in **Figure 2**.

Table 1: I-17 Corridor Segments

Segment	Begin	End	Approx Begin Milepost	Approx End Milepost	Approx Length (miles)	Typical Through Lanes	2014/2035 Average Annual Daily Traffic Volume (vpd)	Character Description
17-1	SR101L	SR 303L	215	222	7	8 + HOV or 6 + HOV	106,400 / 148,800	Segment 17-1 is generally urban/fringe-urban in nature and lies within the urbanized limits of the Phoenix Metropolitan Area in Maricopa County. Segment 17-1 includes six interchanges.
17-2	SR 303L	New River Rd	222	232	10	6 + HOV or 4	62,100 / 89,000	Segment 17-2 is generally fringe urban in nature, includes six interchanges, and is located within Maricopa County.
17-3	New River Rd	Black Canyon City	232	245	13	4	33,100 / 51,400	This segment is generally rural in nature, includes three interchanges, and spans both Maricopa and Yavapai Counties
17-4	Black Canyon City	Sunset Point Rest Area	245	253	8	4	29,700 / 46,600	This segment is rural in nature, includes significant changes in topography, two interchanges, and is within Yavapai County.
17-5	Sunset Point Rest Area	SR 69	253	263	10	4	27,100 / 43,000	This segment is rural in nature, includes three interchanges, and is located within Yavapai County.
17-6	SR 69	SR 169	263	279	16	4	20,200 / 31,800	This segment is rural in nature, passes through generally rolling terrain, includes two interchanges, and is located within Yavapai County.
17-7	SR 169	SR 260	279	288	9	4	25,500 / 40,100	This segment goes through significant topography and elevation changes, is rural in nature, includes two interchanges, and is within Yavapai County.
17-8	SR 260	SR 179	288	299	11	4	22,400 / 33,300	Segment 17-8 is rural in character and is located within Yavapai County. Segment 17-8 passes through rolling terrain and includes three interchanges.
17-9	SR 179	Stoneman Lake Rd	299	307	8	4	19,000 / 27,800	Segment 17-9 is rural in character and is located within Yavapai County. Segment 17-9 passes through significant changes in topography and includes one interchange.
17-10	Stoneman Lake Rd	Rocky Park Rd	307	316	9	4	16,000 / 23,500	Segment 17-10 is rural in nature, includes changes in topography, one interchange, and spans both Yavapai and Coconino Counties.
17-11	Rocky Park Rd	Munds Park Rd	316	323	7	4	16,200 / 23,800	Segment 17-11 is rural in nature, includes three interchanges, and is located within Coconino County.
17-12	Munds Park Rd	I-40	323	340	17	4	19,000 / 27,400	Segment 17-12 transitions from a rural setting to a fringe-urban setting, includes four interchanges, is located within Coconino County, and extends into the City of Flagstaff.

Figure 2: Corridor Location and Segments



1.5 Corridor Characteristics

Arizona is connected with the rest of the country through two major east-west transcontinental interstate corridors, namely I-10 and I-40. I-10 connects Southern Arizona to California (Los Angeles) on the west coast and Florida (Jacksonville) on the east coast. I-40 connects Northern Arizona to California (Los Angeles) on the west coast and North Carolina (Wilmington) on the east coast. I-17 serves as the only major north-south transportation corridor linking the Phoenix Metropolitan Area with northern Arizona and provides a connection between I-10 and I-40.

In terms of existing traffic volumes, I-17 witnesses the highest volumes of traffic in Segments 17-1 and 17-2 ranging from 60,000 to 100,000 vehicles per day. Segments 17-3, 17-4, and 17-5 see significantly lower traffic volumes, ranging from 25,000 to 35,000 vehicles per day. Segments 17-6 through 17-12 carry on average less than 25,000 vehicles per day.

I-17 provides many important functions including a commuter route between northern Maricopa County and Phoenix, a recreational route between Phoenix and northern Arizona, and a commercial route connecting I-10 and I-40.

The I-17 Corridor between Phoenix and Flagstaff was originally built between 1950 and 1975. When Congress authorized the Interstate Highway System in the 1950s, I-17 was earmarked as a fully access-controlled, four-lane highway forming the principal link between southern and northern Arizona, and connecting the state's two transcontinental corridors.

A majority of the existing traffic interchanges (TIs) and other grade separations were built concurrently with the original freeway. Over the last several years, ADOT has made substantial investments in corridor expansion within the section of the corridor in Maricopa County including:

- New traffic interchanges at Jomax Road, Dixileta Drive, Sonoran Desert Drive, Dove Valley Road, and SR 74
- Widening the mainline to provide four general purpose and one HOV lane in each direction of travel from SR 101L to Pinnacle Peak Road
- Widening the mainline to provide three general purpose and one HOV lane in each direction of travel from Pinnacle Peak Road to SR 74
- Widening the mainline to provide three general purpose lanes in each direction of travel from SR 74 to Anthem Way

Further north in the corridor, ADOT investments have focused primarily on preservation projects. Modernization or expansion projects have been limited to the reconstruction of the Cordes Junction and Munds Park TIs, and the addition of a southbound climbing lane through Copper Canyon (south of Camp Verde)

National Context

The Arizona Sun Corridor is one of eleven megapolitan areas in the United States, defined as a conglomeration of two or more intertwined metropolitan areas. The Sun Corridor megapolitan extends from Nogales to Prescott, and is similar to the State of Indiana in area and population. The Sun Corridor is one of the fastest growing areas in the country, with I-17 playing a key role in the transportation infrastructure of its northern portion contributing to its economic success.

Regional Connectivity

I-17 provides the most direct and fastest link between Phoenix (and I-10) and Flagstaff (and I-40). I-17 provides the principal highway link for national and international traffic from Phoenix Sky Harbor International Airport to Prescott, the Verde Valley, Sedona, Flagstaff, the Grand Canyon, and the Navajo and Hopi nations.

I-17 also connects with major freeways in the Phoenix Metropolitan Area, including SR 101L connecting the east and west valleys, SR 303L through the west valley, SR 74 connecting with US 60, SR 69 and SR 169 connecting to the Prescott region, SR 260 connecting to Cottonwood and Clarkdale, and SR 179 connecting with Sedona. I-17 also links Phoenix and Flagstaff with the communities of New River and Camp Verde.

Commercial Truck Traffic

Arizona is primarily a pass-through state for freight traffic coming from the ports of Los Angeles and Long Beach and going east to the central U.S. for distribution. Some of the freight traffic destined for Arizona uses the I-17 Corridor to reach the Phoenix area from I-40, and to reach northern Arizona from I-10. In 2005, approximately 557 million tons of freight valued at $2.3 billion moved to, from, within, or across Arizona. Roughly three-quarters of the freight (by weight) was moved on the state's highway system by truck.

Land use forecasts show a pattern of growth along a linear corridor stretching from the eastern edge of Tucson northwest along I-10 to Phoenix and I-17 toward Prescott (and Flagstaff). This linear growth pattern will dictate the development of transportation networks and therefore the local and regional patterns for distributing goods. As communities north of Phoenix along I-17 continue to grow, the level of traffic along this north-south corridor will increase.

According to the ADOT Multimodal Planning traffic database for 2014, trucks constitute between 8 and 16 percent of the total traffic along I-17.

ADOT has recently completed an effort to identify corridors throughout the state where improvements to the transportation infrastructure will support the greatest potential commercial and economic benefits. These "Key Commerce Corridors" represent a strategic statewide approach to leverage infrastructure improvements to enhance Arizona's competitive economic position. I-17 has been identified as a "Key Commerce Corridor" due to the critical role it plays in the movement of freight /commercial truck traffic in the state.

The U.S. Department of Transportation, under Section 167(c) of title 23 United States Code (U.S.C.), created by Section 1115 of the Moving Ahead for Progress in the 21st Century Act (MAP–21), is directed to establish a National Freight Network (NFN) to assist States in strategically directing resources toward improved system performance for efficient movement of freight on the

highway portion of the Nation's freight transportation system. I-17 has been designated by ADOT as part of the National Primary Freight Network.

Commuter Traffic

I-17 is used by daily commuters between suburban and rural communities and Phoenix and Flagstaff metropolitan areas. I-17 provides access to Phoenix for commuters from Anthem and New River, from as far north as Prescott, Prescott Valley, Dewey-Humboldt, and Camp Verde. I-17 is also a commuter route between Flagstaff and Sedona, Camp Verde, Cottonwood, Clarkdale, and the Prescott Valley area.

Recreation and Tourism

Arizona offers a variety of recreational opportunities for its citizens as well as the millions of visitors that travel to the state in search of warmer weather and outdoor adventure and exploration opportunities. Arizona's warm weather and natural beauty makes tourism one of the state's top industries. According to the Arizona Office of Tourism, in 2013, 33.8 million people visited Arizona who collectively spent $19.8 billion in the state, which supports jobs and generates tax revenue.

I-17 is the main transportation corridor that connects Phoenix Metropolitan Area and Sky Harbor International Airport with some of the biggest tourism and recreational attractions that Arizona has to offer including the Grand Canyon National Park, Sedona, Oak Creek, Slide Rock State Park, and Montezuma Castle National Monument. According to publicly available statistics, Grand Canyon National Park had an annual visitation of 4.5 million visitors in 2013 and Sedona receives an average of 4 million visitors annually. Northern Arizona destinations are especially popular during the summer months due to the cooler temperatures as compared to the rest of the State. The Snow Bowl Ski Resort in Flagstaff is a very popular destination during winter months.

Multi-Modal Uses

Freight Rail

No direct rail freight or passenger service links Phoenix with Flagstaff.

Passenger Rail

No direct rail freight or passenger service links Phoenix with Flagstaff.

Bicycles/Pedestrians

Bicycles are prohibited on I-17 south of SR 74 (Carefree Highway interchange). From SR 74 to Flagstaff, bicyclists are permitted to use the shoulders only. Pedestrians are prohibited on the entire route.

Bus/Transit

The largest metropolitan transit system in Arizona is located in the Phoenix metropolitan area, where Valley Metro and member cities operate a regional system of buses, light rail, and paratransit (demand-responsive service). Bus routes in the I-17 Corridor currently extend as far north as Happy Valley Road. At the other end of the corridor, Flagstaff's metropolitan transit system, known as Mountain Line, does not utilize I-17.

Greyhound Lines, the principal provider of scheduled intercity bus service in the U.S., has several daily trips between Phoenix and Flagstaff that utilize I-17, linking the carrier's cross-country routes on I-10 and I-40. The National Railroad Passenger Corporation (Amtrak) operates its daily Southwest Chief on the BNSF Railway between Chicago and Los Angeles, with a stop in Flagstaff. Amtrak offers connecting bus service between this station and Phoenix, which utilizes I-17.

Aviation

Flagstaff Pulliam Airport, located just east of I-17 and about three miles south of Flagstaff, is primarily a general aviation facility, but US Airways provides daily commercial air service to and from Phoenix Sky Harbor International Airport. Connections are available in Phoenix to destinations throughout the nation and abroad.

Land Ownership, Land Uses and Jurisdictions

Land ownership and management in Arizona are dominated by public land: State Trust (Arizona State Land Department), federal Bureau of Land Management (BLM), U.S. Forest Service, and other federal agencies such as the National Park Service and Bureau of Reclamation. There are also 22 sovereign Indian tribes or nations responsible for 27 percent of Arizona land. Only about one-quarter of the land along the I-17 Corridor is privately owned. It is scattered along the corridor, but concentrated in its southern half. About 45% of the total land lies within the Coconino and Prescott National Forests, located in the northern half of the corridor (north of Cordes Junction).The BLM and Arizona State Land Department are the other major landholders. Tribal land and National Parks account for less than 1% each of the total land ownership.

Population Centers

The Phoenix metropolitan area, spanning a total of 14,565 square miles, is the largest metropolitan area in Arizona and has a population of 4.2 Million people (2010 Census). The metropolitan area falls within two counties, Maricopa and Pinal. Phoenix Metropolitan area is located at the southern end of the I-17 Corridor. Maricopa Association of Governments (MAG) projects the population of the City of Phoenix to grow from 1.45 million in 2010 to about 1.95 million in 2030.

Flagstaff, the largest city in northern Arizona, is located at the north end of the I-17 Corridor and has a current population of about 68,000. It encompasses just over 64 square miles nestled at the base of the San Francisco Peaks. The annual growth rate for the Flagstaff region has fluctuated between 2.2 percent in the 1990s and early 2000s, to about 1.1 percent in the late 2000s. The area's population is expected to grow to 92,500 by 2020 and to nearly 103,000 by 2030. The development density is expected to increase over the next 40 years, owing to the focus on growing within the existing urbanized area to protect surrounding open spaces.

Various Census Designated Places (CDP) are located along the corridor. Census Designated Places are defined as those places which had a population greater than 500 at the time of the 2010 census. These include Anthem, New River, Black Canyon City, Camp Verde, and Munds Park.

Various mid-sized cities and towns are located in the Central Yavapai County region, including the communities of Prescott, Prescott Valley, Sedona, Cottonwood, Clarkdale, Chino Valley, and Dewey Humboldt.

These communities are expected to witness significant growth in the next few decades that will put more pressure on the existing transportation infrastructure along the I-17 Corridor. **Table 2** shows the existing and the projected future 2040 population of the jurisdictions along the study corridor.

Table 2: Current and Future Population

Community	2010 Population	2014 Population	2040 Population
Phoenix	1,445,632	1,495,900	2,116,900
Flagstaff	65,870	68,140	87,735
Prescott	39,843	40,296	46,341
Prescott Valley	38,822	40,309	62,653
Anthem CDP	21,700	NA	NA
New River CDP	14,952	NA	NA
Cottonwood	11,265	11,463	15,633
Camp Verde	10,873	11,037	14,497
Chino Valley	10,817	11,115	17,405
Sedona	10,031	10,189	12,892
Village of Oak Creek CDP	6,147	6,328	8,226
Clarkdale	4,097	4,176	5,848
Dewey Humboldt	3,894	3,960	5,357
Black Canyon City CDP	2,837	NA	NA
Munds Park CDP	631	629	671

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

Major Traffic Generators

The Phoenix Metropolitan area and City of Flagstaff are the major traffic generators for the I-17 Corridor. Additionally, the I-17 Corridor provides primary North/South access to the cities of Prescott, Prescott Valley, and Sedona, which experience significant tourist activity.

Tribes

The lands of the Yavapai-Apache are surrounded by Camp Verde. Most of the nation's land is located north and west of I-17, but a small parcel on the east side contains the Cliff Castle Lodge and Casino, a major attraction and source of revenue, opened in 1995 and served by the Middle Verde Road interchange. The Camp Verde portions of the nation cover 576 acres, with the remainder dispersed elsewhere in the Verde Valley. The Yavapai and Apache are two distinct peoples, with the total Yavapai-Apache population estimated at up to 1,200.

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 actions that can be taken to alleviate those stressors. Using the Habimap Tool that creates an interactive database of information included in the SWAP, the following were identified in relation to the I-17 Corridor.

- Wildlife Waters – Several designated Wildlife Waters are located between SR 74 and the intersection of I-17 with US 69, but are not immediately adjacent to I-17 right-of-way.
- Important Bird Areas – The Agua Fria National Monument Riparian Corridors Important Bird Area contains 17,000 acres of special conservation status. The Monument is located east of I-17 near Badger Springs, Bloody Basin, Cordes Lakes, and Dugas.
- Allotments/Pastures (grazing) – Virtually the entire corridor north of Black Canyon City traverses multiple allotments under the jurisdiction of the State Land Department and the US Forest Service.
- Arizona Game and Fish Department Parcels – None.
- State Land Trust Lands – None.
- Arizona Wildlife Linkages – Extensive Missing or Potential Linkage Zones are noted from approximately milepost 268 north to Flagstaff.
- Species and Habitat Conservation Guide (SHCG) indicates a predominance of medium and high value areas of sensitive habitats throughout the entire corridor.
- Species of Economic and Recreational Importance (SERI) model indicates extensive areas of high importance throughout the southern end of the corridor.
- Species of Greatest Conservation Need (SGCN) identifies extensive areas of high value sensitive habitats throughout the northern part of the corridor.

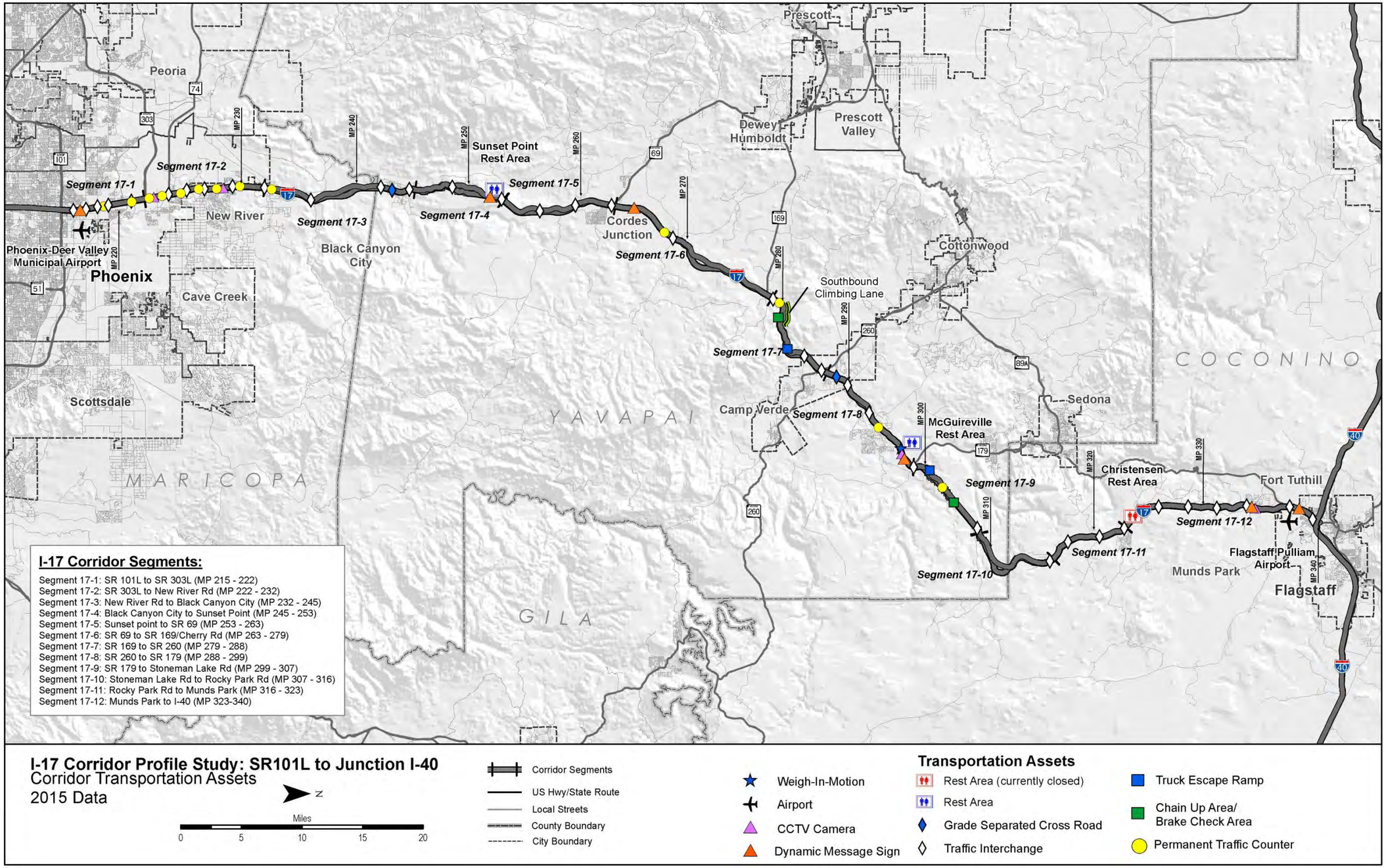
Corridor Assets

Corridor transportation assets are summarized in **Figure 3**.

ADOT operates two rest areas along the corridor for both commercial and non-commercial vehicles. Sunset Point, which doubles as a scenic viewpoint, is located on the west side of I-17 between the Bumble Bee and Badger Springs Road interchanges. Approximately 45 miles north of Sunset Point, between the McGuireville and Sedona interchanges, the recently refurbished McGuireville rest areas exist on both sides of the highway. Both rest areas offer such amenities as restrooms, drinking fountains, vending machines, picnic tables, and pet exercise areas.

Private businesses provide fuel, food, lodging, and related services at several points along I-17 including the communities of Anthem, New River, Rock Springs/Black Canyon City, Cordes Junction, Camp Verde, McGuireville/Lake Montezuma, and Munds Park.

Figure 3: Corridor Transportation Assets



1.6 Corridor Stakeholders and Input Process

A Technical Advisory Committee (TAC) was created that was comprised of representatives from the stakeholders. TAC meetings were held at key milestones to present results and obtain feedback. In addition, several meetings were conducted with the key stakeholders between June 2014 and March 2016 to present the results and obtain feedback.

Key stakeholders identified for this study included:

- ADOT Northcentral District
- ADOT Northwest District
- Central Yavapai Metropolitan Planning Organization (CYMPO)
- Maricopa Association of Governments (MAG)
- Flagstaff Metropolitan Planning Organization (FMPO)
- Northern Arizona Council of Governments (NACOG)
- 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 study identified recommendations from previous studies, plans, and preliminary design documents. Studies, plans, and programs pertinent to the I-17 Corridor were reviewed to understand the full context of future planning and design efforts within and around the study area. These studies are organized below into four categories: Framework and Statewide Studies, Regional Planning Studies, Planning Assistance for Rural Areas (PARAs) and Small Area Transportation Studies (SATS), and Design Concept Reports (DCRs) and Project Assessments (PAs).

Framework and Statewide Studies

- Building a Quality Arizona (bqAZ) Statewide Transportation Planning Framework Study
- Arizona State Rail Plan
- Arizona Multimodal Freight Analysis Study
- Statewide Bicycle and Pedestrian Plan Update
- Climbing and Passing Lane Prioritization Study
- Statewide Dynamic Message Sign (DMS) Master Plan
- What Moves You Arizona Long-Range Transportation Plan 2010-2035

Regional Studies

- 2035 MAG Regional Transportation Plan
- CYMPO 2011 Regional Transportation Plan Update
- Flagstaff Pathways 2030 Regional Transportation Plan

Planning Assistance for Rural Areas and Small Area Transportation Studies

No PARAs or SATS were reviewed

Design Concept Reports and Project Assessments

- I-17 Design Concept Report, New River TI to Jct. SR 69
- I-17 Design Concept Report, SR 179 to I-40
- Design Concept Report, I-17/McGuireville TI
- Location/ Design Concept Report, I-17/SR 69 Cordes Junction TI
- Design Concept Report, I-17/Munds Park TI

Summary of Prior Recommendations

Various studies and plans, including several DCRs, have recommended improvements to the I-17 Corridor as shown in **Table 3** and **Figure 4**. They include, but are not limited to:

- Widening of numerous sections of I-17, some of which will require right-of-way acquisition. Many other proposed improvements are associated with the recommended widening:
  - Adding one general purpose lane in each direction from SR 101L to Pinnacle Peak Road
  - Adding two general purpose lanes in each direction from Pinnacle Peak Road to SR 303L
  - Adding one general purpose lane in each direction from SR 303L to Anthem Way
  - Adding two general purpose lanes in each direction from Anthem Way to SR 69
  - Adding one general purpose lane in each direction from SR 69 to I-40
  - Extending the HOV lane to New River Road TI
- Major TI improvements at the following locations:
  - Pinnacle Peak Road TI
  - Happy Valley Road TI
  - Table Mesa Road TI
  - Canyon Road (Black Canyon) TI
  - Bumble Bee TI
  - Badger Springs TI
  - Bloody Basin TI
  - Cornville Road/McGuireville TI
  - SR 179 TI
  - Stoneman Lake Road TI
  - Rocky Park Road TI
  - Schenbly Hill Road TI
  - Newman Park Road TI
  - Kachina Boulevard TI
  - J.W. Powell Boulevard TI
- Bridge replacement or widening to support the additional mainline travel lanes
- Construction of new TIs on I-17 at SR 303L, and at a new freeway connecting SR 169 and I-17
- Extension of one-way frontage roads from Pinnacle Peak Road to Carefree Highway (SR 74)
- Construction of climbing lanes
- ITS improvements, such as closed circuit television and dynamic message signs
- Curve realignment and flattening

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	215	224	9	SR 101L to Carefree Highway • Widen to provide five general-purpose lanes and one HOV lane in each direction			√	N/A	N/A	Y	Final DCR- I-17 Widening Study (SR 101L TI to Black Canyon City TI), 2004
2	217.1		0	Reconstruct Pinnacle Peak Rd TI		√		N/A	N/A	Y	Final DCR- I-17 Widening Study (SR 101L TI to Black Canyon City TI), 2004
3	218		0	Reconstruct Happy Valley Rd TI		√		N/A	N/A	Y	Final DCR- I-17 Widening Study (SR 101L TI to Black Canyon City TI), 2004
4	222		0	Construct new system TI at SR 303L			√	N/A	N/A	Y	Final DCR- I-17 Widening Study (SR 101L TI to Black Canyon City TI), 2004 2035 MAG Regional Transportation Plan, 2013 bqAZ Statewide Transportation Planning Framework Study, 2010
5	224	232	8	Carefree Highway to New River TI • Widen to provide four general-purpose lanes and one HOV lane in each direction • Construct auxiliary lanes between TIs • Modify Pioneer TI • Widen Deadman wash, New River bridges • Drainage improvement • Install median lighting and FMS			√	N/A	N/A	Y	Final DCR- I-17 Widening Study (SR 101L TI to Black Canyon City TI), 2004
6	224	229	5	Carefree Highway to Anthem Way TI • Construct HOV lane in each direction of travel		√		N/A	N/A	N	2035 MAG Regional Transportation Plan, 2013
7	229	232	3	Anthem Way TI to New River • Widen to provide three lanes in each direction			√	N/A	N/A	N	2035 MAG Regional Transportation Plan, 2013
8	229	340	111	Anthem Way TI to I-40 • Widen to provide three general-purpose lanes in each direction			√	N/A	N/A	N	bqAZ Statewide Transportation Planning Framework Study, 2010

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)?	
9	232	245	13	New River Rd to Coldwater Canyon Rd • Pavement preservation	√			FY 17	H8793 01C	N	2016-2020 Five-Year Transportation Facilities Construction Program
10	232	244.4	12.4	New River TI to Black Canyon City TI • Widen to provide four general-purpose lanes in each direction • Widen bridges at New River Road, Moore's Gulch, Little Squaw Creek, and Agua Fria River • Modify Rock Springs bridges • Reconstruct Table Mesa TI • Replace Black Canyon City TI OP • Drainage improvements • Install roadway lighting			√	N/A	N/A	Y	Final DCR- I-17 Widening Study (SR 101L TI to Black Canyon City TI), 2004
11	238	239	1	Moores Gulch Bridge Southbound	√			FY 17 FY 20	H8454 01C	N	2016-2020 Five-Year Transportation Facilities Construction Program Tentative 2017-2021 Five-Year Transportation Facilities Construction Program
12	240	238	2	Climbing Lane SB. Noted as Tier 3 project (low priority)		√		N/A	N/A	N	Climbing and Passing Lane Prioritization Study, 2015
13	245	251	6	Black Canyon City to Sunset Point • Construct two reversible lanes on Southbound Roadway		√		N/A	N/A	N	I-17, Black Canyon City T.I. to JCT. SR 69 Final Design Concept Report
14	245	252.7	7.7	Construct Safety Improvements		√		FY 20	H7879 01C	N	Tentative 2017-2021 Five-Year Transportation Facilities Construction Program
15	245	262	17	Black Canyon City to Cordes Junction • Construct three SB lanes on new alignment from Black Canyon City to Sunset Point • Convert existing four lanes to Northbound • Widen to three lanes in both directions from Sunset Pt. to Jct. SR 69			√	N/A	N/A	N	I-17, Black Canyon City T.I. to JCT. SR 69 Final Design Concept Report
16	246	250	4	Climbing Lane NB. Noted as Tier 1 project (high priority)		√		N/A	N/A	N	Climbing and Passing Lane Prioritization Study, 2015
17	255	256	1	Climbing Lane NB. Noted as Tier 1 project (high priority)		√		N/A	N/A	N	Climbing and Passing Lane Prioritization Study, 2015
18	263	279	16	SR 69 to SR 169 • Widen to three lanes in each direction			√	N/A	N/A	N	CYMPO 2011 Regional Transportation Plan Update
19	265		0	New system TI connection to new Chino Valley Area Freeway corridor (location approximate)			√	N/A	N/A	N	bqAZ Statewide Transportation Planning Framework Study, 2010

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)?	
20	270	275	5	Climbing Lane NB. Noted as Tier 3 project (low priority)		√		N/A	N/A	N	Climbing and Passing Lane Prioritization Study, 2015
21	281	285	4	Climbing Lane SB. Noted as Tier 1 project (high priority)		√		N/A	N/A	N	Climbing and Passing Lane Prioritization Study, 2015
22	284	286	2	Climbing Lane SB. Noted as Tier 2 project (medium priority)		√		N/A	N/A	N	Climbing and Passing Lane Prioritization Study, 2015
23	287		0	Scour retrofit of Verde River bridges	√			FY 17 FY 18	H8544 01C	N	2016-2020 Five-Year Transportation Facilities Construction Program Tentative 2017-2021 Five-Year Transportation Facilities Construction Program
24	293	293.5	5	McGuireville TI • Reconstruct TI • Construction of new retaining walls, new bridge, and installation of bank protection		√		N/A	N/A	Y	Final Design Concept Report, I-17/McGuireville TI, 2002
25	293	295	2	Climbing Lane SB. Noted Tier 2 project (medium priority)		√		N/A	N/A	N	Climbing and Passing Lane Prioritization Study, 2015
26	294	298	4	Climbing Lane NB. Noted Tier 2 project (medium priority)		√		N/A	N/A	N	Climbing and Passing Lane Prioritization Study, 2015
27	298.5	300.0	1.5	SR 179 TI • Reconstruction of SR 179 TI OP • Mainline reconstruction and roadway realignment • Add one general-purpose lane in each direction • TI reconstruction, including reducing the grade of the north ramps and converting the ramp-crossroad intersections to roundabouts • Installation of complete interchange lighting • CCTV Monitoring			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
28	299	305	6	Climbing Lane NB. Noted as Tier 2 project (medium priority)		√		N/A	N/A	N	Climbing and Passing Lane Prioritization Study, 2015
29	299.7	303.1	3.4	Hog Canyon, Northbound • Mainline reconstruction, including radii improvements to the horizontal curves • Drainage improvements • Add one general-purpose lane and a climbing lane			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012

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)?	
30	300.0	306.0	6	Hog Canyon to Stoneman Lake TI, Southbound • Mainline reconstruction • Add one general-purpose lane • Curve realignment • CCTV monitoring • Drainage improvements			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
31	303.1	306.0	2.9	Hog Canyon to Stoneman Lake TI, Northbound • Mainline reconstruction • Add one general-purpose lane and a climbing lane • Reconstruction of the chain-up area • New Dynamic Message Sign			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
32	305.0		0	New NB DMS, south of Stoneman Lake TI		√		N/A	N/A	N	Statewide Dynamic Message Sign (DMS) Master Plan, ADOT, 2011
33	306.0	307.0	1	Stoneman Lake Road Traffic Interchange • Mainline reconstruction and curve realignment • Add one general-purpose lane in each direction • Add one northbound climbing lane • Reconstruction of Stoneman Lake TI, including flattening the grade, and clearance improvements • CCTV Monitoring • Drainage improvements			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
34	307	311	4	Climbing lane NB. Noted as Tier 1 project (high priority)		√		N/A	N/A	N	Climbing and Passing Lane Prioritization Study, 2015
35	307.0	311.5	4.5	Rattlesnake Canyon to Scenic Overlook • Realignment of horizontal curves • Add one general-purpose lane and a climbing lane • New chain-up area • Wildlife undercrossing structures and associated wildlife fencing, gates and one-way ramps			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
36	307.0	312.6	5.6	Rattlesnake Canyon to Scenic Overlook, Southbound • Mainline reconstruction and curve realignment • Add one general-purpose lane • Wildlife undercrossing structure and wildlife overcrossing structure and associated wildlife fencing, gates, and one-way ramps • Drainage improvements			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012

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)?	
37	311.5	314.1	2.6	Northbound, Scenic Overlook to Rocky Park Meadow • Realignment of NB I-17 • Add one general-purpose lane and a climbing lane • Reconstruction of concrete median barrier • New wildlife overcrossing structure and associated wildlife fencing, gates and one-way ramps • CCTV Monitoring			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
38	312	340	28	Coconino County Line to I-40, Northbound • Pavement preservation (mill and replace)	√			FY 18 FY 19	H8934 01C	N	Tentative 2017-2021 Five-Year Transportation Facilities Construction Program
39	312.6	314.7	2.1	Southbound, Scenic Overlook to Rocky Park Meadow • Mainline reconstruction • Add one general-purpose lane • Drainage improvements • Wildlife overcrossing structure and associated wildlife fencing, gates, and one-way ramps			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
40	314.1	316.4	2.3	Rocky Park TI • Mainline reconstruction • Add one general-purpose lane in each direction • Replacement of the Rocky Park TI OP			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
41	316.4	317.5	1.1	Woods Canyon Bridges and Related Spot Improvements • Reconstruction of Woods Canyon NB Bridge and widening of Woods Canyon SB Bridge • Mainline reconstruction, straightening one horizontal curve and flattening of the vertical grade • Add one general purpose lane in each direction • CCTV monitoring			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
42	317.5	320.1	2.6	Woods Canyon to Schnebly Hill Rd TI • Mainline reconstruction • Add one general-purpose lane in each direction • Reconstruction of ramp connections at Fox Ranch Road TI • Wildlife undercrossing structure at Skeleton Park and associated wildlife fencing, gates, and one-way ramps			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
43	318	316	2	Climbing lane SB. Noted as a Tier 2 project (medium priority)		√		N/A	N/A	N	Climbing and Passing Lane Prioritization Study, 2015

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)?	
44				Schnebly Hill Road TI • Mainline reconstruction • Add one general-purpose lane in each direction • Replacement of Schnebly Hill Road TI OP (serves as dual use wildlife- traffic interchange)			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
45	321.2	322.7	1.5	Munds Canyon Bridges • Mainline reconstruction, including straightening horizontal curve • Add one general-purpose lane in each direction • Widening of Munds Canyon Bridges • Replace existing Old Munds Highway box culvert under I-17 with new single-span bridges (also serving as wildlife crossing) • Wildlife fencing, gates, and one-way ramps			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
46	322.7	324.1	1.4	Munds Park TI to Munds Ranch Road • Mainline reconstruction • Add one general-purpose lane in each direction • Reconstruction of north ramp connections at Munds Park TI • Potential Noise Wall • New triple 10x10-foot concrete box culvert • Complete interchange lighting at Munds Park TI			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
47	324.0		0	New SB DMS, north of Munds Park TI		√		N/A	N/A	N	Statewide Dynamic Message Sign (DMS) Master Plan, ADOT, 2011
48	324.1	325.5	1.4	Munds Ranch Road • Mainline reconstruction • Add one general-purpose lane in each direction • Reconstruction of existing Munds Ranch box culvert with new single-span bridges (also serves as wildlife crossing)			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
49	325.5	326.7	1.2	Willard Springs TI • Mainline reconstruction • Add one general-purpose lane in each direction • Widening of Willard Springs TI OP • Reconstruction of ramp connections at Willard Springs TI and crossroad improvements, including lowering Willard Springs Road			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012

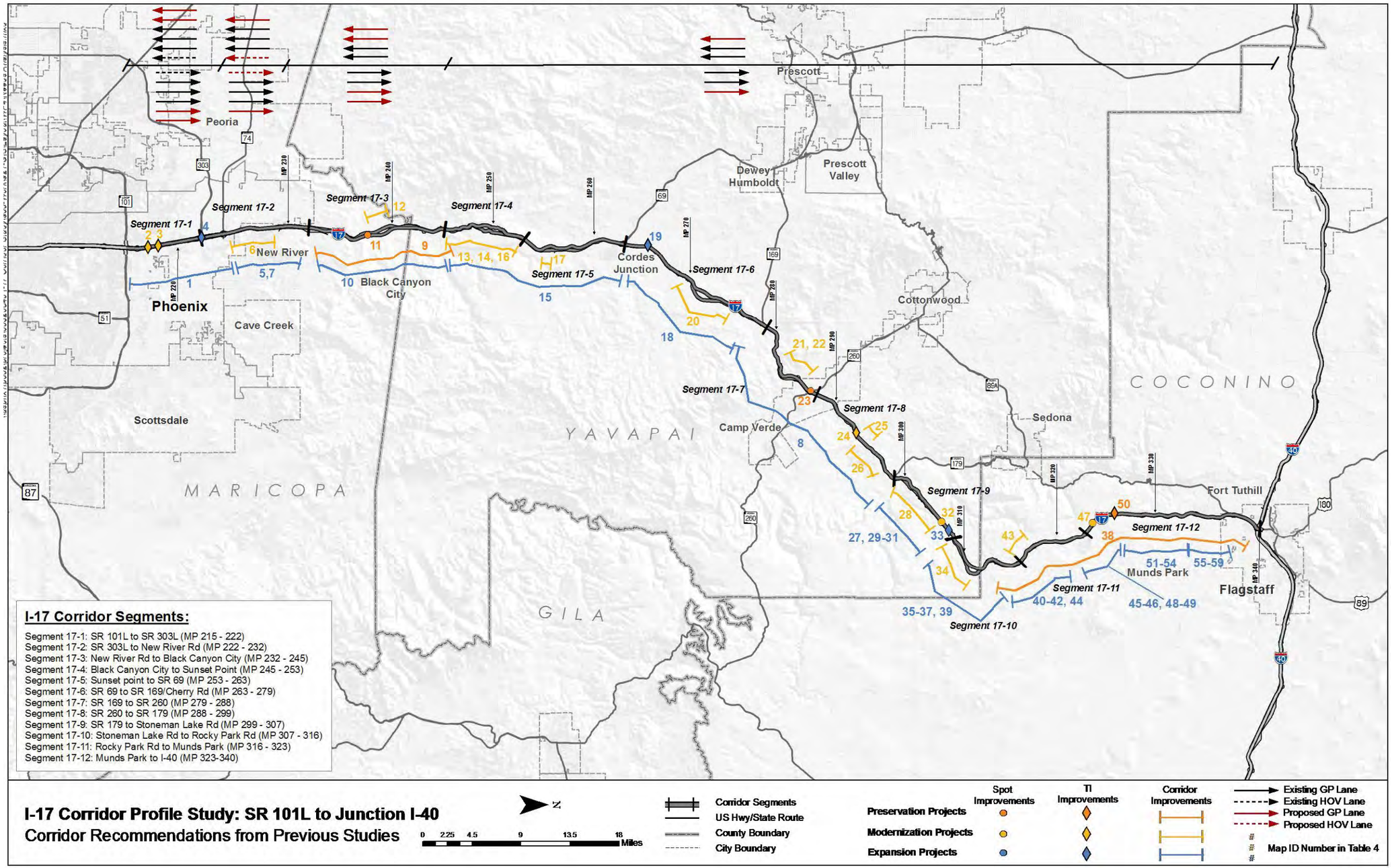
Table 3: Corridor Recommendations from Previous Studies (continued)

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	326		0	Willard Springs TI OP, Southbound	√			FY 18	H8721 01C	N	Tentative 2017-2021 Five-Year Transportation Facilities Construction Program
51	326.7	328.3	1.6	Willard Springs TI to Newman Park TI • Mainline reconstruction • Add one general-purpose lane in each direction • Wildlife overcrossing structure at Willard Springs meadow and associated wildlife fencing, gates, and one-way ramps			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
52	328.3	330.1	1.8	Newman Park TI • Reconstruction of Newman Park TI • Add one general-purpose lane in each direction • Mainline reconstruction • Curve realignment			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
53	330.1	331.7	1.6	James Canyon to Kelly Canyon TI • Mainline reconstruction, including raising the roadway profile • Add one general-purpose lane in each direction • Wildlife undercrossing structure and associated wildlife fencing, gates, and one-way ramps			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
54	331.7	332.9	1.2	Kelly Canyon • Mainline reconstruction • Curve realignment • Add one general-purpose lane in each direction			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
55	332.9	334.4	1.5	Kachina Village TI • Mainline reconstruction • Add one general-purpose lane in each direction • Kachina Village TI Reconstruction • New box culvert at Pumphouse Wash • Wildlife overcrossing structure and associated wildlife fencing, gates, and one-way ramps • Potential noise wall • Complete interchange lighting • CCTV monitoring			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
56	334	340	6	Kachina Boulevard to I-40 • Widen to provide three lanes in each direction			√	N/A	N/A	N	Flagstaff Pathways 2030 Regional Transportation Plan, 2009

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			
					P	M	E	Program Year	Project No.	Environmental Documentation (Y/N)?	
57	334.4	336.8	2.4	Pumphouse Wash to J.W. Powell TI • Mainline reconstruction • Add one general-purpose lane in each direction • New concrete median barrier • Replace existing Old Munds Highway box culvert under I-17 with new single-span bridges • Wildlife fencing, gates, and one-way ramps			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
58	336.8	337.6	.8	J.W. Powell TI • Mainline reconstruction • Add one general-purpose lane in each direction • Reconstruction of J.W. Powell TI and crossroad improvements • New concrete median barrier • Complete interchange lighting • CCTV monitoring			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012
59	337.6	339.8	2.2	J.W. Powell TI to I-40 • Reconstruct NB and SB I-17 • Shoulder widening • Add one general-purpose lane in each direction • New concrete median barrier • Potential noise walls • Replacement of Dynamic Message Sign structure			√	N/A	N/A	Y	Final DCR- I-17, SR 179 to I-40, 2012

Figure 4: Corridor Recommendations from Previous Studies



2.0 CORRIDOR PERFORMANCE

This chapter describes the evaluation of the existing performance of the I-17 Corridor. A series of performance measures is 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. Because 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 falls 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

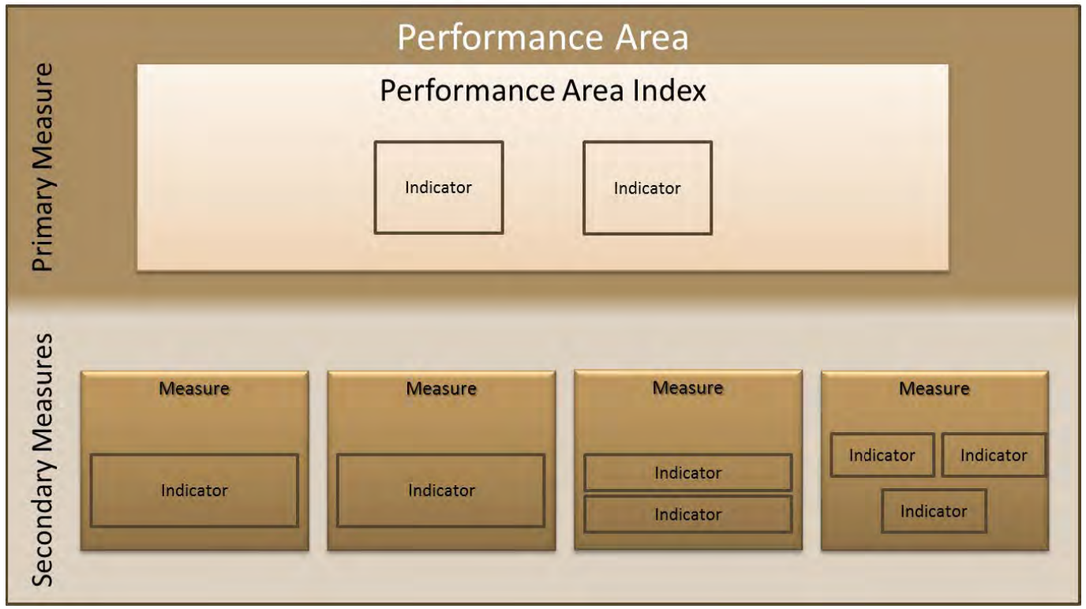
Performance Area	Primary Measure	Secondary Measures
Pavement	**Pavement Index** Based on a combination of International Roughness Index and cracking	• Directional Pavement Serviceability • Pavement Failure • Pavement Hot Spots
Bridge	**Bridge Index** Based on lowest of deck, substructure, superstructure 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

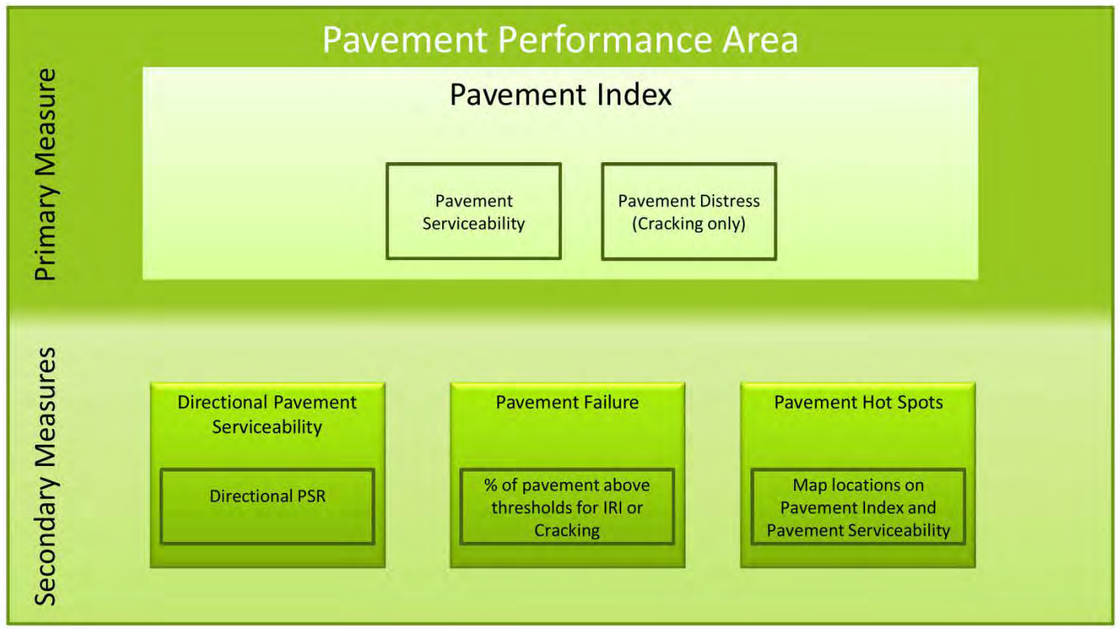
Figure 6: Performance Area Template



2.2 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-17 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-17 Corridor, the following operating environment was identified:

- Interstate: all segments

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 this analysis, the following observations were made:

- Overall, the pavement performance is generally “good” with a few isolated locations showing “poor” performance
- No segments are rated as “poor” performance in either the Pavement Index or the Directional PSR
- Segments 17-11 and 17-12 are the only two segments in the corridor that have a “fair” Pavement Index rating
- There are several pavement failure hot spots located in segments 17-3, 17-7, 17-8, 17-9, 17-11, and 17-12
- More than 20% of the pavement in segments 17-11 and 17-12 is in “poor” condition
- The northbound pavement appears to be in worse condition than the southbound pavement
- Segments 17-11 and 17-12 have the lowest Pavement Index, the lowest PSR, and the highest percentage of pavement in “poor” condition

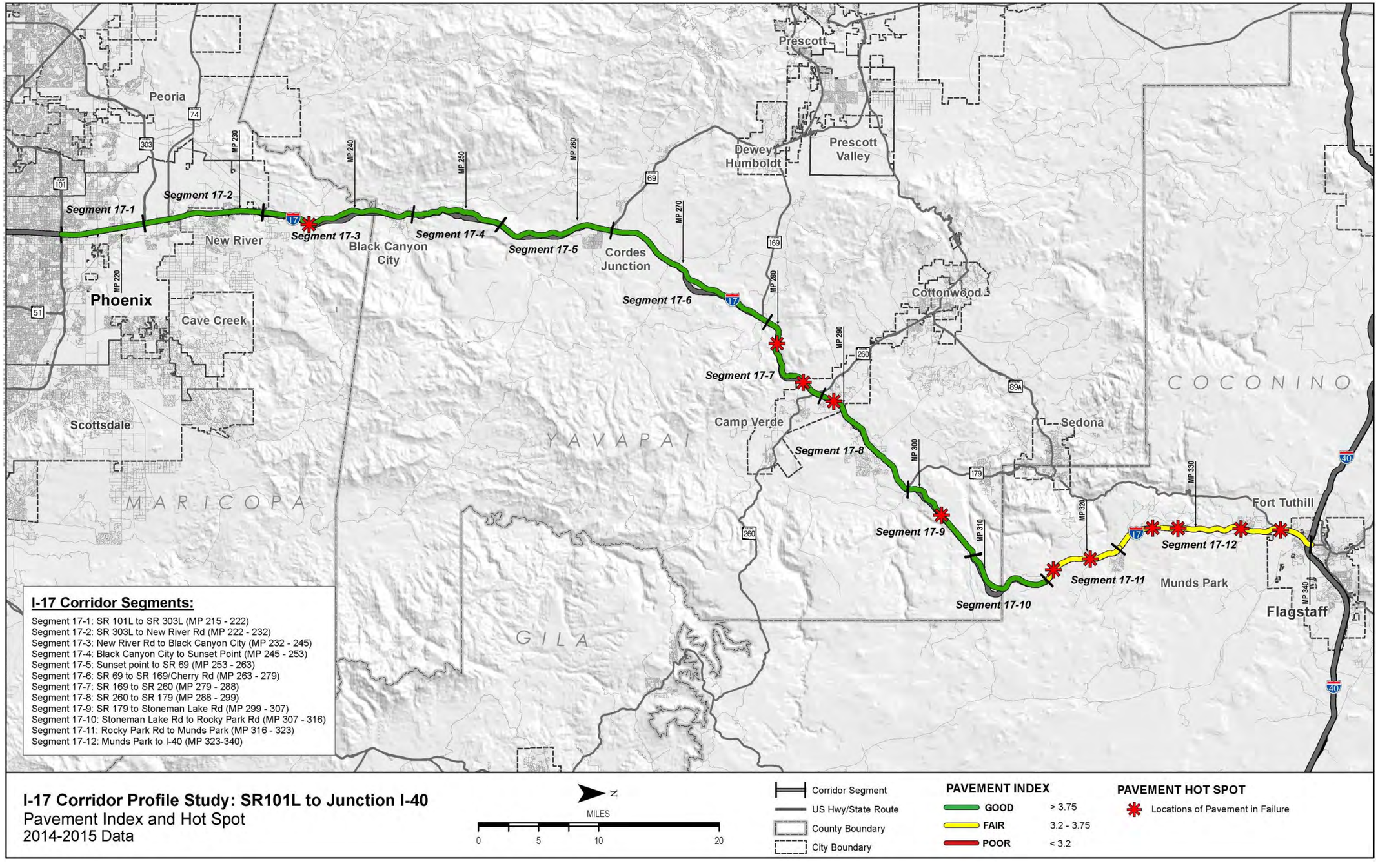
Table 5 summarizes the Pavement performance results for the I-17 Corridor. **Figure 8** illustrates the primary Pavement Index performance and locations of Pavement hot spots along the I-17 Corridor. Maps for each secondary measure can be found in **Appendix A**.

Table 5: Pavement Performance

Segment	Segment Length (miles)	Pavement Index	Directional PSR		% Area Failure
			NB	SB	
17-1	7	4.19	4.24	4.14	0.0%
17-2	10	4.16	4.13	4.15	0.0%
17-3	13	3.85	3.92	3.86	3.8%
17-4	8	4.25	3.65	4.25	0.0%
17-5	10	4.25	4.09	4.02	0.0%
17-6	16	4.26	4.08	4.02	0.0%
17-7	9	3.92	3.78	3.93	16.7%
17-8	11	4.32	4.01	4.17	4.5%
17-9	8	4.21	3.77	4.18	18.8%
17-10	9	4.19	4.01	4.06	0.0%
17-11	7	3.73	3.50	3.82	21.4%
17-12	17	3.70	3.49	3.82	25.7%
Weighted Corridor Average		4.07	3.88	4.02	7.90%

SCALES		
Performance Level	**Interstate**	
Good	> 3.75	< 5%
Fair	3.2 - 3.75	5% - 20%
Poor/Below Average	< 3.2	> 20%

Figure 8: Pavement Performance



I-17 Corridor Segments:

Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
Segment 17-2: SR 303L to New River Rd (MP 222 - 232)
Segment 17-3: New River Rd to Black Canyon City (MP 232 - 245)
Segment 17-4: Black Canyon City to Sunset Point (MP 245 - 253)
Segment 17-5: Sunset point to SR 69 (MP 253 - 263)
Segment 17-6: SR 69 to SR 169/Cherry Rd (MP 263 - 279)
Segment 17-7: SR 169 to SR 260 (MP 279 - 288)
Segment 17-8: SR 260 to SR 179 (MP 288 - 299)
Segment 17-9: SR 179 to Stoneman Lake Rd (MP 299 - 307)
Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)

I-17 Corridor Profile Study: SR101L to Junction I-40
Pavement Index and Hot Spot
2014-2015 Data

N
MILES
0 5 10 20

Corridor Segment
US Hwy/State Route
County Boundary
City Boundary

PAVEMENT INDEX

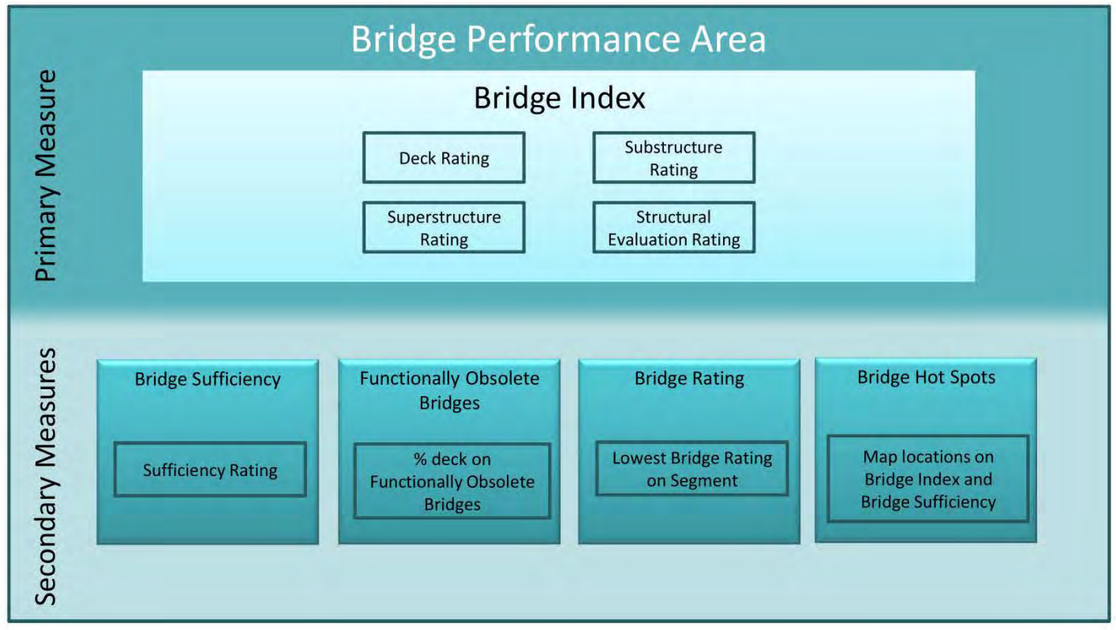
GOOD	> 3.75
FAIR	3.2 - 3.75
POOR	< 3.2

PAVEMENT HOT SPOT
Locations of Pavement in Failure

2.3 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-17 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 high-level assessment of the structural condition of bridges for the corridor and for each segment. The four secondary measures provide more detailed information to assess bridge performance.

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

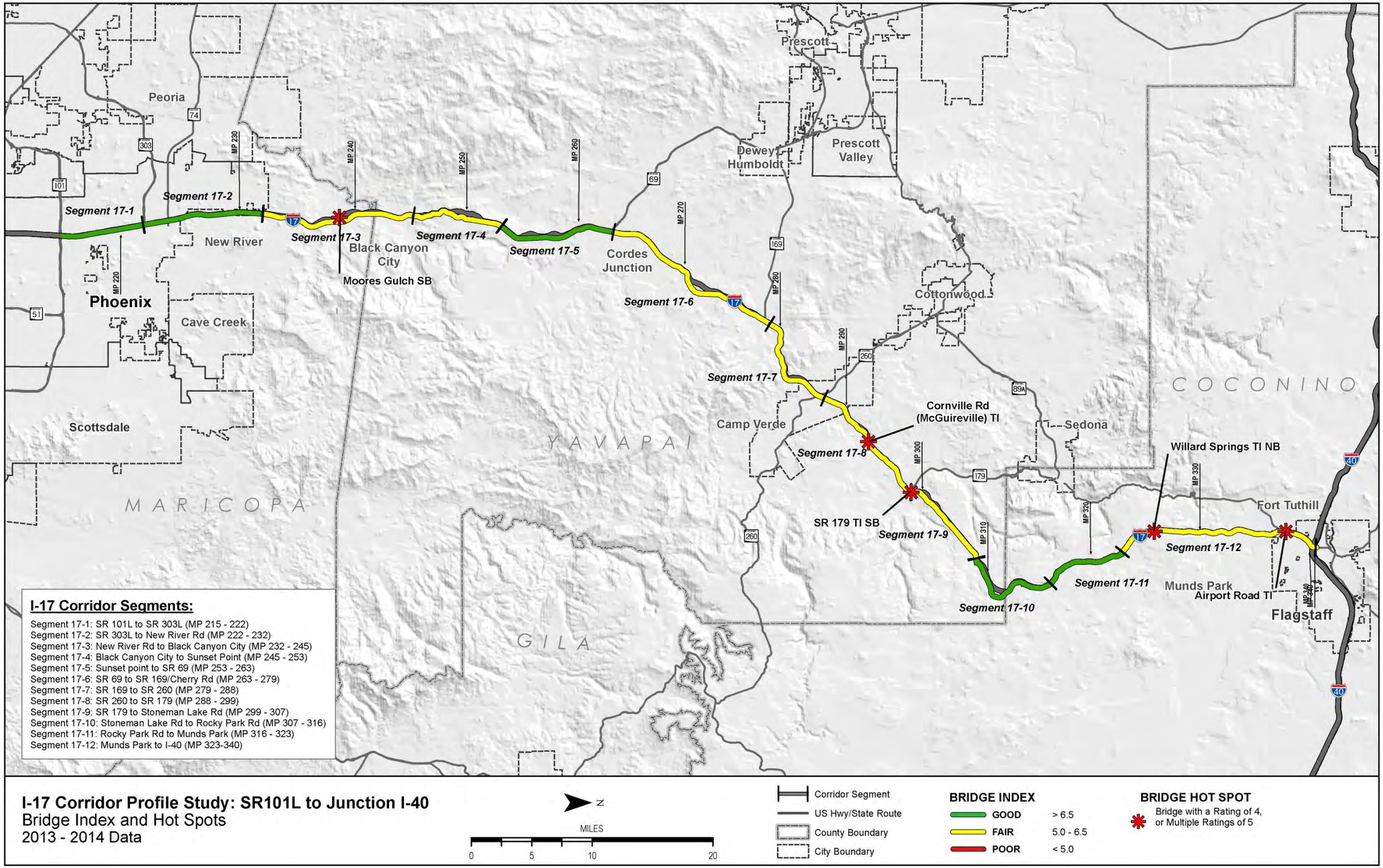
- Nearly all of the bridges are in “good” or “fair” condition
- There is one structurally deficient bridge on the corridor, the McGuireville TI bridge located in segment 17-8
- There are a high number of functionally obsolete bridges along the corridor – nine of the twelve segments show either “fair” or “poor” performance
- Segments 17-4 and 17-12 have the lowest Bridge Index and a high percentage of functionally obsolete bridges

Table 6 summarizes the Bridge performance results for the I-17 Corridor. **Figure 10** illustrates the primary Bridge Index performance and locations of Bridge hot spots along the I-17 Corridor. Maps for each secondary measure can be found in **Appendix A**.

Table 6: Bridge Performance

Segment	Segment Length (miles)	# of Bridges	Bridge Index	Bridge Sufficiency	Lowest Bridge Rating	% Deck Area on Functionally Obsolete Bridges
17-1	7	12	6.98	91.52	5	23.8%
17-2	10	11	6.79	92.73	6	14.6%
17-3	13	15	6.39	91.10	5	31.3%
17-4	8	4	5.71	93.97	5	60.9%
17-5	10	8	7.15	96.27	6	16.9%
17-6	16	10	6.19	94.82	5	8.5%
17-7	9	5	6.31	91.41	6	0.0%
17-8	11	7	6.04	89.20	4	13.6%
17-9	8	2	6.00	93.00	6	100.0%
17-10	9	2	6.52	94.00	6	100.0%
17-11	7	9	6.91	96.48	5	3.4%
17-12	17	10	5.80	92.00	5	62.3%
Weighted Corridor Average			6.34	92.94	5.28	35.55%
SCALES						
Performance Level			**ALL**			
Good			> 6.5	> 80	> 6	< 12%
Fair			5.0 - 6.5	50 - 80	5 – 6	12% - 40%
Poor			< 5.0	< 50	< 5	> 40 %

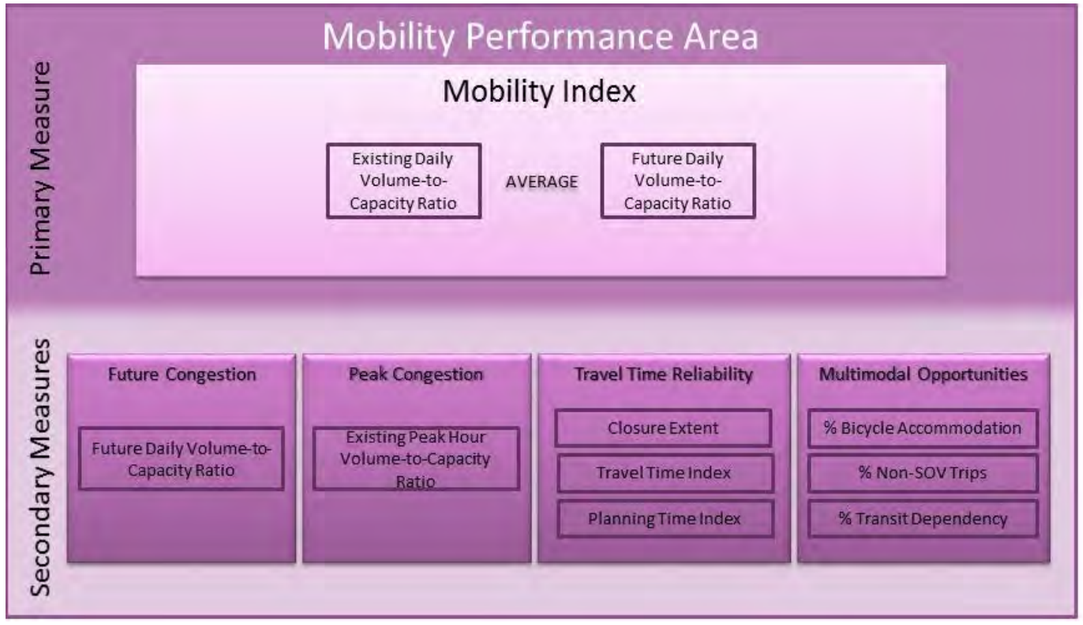
Figure 10: Bridge Performance



2.4 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-17 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-17 Corridor, the following operating environments were identified:

- Urban Uninterrupted Flow: Segments 17-1, 17-2, and 17-12
- Rural Uninterrupted Flow: Segments 17-3 through 17-11

Secondary Mobility Measures

Four secondary measures provide an 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.

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

- Overall, based on the weighted average of the Mobility Index, the traffic operations are in "good" condition
- The existing peak hour traffic operations show generally "good" performance
- The future traffic operations are anticipated to perform "poor" in two of the twelve segments and "fair" in four of the twelve segments
- Segments 17-1, 17-3, 17-4, and 17-5 have the lowest Mobility Index and segments 17-1 and 17-4 show "poor" performance in the Future Daily V/C performance measure
- A majority of the segments show either "fair" or "poor" performance in the Closure performance measure
- Segments 17-3 and 17-4 have the highest number of closures
- The TTI and PTI measures generally show "fair" or "poor" performance in the uphill direction of travel in mountainous areas
- Segments 17-4, 17-6, 17-9, and 17-10 appear to have least reliable travel time as they have the greatest difference between the TTI and PTI
- A majority of the corridor shows "poor" or "fair" performance for non-SOV trips meaning that many vehicles carry only a single occupant
- All segments show "good" performance for bicycle accommodations

Table 7 summarizes the Mobility performance results for the I-17 Corridor. **Figure 12** illustrates the primary Mobility Index performance along the I-17 Corridor. Maps for each secondary measure can be found in **Appendix A**.

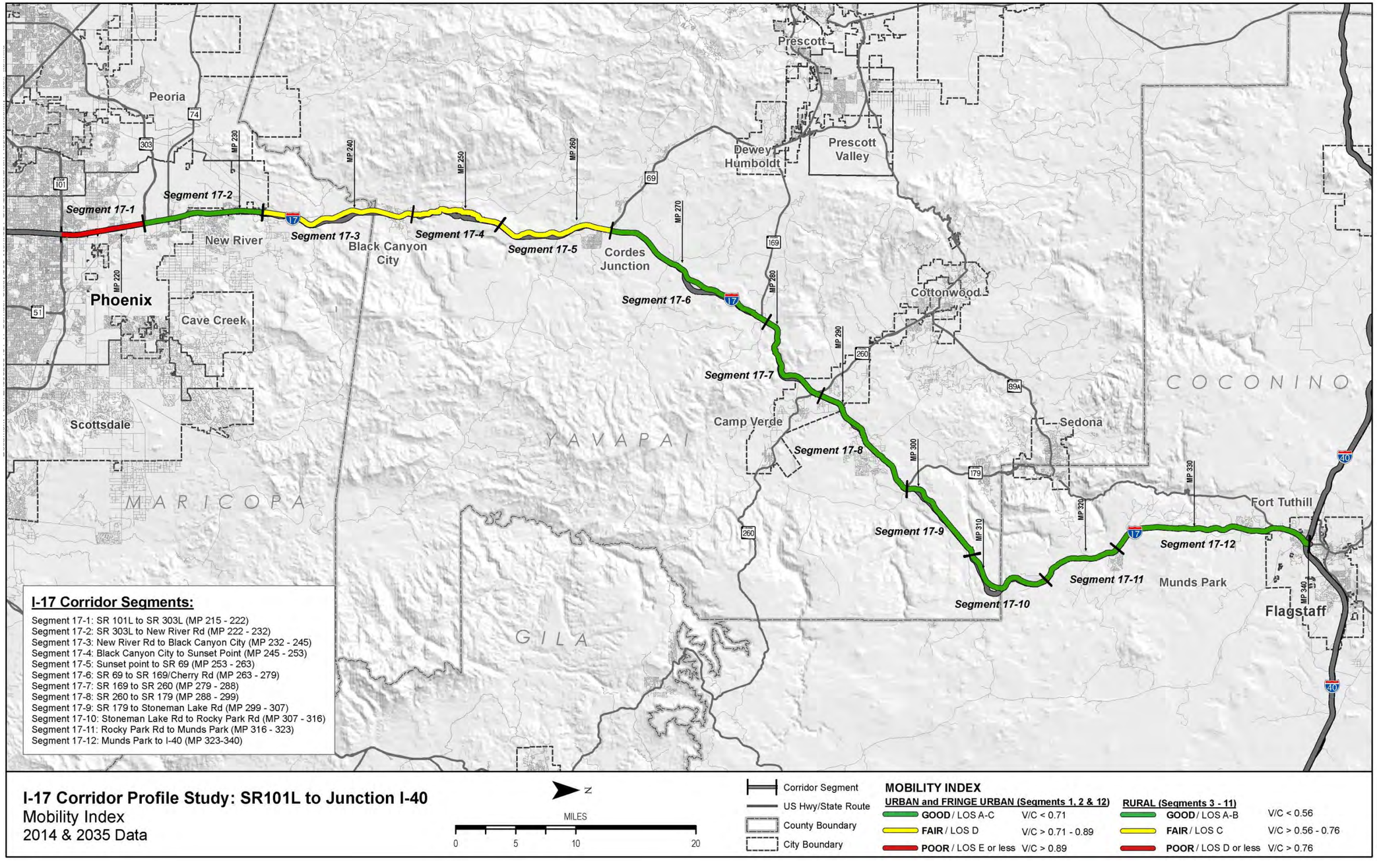
Table 7: Mobility Performance

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
				NB	SB	NB	SB	NB	SB	NB	SB		
17-1[1]	7	0.90	1.09	0.67	0.67	0.41	0.03	1.00	1.00	1.03	1.03	99%	10.7%
17-2[1]	10	0.68	0.80	0.51	0.53	0.41	0.00	1.08	1.05	1.15	1.11	100%	12.3%
17-3[2]	13	0.58	0.71	0.40	0.40	0.78	0.11	1.09	1.11	1.17	1.20	100%	12.0%
17-4[2]	8	0.64	0.78	0.38	0.38	0.75	0.61	1.21	1.00	1.61	1.07	97%	12.3%
17-5[2]	10	0.59	0.72	0.38	0.40	0.42	0.28	1.20	1.14	1.34	1.21	100%	15.5%
17-6[2]	16	0.37	0.45	0.33	0.33	0.05	0.15	1.13	1.38	1.23	1.69	100%	7.7%
17-7[2]	9	0.55	0.68	0.47	0.48	0.27	0.11	1.09	1.15	1.27	1.31	98%	7.7%
17-8[2]	11	0.39	0.47	0.35	0.35	0.15	0.22	1.14	1.13	1.27	1.24	100%	14.1%
17-9[2]	8	0.41	0.49	0.32	0.32	0.35	0.20	1.30	1.12	1.61	1.22	100%	6.6%
17-10[2]	9	0.35	0.41	0.27	0.27	0.20	0.29	1.29	1.13	1.60	1.25	100%	6.3%
17-11[2]	7	0.29	0.34	0.23	0.21	0.00	0.29	1.10	1.08	1.18	1.16	100%	6.2%
17-12[1]	17	0.29	0.34	0.18	0.18	0.07	0.31	1.06	1.05	1.13	1.11	94%	17.9%
Weighted Corridor Average		0.48	0.58	0.36	0.36	0.30	0.21	1.13	1.13	1.28	1.24	98.79%	11.28%

SCALES						
Performance Level	**Urban (Rural)**	**ALL**	**Uninterrupted Flow**		**All**	
Good	< 0.71 (< 0.56)	< 0.22	< 1.15	<1.30	> 90%	> 17%
Fair	0.71 - 0.89 (0.56 - 0.76)	0.22 – 0.62	1.15 - 1.33	1.30 - 1.50	60% - 90%	11% - 17%
Poor	> 0.89 (> 0.76)	> 0.62	> 1.33	>1.50	< 60%	< 11%

1: Urban or Fringe Urban Operating Environment
2: Rural Operating Environment

Figure 12: Mobility Performance



2.5 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. Because 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-17 Corridor, the following operating environments were identified:

- Urban >6 Lane Freeway: Segment 17-1
- Urban or Rural 6 Lane Freeway: Segment 17-2
- Rural 4 Lane Freeway with Daily Volume >25,000: Segments 17-3, 17-4, 17-5, 17-7
- Rural 4 Lane Freeway with Daily Volume <25,000: Segments 17-6, 17-8 through 17-12

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.

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

- The crash unit type performance measure for crashes involving non-motorized travelers have insufficient data to generate reliable performance ratings for the I-17 Corridor. Therefore, this measure was not included in the performance evaluation for this corridor.
- All segments rate as either “average” or “below average” performance in the Safety Index.
- The overall corridor average Safety Index is rated “below average” performance.
- Segments 17-8 and 17-9 have the highest Safety Index ratings meaning those segments experience higher frequency and rate of fatal and incapacitating crashes compared to other similar operating environments.
- There is some directional variation on the northbound and southbound roadways, providing insight to the conditions and factors contributing to the crash history.
- Segments 17-4 and 17-11 have the highest variation between northbound and southbound roadways with southbound segment 17-4 and northbound segment 17-11 experiencing higher frequency and rate of fatal and incapacity crashes.
- Safety hot spots include:
  - Northbound MP 216-221 (Segment 17-1)
  - Southbound MP 218-221 (Segment 17-1)
  - Northbound MP 222-224 (Segment 17-2)
  - Southbound MP 224-228 (Segment 17-2)
  - Southbound MP 231-232 (Segment 17-2)
  - Northbound MP 238-240 (Segment 17-3)
  - Southbound MP 232-235 (Segment 17-3)
  - Southbound MP 297-299 (Segment 17-8)
  - Southbound MP 299-302 (Segment 17-9)
  - Southbound MP 311 (Segment 17-10)
  - Northbound MP 317 (Segment 17-11)

Table 8 summarizes the Safety performance results for the I-17 Corridor. **Figure 14** illustrates the primary Safety Index performance and locations of Safety hot spots along the I-17 Corridor. Maps for each secondary measure can be found in **Appendix A**.

Table 8: Safety Performance

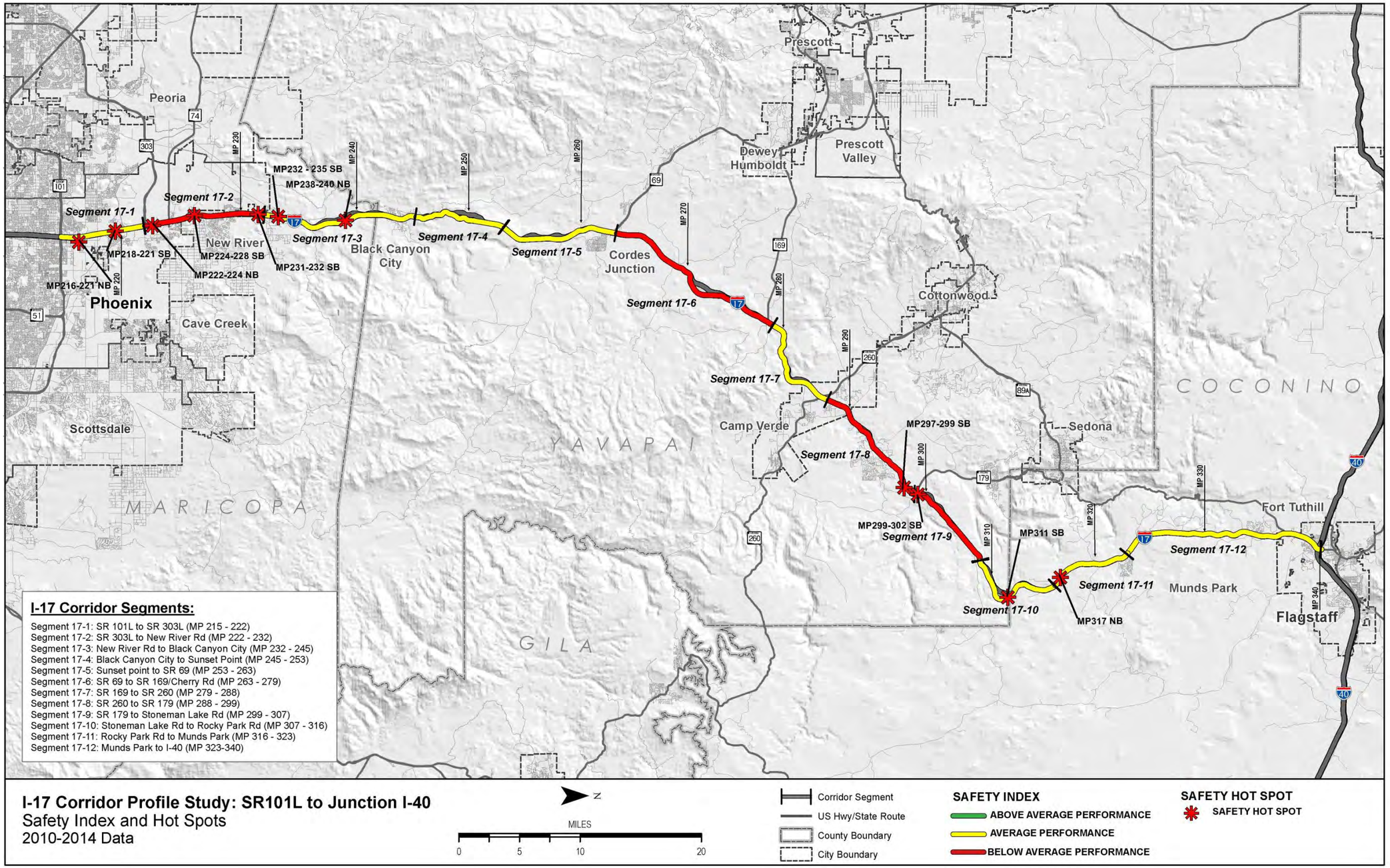
Segment	Segment Length (miles)	Total Fatal & Incapacitating Crashes (F/I)	Safety Index	Directional Safety Index		% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	% of Fatal + Incapacitating Injury Crashes Involving Trucks	% of Fatal + Incapacitating Injury Crashes Involving Motorcycles
				NB	SB			
17-1[a]	7	7 / 27	1.13	1.03	1.24	0%	6%	12%
17-2[b]	10	11 / 24	1.67	1.51	1.83	31%	11%	9%
17-3[c]	13	7 / 22	0.75	0.84	0.67	69%	10%	17%
17-4[c]	8	6 / 11	1.06	0.49	1.64	35%	12%	29%
17-5[c]	10	7 / 13	1.01	1.36	0.65	35%	10%	15%
17-6[d]	16	7 / 11	1.32	1.09	1.55	56%	6%	17%
17-7[c]	9	5 / 10	0.85	0.98	0.72	47%	*Insufficient Data*	13%
17-8[d]	11	10 / 9	2.54	3.00	2.08	58%	16%	5%
17-9[d]	8	5 / 16	2.18	2.39	1.97	48%	10%	0%
17-10[d]	9	2 / 8	0.86	0.81	0.91	50%	*Insufficient Data*	*Insufficient Data*
17-11[d]	7	2 / 12	1.21	2.19	0.24	29%	7%	7%
17-12[d]	17	5 /19	1.04	0.53	1.54	33%	4%	8%
Weighted Corridor Average			1.29	1.29	1.29	43.1%	8.9%	12.1%

SCALES				
Performance Level	**Urban >6 Lane Freeway**			
Above Average	< 0.80	< 42.6%	< 2.5%	< 12.6%
Average	0.80 – 1.20	42.6% - 54.8%	2.5% - 6.0%	12.6% - 20.0%
Below Average	> 1.20	> 54.8%	> 6.0%	> 20.0%
Performance Level	**Urban or Rural 6 Lane Freeway**			
Above Average	< 0.82	< 33.5%	< 6.2%	< 6.7%
Average	0.82 – 1.18	33.5% - 57.2%	6.2% - 11.0%	6.7% - 12.9%
Below Average	> 1.18	> 57.2%	> 11.0%	> 12.9%
Performance Level	**Rural 4 Lane Freeway with Daily Volume > 25,000**			
Above Average	< 0.68	< 40.8%	< 7.2%	< 7.7%
Average	0.68 – 1.32	40.8% - 57.1%	7.2% - 12.9%	7.7% - 17.1%
Below Average	> 1.32	> 57.1%	> 12.9%	> 17.1%
Performance Level	**Rural 4 Lane Freeway with Daily Volume < 25,000**			
Above Average	< 0.73	< 42.8%	< 13.2%	< 5.0%
Average	0.73 – 1.27	42.8% - 52.9%	13.2% - 17.0%	5.0% - 8.5%
Below Average	> 1.27	> 52.9%	> 17.0%	> 8.5%

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

a: Urban >6 Lane Freeway, b: Urban or Rural 6 Lane Freeway, c: Rural 4 Lane Freeway > 25,000 vpd, d: Rural 4 Lane Freeway < 25,000 vpd

Figure 14: Safety Performance



2.6 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-17 Corridor, the following operating environments were identified:

- Urban Uninterrupted Flow: Segments 17-1, 17-2, and 17-12
- Rural Uninterrupted Flow: Segments 17-3 through 17-11

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.

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

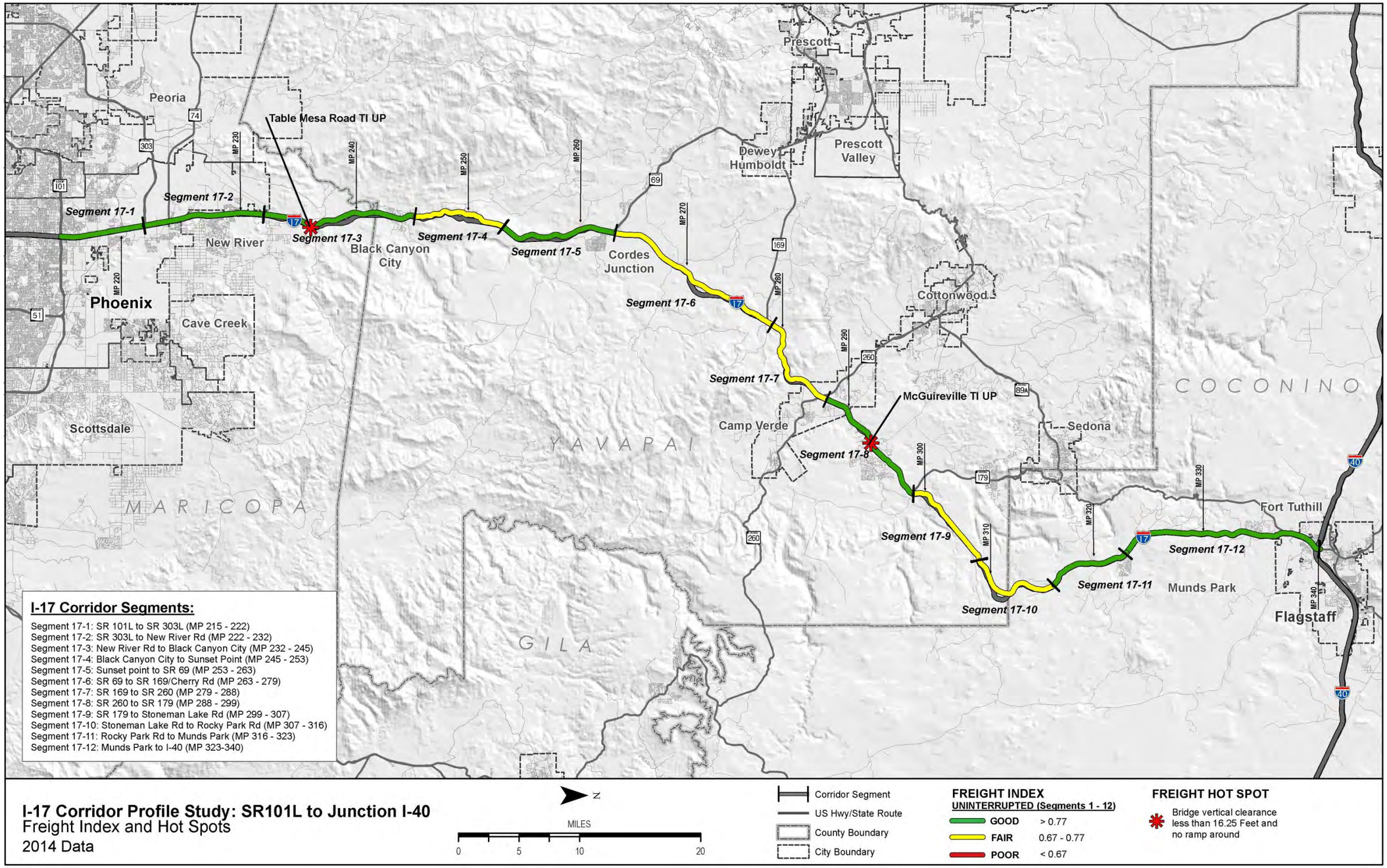
- Overall, based on the weighted average of the Freight Index, the freight mobility is in "good" condition.
- All of the segments show either "good" or "fair" performance in the Freight Index.
- The TTI and PTI measures generally show "fair" or "poor" performance in the uphill direction of travel in mountainous areas.
- Segment 17-4 has the lowest Freight Index and performs the worst in the TTI and PTI performance measures.
- Segment 17-4 (northbound) appears to have the least reliable travel time as it has the greatest difference between the TTI and PTI.
- All of the segments show either "fair" or "poor" performance in the closure performance measure, except segment 17-6 which shows "good" performance.
- Segments 17-1, 17-3, and 17-4 have the longest duration of closures.
- There are two locations along the corridor that have a vertical clearance restriction that cannot be by-passed by using ramps, Table Mesa TI (southbound) and McGuireville TI (southbound).

Table 9 summarizes the Freight performance results for the I-17 Corridor. **Figure 16** illustrates the primary Freight Index performance and locations of freight hot spots along the I-17 Corridor. Maps for each secondary measure can be found in **Appendix A**.

Table 9: Freight Performance

Segment	Segment Length (miles)	Freight Index	Directional TTTI		Directional TPTI		Closure Duration (minutes/milepost /year/mile)		Bridge Vertical Clearance (feet)
			NB	SB	NB	SB	NB	SB	
17-1	7	0.94	1.03	1.03	1.07	1.07	134.0	4.5	16.80
17-2	10	0.95	1.02	1.00	1.06	1.04	108.5	0.0	16.23
17-3	13	0.94	1.01	1.03	1.04	1.09	209.8	19.7	16.01
17-4	8	0.67	1.34	1.07	1.81	1.16	194.0	175.3	16.29
17-5	10	0.88	1.09	1.02	1.20	1.07	120.0	49.4	18.22
17-6	16	0.74	1.03	1.27	1.08	1.61	13.6	24.9	16.85
17-7	9	0.75	1.07	1.27	1.15	1.52	64.0	20.7	16.91
17-8	11	0.88	1.08	1.05	1.15	1.11	32.7	44.2	15.18
17-9	8	0.75	1.29	1.06	1.55	1.13	122.5	107.0	No UP
17-10	9	0.74	1.25	1.07	1.57	1.15	41.7	121.2	No UP
17-11	7	0.94	1.03	1.02	1.07	1.06	0.0	124.4	16.87
17-12	17	0.93	1.05	1.03	1.10	1.06	12.6	122.3	16.51
Weighted Corridor Average		0.85	1.09	1.08	1.21	1.19	81.80	65.21	16.56
SCALES									
Performance Level			**Uninterrupted**				**All**		
Good		> 0.77	< 1.15		< 1.30		< 44.18	> 16.5	
Fair		0.67 - 0.77	1.15 -1.33		1.30 - 1.50		44.18 - 124.86	16.0 - 16.5	
Poor		< 0.67	> 1.33		>1.50		> 124.86	< 16.0	

Figure 16: Freight Performance



2.7 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-17 Corridor:

- The bridges and pavement are generally in “good” or “fair” condition with the exception of a few isolated locations
- The McGuireville TI is a structurally deficient bridge, has a low Sufficiency Rating, and has a sub-standard vertical clearance which obstructs freight movement since the southbound exit ramp is a loop ramp and does not allow trucks to by-pass the restriction
- Currently, the general mobility along the corridor is “good” (during a typical weekday) but projected traffic growth is expected to result in “poor” or “fair” performance in approximately 45% of the corridor (at the south end and in the middle of the corridor) by the year 2035
- There are several locations along the corridor where recurring and non-recurring delays show either “fair” or “poor” performance, primarily due to uphill grades, as reflected in both the Mobility and Freight Performance Areas
- Currently, the freight mobility along the corridor is “good” with a few spot locations that show “fair” performance primarily due to uphill grades
- The frequency of closures along the corridor generally match the statewide average with the exception of segments 3 and 4 which exceed the statewide average
- The duration of closures along the corridor generally match the statewide average with the exception of segments 1, 3, and 4 which exceed the statewide average
- A majority of the segments perform either “average” or “below average” in the Safety Index

Figure 17 shows the percentage of the I-17 Corridor that rates as “good/above average” performance, “fair/average” performance, or “poor/below average” performance for each primary measure. Approximately 81% of the corridor shows “good” performance in the Pavement Index. For the Bridge Index, 34% of the corridor shows “good” performance, and 66% shows “fair” performance. Approximately 70% of the corridor shows “good”, 25% “fair” and 5% “poor” performance in Mobility. Over one-third of the corridor (36%) for the Safety Index shows “below average” performance, while the remaining 64% of the corridor shows “fair” performance. For the Freight Index, approximately 60% of the corridor shows “good” performance while 40% shows “fair” performance.

The lowest performance along the I-17 Corridor occurs in the Safety and Bridge Performance Areas while the Pavement and Mobility 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-17 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

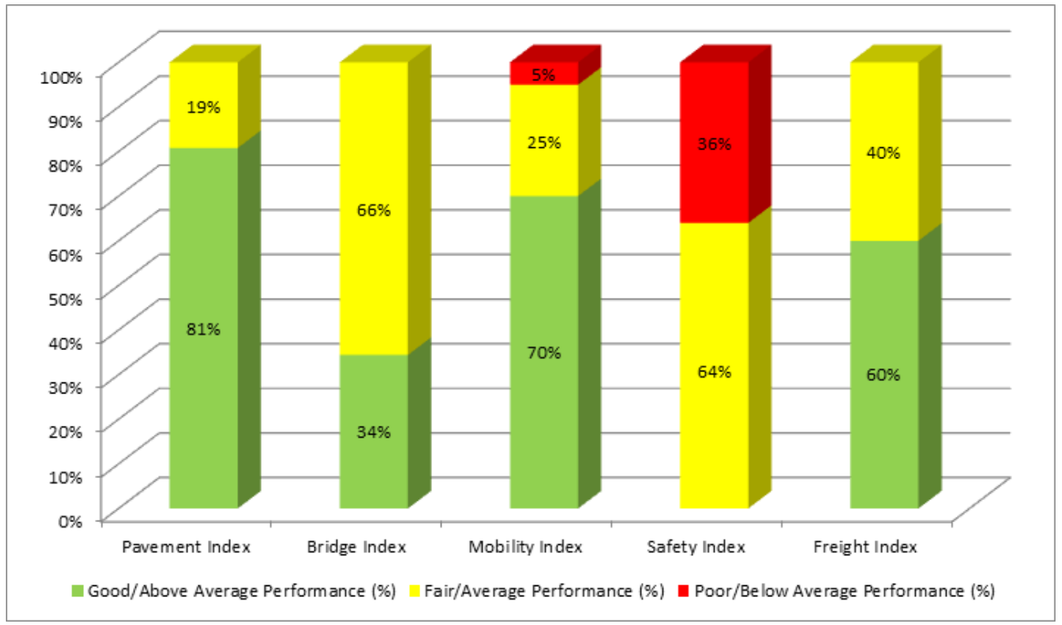


Figure 18: Corridor Performance Summary by Performance Measure

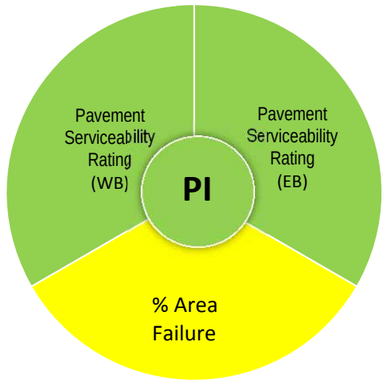
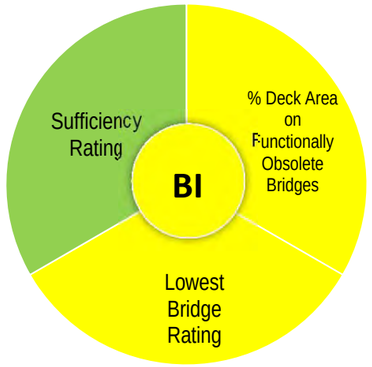
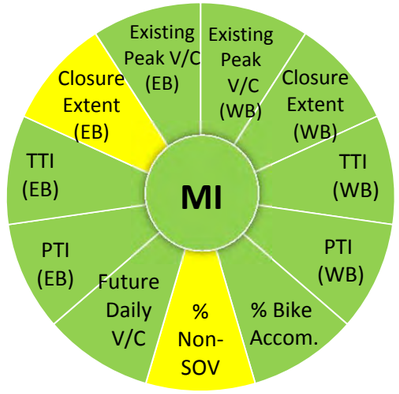
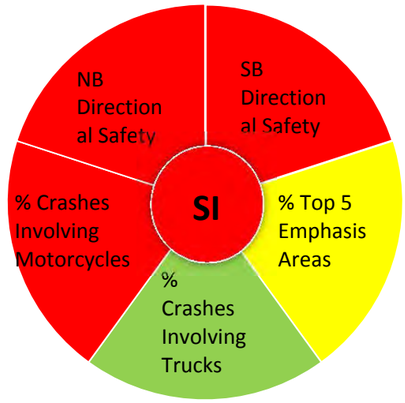
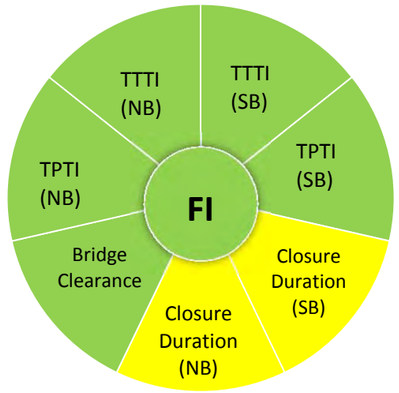
Pavement	Bridge	Mobility	Safety	Freight
				
Pavement Index (PI): based on two pavement condition ratings from the ADOT Pavement Database. The two ratings are the International Roughness Index (IRI) and the Cracking Rating. The calculation of the Pavement Index uses a combination of these two ratings	**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 current volume-to-capacity (V/C) ratio and the projected 2035 V/C ratio.	**Safety Index (SI):** combines the bi-directional frequency and rate of fatal 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 total travel time needed for 95 percent on-time arrival to free-flow travel time. The PTI represents non-recurring delay along the corridor. ➢ **% Non-single Occupancy Vehicle Trips (Non-SOV)** – represents the percentage of trips that are taken by vehicles carrying more than one occupant. ➢ **% Bicycle Accommodation** – represents the percentage of roadway that is accommodating for bicycle travel.	➢ **% SHSP Emphasis Area** – 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 of crashes involving at least one of the five SHSP Emphasis Areas on roads with similar operating environments. ➢ **Directional Safety Index** – the combination of the directional frequency and rate of fatal incapacitating injury crashes, compared to crash occurrences on similar roadways in Arizona. ➢ **% 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) is compared to the statewide average percentage on roads with similar operating environments	➢ **Directional Truck Planning Time Index (TPTI)** – the ratio of total travel time (for trucks only) needed for 95 percent on-time arrival to free-flow travel time. The TPTI represents non-recurring delay along the corridor. ➢ **Directional Truck Travel Time Index (TTTI)** – the ratio of the average peak period travel time (for trucks only) to the free-flow travel time. The TTTI represents recurring delay that occurs along the corridor. ➢ **Directional Closure Duration** – the average time a given location in the corridor was closed per mile per year. ➢ **Bridge Clearance** – the minimum vertical clearance for all underpass structures within each segment as determined via the ADOT Bridge Database.

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	Lowest Bridge Rating	% of Deck Area on Functionally Obsolete Bridges	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
			NB	SB								NB	SB	NB	SB	NB	SB	NB	SB		
17-1[1]	7	4.19	4.24	4.14	0.0%	6.98	91.52	5	23.8%	0.90	1.09	0.67	0.67	0.41	0.03	1.00	1.00	1.03	1.03	99%	10.7%
17-2[1]	10	4.16	4.13	4.15	0.0%	6.79	92.73	6	14.6%	0.68	0.80	0.51	0.53	0.41	0.00	1.08	1.05	1.15	1.11	100%	12.3%
17-3[2]	13	3.85	3.92	3.86	3.8%	6.39	91.10	5	31.3%	0.58	0.71	0.40	0.40	0.78	0.11	1.09	1.11	1.17	1.20	100%	12.0%
17-4[2]	8	4.25	3.65	4.25	0.0%	5.71	93.97	5	60.9%	0.64	0.78	0.38	0.38	0.75	0.61	1.21	1.00	1.61	1.07	97%	12.3%
17-5[2]	10	4.25	4.09	4.02	0.0%	7.15	96.27	6	16.9%	0.59	0.72	0.38	0.40	0.42	0.28	1.20	1.14	1.34	1.21	100%	15.5%
17-6[2]	16	4.26	4.08	4.02	0.0%	6.19	94.82	5	8.5%	0.37	0.45	0.33	0.33	0.05	0.15	1.13	1.38	1.23	1.69	100%	7.7%
17-7[2]	9	3.92	3.78	3.93	16.7%	6.31	91.41	6	0.0%	0.55	0.68	0.47	0.48	0.27	0.11	1.09	1.15	1.27	1.31	98%	7.7%
17-8[2]	11	4.32	4.01	4.17	4.5%	6.04	89.20	4	13.6%	0.39	0.47	0.35	0.35	0.15	0.22	1.14	1.13	1.27	1.24	100%	14.1%
17-9[2]	8	4.21	3.77	4.18	18.8%	6.00	93.00	6	100.0%	0.41	0.49	0.32	0.32	0.35	0.20	1.30	1.12	1.61	1.22	100%	6.6%
17-10[2]	9	4.19	4.01	4.06	0.0%	6.52	94.00	6	100.0%	0.35	0.41	0.27	0.27	0.20	0.29	1.29	1.13	1.60	1.25	100%	6.3%
17-11[2]	7	3.73	3.50	3.82	21.4%	6.91	96.48	5	3.4%	0.29	0.34	0.23	0.21	0.00	0.29	1.10	1.08	1.18	1.16	100%	6.2%
17-12[1]	17	3.70	3.49	3.82	25.7%	5.80	92.00	5	62.3%	0.29	0.34	0.18	0.18	0.07	0.31	1.06	1.05	1.13	1.11	94%	17.9%
Weighted Corridor Average		4.07	3.88	4.02	7.9%	6.34	92.94	5.28	35.6%	0.48	0.58	0.36	0.36	0.30	0.21	1.13	1.13	1.28	1.24	98.8%	11.3%

SCALES

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

Performance Level	Rural
Good/Above Average	< 0.56
Fair/Average	0.56 - 0.76
Poor/Below Average	> 0.76

1: Urban or Fringe Urban
2: Rural

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 TTTI		Directional TPTI		Closure Duration (mins/milepost/year/mile)		Bridge Vertical Clearance (feet)
			NB	SB						NB	SB	NB	SB	NB	SB	
17-1[a]	7	1.13	1.03	1.24	0%	6%	12%	Insufficient Data	0.94	1.03	1.03	1.07	1.07	134.0	4.5	16.80
17-2[b]	10	1.67	1.51	1.83	31%	11%	9%	Insufficient Data	0.95	1.02	1.00	1.06	1.04	108.5	0.0	16.23
17-3[c]	13	0.75	0.84	0.67	69%	10%	17%	Insufficient Data	0.94	1.01	1.03	1.04	1.09	209.8	19.7	16.01
17-4[c]	8	1.06	0.49	1.64	35%	12%	29%	Insufficient Data	0.67	1.34	1.07	1.81	1.16	194.0	175.3	16.29
17-5[c]	10	1.01	1.36	0.65	35%	10%	15%	Insufficient Data	0.88	1.09	1.02	1.20	1.07	120.0	49.4	18.22
17-6[d]	16	1.32	1.09	1.55	56%	6%	17%	Insufficient Data	0.74	1.03	1.27	1.08	1.61	13.6	24.9	16.85
17-7[c]	9	0.85	0.98	0.72	47%	Insufficient Data	13%	Insufficient Data	0.75	1.07	1.27	1.15	1.52	64.0	20.7	16.91
17-8[d]	11	2.54	3.00	2.08	58%	16%	5%	Insufficient Data	0.88	1.08	1.05	1.15	1.11	32.7	44.2	15.18
17-9[d]	8	2.18	2.39	1.97	48%	10%	0%	Insufficient Data	0.75	1.29	1.06	1.55	1.13	122.5	107.0	No UP
17-10[d]	9	0.86	0.81	0.91	50%	Insufficient Data	Insufficient Data	Insufficient Data	0.74	1.25	1.07	1.57	1.15	41.7	121.2	No UP
17-11[d]	7	1.21	2.19	0.24	29%	7%	7%	Insufficient Data	0.94	1.03	1.02	1.07	1.06	0.0	124.4	16.87
17-12[d]	17	1.04	0.53	1.54	33%	4%	8%	Insufficient Data	0.93	1.05	1.03	1.10	1.06	12.6	122.3	16.51
Weighted Corridor Average		1.29	1.29	1.29	43.1%	8.9%	12.1%	Insufficient Data	0.85	1.09	1.08	1.21	1.19	81.8	65.2	16.56

SCALES

Performance Level	Urban >6 Lane Freeway					Uninterrupted			All	
Good/Above Average	< 0.80	< 42.6%	< 2.5%	< 12.6%	-	> 0.77	< 1.15	< 1.30	< 44.18	> 16.5
Fair/Average	0.80 – 1.20	42.6% - 54.8%	2.5% - 6.0%	12.6% - 20.0%	-	0.67 - 0.77	1.15 -1.33	1.30 -1.50	44.18 -124.86	16.0-16.5
Poor/Below Average	> 1.20	> 54.8%	> 6.0%	> 20.0%	-	< 0.67	> 1.33	>1.50	> 124.86	< 16.0
Performance Level	**Urban or Rural 6 Lane Freeway**									
Good/Above Average	< 0.82	< 33.5%	< 6.2%	< 6.7%	-					
Fair/Average	0.82 – 1.18	33.5% - 57.2%	6.2% - 11.0%	6.7% - 12.9%	-					
Poor/Below Average	> 1.18	> 57.2%	> 11.0%	> 12.9%	-					
Performance Level	**Rural 4 Lane Freeway > 25,000 vpd**									
Good/Above Average	< 0.68	< 40.8%	< 7.2%	< 7.7%	-					
Fair/Average	0.68 – 1.32	40.8% - 57.1%	7.2% - 12.9%	7.7% - 17.1%	-					
Poor/Below Average	> 1.32	> 57.1%	> 12.9%	> 17.1%	-					
Performance Level	**Rural 4 Lane Freeway < 25,000 vpd**									
Good/Above Average	< 0.73	< 42.8%	< 13.2%	< 5.0%	-					
Fair/Average	0.73 – 1.27	42.8% - 52.9%	13.2% - 17.0%	5.0% - 8.5%	-					
Poor/Below Average	> 1.27	> 52.9%	> 17.0%	> 8.5%	-					

a: Urban >6 Lane Freeway b: Urban or Rural 6 Lane Freeway c: Rural 4 Lane Freeway > 25,000 vpd d: Rural 4 Lane Freeway < 25,000 vpd

Notes: "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-17 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, two "Emphasis Areas" were identified for the I-17 Corridor: Mobility and Safety.

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-17 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-17 Corridor Goals	I-17 Corridor Objectives	Performance Area	Performance Measure	Performance Objective	
				Secondary Measure Indicators	Corridor Average	Segment
Preserve & Maintain the State Transportation System	Maintain and preserve highway infrastructure	Maintain acceptable level of pavement ride quality	Pavement	Pavement Index	Fair or better	Fair or better
				Pavement Serviceability (Directional)		
				Percent Pavement Area Failure		
		Reduce the number of structurally deficient bridges	Bridge	Bridge Index	Fair or better	Fair or better
				Bridge Rating		
				Bridge Sufficiency		
				Obsolete Bridges		
Improve Mobility & Accessibility **Support Economic Growth**	Provide reliable route for recreation and tourist travel to/from Northern Arizona Provide efficient commuting route between Southern Coconino County and Flagstaff Provide efficient commuting route between Metro Phoenix and Northern Maricopa County and Central Yavapai County Provide efficient commuting route between Verde Valley and the surrounding communities of Sedona, Prescott Valley, and Flagstaff	Reduce current and future congestion Reduce delays from non-recurring events and incidents to enhance travel time reliability	Mobility *(Emphasis Area)*	Mobility Index	Good	Fair or better
				Future V/C		
				Existing Peak Hour V/C (Directional)		
				Closure Extent (Directional)		
				Travel Time Index (Directional)		
				Planning Time Index (Directional)		
				Percent Non-SOV Trips		
				Bicycle Accommodation		
Enhance Safety & Security	Enhance safety	Reduce fatal and incapacitating injury crashes for all roadway users	Safety *(Emphasis Area)*	Safety Index	Above Average	Average or better
				Safety Index (Directional)		
				Percent Fatal/Incapacitating Crashes in SHSP Emphasis Areas		
				Percent Fatal/Incapacitating Truck Crashes		
				Percent Fatal/Incapacitating Motorcycle Crashes		
				Percent Fatal/Incapacitating Non-motorized Crashes		
Improve Mobility & Accessibility **Support Economic Growth**	Provide reliable route for freight connection between I-10 and I-40	Reduce delays and restrictions to freight movements and improve travel time reliability	Freight	Freight Index	Fair or better	Fair or better
				Travel Time Index (Directional)		
				Planning Time Index (Directional)		
				Closure Duration		
				Bridge Vertical Clearance		

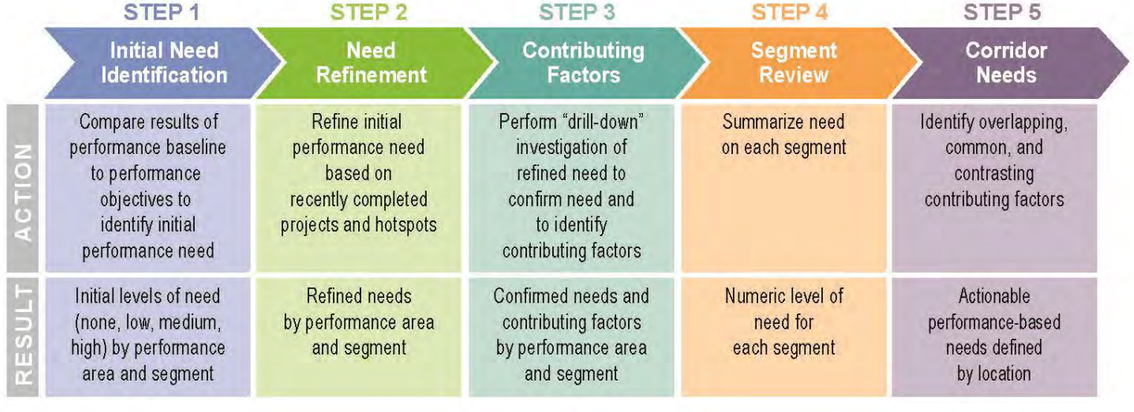
3.2 Needs Assessment Process

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		
	Fair	Low	Middle 1/3 of Fair (5.5-6.0)
5.0	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 levels of need for each primary and secondary performance measure are combined to produce a weighted 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 1 and refined in Step 2 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

- Pavement hot spots were identified in Segments 17-3, 17-7, 17-8, 17-9, 17-11, and 17-12.
- Three segments (17-7, 17-8, and 17-9) had recent paving projects that addressed the Needs, resulting in changing the need from “Low” to “None”.
- The only change in the level of Need resulting from hot spot analysis occurs on segment 17-3, resulting in raising the level of Need from “None” to “Low”. Hot Spot is expected to be mitigated through upcoming projects.
- Segments 17-1, 17-2, 17-5, 17-8, 17-9, 17-10, and 17-12 show a high level of historical investment, meaning that some previous projects have proven to provide only temporary improvements and require frequent attention.
- The final Pavement Needs are typically classified as “None”, with three segments classified as “Low”.
- See **Appendix D** for detailed information on contributing factors.

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				
		NB	SB					
17-1	4.19	4.24	4.14	0.0%	0.0			None
17-2	4.16	4.13	4.15	0.0%	0.0			None
17-3	3.85	3.92	3.86	3.8%	0.0	NB MP 236-237	Presence of hot spot elevated Need from None to Low; Project is programmed in FY 17	Low
17-4	4.25	3.65	4.25	0.0%	0.0			None
17-5	4.25	4.09	4.02	0.0%	0.0			None
17-6	4.26	4.08	4.02	0.0%	0.0			None
17-7	3.92	3.78	3.93	16.7%	0.4	NB MP 281-282 and 286-287, SB MP 281-282	Recent pavement preservation project	None
17-8	4.32	4.01	4.17	4.5%	0.0	NB MP 289-290	Recent pavement preservation project	None
17-9	4.21	3.77	4.18	18.8%	0.4	NB MP 302-305	Recent pavement preservation project	None
17-10	4.19	4.01	4.06	0.0%	0.0			None
17-11	3.73	3.50	3.82	21.4%	0.5	NB MP 316-317 and 320-322		Low
17-12	3.70	3.49	3.82	25.7%	0.7	NB MP 326-327, 328-330, 332-334, 339-340, & SB MP 339-340	Project is programmed in FY 19	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

- Bridge needs occur due to under-performing bridges or hot spots on nine of the twelve segments.
- Bridge needs were identified at 16 of the total 98 bridges (16%).
- Eight bridges have potential repetitive investment issues and are candidates for life-cycle cost analysis to evaluate alternative solutions.
- See **Appendix D** for detailed information on contributing factors.

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	Lowest Bridge Rating	% Deck on Functionally Obsolete Bridges				
17-1	6.98	91.5	5	23.8%	0.3			Low
17-2	6.79	92.7	6	14.6%	0.0			None
17-3	6.39	91.1	5	31.3%	0.4	Moores Gulch SB		Low
17-4	5.71	94.0	5	60.9%	1.5			Medium
17-5	7.15	96.3	6	16.9%	0.0			None
17-6	6.19	94.8	5	8.5%	0.2			Low
17-7	6.31	91.4	6	0.0%	0.0			None
17-8	6.04	89.2	4	13.6%	0.4	McGuireville TI and SR 179 TI SB		Low
17-9	6.00	93.0	6	100.0%	0.3			Low
17-10	6.52	94.0	6	100.0%	0.3			Low
17-11	6.91	96.5	5	3.4%	0.2			Low
17-12	5.80	92.0	5	62.3%	1.5	Willard Springs TI NB & Airport Rd TI		Medium

Level of Need (Score)	Performance Score Need Scale				Segment Level Need Scale
None (0)	> 6.0	> 70	> 5.0	< 21.0%	0
Low (1)	5.5 – 6.0	60 – 70	5.0	21.0% - 31.0%	< 1.5
Medium (2)	4.5 – 5.5	40 – 60	4.0	31.0% - 49.0%	1.5 – 2.5
High (3)	< 4.5	< 40	< 4.0	> 49.0%	> 2.5

*A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicated 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

- "Low" Mobility needs were identified on eight of the twelve segments (65% of corridor).
- "Medium" Mobility needs were identified on segment 17-4 primarily due to the grades/terrain and restrictions due to closures.
- A majority of the needs are related to future travel demand, directional TTI and PTI issues, and closures.
- See **Appendix D** for detailed information on contributing factors.

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			
			NB	SB	NB	SB	NB	SB	NB	SB				
17-1[1]	0.90	1.09	0.67	0.67	0.41	0.03	1.00	1.00	1.03	1.03	99%	2.7		High
17-2[1]	0.68	0.80	0.51	0.53	0.41	0.00	1.08	1.05	1.15	1.11	100%	0.3		Low
17-3[2]	0.58	0.71	0.40	0.40	0.78	0.11	1.09	1.11	1.17	1.20	100%	0.7		Low
17-4[2]	0.64	0.78	0.38	0.38	0.75	0.61	1.21	1.00	1.61	1.07	97%	2.1		Medium
17-5[2]	0.59	0.72	0.38	0.40	0.42	0.28	1.20	1.14	1.34	1.21	100%	0.5		Low
17-6[2]	0.37	0.45	0.33	0.33	0.05	0.15	1.13	1.38	1.23	1.69	100%	0.5		Low
17-7[2]	0.55	0.68	0.47	0.48	0.27	0.11	1.09	1.15	1.27	1.31	98%	0.2	SB Climbing Lane MP 280-282	Low
17-8[2]	0.39	0.47	0.35	0.35	0.15	0.22	1.14	1.13	1.27	1.24	100%	0		None
17-9[2]	0.41	0.49	0.32	0.32	0.35	0.20	1.30	1.12	1.61	1.22	100%	0.5		Low
17-10[2]	0.35	0.41	0.27	0.27	0.20	0.29	1.29	1.13	1.60	1.25	100%	0.5		Low
17-11[2]	0.29	0.34	0.23	0.21	0.00	0.29	1.10	1.08	1.18	1.16	100%	0		None
17-12[1]	0.29	0.34	0.18	0.18	0.07	0.31	1.06	1.05	1.13	1.11	94%	0		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 or Fringe Urban
2: Rural

* *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

- "High" Safety Needs were identified on six of the twelve segments (47% of corridor).
- Multiple safety hot spots are identified, especially in the southern portion of the corridor between Segments 17-1 and 17-3.
- At the overall corridor level, 62% of the fatal and incapacitating crashes involve either over-turning or colliding with a fixed object, 52% involve run-off-road crashes, and 30% involve speed too fast for conditions.
- While a "High" level of Need was identified on segments 17-1 and 17-2, both of these segments have recently been reconstructed/widened which has changed the operating conditions of these segments and may have addressed some of the safety issues.
- See **Appendix D** for detailed information on contributing factors.

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				
		NB	SB							
17-1[a]	1.13	1.03	1.24	0%	6%	12%	2.7	NB MP 216-221, SB MP 218-221	Recent construction may have addressed issue	High
17-2[b]	1.67	1.51	1.83	31%	11%	9%	4.0	NB MP 222-224, SB MP 224-228,SB MP 231-232	Recent construction may have addressed issue	High
17-3[c]	0.75	0.84	0.67	69%	10%	17%	1.0	NB MP 238-240, SB MP 232-235		Low
17-4[c]	1.06	0.49	1.64	35%	12%	29%	2.3			Medium
17-5[c]	1.01	1.36	0.65	35%	10%	15%	1.6			Medium
17-6[d]	1.32	1.09	1.55	56%	6%	17%	3.7			High
17-7[c]	0.85	0.98	0.72	47%	*Insufficient Data*	13%	0.5			Low
17-8[d]	2.54	3.00	2.08	58%	16%	5%	4.2	SB MP 297-299		High
17-9[d]	2.18	2.39	1.97	48%	10%	0%	3.8	SB MP 299-302		High
17-10[d]	0.86	0.81	0.91	50%	*Insufficient Data*	Insufficient Data	0.4	SB MP 311		Low
17-11[d]	1.21	2.19	0.24	29%	7%	7%	2.7	NB MP 317		High
17-12[d]	1.04	0.53	1.54	33%	4%	8%	1.7			Medium

Level of Need (Score)		Performance Score Needs Scale				Segment Level Need Scale
None (0)	a	≤ 0.93	≤ 47%	≤ 4%	≤ 15%	0
	b	≤ 0.94	≤ 42%	≤ 8%	≤ 9%	
	c	≤ 0.89	≤ 46%	≤ 9%	≤ 11%	
	d	≤ 0.91	≤ 46%	≤ 14%	≤ 6%	
Low (1)	a	0.93 - 1.06	47% - 51%	4% - 5%	15% - 17%	≤ 1.5
	b	0.94 - 1.06	42% - 50%	8% - 10%	9% - 11%	
	c	0.89 - 1.10	46% - 51%	9% - 11%	11% - 14%	
	d	0.91 - 1.09	46% - 49%	14% - 15%	6% - 7%	
Medium (2)	a	1.06 - 1.33	51% - 59%	5% - 7%	17% - 22%	1.5 - 2.5
	b	1.06 - 1.30	50% - 65%	10% - 13%	11% - 15%	
	c	1.10 - 1.53	51% - 62%	11% - 15%	14% - 20%	
	d	1.09 - 1.45	49% - 56%	15% - 18%	7% - 9%	
High (3)	a	≥ 1.33	≥ 59%	≥ 7%	≥ 22%	≥ 2.5
	b	≥ 1.30	≥ 65%	≥ 13%	≥ 15%	
	c	≥ 1.53	≥ 62%	≥ 15%	≥ 20%	
	d	≥ 1.45	≥ 56%	≥ 18%	≥ 9%	

a: Urban >6 Lane Freeway
b: Urban or Rural 6 Lane Freeway
c: Rural 4 Lane Freeway > 25,000 vpd
d: Rural 4 Lane Freeway < 25,000 vpd

**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

- Freight Needs are Low for the majority of the corridor, with segment 17-4 showing High need.
- Elevated values for TTII and TPTI are generally shown in the uphill directions of mountainous terrain.
- Closure durations are higher than the statewide average on the southern end (segments 17-1 through 17-5) and the northern end (segments 17-9 through 17-12) of the corridor.
- Segment 17-4 experiences longer than average closures in both directions of travel.
- Two bridges provide less than 16.25' vertical clearance and cannot be by-passed by using ramps:
  - Table Mesa Rd TI UP (MP 236 southbound)
  - McGuireville TI UP (MP 293 southbound)
- See **Appendix D** for detailed information on contributing factors.

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				
		NB	SB	NB	SB	NB	SB					
17-1	0.94	1.03	1.03	1.07	1.07	133.98	4.49	16.80	0.2			Low
17-2	0.95	1.02	1.00	1.06	1.04	108.47	0.00	16.23	0.4			Low
17-3	0.94	1.01	1.03	1.04	1.09	209.83	19.72	16.01	0.7	Table Mesa Rd TI UP (MP 236 SB)		Low
17-4	0.67	1.34	1.07	1.81	1.16	194.02	175.25	16.29	3.3			High
17-5	0.88	1.09	1.02	1.20	1.07	119.96	49.38	18.22	0.2			Low
17-6	0.74	1.03	1.27	1.08	1.61	13.57	24.86	16.85	0.4			Low
17-7	0.75	1.07	1.27	1.15	1.52	63.96	20.73	16.91	0.3		SB Climbing Lane MP 280-282	Low
17-8	0.88	1.08	1.05	1.15	1.11	32.69	44.2	15.18	0.6	McGuireville TI UP (MP 293 SB)		Low
17-9	0.75	1.29	1.06	1.55	1.13	122.53	107	No UP	0.8			Low
17-10	0.74	1.25	1.07	1.57	1.15	41.70	121.24	No UP	0.6			Low
17-11	0.94	1.03	1.02	1.07	1.06	0.00	124.43	16.87	0.2			Low
17-12	0.93	1.05	1.03	1.10	1.06	12.62	122.31	16.51	0.2			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 average need score for each segment presented in the last row of the table. A weighting factor of 1.5 is applied to the need scores of the performance areas identified as emphasis areas (Mobility and Safety for the I-17 Corridor). There are nine segments with a Medium overall average need, and three segments with a Low overall average need.

Table 17: Summary of Needs by Segment

Performance Area	Segment Number and Mileposts (MP)											
	17-1	17-2	17-3	17-4	17-5	17-6	17-7	17-8	17-9	17-10	17-11	17-12
	MP 215-222	MP 222-232	MP 232-245	MP 245-253	MP 253-263	MP 263-279	MP 279-288	MP 288-299	MP 299-307	MP 307-316	MP 316-323	MP 323-340
Pavement	None	None	Low	None	None	None	None	None	None	None	Low	Low
Bridge	Low	None	Low	Medium	None	Low	None	Low	Low	Low	Low	Medium
Mobility+	High	Low	Low	Medium	Low	Low	Low	None	Low	Low	None	None
Safety+	High	High	Low	Medium	Medium	High	Low	High	High	Low	High	Medium
Freight	Low	Low	Low	High	Low	Low	Low	Low	Low	Low	Low	Low
Average Need (0-3)	**2.07**	**1.33**	**1.00**	**1.87**	**1.03**	**1.47**	**0.73**	**1.17**	**1.47**	**0.87**	**1.30**	**1.13**

**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-17 Corridor.

Scale	
None	< 0.1
Low	0.1 - 1.00
Medium	1.00 - 2.00
High	> 2.00

Summary Corridor Needs

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

Pavement Needs

- The Pavement Performance Area is not an emphasis area for I-17.
- Pavement needs were identified on three segments (17-3, 17-11, and 17-12).
- Programmed pavement rehabilitation projects will likely mitigate two of these segments.
- A high level of historical investment was identified on approximately 72 miles of the corridor, meaning that some projects have proven to provide only temporary improvements and require frequent attention. These locations may be candidates for life-cycle cost analysis to evaluate alternative solutions.

Bridge Needs

- The Bridge Performance Area is not an emphasis area for I-17.
- Bridge needs occur due to under-performing bridges or hot spots on nine of the twelve segments.
- Bridge Needs were identified at 16 of the total 98 bridges (16%).
- Projects are programmed at two bridges which could address the Needs at Moores Gulch (southbound) and Willard Springs TI.
- Eleven bridges have current ratings of 5, and one bridge has current rating of 4.
- Eight bridges have current deck ratings of 5 or less.
- Eight bridges have potential historical rating issues and may be candidates for life-cycle cost analysis to evaluate alternative solutions.

Mobility Needs

- The Mobility Performance Area is an emphasis area for I-17.
- Mobility needs were identified on nine of the twelve segments (70% of corridor).
- A majority of the Needs are related to future travel demand, directional TTI and PTI issues, and closures.
- “Medium” Mobility Needs were identified on segment 17-4 primarily due to the grades/terrain and restrictions due to closures.
- The lowest trip reliability is on segment 17-4 (MP 245-253).

Safety Needs

- The Safety Performance Area is an emphasis area for I-17.
- Safety needs were identified on all segments along the I-17 Corridor.
- “High” Safety needs were identified on six of the twelve segments (47% of corridor).
- Multiple safety hot spots were identified, especially in the southern part of the corridor on segments 17-1 through 17-3.
- At the overall corridor level, 62% of the fatal and incapacitating crashes involve either over-turning or colliding with a fixed object, 52% involve run-off-road crashes, and 30% involve speed too fast for conditions.
- While a “High” level of need was identified on segments 17-1 and 17-2, both of these segments have recently been reconstructed/widened which has changed the operating conditions of these segments and may have addressed some of the safety issues.

Freight Needs

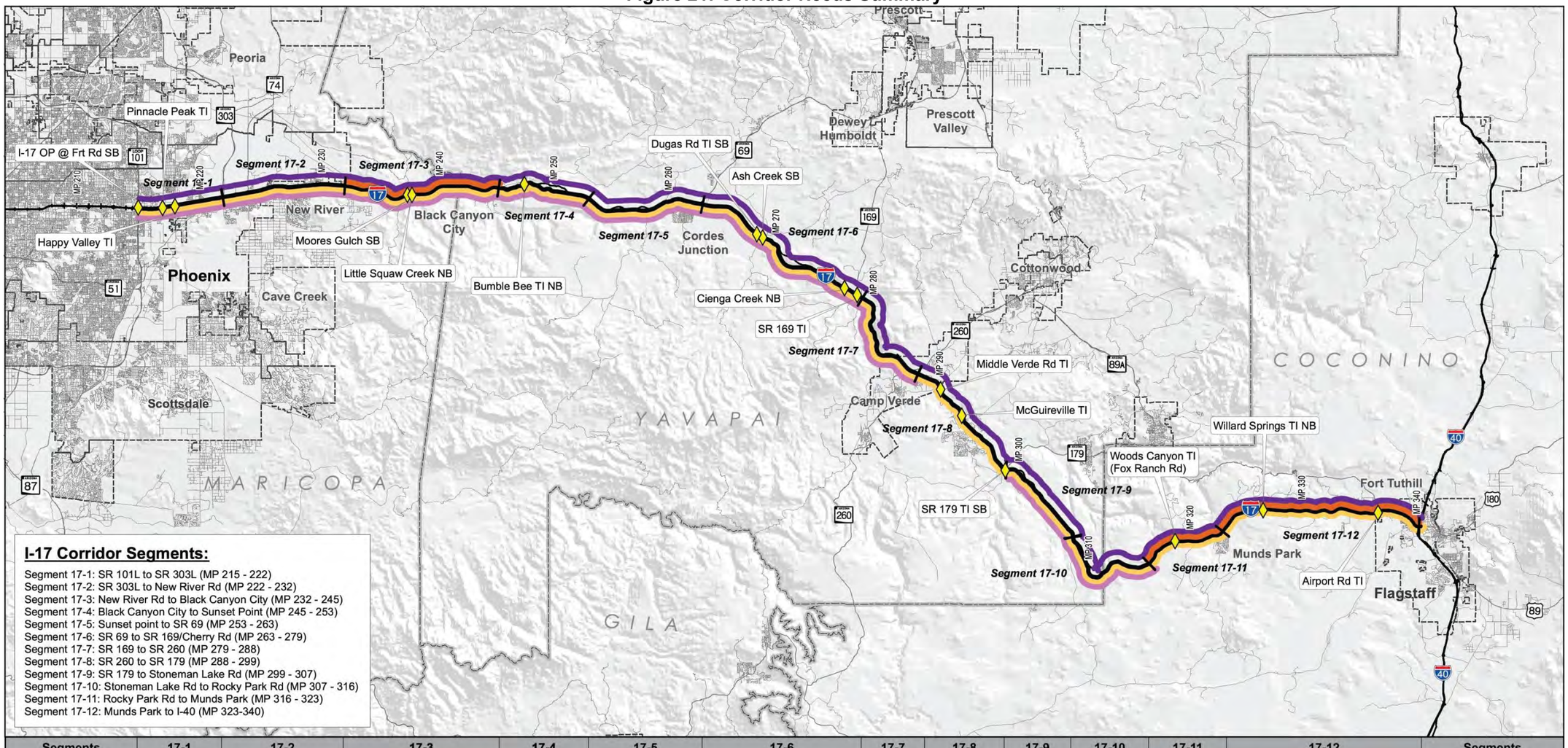
- The Freight Performance Area is not an emphasis area for I-17.
- Freight needs were identified on all segments along the I-17 Corridor.
- All segments show “Low” Need, except on segment 17-4. Other than on segment 17-4, impediments to freight mobility and travel times are not significant.
- Elevated values for TTTI and TPTI are generally shown in the uphill directions of mountainous terrain.
- Closure durations are higher than the statewide average on the southern end (segments 17-1 through 17-5) and the northern end (segments 17-9 through 17-12) of the corridor.
- Two bridges provide less than 16.25’ vertical clearance and cannot by by-passed by using ramps: Table Mesa Rd TI UP (MP 236 southbound) and McGuireville TI UP (MP 293 southbound)

Overlapping Needs

This section identifies overlapping performance needs on the I-17 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:

- MP 245 to 253 (Segment 17-4) has overlapping needs in the Bridge, Mobility, Safety, and Freight performance areas with Medium or High levels of Need in all four areas. The ADOT Northwest District has indicated that this location is a high crash area and has significant mobility issues. This area has substantial grades and is classified as mountainous terrain which is the primary contributing factor to the freight and mobility issues. Mountainous terrain typically creates speed differentials between vehicles and two travel lanes do not supply ample passing opportunities leading to improper lane changes. The ADOT Climbing and Passing Lane Prioritization Study (2015) indicated that the implementation of a climbing lane on this section of the corridor is ranked number 1 on the prioritized list of climbing lanes on multi-lane highways within the state.

Figure 21: Corridor Needs Summary



I-17 Corridor Segments:

Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
Segment 17-2: SR 303L to New River Rd (MP 222 - 232)
Segment 17-3: New River Rd to Black Canyon City (MP 232 - 245)
Segment 17-4: Black Canyon City to Sunset Point (MP 245 - 253)
Segment 17-5: Sunset point to SR 69 (MP 253 - 263)
Segment 17-6: SR 69 to SR 169/Cherry Rd (MP 263 - 279)
Segment 17-7: SR 169 to SR 260 (MP 279 - 288)
Segment 17-8: SR 260 to SR 179 (MP 288 - 299)
Segment 17-9: SR 179 to Stoneman Lake Rd (MP 299 - 307)
Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)

Segments	17-1	17-2	17-3	17-4	17-5	17-6	17-7	17-8	17-9	17-10	17-11	17-12	Segments
Pavement	None	None	Low	None	None	None	None	None	None	None	Low	Low	Pavement
Bridge	Low	None	Low	Medium	None	Low	None	Low	Low	Low	Low	Medium	Bridge
Mobility*	High	Low	Low	Medium	Low	Low	Low	None	Low	Low	None	None	Mobility*
Safety*	High	High	Low	Medium	Medium	High	Low	High	High	Low	High	Medium	Safety*
Freight	Low	Low	Low	High	Low	Low	Low	Low	Low	Low	Low	Low	Freight
Average Need (0-3)	2.07	1.33	1.00	1.87	1.03	1.47	0.73	1.17	1.47	0.87	1.30	1.13	Average Need (0-3)

**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 Emphasis Area for I-17 corridor

I-17 Corridor Profile Study: SR 101L to Junction I-40

Corridor Needs Summary

N

0 2.5 5 10 15 20 Miles

Needs Symbology

Safety
Pavement
Freight
Mobility
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-17 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



I-17 Corridor Segments:

Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
Segment 17-2: SR 303L to New River Rd (MP 222 - 232)
Segment 17-3: New River Rd to Black Canyon City (MP 232 - 245)
Segment 17-4: Black Canyon City to Sunset Point (MP 245 - 253)
Segment 17-5: Sunset point to SR 69 (MP 253 - 263)
Segment 17-6: SR 69 to SR 169/Cherry Rd (MP 263 - 279)
Segment 17-7: SR 169 to SR 260 (MP 279 - 288)
Segment 17-8: SR 260 to SR 179 (MP 288 - 299)
Segment 17-9: SR 179 to Stoneman Lake Rd (MP 299 - 307)
Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)

Segments	17-1	17-2	17-3	17-4	17-5	17-6	17-7	17-8	17-9	17-10	17-11	17-12	Segments
Pavement	-	-	Hotspot	-	-	-	-	-	-	-	Hotspot	Hotspot	Pavement
Bridge	-	-	Hotspot	Medium	-	-	-	Hotspot	-	-	-	Medium	Bridge
Mobility*	High	-	-	Medium	-	-	-	-	-	-	-	-	Mobility*
Safety*	High	High	Hotspot	Medium	Medium	High	-	High	High	Hotspot	High	Medium	Safety*
Freight	-	-	Hotspot	High	-	-	-	Hotspot		-	-	-	Freight
Average Need (0-3)	2.07	1.33	1.00	1.87	1.03	1.47	0.73	1.17	1.47	0.87	1.30	1.13	Average Need (0-3)

* Identified as Emphasis Area for I-17 corridor

I-17 Corridor Profile Study: SR 101L to Junction I-40
Strategic Investment Areas

0 2.5 5 10 15 20 Miles

Strategic Investment Areas
Safety
Pavement
Freight
Mobility
Bridge

Level of Need
Low
Medium
High

Table 18: Strategic Investment Area Screening

Segment # and MP	Level of Strategic Need					Location #	Type	Need Description	Advance (Y/N)	Screening Description
	Pavement	Bridge	Mobility	Safety	Freight					
17-1 MP 215-222			High	High		L1	Safety	Crash trends show run off road (27%), collision with a fixed object (32%), and rear end (24%) crashes	N	Recent reconstruction changed characteristics of segment which would change crash trends that have been identified.
						L2	Mobility	Mobility Index and Future V/C due to projected future travel demand	N	Need is driven by future travel demand and future V/C. Future travel demand is elevated due to future free-flow, freeway-to-freeway interchange with SR 303L. Improvements to I-17 to accommodate this future demand and associated interchange will be part of the future TI project.
17-2 MP 222-232				High		L3	Safety	Crash trends show run off road (37%), pedestrian (3%), over-turning (37%), and rear-end (23%) crashes	N	Recent reconstruction changed characteristics of segment which would change crash trends that have been identified.
17-3 MP 232-245	Hot Spot	Hot Spot		Hot Spot	Hot Spot	L4	Pavement	NB MP 236-237 with medium level of previous investment	N	Pavement preservation project programmed in FY 17 and does not meet criteria for previous investment, therefore not considered strategic.
						L5	Bridge	Moores Gulch SB bridge has current deck and superstructure ratings of 5 with historical concern	N	Bridge replacement programmed in FY 17.
						L6	Safety	NB MP 237-240 and SB MP 232-235	N	No discernible trends in the crash data.
						L7	Freight	Table Mesa TI bridge has low vertical clearance and cannot be by-passed	Y	
17-4 MP 245-253		Medium	Medium	Medium	High	L8	Mobility, Safety, & Freight	Mobility, Safety, and Freight Needs primarily associated with geometric characteristics of the segment. Crash trends involve collision with fixed object (35%), single vehicle (59%), speed too fast for conditions (31%), and run off road (59%) crashes.	Y	
						L9	Bridge	Bumble Bee TI bridge has current deck rating of 5 without historical concern	N	Bridge does not meet criteria for historical review, therefore not considered strategic.
17-5 MP 253-263				Medium		L10	Safety	Crash trends show run off road left (45%), single vehicle (65%), over-turning (55%) crashes and lack of safety device use (30%)	Y	
17-6 MP 263-279				High		L11	Safety	Crash trends show run off road (72%), single vehicle (94%), over-turning (67%) crashes. Other contributing factors include speed too fast for conditions (56%), slush conditions (6%), and lack of safety device used (39%).	Y	
17-8 MP 288-299		Hot Spot		High	Hot Spot	L12	Bridge	SR 179 TI SB bridge has current deck and substructure ratings of 5 without historical concerns	N	Bridge does not meet criteria for historical review, therefore not considered strategic.
						L13	Bridge	McGuireville TI bridge has current superstructure rating of 4 and has historical concerns	Y	
						L14	Safety	Crash trends show run off road (63%), single vehicle (68%), head-on (16%), and equipment failure (21%) crashes.	Y	
						L15	Freight	McGuireville TI bridge has low vertical clearance and cannot be by-passed	Y	
17-9 MP 299-307				High		L16	Safety	Crash trends show run off road (62%) and single vehicle (81%) crashes	Y	
17-10 MP 307-316				Hot Spot		L17	Safety	SB MP 311-312	Y	

Legend: Strategic investment area screened out from further consideration.

Table 18: Strategic Investment Area Screening (continued)

Segment	Level of Strategic Need					Location #	Type	Need Description	Advance (Y/N)	Screening Description
	Pavement	Bridge	Mobility	Safety	Freight					
17-11 MP 316-323	Hot Spot			High		L18	Pavement	NB MP 316-317 and 320-322 with low level of previous investment	N	Pavement rehabilitation project is programmed in FY 19 and does not meet criteria for previous investment, therefore not considered strategic.
						L19	Safety	Crash trends show single vehicle (64%), over-turning (50%), collision with animal (7%) crashes. Other contributing factors include speed too fast for conditions (43%), snow (21%), and ice/frost (21%).	Y	
17-12 MP 323-340	Hot Spot	Medium		Medium		L20	Pavement	NB MP 326-334 and 339-340 , SB MP 339-340 with high level of previous investment	N	Pavement rehabilitation project is programmed in FY 19.
						L21	Bridge	Willard Springs TI NB bridge has current deck and superstructure ratings of 5 and historical concerns	N	Bridge replacement programmed in FY 17.
						L22	Bridge	Airport Rd TI bridge has current substructure and superstructure ratings of 5 and historical concerns	Y	
						L23	Safety	Crash trends show single vehicle (92%), over-turning (78%), run off road (75%), and crossed centerline (4%) crashes. Other contributing factors include lack of safety device use (21%) and dark-unlighted (38%) conditions.	N	Recommend to modify scope of programed pavement preservation project to address safety needs.

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-17 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 19 candidate solutions are proposed to address the identified needs on the I-17 Corridor.

Table 19 identifies each strategic location that has been assigned a candidate solution with a number (e.g., CS 17.1, 17.2, 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.

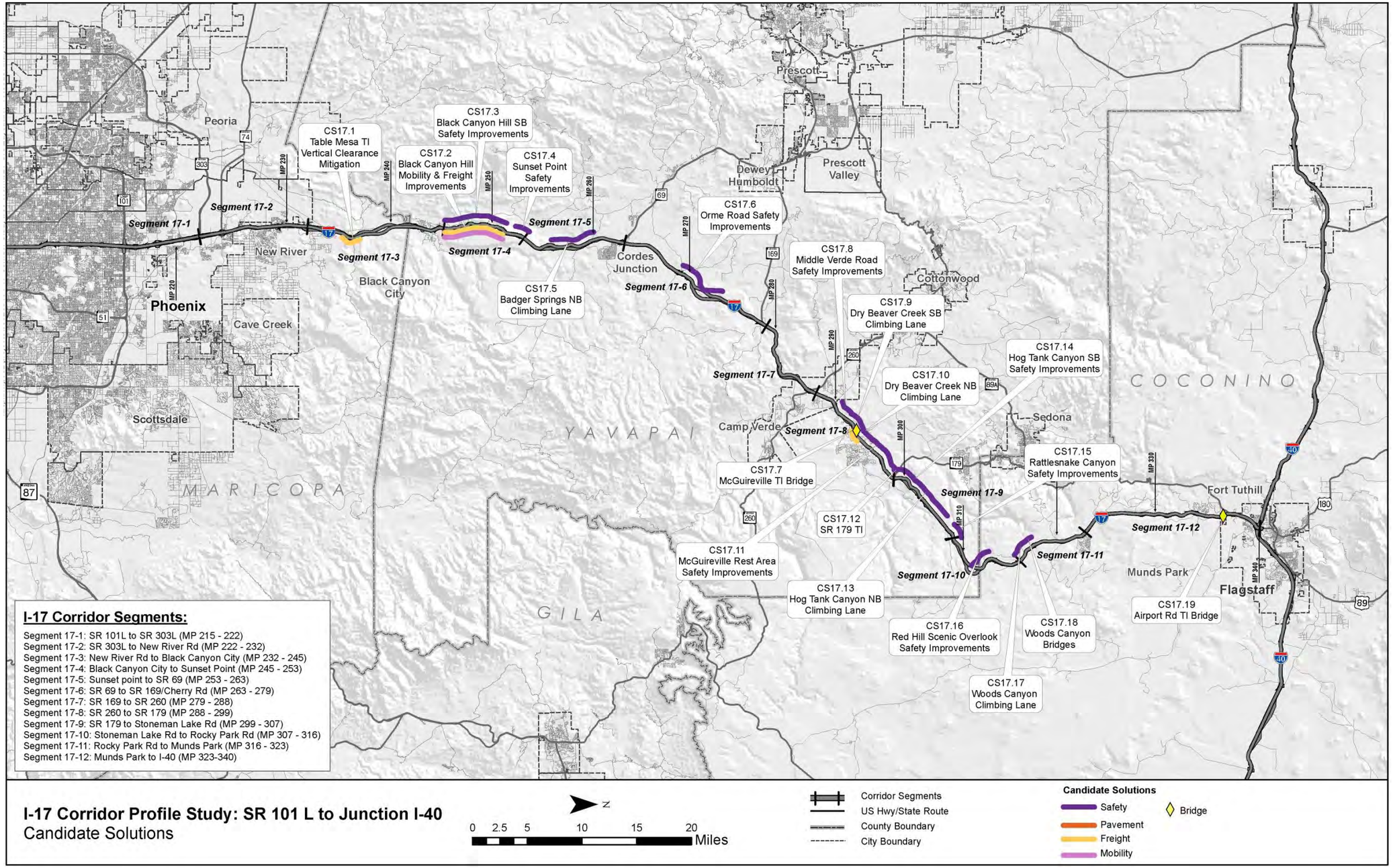
Table 19: Candidate Solutions

Candidate Solution #	Segment	Location #	Beg Milepost	End Milepost	Candidate Solution Name	Option*	Scope	Investment Category (Preservation [P], Modernization [M], Expansion [E])
CS 17.01	17-3	L7	235.5	236.5	Table Mesa Rd TI Vertical Clearance Mitigation	-	Re-profile southbound roadway	M
CS 17.02	17-4	L8	245	251	Black Canyon Hill Mobility & Freight Improvements	A	Construct NB Climbing lane & replace NB Bumble Bee Rd Bridge	M
						B	Construct reversible lanes & replace SB Bumble Bee Rd Bridge	M
						C	Shoulder running for NB traffic	M
CS 17.03	17-4	L8	SB 245	251	Black Canyon Hill Southbound Safety Improvements	-	Enhance roadside design (replace guardrail) Install high visibility striping and delineators, raised pavement markers, and rumble strips Install chevrons on curves Excavate/grade cut slopes to improve sight distance Install dynamic speed feedback system on southbound roadway (near MP 248 and MP 251)	M
CS 17.04	17-4	L8	252	253	Sunset Point Safety Improvements	-	Construct/ extend NB & SB parallel exit ramps at Sunset Point TI Install roadway weather information systems (RWIS) Install dynamic wind warning system	M
CS 17.05	17-5	L10	NB 256	260	Badger Springs Northbound Climbing Lane	-	Construct northbound climbing lane	M
CS 17.06	17-6	L10	SB 269	274	Orme Road Southbound Safety Improvements	-	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace) Install high visibility striping and delineators, raised pavement markers, and rumble strips Install chevrons on curves Install dynamic speed feedback system (near MP 272 & MP 274)	M
CS 17.07	17-8	L13 & L15	293		McGuireville TI Bridge	A	Rehabilitate/repair McGuireville TI bridge and construct new southbound exit ramp	P
						B	Replace McGuireville TI bridge	M
CS 17.08	17-8	L14	NB 290	293	Middle Verde Road Northbound Safety Improvements	-	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace) Install high visibility striping and delineators, raised pavement markers, and rumble strips Install chevrons on curves Install dynamic speed feedback system (near MP 291 & MP 293) Install CCTV near existing DMS located at MP 289	M
CS 17.09	17-8	L14	SB 292	294	Dry Beaver Creek Southbound Climbing Lane	-	Construct southbound climbing lane and widen Dry Beaver Creek Bridge	M
CS 17.10	17-8	L14	NB 294	298	Dry Beaver Creek Northbound Climbing Lane	-	Construct northbound climbing lane	M
CS 17.11	17-8	L14	SB 295	299	McGuireville Rest Area Southbound Safety Improvements	-	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace) Install high visibility striping and delineators, raised pavement markers, and rumble strips Install chevrons on curves Install dynamic speed feedback system (near MP 297 & MP 299) Install CCTV near existing DMS located at MP 297.4	M
CS 17.12	17-8	L14	298.5	299	SR 179 TI Safety Improvements	-	Construct/extend parallel southbound entrance and northbound exit ramps at SR179 TI	M
CS 17.13	17-9	L16	NB 299	305	Hog Tank Canyon Northbound Climbing Lane	-	Construct northbound climbing lane Install new DMS at MP 303.4 with CCTV	M

Candidate Solution #	Segment	Location #	Beg Milepost	End Milepost	Candidate Solution Name	Option*	Scope	Investment Category (Preservation [P], Modernization [M], Expansion [E])
CS 17.14	17-9	L16	SB 300	302	Hog Tank Canyon Southbound Safety Improvements	-	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace) Install high visibility striping and delineators, raised pavement markers, and rumble strips Install chevrons Install dynamic speed feedback system (near MP 302) Excavate/grade cut slopes to improve sight distance	M
CS 17.15	17-9	L16	NB 305	307	Rattlesnake Canyon Northbound Safety Improvements	-	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace) Install high visibility striping and delineators, raised pavement markers, and rumble strips Install chevrons on curves Install dynamic speed feedback system (near MP 305) Construct/extend northbound parallel entrance ramp at Stoneman Lake TI Install CCTV near MP 306.5	M
CS 17.16	17-10	L17	SB 309	313	Red Hill Scenic Overlook Southbound Safety Improvements	-	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace) Install chevrons on curves Install dynamic speed feedback system (near MP 311 & MP 313) Install CCTV near MP 312.3	M
CS 17.17	17-11	L19	SB 316	317	Woods Canyon Southbound Climbing Lane	-	Construct southbound climbing lane	M
CS17.18	17-11	L19	316.5	317.5	Woods Canyon Safety Improvements	-	Realign roadway and construct new bridges over Woods Canyon with de-icing system Install roadway weather information system (RWIS) near Rocky Park TI or Woods Canyon	M
CS 17.19	17-12	L22	337		Airport Rd TI Bridge	A	Rehabilitate/repair Airport Rd TI bridge	P
						B	Replace Airport Rd TI bridge	M

* '-': Indicates only one solution is being proposed and no options are being considered

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.

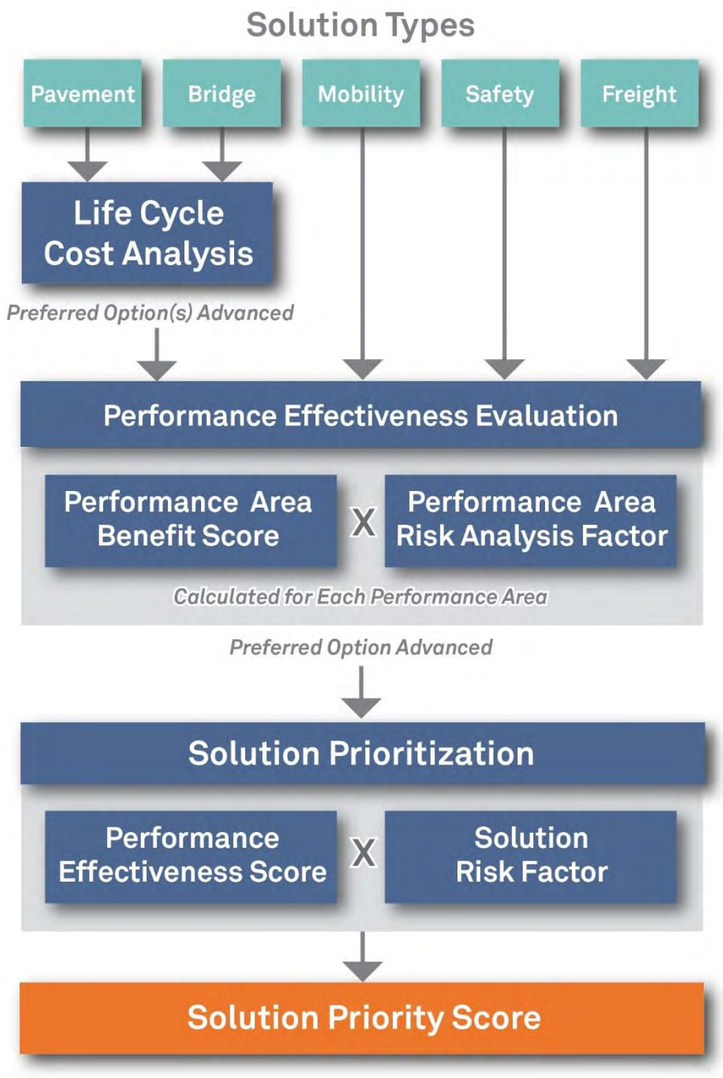
Solution Risk Analysis

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 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
- 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,** LCAA was conducted for two bridge projects on the I-17 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**, an LCCA was not conducted for any pavement projects on the I-17 Corridor. A summary of this analysis is shown in **Table 21**.

As shown in **Table 20** and **Table 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 these will be addressed through normal programming processes and these candidate solutions will be dropped from further consideration.
    - Airport Rd Bridge (CS17.19)
- Rehabilitation or repair was determined to be the most effective approach for the candidate solutions listed below. However, these locations do have other Needs so multiple candidate solutions will be carried forward for further consideration.
    - McGuireville Rd TI Bridge (CS17.7)

Benefit-Cost Analysis

Benefit-Cost Analysis (BCA) is an economic analysis that compares cost streams and benefit streams over time and presents the results in a common measure, the present value in dollars. In the BCA, the benefits and costs of a project were estimated and compared to each other to determine if benefits exceed the costs. This was accomplished by quantifying the benefits in dollars and using a ratio (benefits divided by costs) to make the comparison. If the resulting ratio is greater than 1.0, then the benefits are greater than the costs. The higher the ratio is above 1.0, the more the benefits exceed the costs.

Based on the candidate solutions presented in **Table 19**, BCA was conducted for one location on the I-17 Corridor. Additional information regarding the BCA is included in **Appendix E.**

The following conclusions were determined based on the BCA:

- The Black Canyon Hill Mobility & Freight Improvements (Option A) has the highest BCA, primarily due to the safety benefits. Therefore, the climbing lane will be carried forward for further evaluation. Option B was recommended for implementation in a recent DCR and therefore will be carried forward for further evaluation. The following option was eliminated from further consideration.
    - Black Canyon Hill Mobility & Freight Improvements (CS17.2 Option C)

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		
McGuireville Rd TI Bridge (CS17.06)	$3,288,000	$3,990,000	$2,460,000	1.34	1.62	1.00	Yes	Not strategic as a stand-alone solution; carry forward for further evaluation with other needs
Airport Rd TI Bridge (CS17.19)	$3,623,000	$3,022,000	$3,056,000	1.20	1.00	1.01	No	Not strategic as a stand-alone solution and no other Needs—no further evaluation

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		
No LCCA conducted for any pavement candidate solution on the I-17 Corridor										

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 Performance Effectiveness Score (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 net present value (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 = estimated 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-17 Corridor, the following candidate solutions have multiple options.

- CS17.02 (Options A & B) – Black Canyon Hill Mobility & Freight Improvements
- CS17.07 (Options A & B) – McGuireville TI Bridge

For CS17.02 (Black Canyon Hill), the Performance Effectiveness results indicate that both Option A and Option B should be advanced to solution prioritization.

For CS17.07 (McGuireville TI Bridge), the Performance Effectiveness results indicate that both Option A and Option B be should be advanced to solution prioritization.

Following the LCCA and BCA, two candidate solutions were dropped from further consideration. No PES values were calculated for these solutions, as shown in **Table 22**.

- Black Canyon Hill Shoulder Running (CS17.2-C)
- Airport Rd TI Bridge (CS17.19)

Table 22: Performance Effectiveness Scores

Candidate Solution #	Segment	Option	Candidate Solution Name	Milepost Location	Estimated Cost[1] (in millions)	Risk Factored Benefit Score					Risk Factored Emphasis Area Scores		Total Factored Benefit Score	F_{VMT}	F_{NPV}	Performance Effectiveness Score
						Pavement	Bridge	Mobility	Safety	Freight	Safety	Mobility				
CS17.1	17-3	-	Table Mesa Rd TI Vertical Clearance Mitigation	236	$2.41	0.00	0.00	0.00	0.003	1.51	0.003	0.00	1.51	1.03	20.2	13.0
CS17.2 – A	17-4	A	Black Canyon Hill Mobility & Freight Improvements (NB Climbing Lane)	NB 245-251	$47.57	0.00	3.99	3.89	0.78	1.24	0.06	0.09	10.06	3.55	20.2	15.2
CS17.2 – B	17-4	B	Black Canyon Hill Mobility & Freight Improvements (Reversible Lanes)	245-251	$146.22	0.00	1.44	5.63	2.19	7.84	0.17	0.15	17.42	4.58	20.2	11.0
CS17.3	17-4		Black Canyon Hill Southbound Safety Improvements	SB 245-251	$3.15	0.00	0.00	0.10	2.48	0.43	0.18	0.00	3.19	3.55	15.3	55.1
CS17.4	17-4	-	Sunset Point Safety Improvements	252-253	$2.31	0.00	0.00	0.45	1.77	1.81	0.14	0.00	4.17	0.93	20.2	34.0
CS17.5	17-5	-	Badger Springs Climbing Lane	NB 256-260	$14.9	0.00	0.00	1.02	0.94	0.03	0.09	0.05	2.12	2.65	20.2	7.6
CS17.6	17-6	-	Orme Road Safety Improvements	SB 269-274	$4.72	0.00	0.00	0.24	1.13	0.33	0.26	0.00	1.97	2.52	20.2	21.2
CS17.7 – A	17-8	A	McGuireville TI Bridge (Rehabilitate/Repair)	293	$7.79	0.00	2.61	0.00	0.00	1.96	0.00	0.00	4.56	0.30	20.2	3.6
CS17.7 – B	17-8	B	McGuireville TI Bridge (Replace)	293	$18.86	0.00	4.09	0.00	0.00	1.96	0.00	0.00	6.04	0.30	30.6	3.0
CS17.8	17-8	-	Middle Verde Road Safety Improvements	NB 290-293	$3.77	0.00	0.000	0.01	1.36	0.01	0.19	0.00	1.57	1.86	20.2	15.7
CS17.9	17-8	-	Dry Beaver Creek Southbound Climbing Lane	SB 292-294	$9.35	0.00	0.000	0.06	0.00	0.00	0.004	0.01	0.07	1.34	20.2	0.2
CS17.10	17-8	-	Dry Beaver Creek Northbound Climbing Lane	NB 294-298	$14.90	0.00	0.000	0.18	1.36	0.01	0.19	0.02	1.76	2.32	20.2	5.5
CS17.11	17-8	-	McGuireville Rest Area Safety Improvements	SB 295-299	$4.66	0.00	0.000	0.01	2.62	0.01	0.37	0.00	3.02	2.32	20.2	30.3
CS17.12	17-8	-	SR179 TI Safety Improvements	299	$2.22	0.00	0.000	0.02	1.43	0.02	0.20	0.00	1.67	0.37	20.2	5.7
CS17.13	17-9	-	Hog Tank Canyon Northbound Climbing Lane	NB 299-305	$22.37	0.00	0.000	1.17	0.30	0.59	0.04	0.05	2.15	2.73	20.2	5.3
CS17.14	17-9	-	Hog Tank Canyon SB Safety Improvements	SB 300-302	$4.03	0.00	0.000	0.02	4.21	0.27	0.43	0.00	4.93	1.16	20.2	28.6
CS17.15	17-9	-	Rattlesnake Canyon Safety Improvements	NB 305-307	$2.19	0.00	0.000	0.43	4.06	0.82	0.41	0.00	5.71	1.16	20.2	61.0
CS17.16	17-10	-	Red Hill Scenic Overlook Safety Improvements	SB 309-313	$7.17	0.00	0.000	0.03	0.43	0.51	0.29	0.00	1.26	1.80	20.2	6.4
CS17.17	17-11	-	Woods Canyon Climbing Lane	SB 316-317	$5.60	0.00	0.000	0.04	0.00	0.004	0.01	0.00	0.05	0.53	20.2	0.1
CS17.18	17-11	-	Woods Canyon Safety Improvements	316.5 - 317.5	$36.14	1.39	0.000	0.02	2.83	0.06	0.20	0.00	4.50	1.01	20.2	2.5

[1] See Table 24 for total construction costs

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: Prioritized Scores

Candidate Solution #	Segment	Option	Candidate Solution Name	Milepost Location	Estimated Cost (in millions)	Performance Effectiveness Score	Weighted Risk Factor	Segment Average Need Score	Prioritization Score	Percentage by which Solution Reduces Performance Area Segment Needs				
										Pavement	Bridge	Safety	Mobility	Freight
CS17.01	17-3	-	Table Mesa Rd TI Vertical Clearance Mitigation	236	$2.41	13.0	1.36	1.00	**18**	0%	0%	0%	0%	37%
CS17.02	17-4	A	Black Canyon Hill Mobility & Freight Improvements (NB Climbing Lane)	NB 245-251	$47.57	15.2	1.46	1.87	**41**	0%	90%	10%	28%	6%
CS17.02	17-4	B	Black Canyon Hill Mobility & Freight Improvements (Reversible Lanes)	245-251	$146.22	11.0	1.43	1.87	**29**	0%	74%	28%	40%	35%
CS17.3	17-4		Black Canyon Hill Southbound Safety Improvements	SB 245-251	$3.15	55.1	1.71	1.87	**176**	0%	0%	31%	1%	3%
CS17.04	17-4	-	Sunset Point Safety Improvements	252-253	$2.47	34.0	1.55	1.87	**99**	0%	0%	32%	4%	8%
CS17.05	17-5	-	Badger Springs Climbing Lane	NB 256-260	$14.90	7.6	1.56	1.03	**12**	0%	0%	22%	16%	2%
CS17.06	17-6	-	Orme Road Safety Improvements	SB 269-274	$4.72	21.2	1.66	1.47	**52**	0%	0%	13%	4%	6%
CS17.07	17-8	A	McGuireville TI Bridge (Rehabilitate/Repair)	293.25-293.75	$7.79	3.6	1.36	1.17	**6**	0%	64%	0%	0%	62%
CS17.07	17-8	B	McGuireville TI Bridge (Replace)	293	$18.86	3.0	1.46	1.17	**5**	0%	100%	0%	0%	62%
CS17.08	17-8	-	Middle Verde Road Safety Improvements	NB 290-293	$3.83	15.7	1.77	1.17	**32**	0%	0%	15%	0%	0%
CS17.09	17-8	-	Dry Beaver Creek Southbound Climbing Lane	SB 292-294	$9.35	0.2	1.38	1.17	**1**	0%	0%	0%	2%	0%
CS17.10	17-8	-	Dry Beaver Creek Northbound Climbing Lane	NB 294-298	$14.90	5.5	1.73	1.17	**11**	0%	0%	6%	5%	0%
CS17.11	17-8	-	McGuireville Rest Area Safety Improvements	SB 295-299	$4.73	30.3	1.78	1.17	**63**	0%	0%	12%	0%	0%
CS17.12	17-8	-	SR179 TI Safety Improvements	299	$2.22	5.7	1.77	1.17	**12**	0%	0%	10%	1%	1%
CS17.13	17-9	-	Hog Tank Canyon Northbound Climbing Lane	NB 299-305	$23.06	5.3	1.43	1.47	**11**	0%	0%	2%	19%	9%
CS17.14	17-9	-	Hog Tank Canyon SB Safety Improvements	SB 300-302	$4.03	28.6	1.76	1.47	**74**	0%	0%	23%	0%	5%
CS17.15	17-9	-	Rattlesnake Canyon Safety Improvements	NB 305-307	$2.25	61.0	1.69	1.47	**151**	0%	0%	31%	8%	13%
CS17.16	17-10	-	Red Hill Scenic Overlook Safety Improvements	SB 309-313	$7.23	6.4	1.60	0.87	**9**	0%	0%	14%	1%	10%
CS17.17	17-11	-	Woods Canyon Climbing Lane	SB 316-317	$5.60	0.1	1.41	1.30	**1**	0%	0%	0%	2%	0%
CS17.18	17-11	-	Woods Canyon Safety Improvements	316.5-317.5	$36.28	2.5	1.57	1.30	**5**	50%	0%	51%	1%	4%

6.0 SUMMARY OF CORRIDOR RECOMMENDATIONS

6.1 Prioritized Candidate Solution Recommendations

Table 24 and **Figure 27** show the ranked prioritized candidate solutions recommended for the I-17 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-17 Corridor. The following observations were noted about the prioritized solutions:

- Several of top scoring solutions include safety improvements which would likely reduce the incidence of run off the road type vehicle crashes that often result in fatal and serious injuries.
- Segment 17-4 showed Mobility, Safety, and Freight Needs and had the 2nd highest average need score. However, due to the high cost of implementing a solution at this location, it is ranked 7th in the prioritization scores.
- The two lowest scoring solutions occur in locations that do not exhibit Mobility needs but were rather based on Safety Needs. However, at the specific locations of the solutions, there is not a high frequency of fatal or incapacitating crashes which results in a low benefit score.
- Solutions that address multiple performance areas tend to score higher in this process.
- The highest ranking solutions tended to have overlapping benefits in Safety, Mobility, and Freight.

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-17 Corridor.

- Conduct study to investigate paving roadway along existing dirt roads connecting Bumble Bee Rd (MP 248) to Bloody Basin Rd (MP 259) for use during closures, similar to N20 interim detour for US 89.
- Continue to provide additional driver messaging and emphasis on safety during holiday weekends.
- The scoping and design of project H893401C (Coconino County Line to I-40) (FY 18) should investigate safety improvements such as installing high visibility striping and delineators, raised pavement markers, rumble strips and widening/rehabilitating the inside (median) shoulder in both directions of travel.
- When recommending future projects along I-17, review historical ratings and levels of investment. According to data used for this study, the following pavement and bridge locations have exhibited high historical investment (pavement) or rating fluctuation (bridge) issues:
    - I-17 OP @ Frt Rd SB #2180 (MP 215)
    - Pavement MP 215 – MP 222
    - Pavement MP 222 – MP 232
    - Moores Gulch SB #339 (MP 238.6)
    - Pavement MP 253 – MP 263
    - Dugas Rd TI SB #1080 (MP 268.75)
    - Cienga Creek NB #428 (MP 277.93)
    - Middle Verde Rd TI #1733 (MP 289.97)
    - Pavement MP 288 – MP 299
    - Pavement MP 299 – MP 307
    - Pavement MP 307 – MP 316
    - McGuireville TI #652 (MP 293.26)
    - Pavement MP 323 – MP 340
    - Willard Springs TI NB #1583 (MP 326)
    - Airport Rd TI #632 (MP 337.39)

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-17, 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

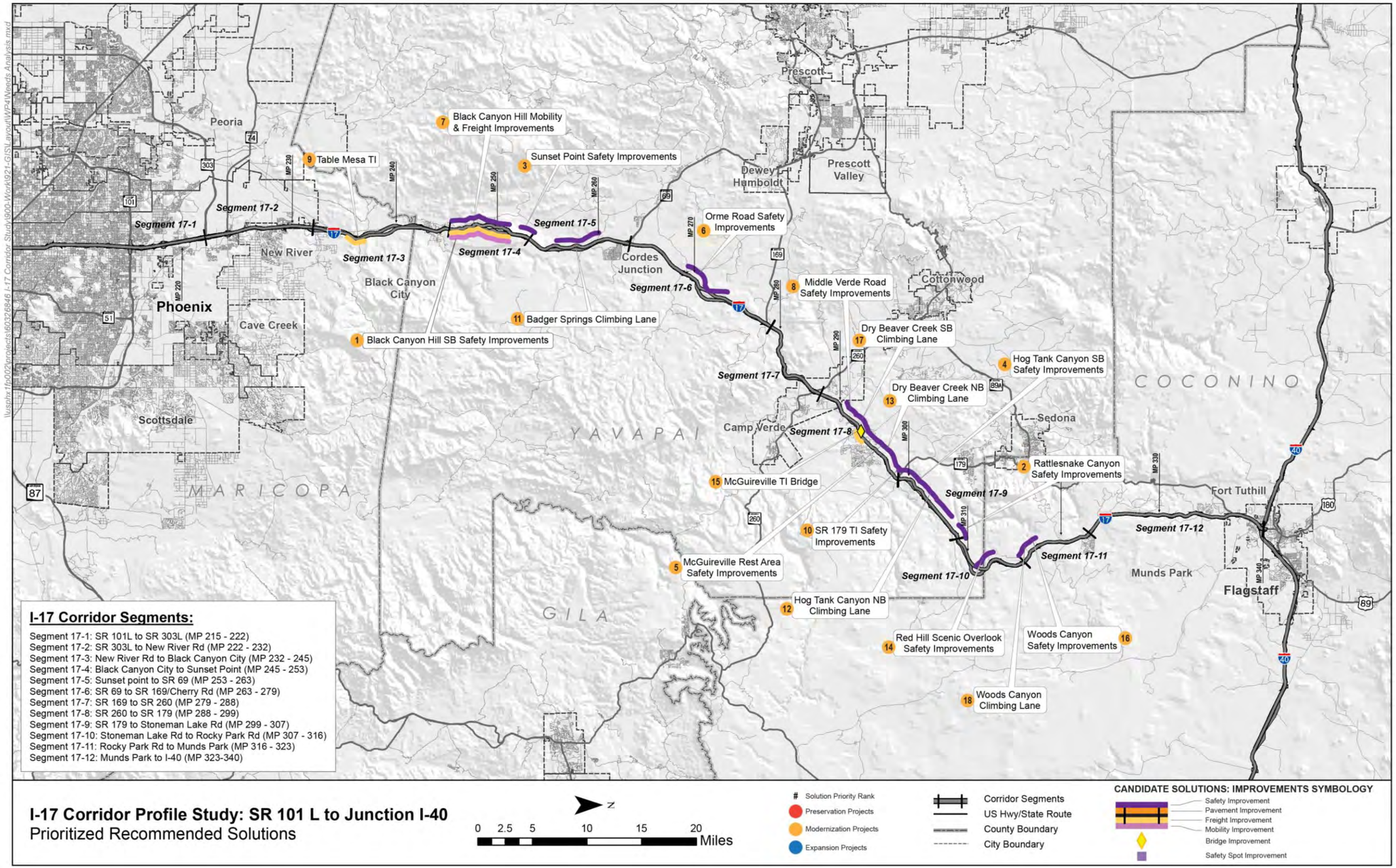
Table 24: Prioritized Recommended Solutions

Rank	Candidate Solution #	Option	Solution Name and Location	Description / Scope	Estimated Cost (in millions)	Investment Category Preservation [P] Modernization [M] Expansion [E]	Prioritization Score
1	CS17.03	-	Black Canyon Hill Southbound Safety Improvements (SB MP 245 -251)	Enhance roadside design (replace guardrail). Install high visibility striping and delineators, raised pavement markers, and rumble strips. Install chevrons on curves. Excavate/grade cut slopes to improve sight distance. Install dynamic speed feedback system on southbound roadway (near MP 248 & MP 251).	$3.15	M	176
2	CS17.15	-	Rattlesnake Canyon Northbound Safety Improvements (NB MP 305-307)	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace). Install high visibility striping and delineators, raised pavement markers, and rumble strips. Install chevrons on curves. Install dynamic speed feedback system. Construct/extend northbound parallel entrance ramp at Stoneman Lake TI. Install CCTV near MP 306.5.	$2.25	M	151
3	CS17.04	-	Sunset Point Safety Improvements (MP 252-253)	Construct/ extend parallel northbound and southbound exit ramps at Sunset Point TI. Install roadway weather information systems (RWIS). Install dynamic wind warning system.	$2.47	M	99
4	CS17.14	-	Hog Tank Canyon Southbound SB Safety Improvements (SB MP 300-302)	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace). Install high visibility striping and delineators, raised pavement markers, and rumble strips. Install chevrons on curves. Install dynamic speed feedback system. Excavate/grade cut slopes to improve sight distance.	$4.03	M	74
5	CS17.11	-	McGuireville Rest Area Safety Improvements (SB MP 295-299)	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace). Install high visibility striping and delineators, raised pavement markers, and rumble strips. Install chevrons on curves. Install dynamic speed feedback system near MP 297 and MP 299. Install CCTV on existing DMS located at MP 297.4.	$4.73	M	63
6	CS17.06	-	Orme Rd Southbound Safety Improvements (SB MP 269-274)	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace). Install high visibility striping and delineators, raised pavement markers, and rumble strips. Install chevrons on curves. Install dynamic speed feedback system near MP 272 & 274.	$4.72	M	52
7	CS17.02	A	Black Canyon Hill Mobility & Freight Improvements (MP 245-251)	Construct northbound climbing lane and replace southbound Bumble Bee Rd Bridge.	$47.57	M	41
		B		Construct reversible lanes and replace southbound Bumble Bee Rd Bridge.	$146.22	M	29
8	CS17.08	-	Middle Verde Rd Northbound Safety Improvements (NB MP 290-293)	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace). Install high visibility striping and delineators, raised pavement markers, and rumble strips. Install chevrons on curves. Install dynamic speed feedback system near MP 291 & MP 293. Install CCTV near existing DMS located at MP 289.	$3.83	M	32
9	CS17.01	-	Table Mesa TI Vertical Clearance Mitigation (MP 236)	Re-profile southbound roadway	$2.41	M	18

Table 24: Prioritized Recommended Solutions (continued)

Rank	Candidate Solution #	Option	Solution Name and Location	Description / Scope	Estimated Cost (in millions)	Investment Category Preservation [P] Modernization [M] Expansion [E]	Prioritization Score
10	CS17.12	-	SR 179 TI Safety Improvements (MP 299)	Construct/extend parallel southbound entrance and northbound exit ramps at SR179 TI.	$2.22	M	12
11	CS17.05	-	Badger Springs Northbound Climbing Lane (NB MP 256-260)	Construct northbound climbing lane.	$14.90	M	12
12	CS17.13	-	Hog Tank Canyon NB Climbing Lane (NB MP 299-305)	Construct northbound climbing lane. Install new DMS at MP 303.4 with CCTV.	$23.06	M	11
13	CS17.10	-	Dry Beaver Creek NB Climbing Lane (NB MP 294-298)	Construct northbound climbing lane	$14.90	M	11
14	CS17.16	-	Red Hill Scenic Overlook Southbound Safety Improvements (SB MP 309-313)	Improve skid resistance (reconstruct pavement, increase super-elevation, or mill and replace). Install chevrons on curves. Install dynamic speed feedback system near MP 311 and MP 313. Install CCTV near MP 312.3.	$7.23	M	9
15	CS17.07	A	McGuireville TI Bridge (MP 293.25-293.75)	Rehabilitate/repair McGuireville TI bridge and construct new southbound exit ramp	$7.79	M	6
		B		Replace McGuireville TI bridge	$18.86	M	5
16	CS17.18	-	Woods Canyon Safety Improvements (MP 316.5-317.5)	Realign roadway and construct new bridges over Woods Canyon with de-icing system. Install roadway weather information system (RWIS) near Rocky Park TI or Woods Canyon.	$36.28	M	5
17	CS17.09	-	Dry Beaver Creek SB Climbing Lane (SB MP 292-294)	Construct southbound climbing lane and widen Dry Beaver Creek Bridge	$9.35	M	1
18	CS17.17	-	Woods Canyon Southbound Climbing Lane (SB MP 316-317)	Construct southbound climbing lane	$5.60	M	1

Figure 27: Prioritized Recommended Solutions



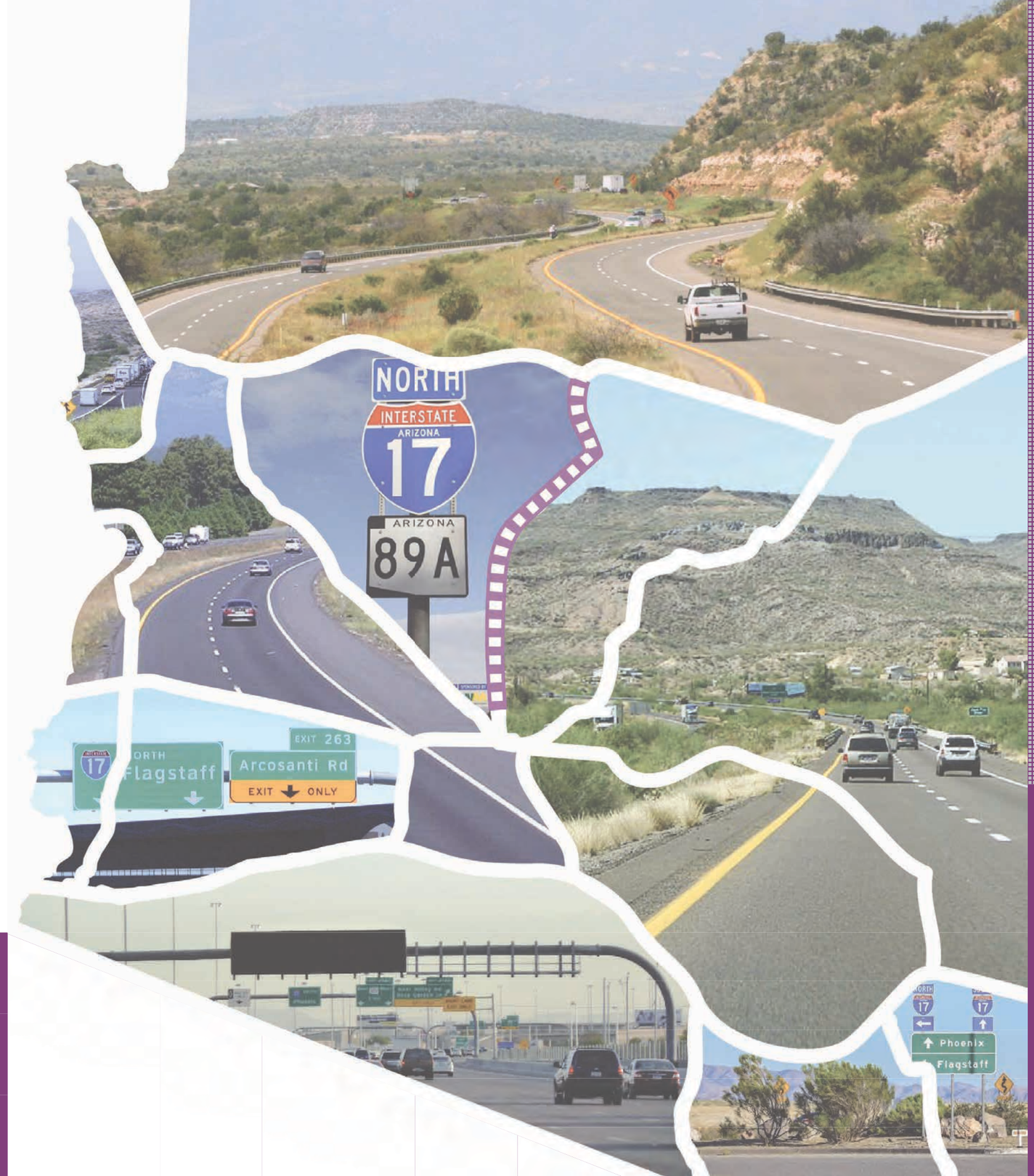
6.4 Next Steps

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-17 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.

Appendices


NORTH
INTERSTATE
ARIZONA
17
ARIZONA
89A
EXIT 263
Arcosanti Rd
EXIT ONLY
Phoenix
Flagstaff

Appendix A: Corridor Performance Maps

This appendix contains maps of each primary and secondary measure associated with the five performance areas for the I-17 Corridor. The following are the areas and maps included:

Pavement Performance Area:

- Pavement Index and Hot Spots
- Pavement Serviceability (directional)
- Percentage of Pavement Area Failure

Bridge Performance Area:

- Bridge Index and Hot Spots
- Bridge Sufficiency
- Percent of Deck Area on Functionally Obsolete Bridges
- Lowest Bridge Rating

Mobility Performance Area:

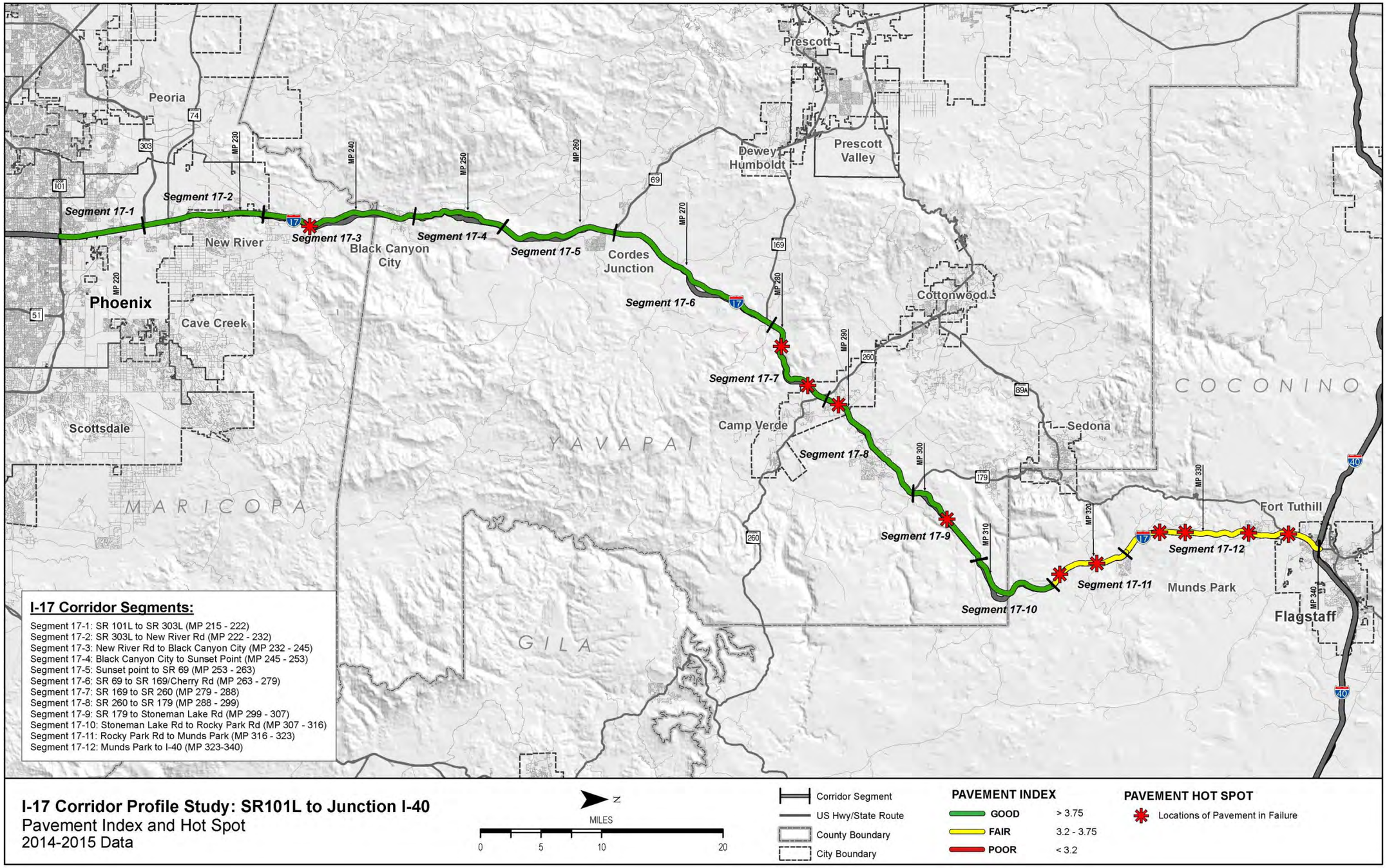
- Mobility Index
- Future Daily V/C
- Existing Peak V/C (directional)
- Average Instances Per Year a Given Milepost is Closed Per Segment Mile
- All Vehicles Travel Time Index
- All Vehicles Planning Time Index
- Multimodal Opportunities
- Percentage of Bicycle Accommodation

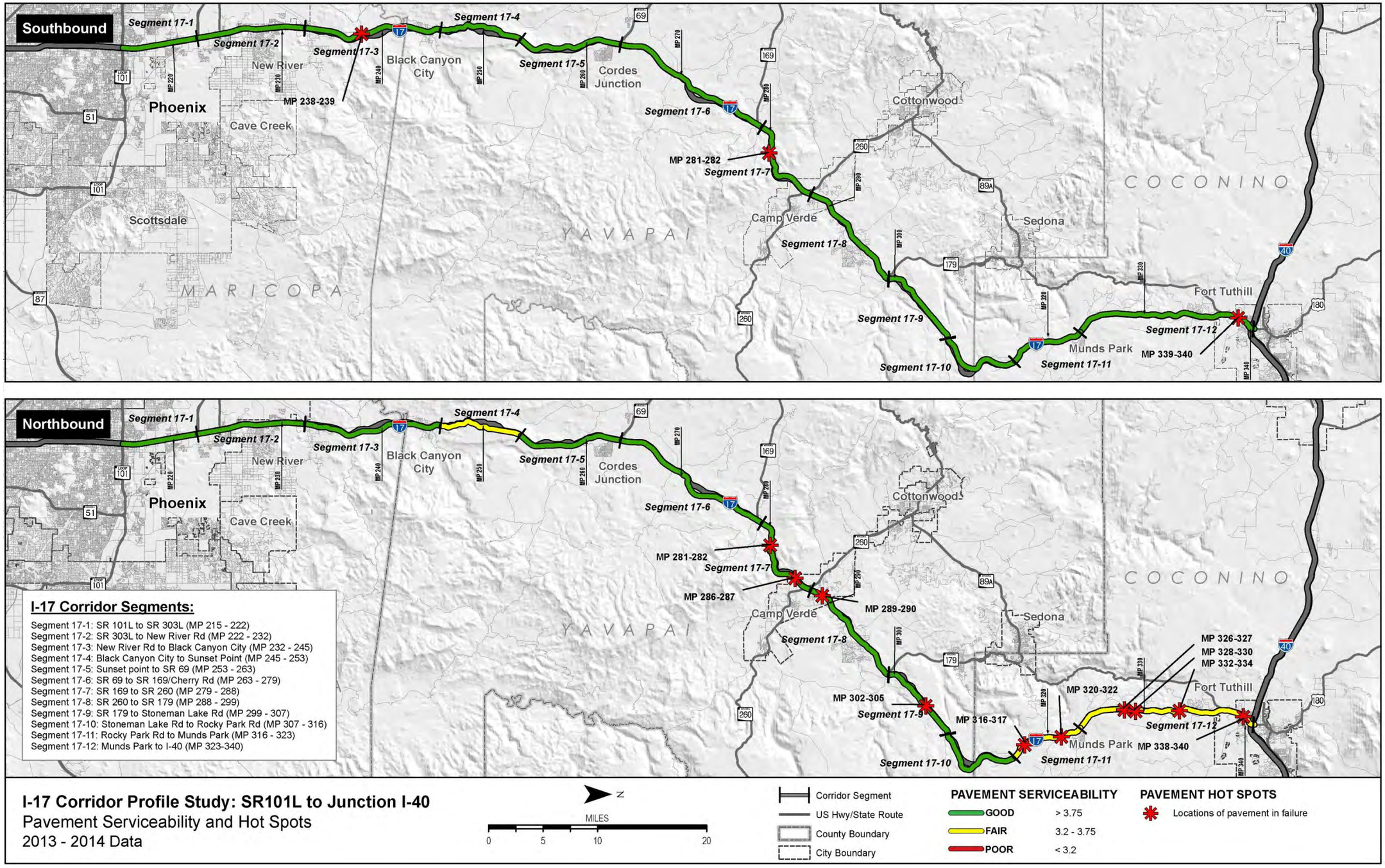
Safety Performance Area:

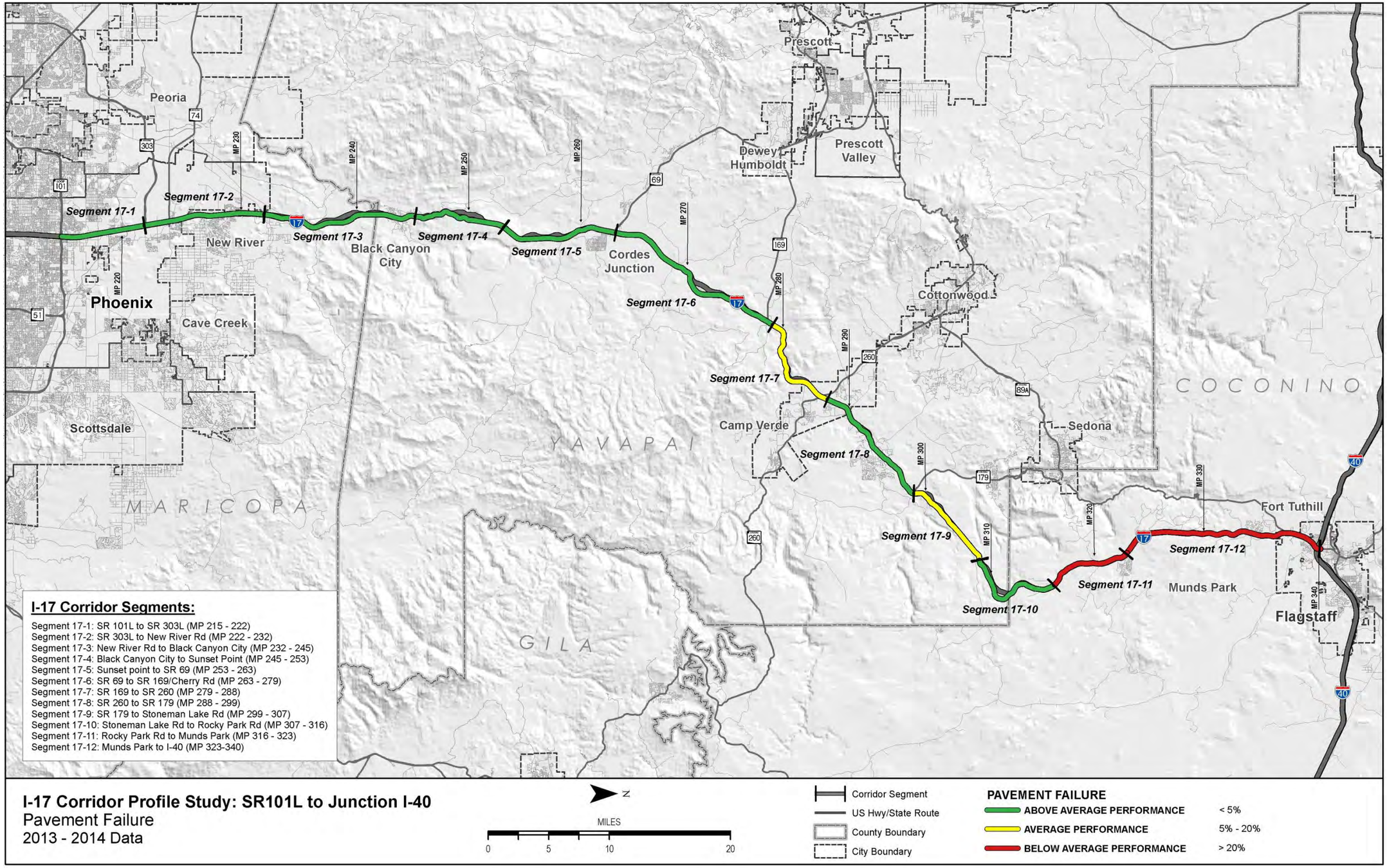
- Safety Index and Hot Spots
- Safety Index and Hot Spots (directional)
- Relative Frequency of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors Compared to the Statewide Average for Similar Segments
- Relative Frequency of Fatal + Incapacitating Injury Crashes Involving Motorcycles Compared to the Statewide Average for Similar Segments
- Relative Frequency of Fatal + Incapacitating Injury Crashes Involving Trucks Compared to the Statewide Average for Similar Segments

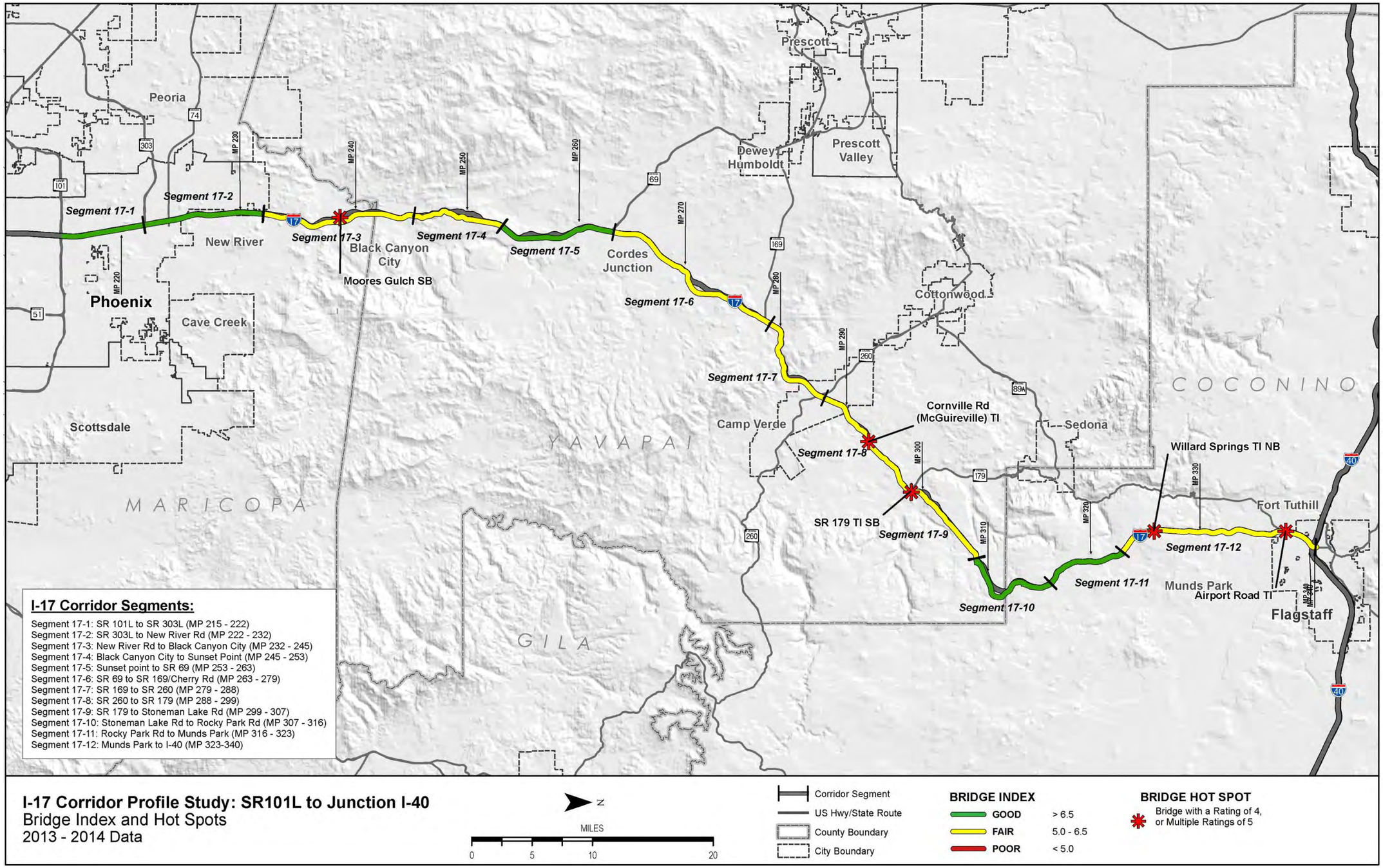
Freight Performance Area:

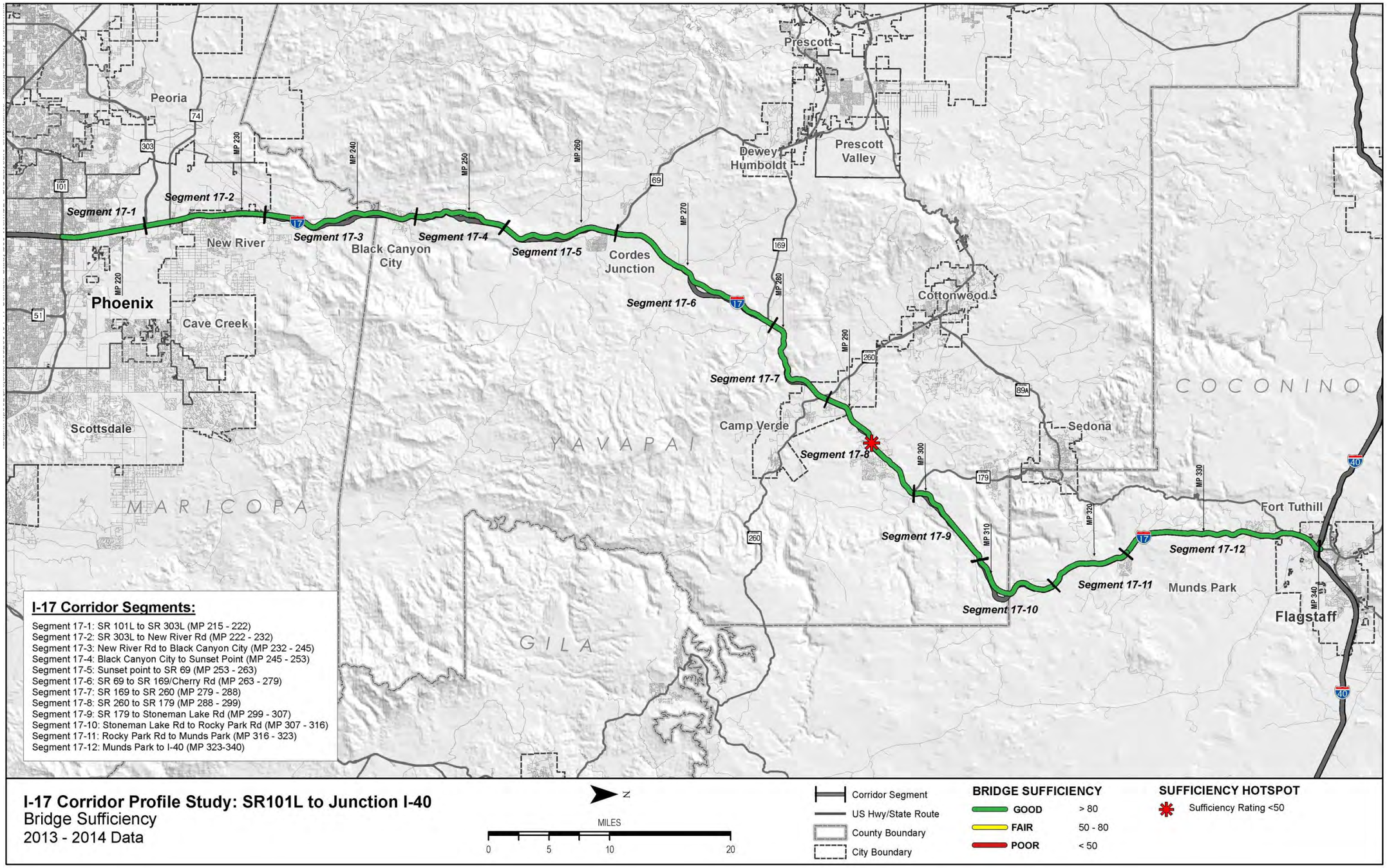
- Freight Index and Hot Spots
- Truck Travel Time Index
- Truck Planning Time Index
- Average Minutes Per Year Given Milepost is Closed Per Segment Mile
- Bridge Vertical Clearance

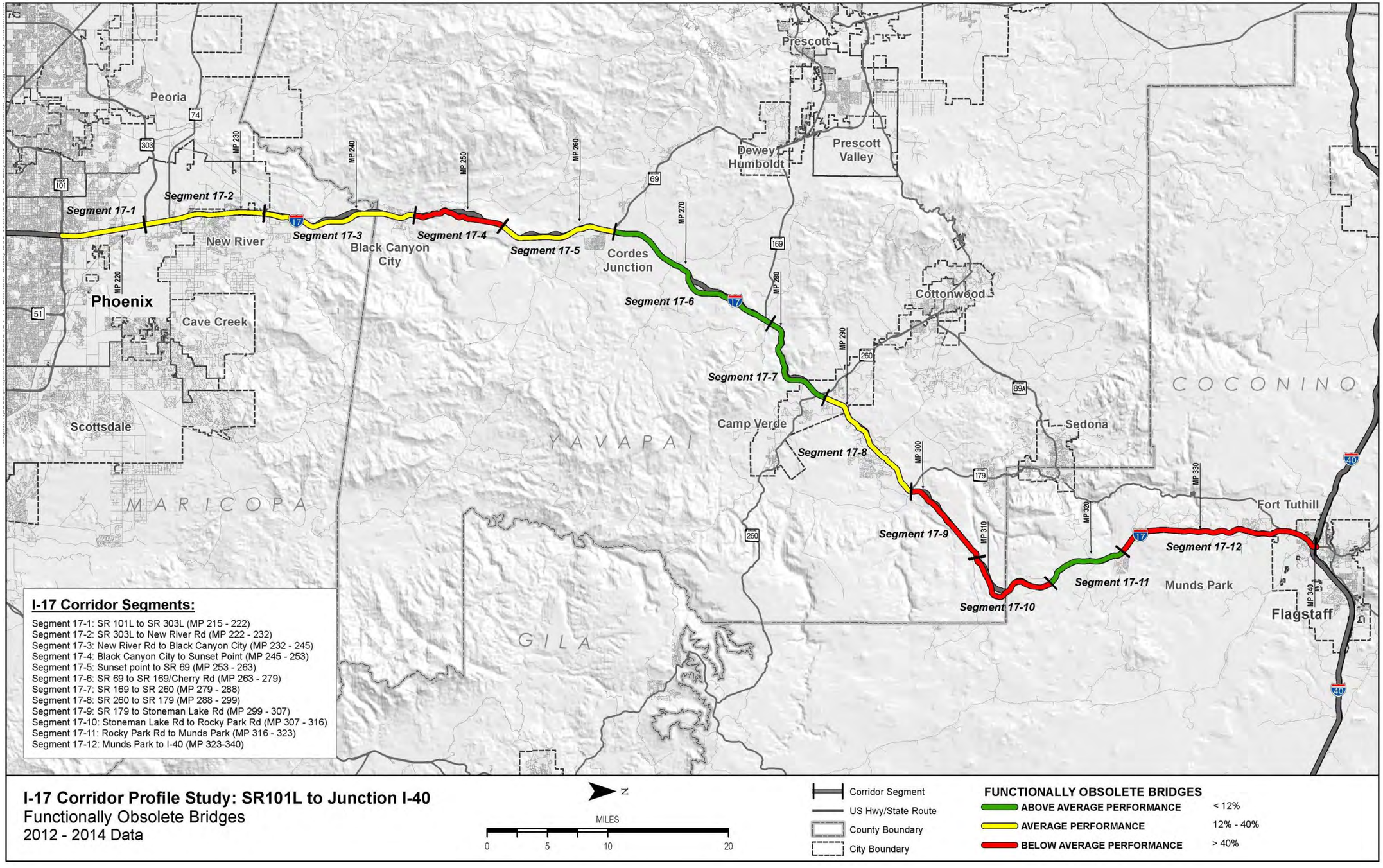

Peoria
Phoenix
Cave Creek
Scottsdale
New River
Black Canyon City
Cordes Junction
Prescott
Dewey-Humboldt
Prescott Valley
Cottonwood
Camp Verde
Sedona
Munds Park
Fort Tuthill
Flagstaff
MARICOPA
YAVAPAI
GILA
COCONINO
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
MP 220
MP 230
MP 240
MP 250
MP 260
MP 270
MP 280
MP 290
MP 300
MP 310
MP 320
MP 330
MP 340
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
Segment 17-2: SR 303L to New River Rd (MP 222 - 232)
Segment 17-3: New River Rd to Black Canyon City (MP 232 - 245)
Segment 17-4: Black Canyon City to Sunset Point (MP 245 - 253)
Segment 17-5: Sunset point to SR 69 (MP 253 - 263)
Segment 17-6: SR 69 to SR 169/Cherry Rd (MP 263 - 279)
Segment 17-7: SR 169 to SR 260 (MP 279 - 288)
Segment 17-8: SR 260 to SR 179 (MP 288 - 299)
Segment 17-9: SR 179 to Stoneman Lake Rd (MP 299 - 307)
Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Pavement Index and Hot Spot
2014-2015 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
PAVEMENT INDEX
GOOD > 3.75
FAIR 3.2 - 3.75
POOR < 3.2
PAVEMENT HOT SPOT
Locations of Pavement in Failure

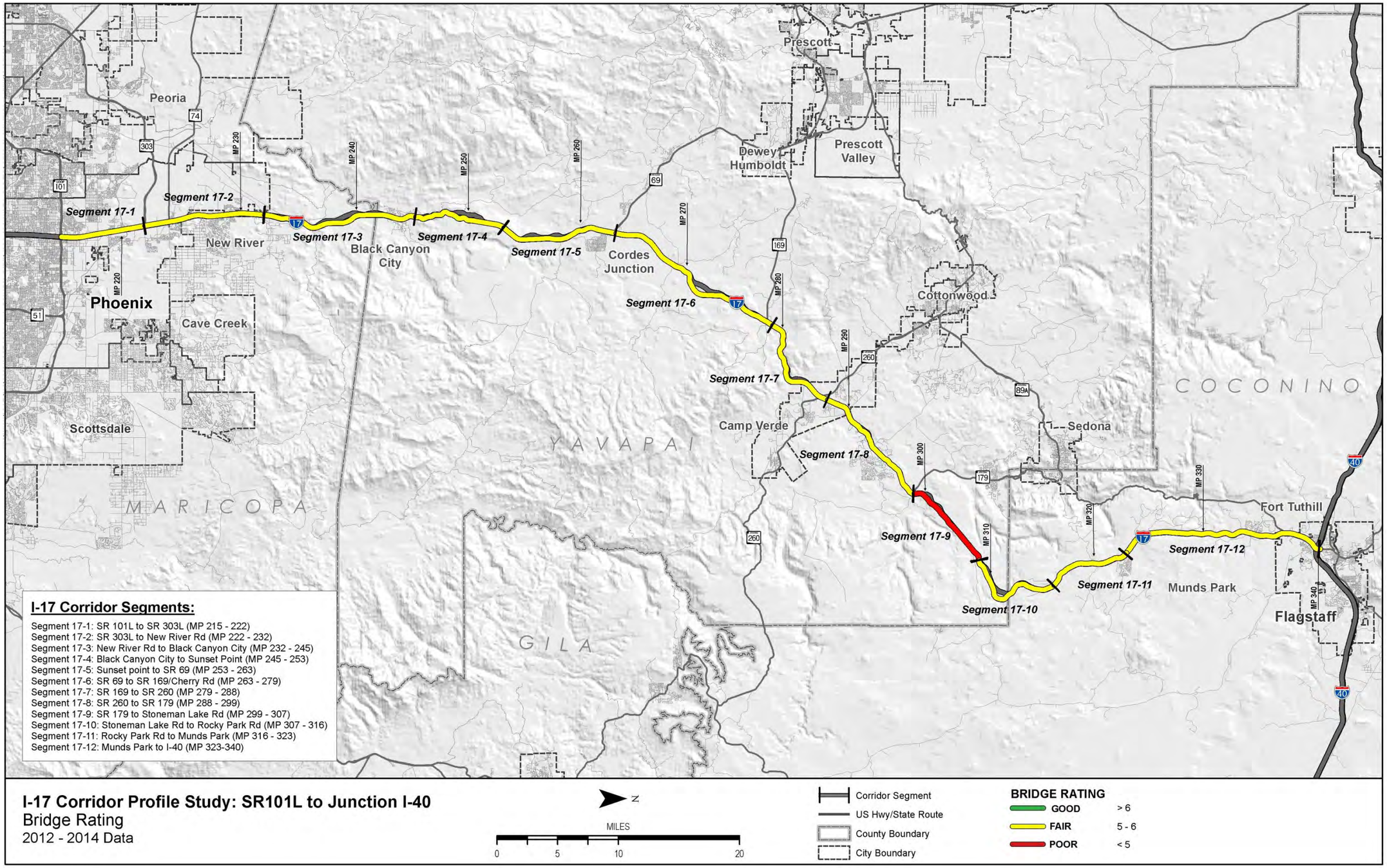

Southbound
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
MP 238-239
MP 281-282
MP 339-340
Phoenix
Scottsdale
Cave Creek
New River
Black Canyon City
Cordes Junction
Cottonwood
Camp Verde
Sedona
Munds Park
Fort Tuthill
MARICOPA
YAVAPAI
COCONINO
Northbound
MP 286-287
MP 289-290
MP 302-305
MP 316-317
MP 320-322
MP 326-327
MP 328-330
MP 332-334
MP 338-340
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
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Segment 17-8: SR 260 to SR 179 (MP 288 - 299)
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Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Pavement Serviceability and Hot Spots
2013 - 2014 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
PAVEMENT SERVICEABILITY
GOOD > 3.75
FAIR 3.2 - 3.75
POOR < 3.2
PAVEMENT HOT SPOTS
Locations of pavement in failure

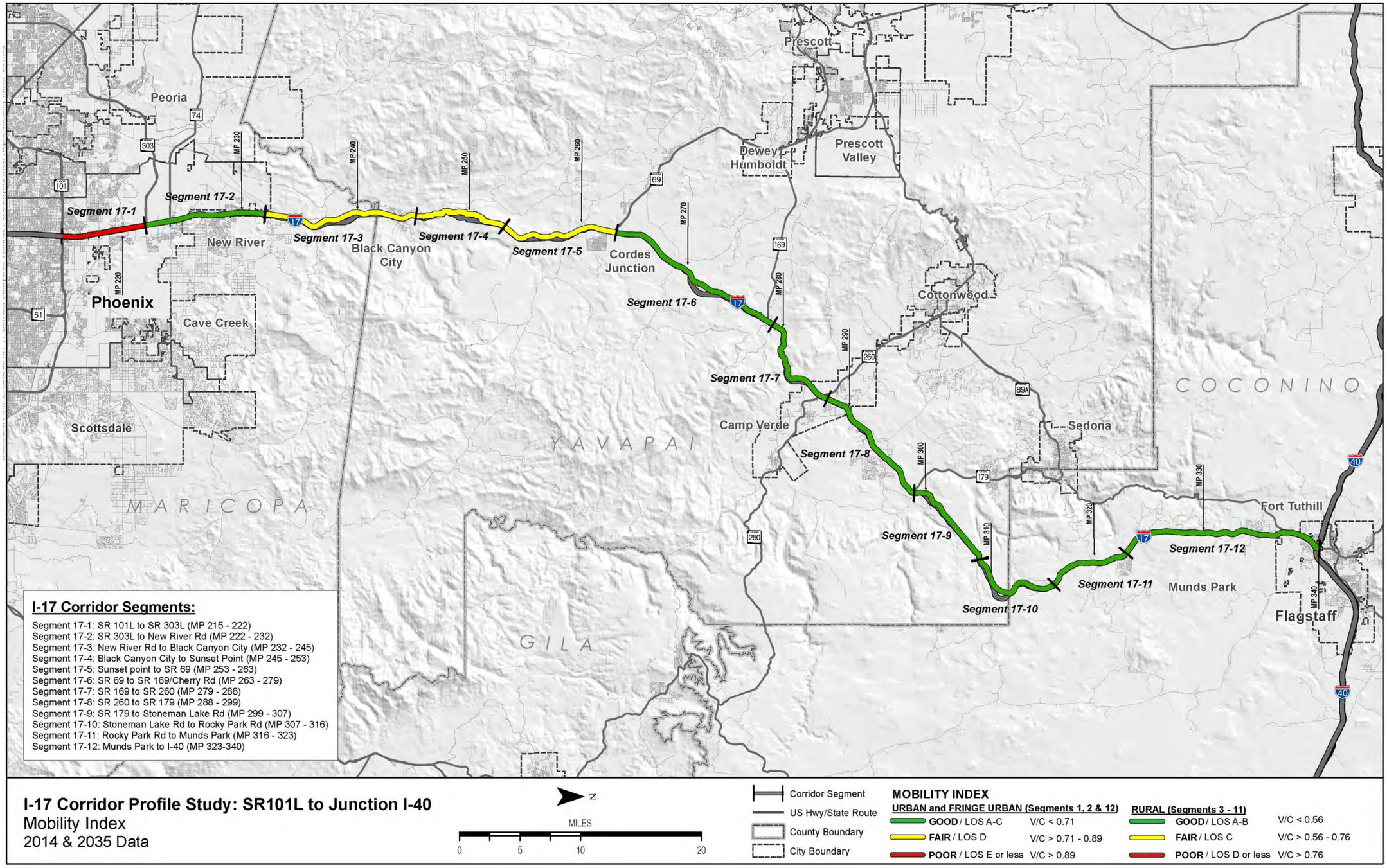

Peoria
Phoenix
Scottsdale
Cave Creek
New River
Black Canyon City
Cordes Junction
Prescott
Dewey Humboldt
Prescott Valley
Cottonwood
Camp Verde
Sedona
Munds Park
Fort Tuthill
Flagstaff
MARICOPA
YAVAPAI
GILA
COCONINO
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
MP 220
MP 230
MP 240
MP 250
MP 260
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MP 280
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MP 330
MP 340
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
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Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Pavement Failure
2013 - 2014 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
PAVEMENT FAILURE
ABOVE AVERAGE PERFORMANCE < 5%
AVERAGE PERFORMANCE 5% - 20%
BELOW AVERAGE PERFORMANCE > 20%

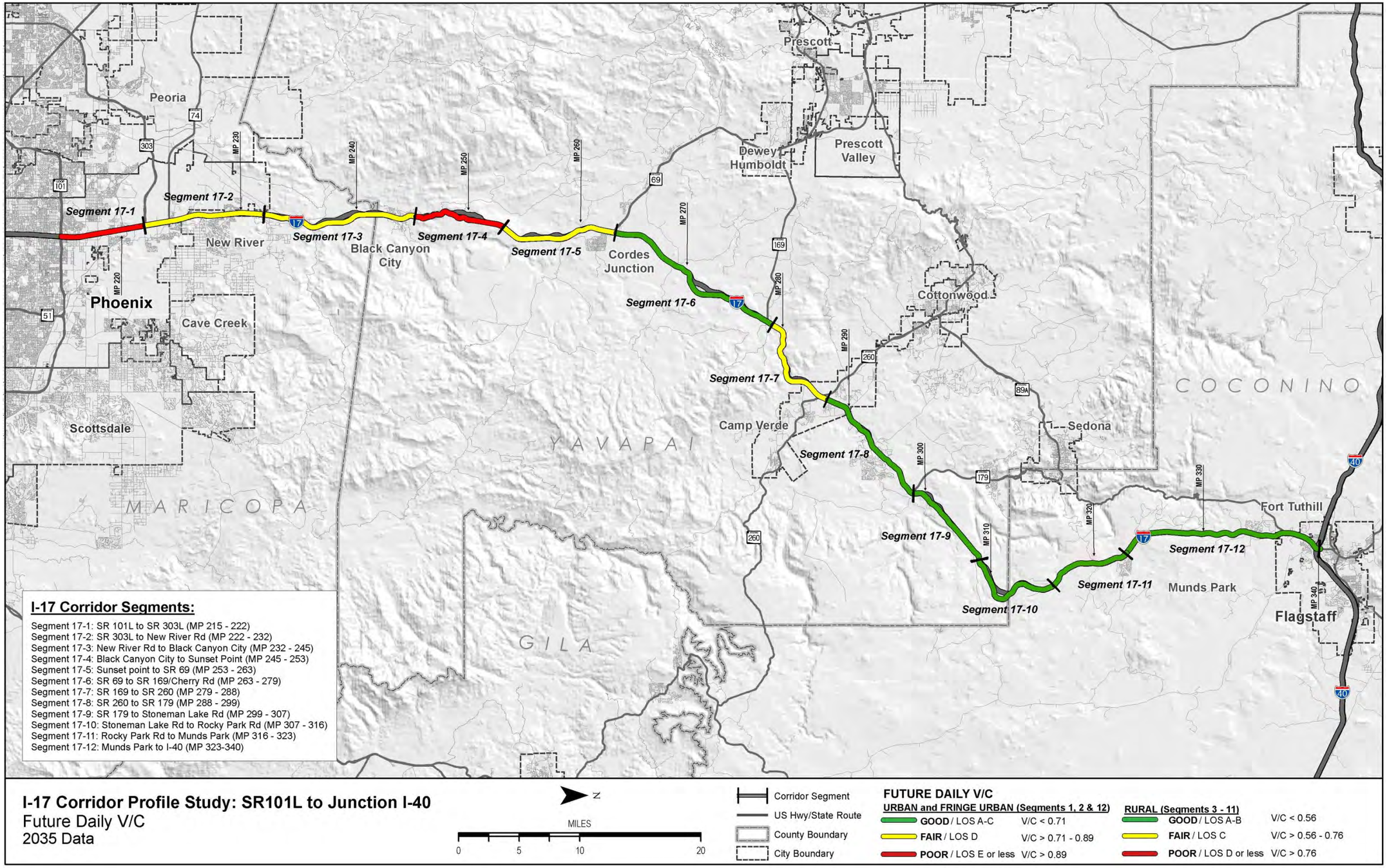

Peoria
Phoenix
Cave Creek
Scottsdale
New River
Black Canyon City
Moores Gulch SB
Cordes Junction
Prescott
Dewey-Humboldt
Prescott Valley
Cottonwood
Camp Verde
Sedona
Cornville Rd (McGuireville) TI
SR 179 TI SB
Willard Springs TI NB
Munds Park
Airport Road TI
Fort Tuthill
Flagstaff
MARICOPA
YAVAPAI
GILA
COCONINO
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
MP 220
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MP 240
MP 250
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MP 270
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MP 310
MP 320
MP 330
MP 340
I-17 Corridor Segments:
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Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Bridge Index and Hot Spots
2013 - 2014 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
BRIDGE INDEX
GOOD > 6.5
FAIR 5.0 - 6.5
POOR < 5.0
BRIDGE HOT SPOT
Bridge with a Rating of 4, or Multiple Ratings of 5


Prescott
Peoria
Dewey-Humboldt
Prescott Valley
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
New River
Black Canyon City
Cordes Junction
Phoenix
Cave Creek
Cottonwood
Scottsdale
Camp Verde
Sedona
Fort Tuthill
Munds Park
Flagstaff
MARICOPA
YAVAPAI
GILA
COCONINO
MP 220
MP 230
MP 240
MP 250
MP 260
MP 270
MP 280
MP 290
MP 300
MP 310
MP 320
MP 330
MP 340
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
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Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Bridge Sufficiency
2013 - 2014 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
BRIDGE SUFFICIENCY
GOOD > 80
FAIR 50 - 80
POOR < 50
SUFFICIENCY HOTSPOT
Sufficiency Rating <50

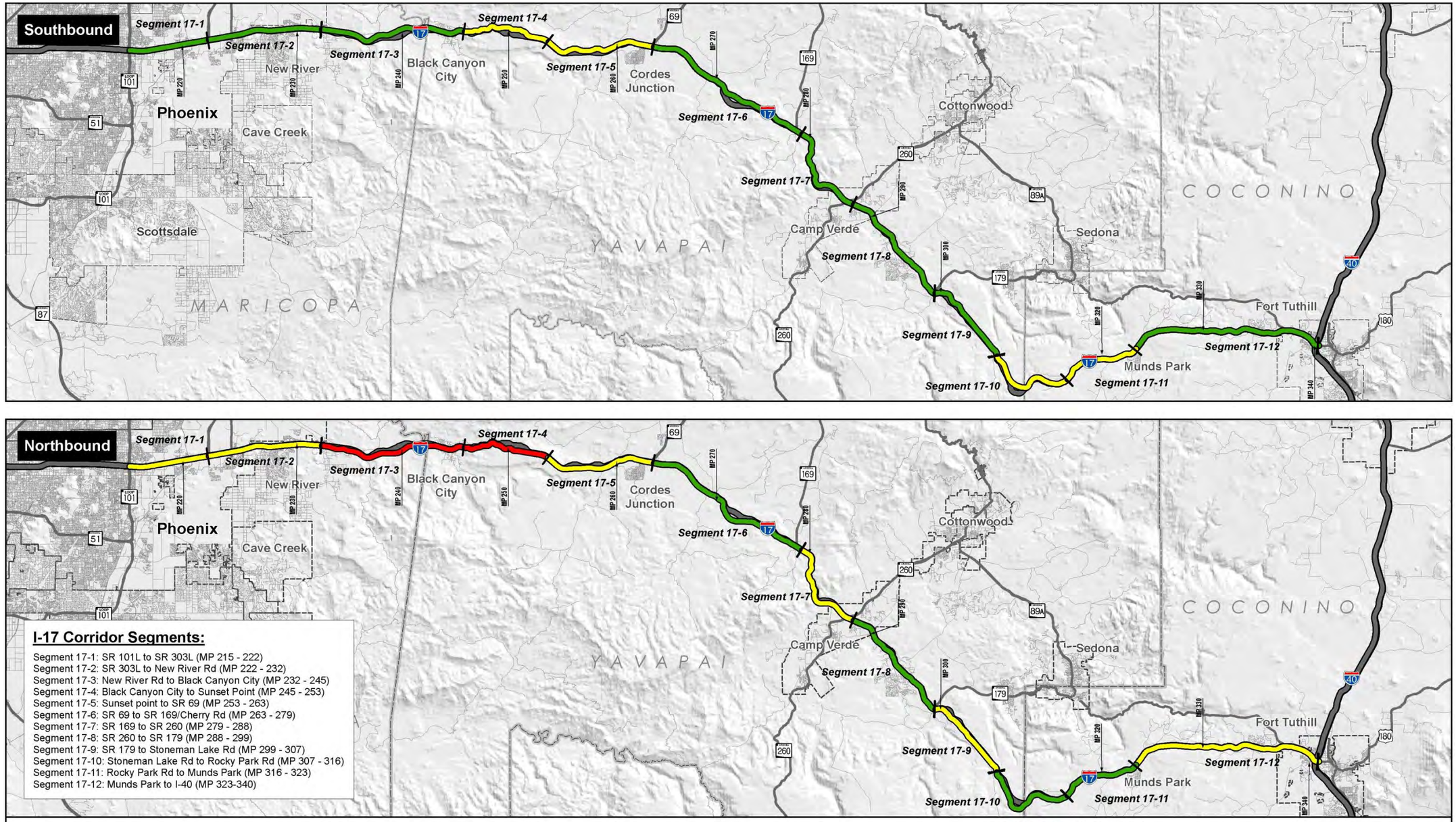

Peoria
Phoenix
Cave Creek
Scottsdale
New River
Black Canyon City
Cordes Junction
Prescott
Dewey Humboldt
Prescott Valley
Cottonwood
Camp Verde
Sedona
Fort Tuthill
Munds Park
Flagstaff
MARICOPA
YAVAPAI
GILA
COCONINO
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
MP 220
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MP 260
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MP 310
MP 320
MP 330
MP 340
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
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Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Functionally Obsolete Bridges
2012 - 2014 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
FUNCTIONALLY OBSOLETE BRIDGES
ABOVE AVERAGE PERFORMANCE < 12%
AVERAGE PERFORMANCE 12% - 40%
BELOW AVERAGE PERFORMANCE > 40%

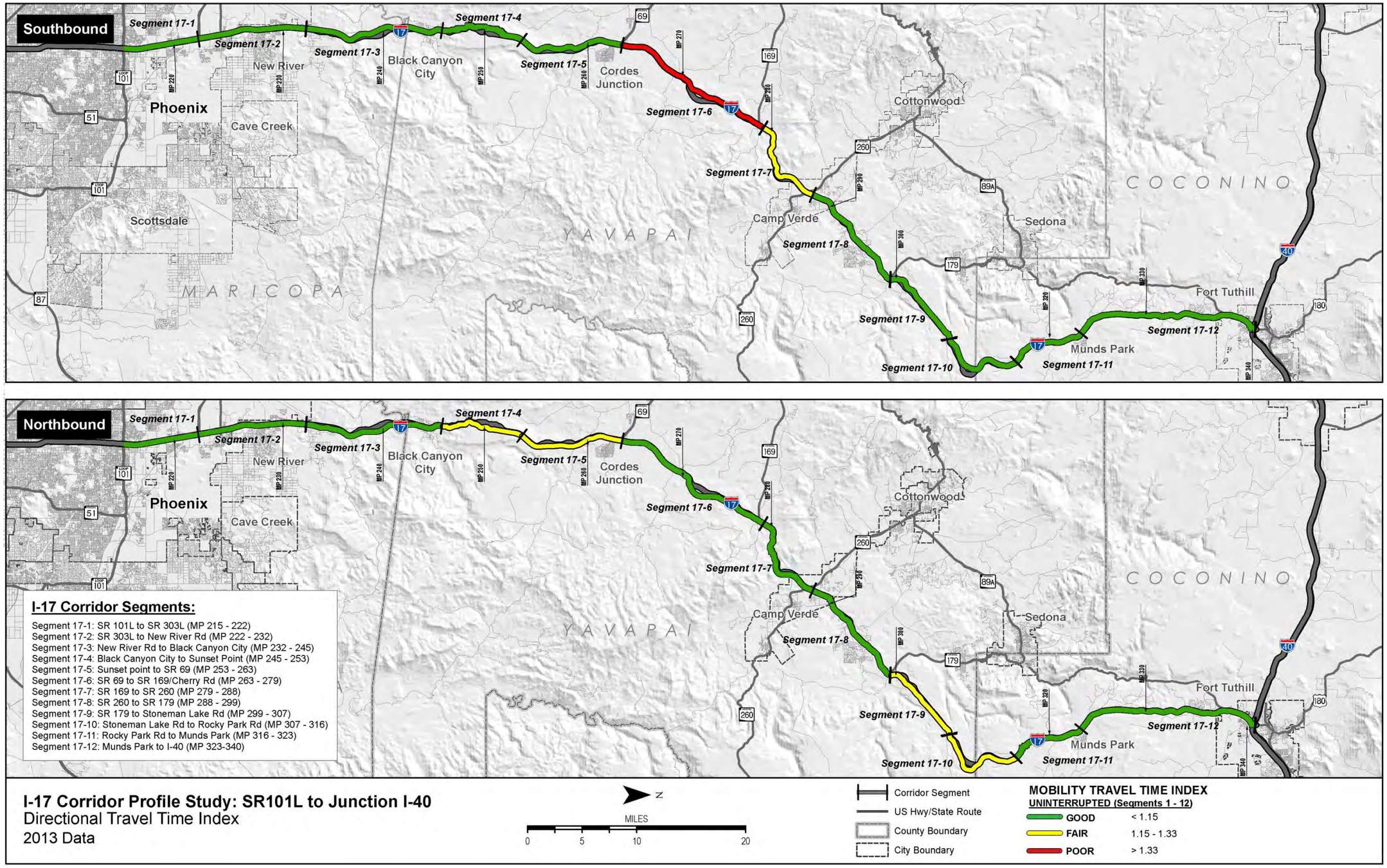

Prescott
Peoria
Dewey-Humboldt
Prescott Valley
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
New River
Black Canyon City
Cordes Junction
Phoenix
Cave Creek
Cottonwood
Scottsdale
Camp Verde
Sedona
Munds Park
Fort Tuthill
Flagstaff
MARICOPA
YAVAPAI
GILA
COCONINO
MP 220
MP 230
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MP 330
MP 340
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
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Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Bridge Rating
2012 - 2014 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
BRIDGE RATING
GOOD > 6
FAIR 5 - 6
POOR < 5

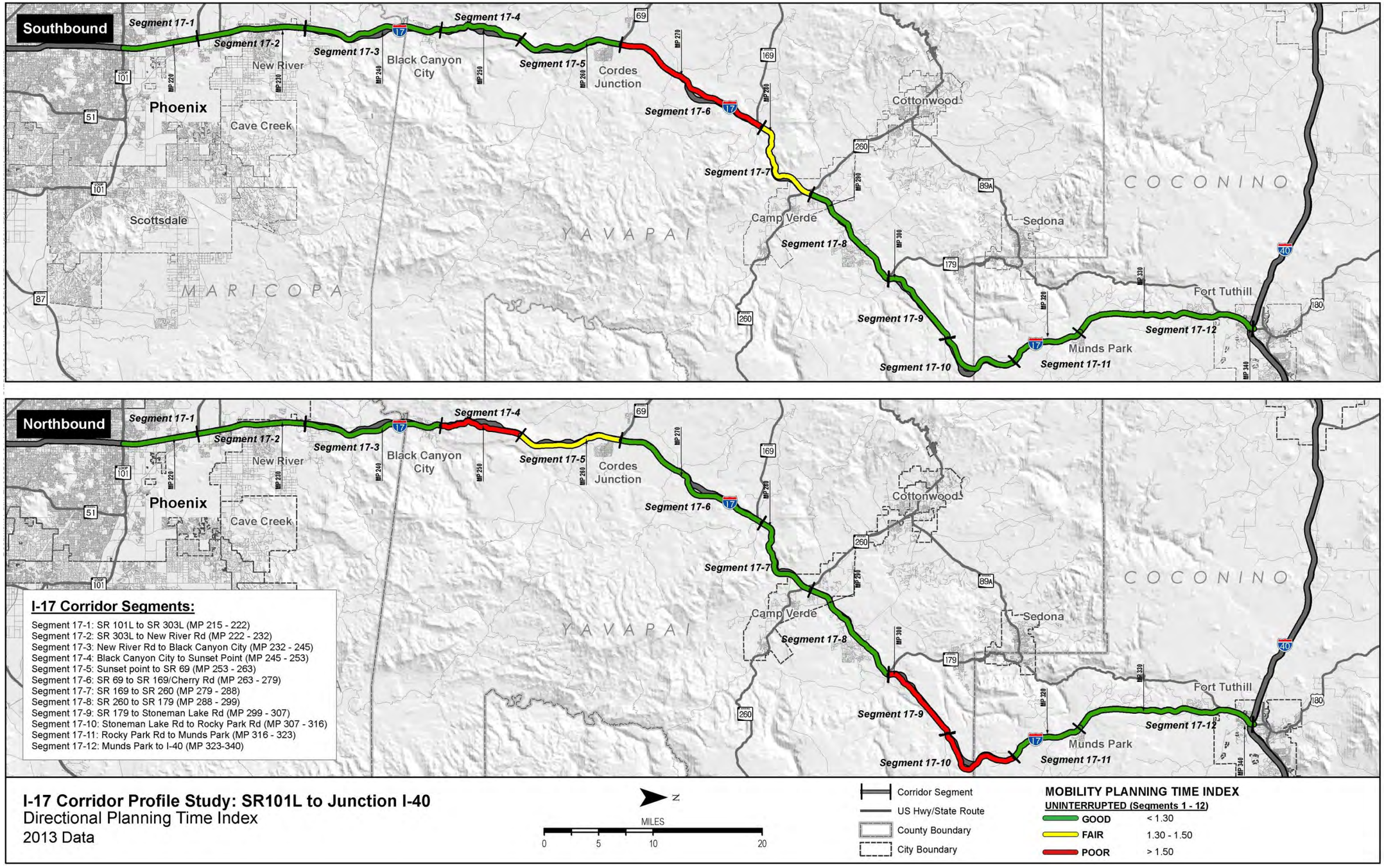

Prescott
Peoria
Dewey-Humboldt
Prescott Valley
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
New River
Black Canyon City
Cordes Junction
Cottonwood
Phoenix
Cave Creek
Scottsdale
Camp Verde
Sedona
Munds Park
Fort Tuthill
Flagstaff
MARICOPA
YAVAPAI
GILA
COCONINO
MP 220
MP 230
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MP 260
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MP 320
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MP 340
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
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Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Mobility Index
2014 & 2035 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
MOBILITY INDEX
URBAN and FRINGE URBAN (Segments 1, 2 & 12)
GOOD / LOS A-C V/C < 0.71
FAIR / LOS D V/C > 0.71 - 0.89
POOR / LOS E or less V/C > 0.89
RURAL (Segments 3 - 11)
GOOD / LOS A-B V/C < 0.56
FAIR / LOS C V/C > 0.56 - 0.76
POOR / LOS D or less V/C > 0.76

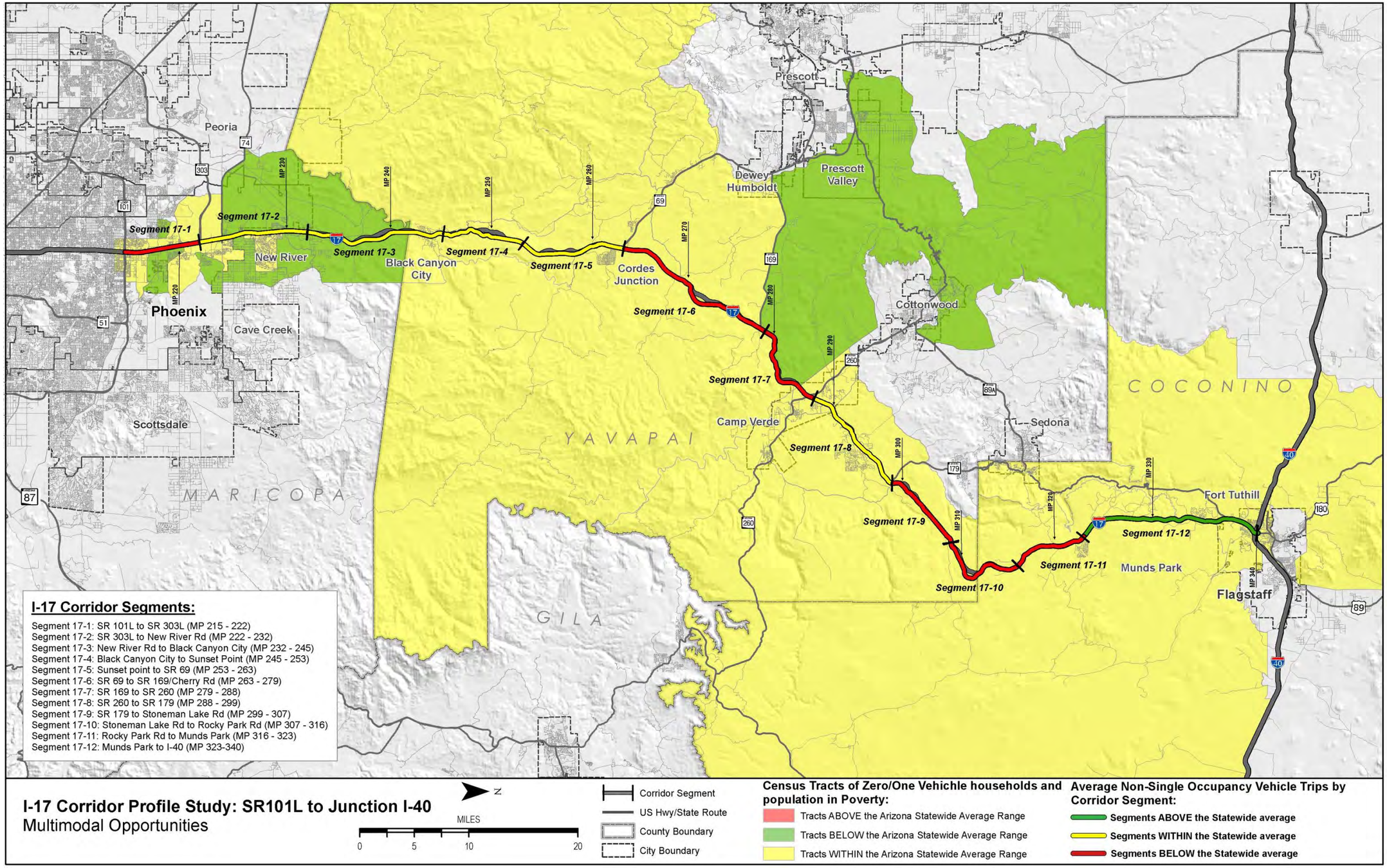

Prescott
Peoria
Dewey-Humboldt
Prescott Valley
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
New River
Black Canyon City
Cordes Junction
Phoenix
Cave Creek
Cottonwood
Scottsdale
Camp Verde
Sedona
Munds Park
Fort Tuthill
Flagstaff
MARICOPA
YAVAPAI
COCONINO
GILA
MP 220
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MP 320
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MP 340
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
Segment 17-2: SR 303L to New River Rd (MP 222 - 232)
Segment 17-3: New River Rd to Black Canyon City (MP 232 - 245)
Segment 17-4: Black Canyon City to Sunset Point (MP 245 - 253)
Segment 17-5: Sunset point to SR 69 (MP 253 - 263)
Segment 17-6: SR 69 to SR 169/Cherry Rd (MP 263 - 279)
Segment 17-7: SR 169 to SR 260 (MP 279 - 288)
Segment 17-8: SR 260 to SR 179 (MP 288 - 299)
Segment 17-9: SR 179 to Stoneman Lake Rd (MP 299 - 307)
Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Future Daily V/C
2035 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
FUTURE DAILY V/C
URBAN and FRINGE URBAN (Segments 1, 2 & 12)
GOOD / LOS A-C V/C < 0.71
FAIR / LOS D V/C > 0.71 - 0.89
POOR / LOS E or less V/C > 0.89
RURAL (Segments 3 - 11)
GOOD / LOS A-B V/C < 0.56
FAIR / LOS C V/C > 0.56 - 0.76
POOR / LOS D or less V/C > 0.76

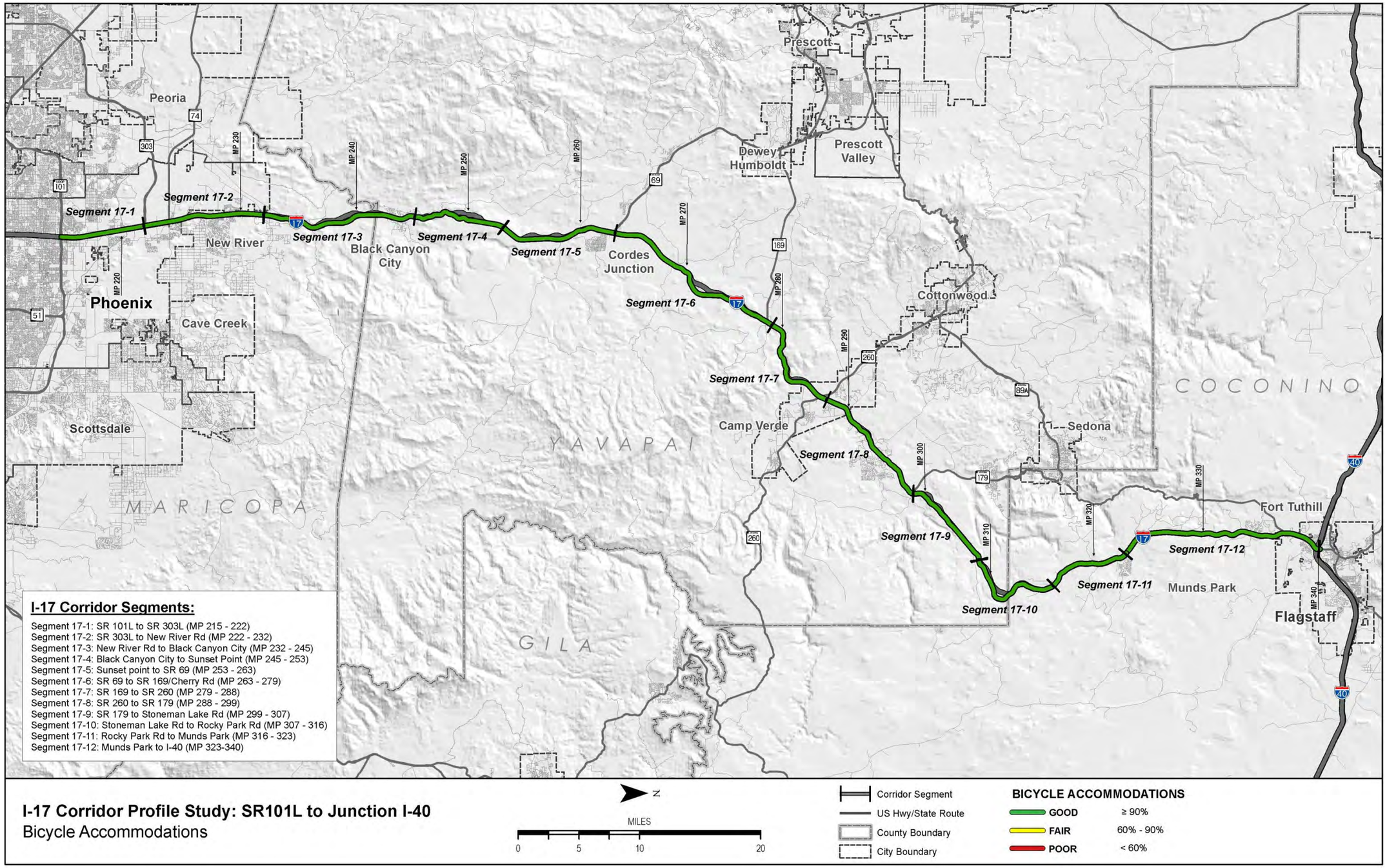

Southbound
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
New River
Black Canyon City
Cordes Junction
Phoenix
Cave Creek
Scottsdale
Cottonwood
Camp Verde
Sedona
Fort Tuthill
Munds Park
MARICOPA
YAVAPAI
COCONINO
Northbound
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
Segment 17-2: SR 303L to New River Rd (MP 222 - 232)
Segment 17-3: New River Rd to Black Canyon City (MP 232 - 245)
Segment 17-4: Black Canyon City to Sunset Point (MP 245 - 253)
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Segment 17-9: SR 179 to Stoneman Lake Rd (MP 299 - 307)
Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Existing Peak Hour V/C
2014 Data
N
MILES
0 5 10 20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
EXISTING PEAK HOUR V/C
URBAN and FRINGE URBAN (Segments 1, 2 & 12)
GOOD / LOS A-C V/C ≤ 0.71
FAIR / LOS D V/C > 0.71 & ≤ 0.89
POOR / LOS E or less V/C > 0.89
RURAL (Segments 3 - 11)
GOOD / LOS A-B V/C ≤ 0.56
FAIR / LOS C V/C > 0.56 & ≤ 0.76
POOR / LOS D or less V/C > 0.76

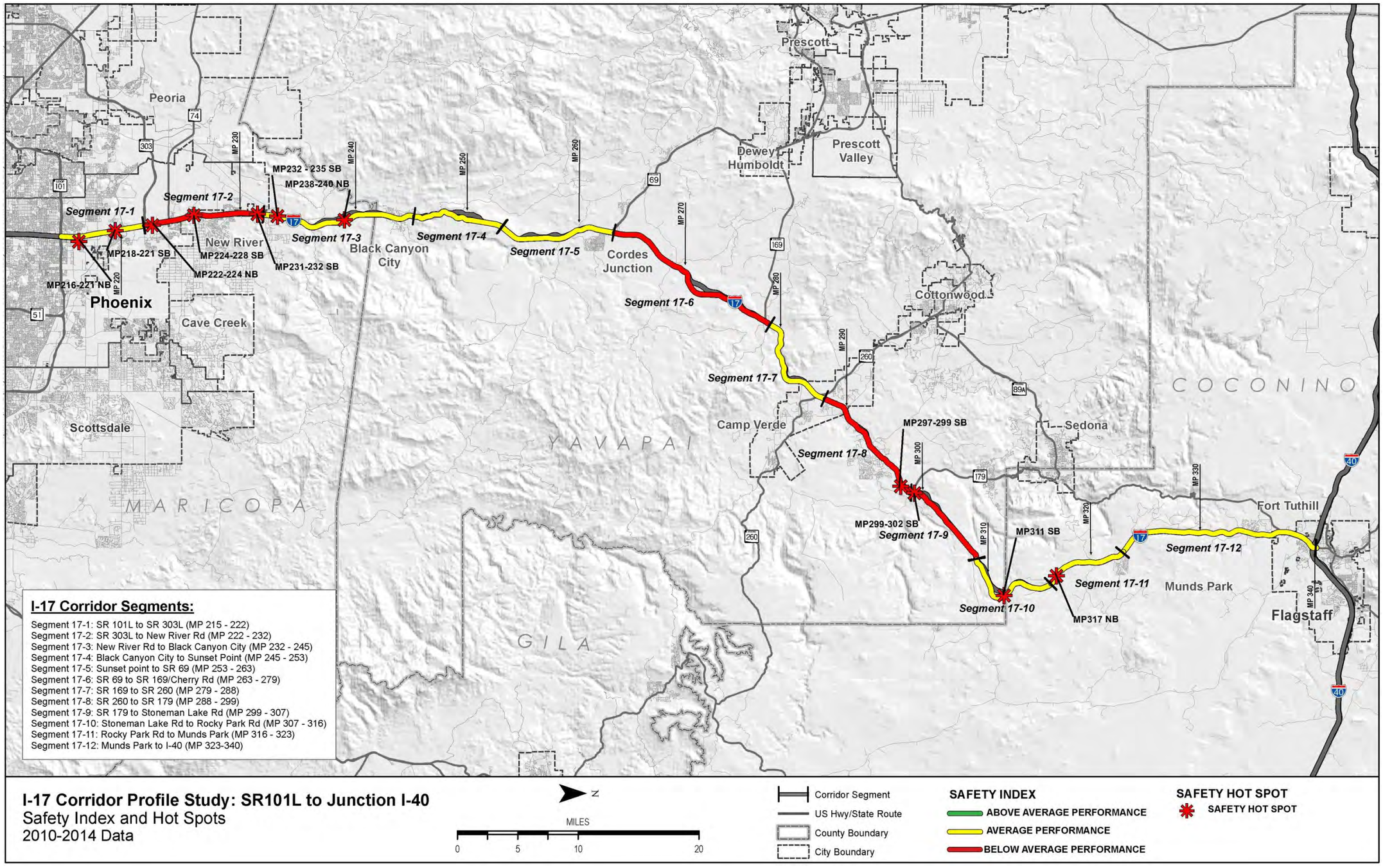

Southbound
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
Phoenix
Scottsdale
Cave Creek
New River
Black Canyon City
Cordes Junction
Cottonwood
Camp Verde
Sedona
Munds Park
Fort Tuthill
MARICOPA
YAVAPAI
COCONINO
Northbound
I-17 Corridor Segments:
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Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Closure Frequency
2009 - 2013 Data
N
MILES
0 5 10 20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
CLOSURE FREQUENCY
(#/miles/year)
ABOVE AVERAGE PERFORMANCE < 0.22
AVERAGE PERFORMANCE 0.22 - 0.62
BELOW AVERAGE PERFORMANCE > 0.62


Southbound
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
Phoenix
Scottsdale
Cave Creek
New River
Black Canyon City
Cordes Junction
Cottonwood
Camp Verde
Sedona
Munds Park
Fort Tuthill
MARICOPA
YAVAPAI
COCONINO
Northbound
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Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Directional Travel Time Index
2013 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
MOBILITY TRAVEL TIME INDEX
UNINTERRUPTED (Segments 1 - 12)
GOOD < 1.15
FAIR 1.15 - 1.33
POOR > 1.33


Southbound
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
Phoenix
Scottsdale
Cave Creek
New River
Black Canyon City
Cordes Junction
Cottonwood
Camp Verde
Sedona
Munds Park
Fort Tuthill
MARICOPA
YAVAPAI
COCONINO
Northbound
I-17 Corridor Segments:
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Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Directional Planning Time Index
2013 Data
N
MILES
0 5 10 20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
MOBILITY PLANNING TIME INDEX
UNINTERRUPTED (Segments 1 - 12)
GOOD < 1.30
FAIR 1.30 - 1.50
POOR > 1.50


Peoria
Phoenix
Cave Creek
Scottsdale
New River
Black Canyon City
Cordes Junction
Prescott
Dewey Humboldt
Prescott Valley
Cottonwood
Camp Verde
Sedona
Fort Tuthill
Munds Park
Flagstaff
COCONINO
YAVAPAI
MARICOPA
GILA
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
MP 220
MP 230
MP 240
MP 250
MP 260
MP 270
MP 280
MP 290
MP 300
MP 310
MP 320
MP 330
MP 340
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
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Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Multimodal Opportunities
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
Census Tracts of Zero/One Vehichle households and population in Poverty:
Tracts ABOVE the Arizona Statewide Average Range
Tracts BELOW the Arizona Statewide Average Range
Tracts WITHIN the Arizona Statewide Average Range
Average Non-Single Occupancy Vehicle Trips by Corridor Segment:
Segments ABOVE the Statewide average
Segments WITHIN the Statewide average
Segments BELOW the Statewide average


Prescott
Peoria
74
303
101
MP 230
MP 240
MP 250
MP 260
69
MP 270
169
MP 280
MP 290
260
89A
Dewey
Humboldt
Prescott
Valley
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
New River
Black Canyon
City
Cordes
Junction
Cottonwood
MP 220
Phoenix
51
Cave Creek
Scottsdale
MARICOPA
YAVAPAI
GILA
COCONINO
Camp Verde
Sedona
MP 300
179
MP 310
MP 320
MP 330
MP 340
40
Fort Tuthill
Munds Park
Flagstaff
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
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Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Bicycle Accommodations
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
BICYCLE ACCOMMODATIONS
GOOD ≥ 90%
FAIR 60% - 90%
POOR < 60%



I-17 Corridor Segments:

Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
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Segment 17-12: Munds Park to I-40 (MP 323-340)

I-17 Corridor Profile Study: SR101L to Junction I-40
Safety Index and Hot Spots
2010-2014 Data

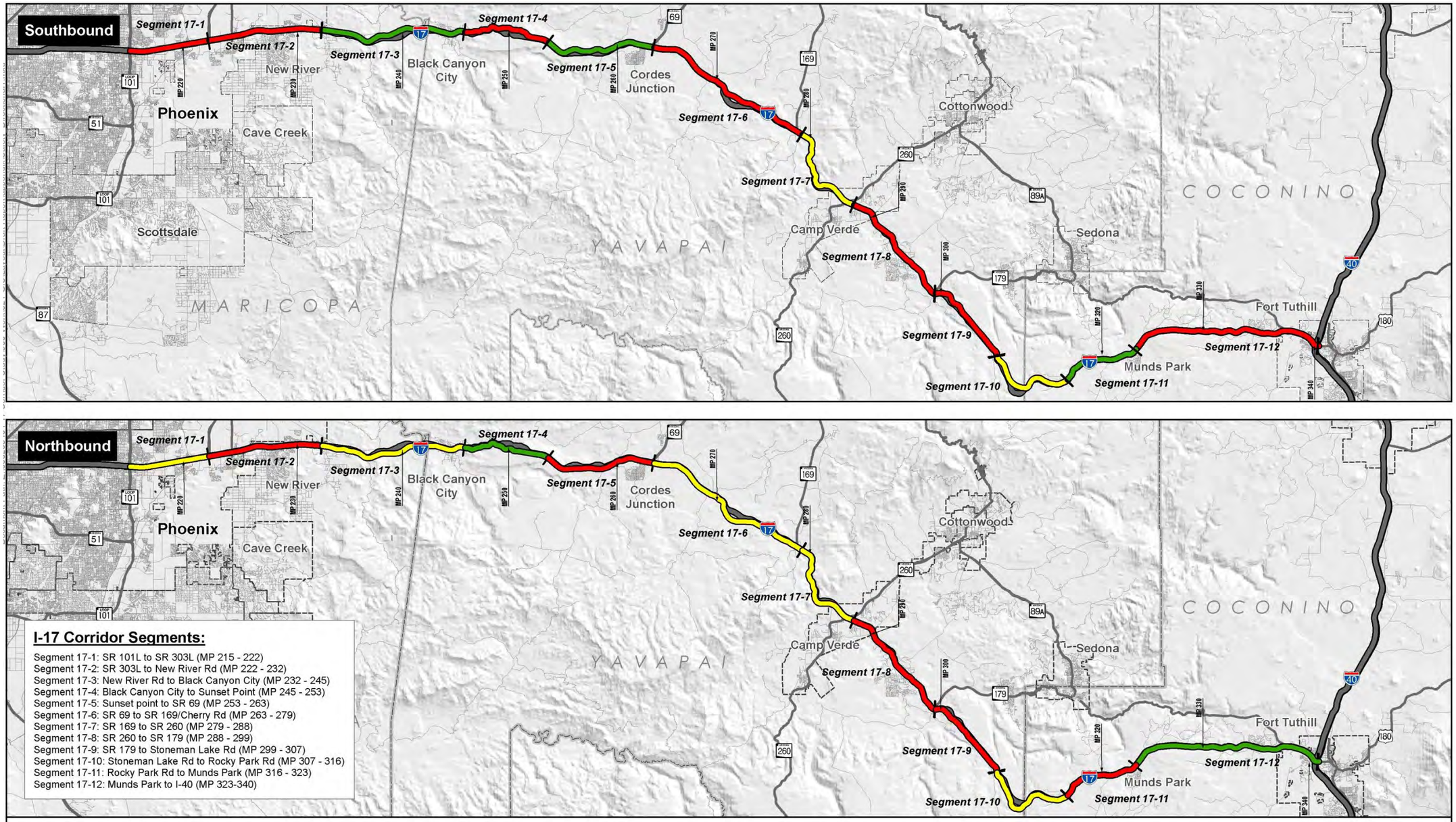
N

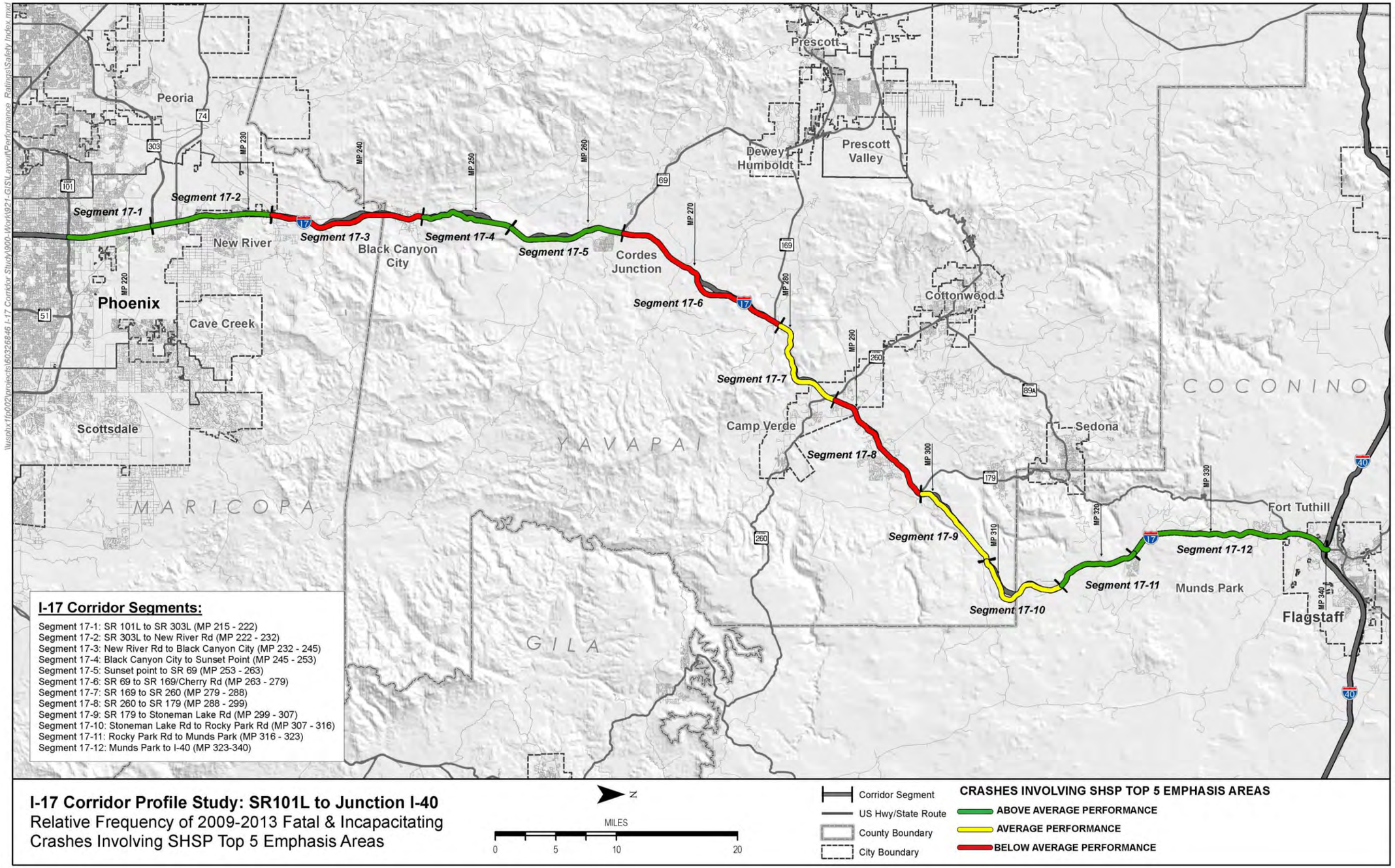
MILES
0 5 10 20

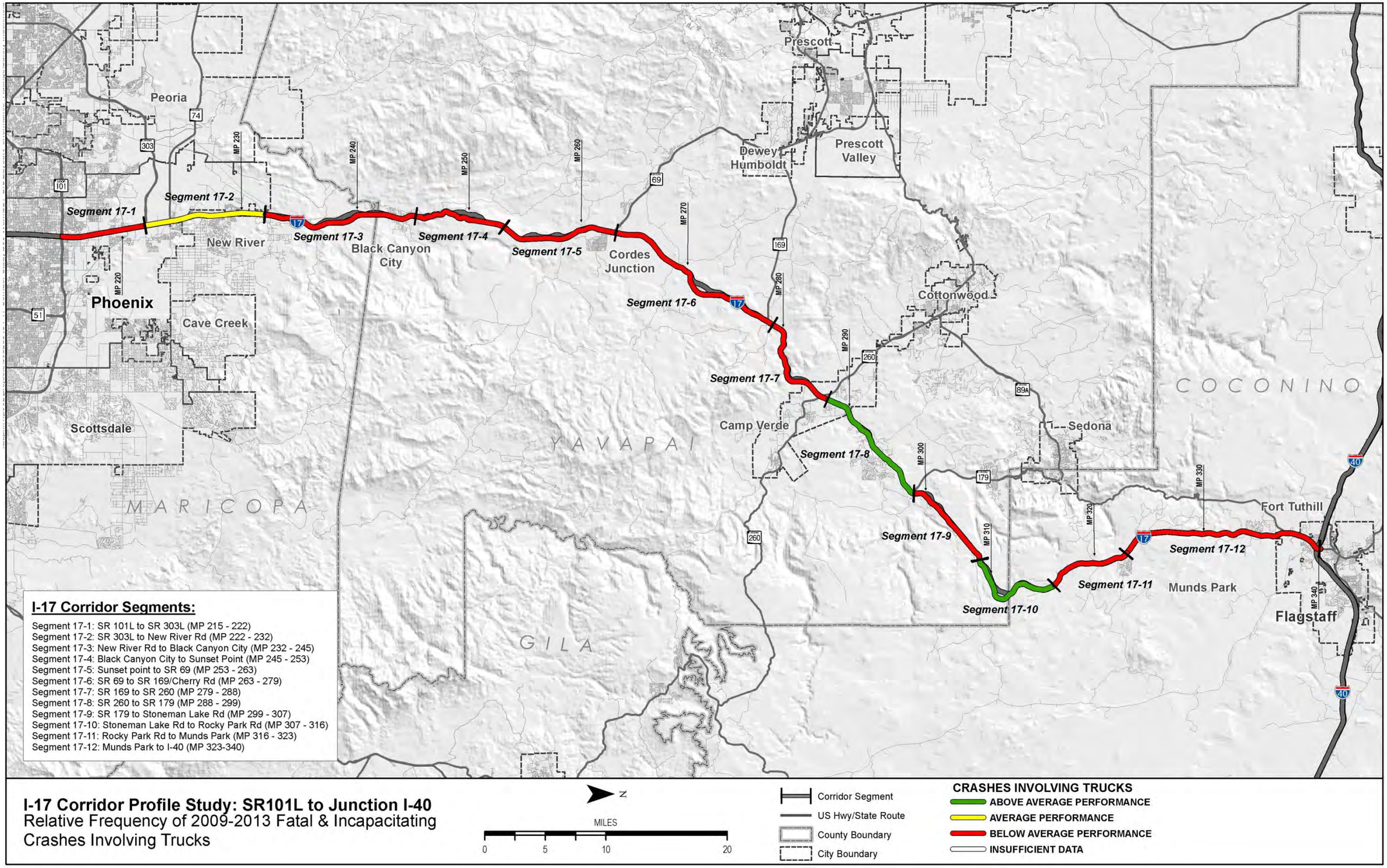
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary

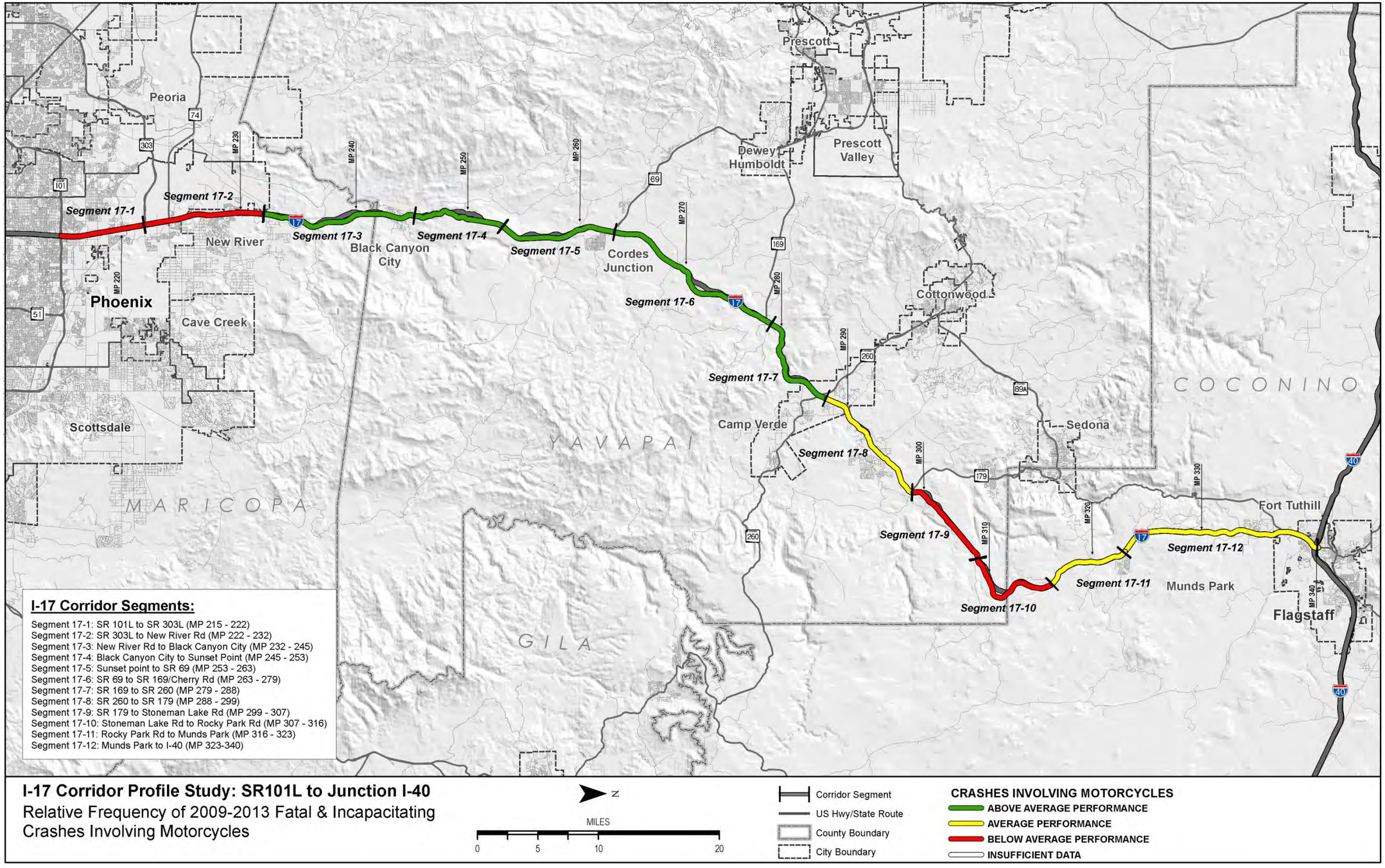
SAFETY INDEX
ABOVE AVERAGE PERFORMANCE
AVERAGE PERFORMANCE
BELOW AVERAGE PERFORMANCE

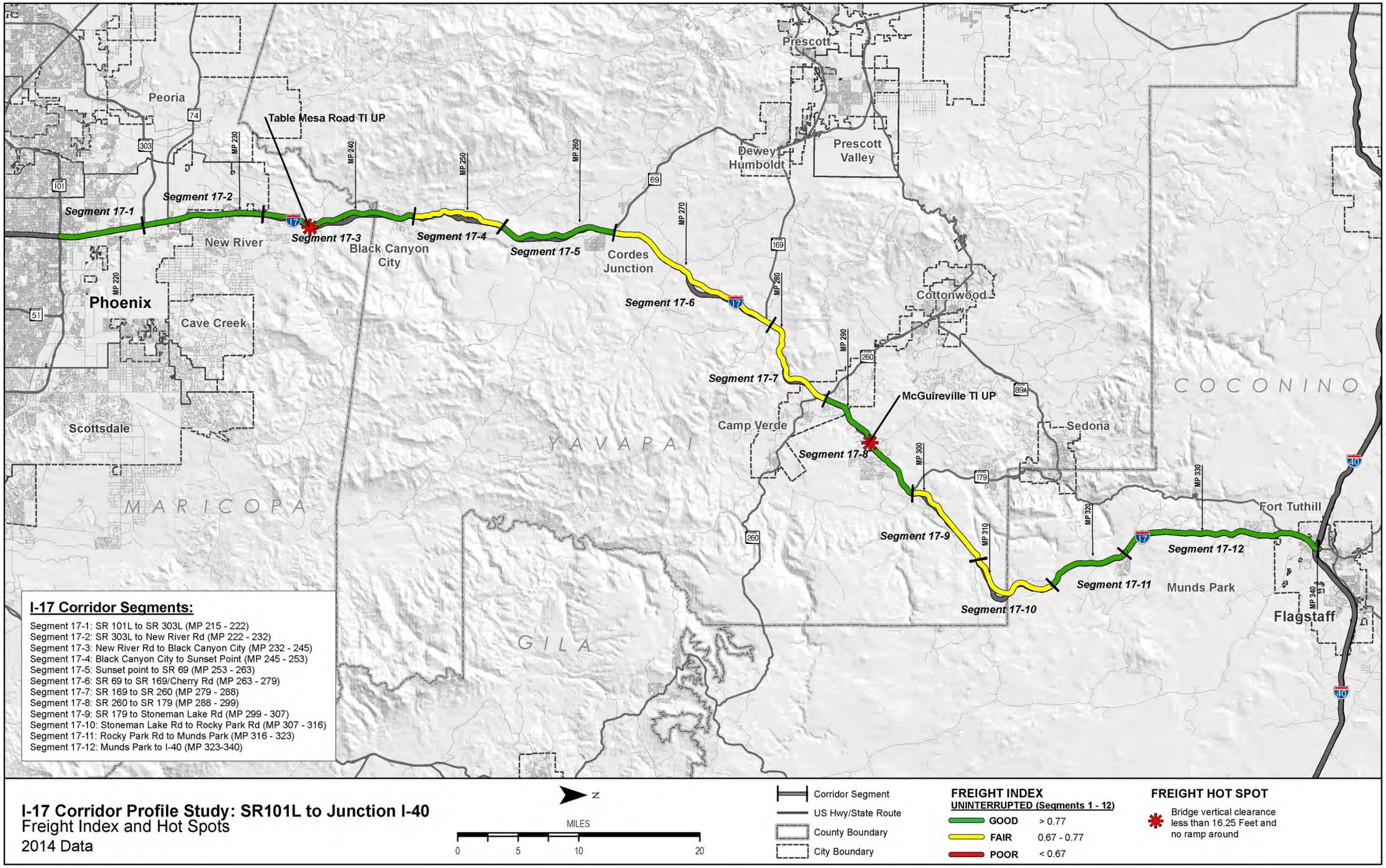
SAFETY HOT SPOT
SAFETY HOT SPOT

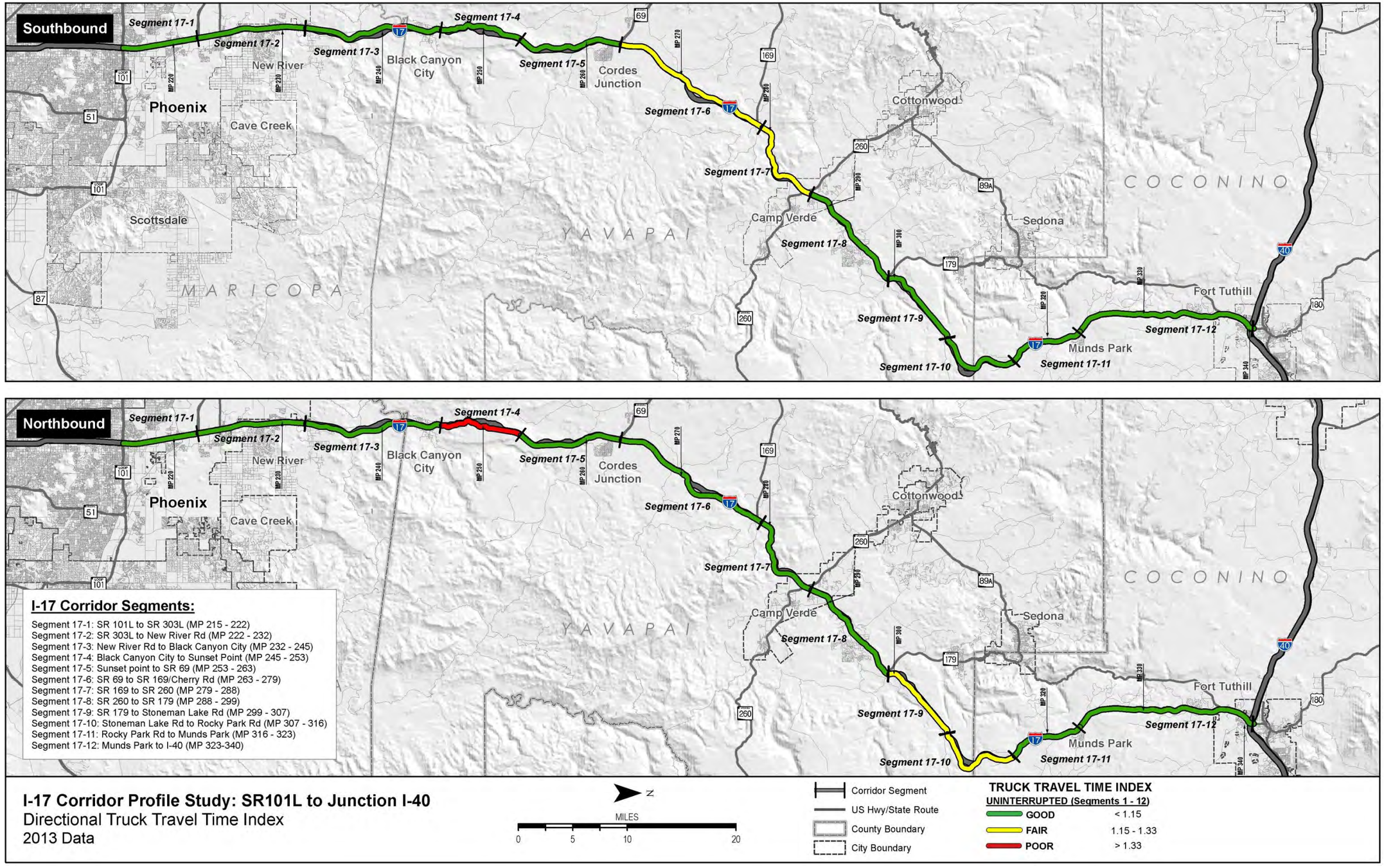

Southbound
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
Phoenix
Scottsdale
New River
Cave Creek
Black Canyon City
Cordes Junction
Cottonwood
Camp Verde
Sedona
Munds Park
Fort Tuthill
MARICOPA
YAVAPAI
COCONINO
Northbound
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
Segment 17-2: SR 303L to New River Rd (MP 222 - 232)
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Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Directional Safety Index
2013 - 2014 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
DIRECTIONAL SAFETY INDEX
ABOVE AVERAGE PERFORMANCE
AVERAGE PERFORMANCE
BELOW AVERAGE PERFORMANCE

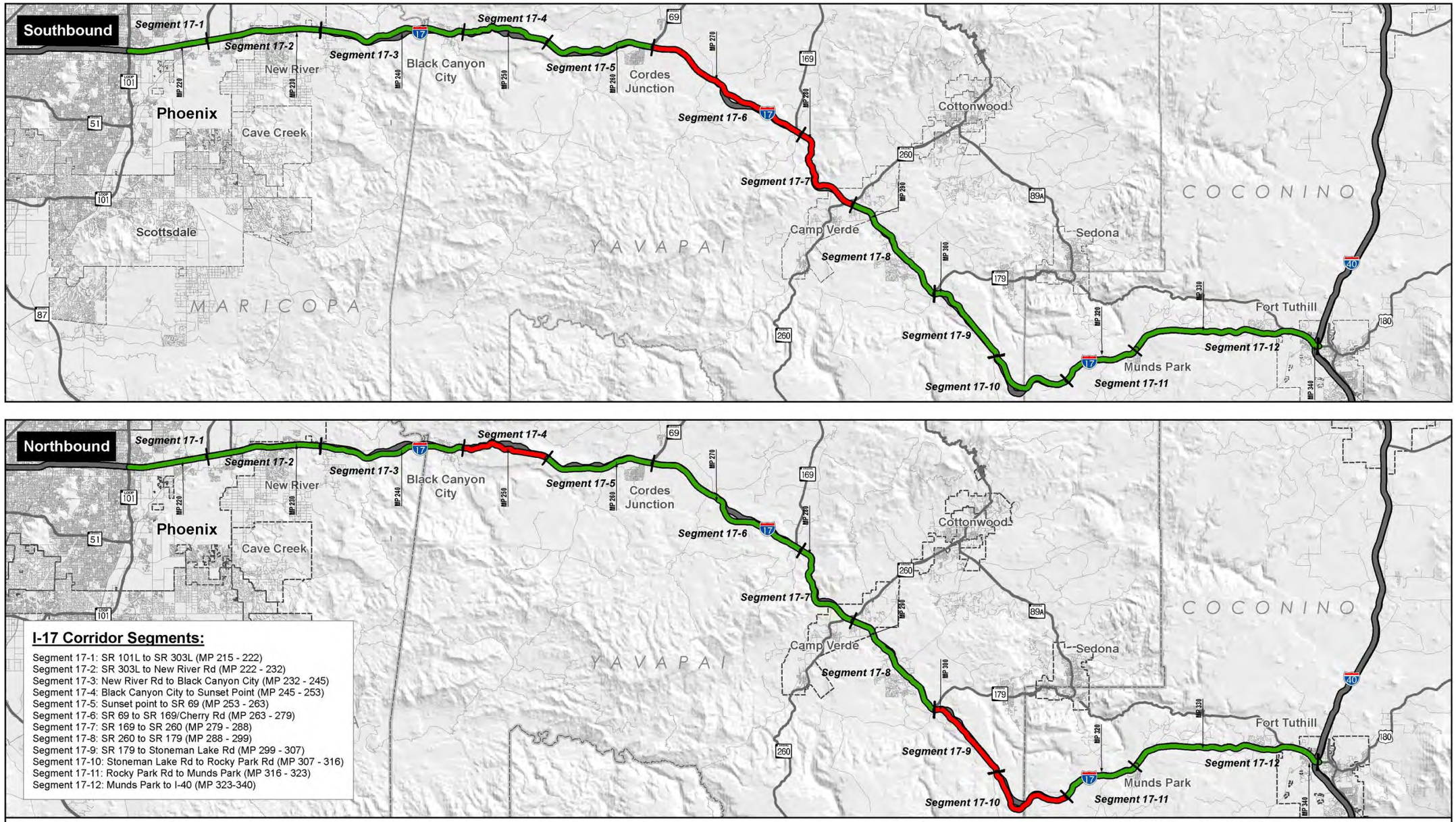

Peoria
Phoenix
Scottsdale
Cave Creek
New River
Black Canyon City
Cordes Junction
Prescott
Dewey-Humboldt
Prescott Valley
Cottonwood
Camp Verde
Sedona
Munds Park
Fort Tuthill
Flagstaff
MARICOPA
YAVAPAI
COCONINO
GILA
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
MP 220
MP 230
MP 240
MP 250
MP 260
MP 270
MP 280
MP 290
MP 300
MP 310
MP 320
MP 330
MP 340
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
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I-17 Corridor Profile Study: SR101L to Junction I-40
Relative Frequency of 2009-2013 Fatal & Incapacitating Crashes Involving SHSP Top 5 Emphasis Areas
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
CRASHES INVOLVING SHSP TOP 5 EMPHASIS AREAS
ABOVE AVERAGE PERFORMANCE
AVERAGE PERFORMANCE
BELOW AVERAGE PERFORMANCE

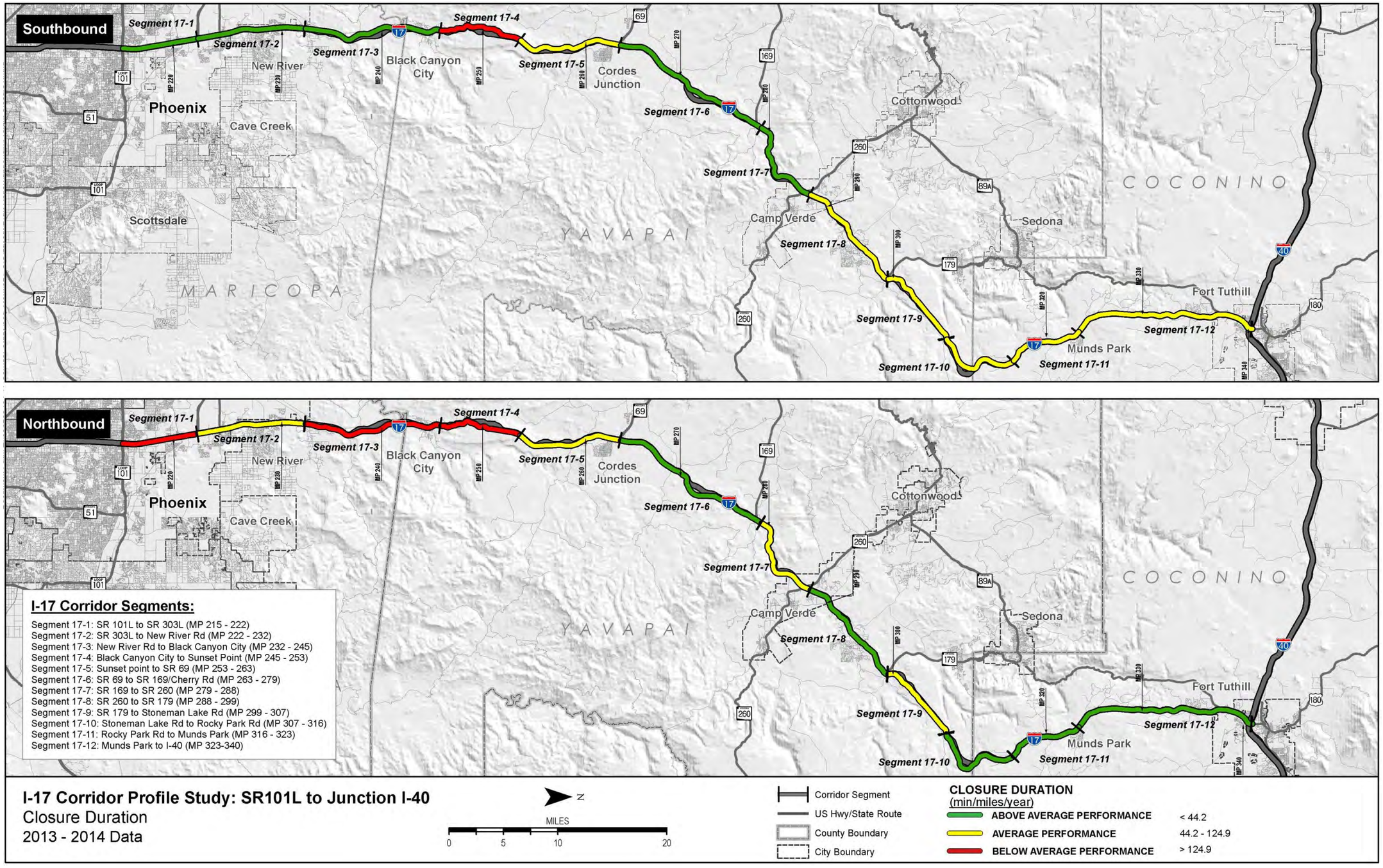

Prescott
Peoria
Dewey
Humboldt
Prescott
Valley
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
MP 220
MP 230
MP 240
MP 250
MP 260
MP 270
MP 280
MP 290
MP 300
MP 310
MP 320
MP 330
MP 340
New River
Black Canyon
City
Cordes
Junction
Phoenix
Cave Creek
Cottonwood
Scottsdale
Camp Verde
Sedona
Fort Tuthill
Munds Park
Flagstaff
MARICOPA
YAVAPAI
GILA
COCONINO
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Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Relative Frequency of 2009-2013 Fatal & Incapacitating
Crashes Involving Trucks
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
CRASHES INVOLVING TRUCKS
ABOVE AVERAGE PERFORMANCE
AVERAGE PERFORMANCE
BELOW AVERAGE PERFORMANCE
INSUFFICIENT DATA

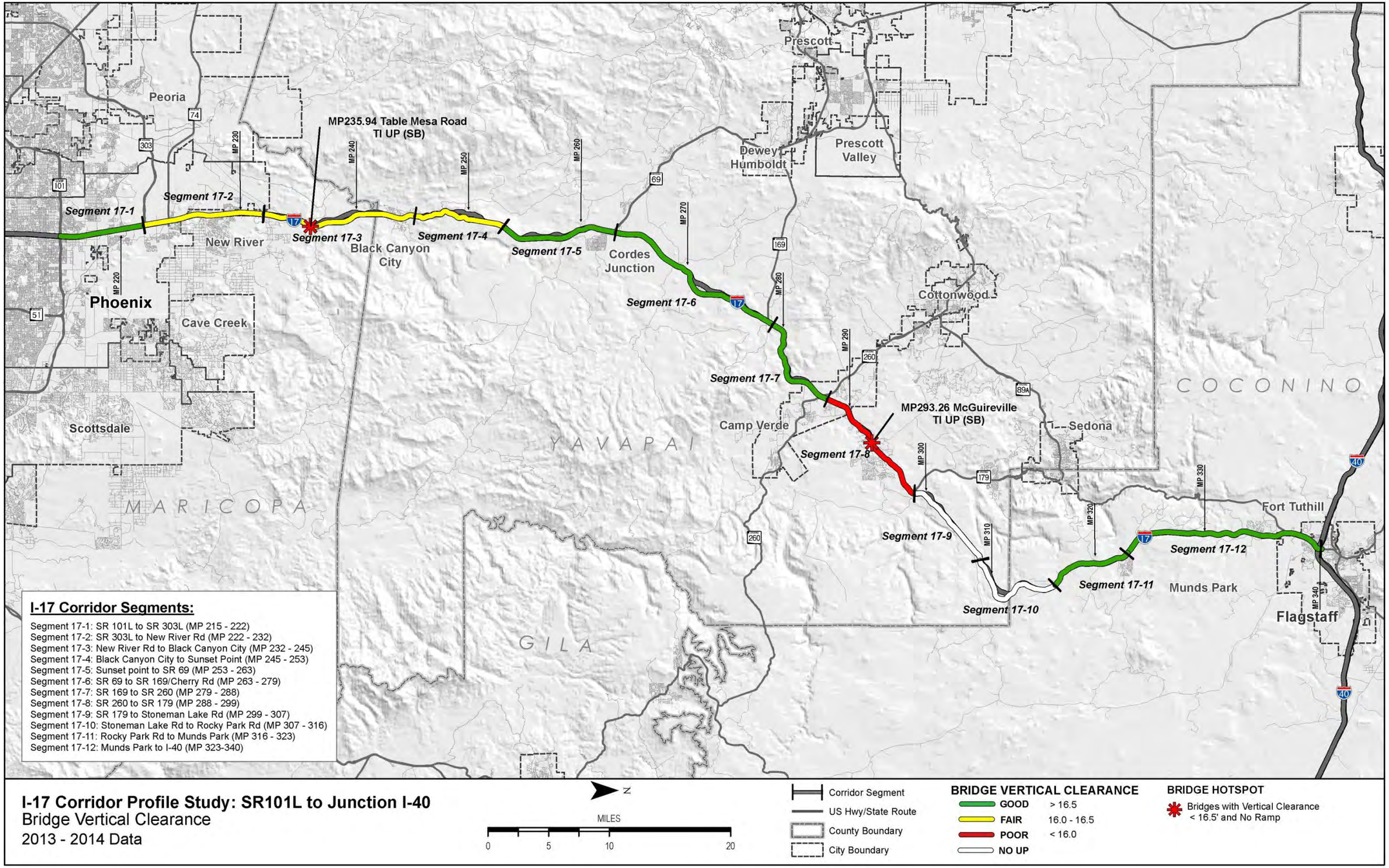

Prescott
Peoria
Dewey
Humboldt
Prescott
Valley
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
New River
Black Canyon
City
Cordes
Junction
Phoenix
Cave Creek
Cottonwood
Scottsdale
Camp Verde
Sedona
Munds Park
Fort Tuthill
Flagstaff
MARICOPA
YAVAPAI
COCONINO
GILA
MP 220
MP 230
MP 240
MP 250
MP 260
MP 270
MP 280
MP 290
MP 300
MP 310
MP 320
MP 330
MP 340
I-17 Corridor Segments:
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I-17 Corridor Profile Study: SR101L to Junction I-40
Relative Frequency of 2009-2013 Fatal & Incapacitating Crashes Involving Motorcycles
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
CRASHES INVOLVING MOTORCYCLES
ABOVE AVERAGE PERFORMANCE
AVERAGE PERFORMANCE
BELOW AVERAGE PERFORMANCE
INSUFFICIENT DATA


Peoria
Table Mesa Road TI UP
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
New River
Black Canyon City
Cordes Junction
Prescott
Dewey-Humboldt
Prescott Valley
Cottonwood
Phoenix
Cave Creek
Scottsdale
Camp Verde
McGuireville TI UP
Sedona
Munds Park
Fort Tuthill
Flagstaff
MARICOPA
YAVAPAI
COCONINO
GILA
MP 220
MP 230
MP 240
MP 250
MP 260
MP 270
MP 280
MP 290
MP 300
MP 310
MP 320
MP 330
MP 340
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
Segment 17-2: SR 303L to New River Rd (MP 222 - 232)
Segment 17-3: New River Rd to Black Canyon City (MP 232 - 245)
Segment 17-4: Black Canyon City to Sunset Point (MP 245 - 253)
Segment 17-5: Sunset point to SR 69 (MP 253 - 263)
Segment 17-6: SR 69 to SR 169/Cherry Rd (MP 263 - 279)
Segment 17-7: SR 169 to SR 260 (MP 279 - 288)
Segment 17-8: SR 260 to SR 179 (MP 288 - 299)
Segment 17-9: SR 179 to Stoneman Lake Rd (MP 299 - 307)
Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Freight Index and Hot Spots
2014 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
FREIGHT INDEX
UNINTERRUPTED (Segments 1 - 12)
GOOD > 0.77
FAIR 0.67 - 0.77
POOR < 0.67
FREIGHT HOT SPOT
Bridge vertical clearance less than 16.25 Feet and no ramp around


Southbound
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
Phoenix
Scottsdale
Cave Creek
New River
Black Canyon City
Cordes Junction
Cottonwood
Camp Verde
Sedona
Munds Park
Fort Tuthill
YAVAPAI
MARICOPA
COCONINO
Northbound
I-17 Corridor Segments:
Segment 17-1: SR 101L to SR 303L (MP 215 - 222)
Segment 17-2: SR 303L to New River Rd (MP 222 - 232)
Segment 17-3: New River Rd to Black Canyon City (MP 232 - 245)
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Segment 17-6: SR 69 to SR 169/Cherry Rd (MP 263 - 279)
Segment 17-7: SR 169 to SR 260 (MP 279 - 288)
Segment 17-8: SR 260 to SR 179 (MP 288 - 299)
Segment 17-9: SR 179 to Stoneman Lake Rd (MP 299 - 307)
Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Directional Truck Travel Time Index
2013 Data
N
MILES
0 5 10 20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
TRUCK TRAVEL TIME INDEX
UNINTERRUPTED (Segments 1 - 12)
GOOD < 1.15
FAIR 1.15 - 1.33
POOR > 1.33


Southbound
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
Phoenix
Scottsdale
Cave Creek
New River
Black Canyon City
Cordes Junction
Cottonwood
Camp Verde
Sedona
Munds Park
Fort Tuthill
MARICOPA
YAVAPAI
COCONINO
Northbound
I-17 Corridor Segments:
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Segment 17-7: SR 169 to SR 260 (MP 279 - 288)
Segment 17-8: SR 260 to SR 179 (MP 288 - 299)
Segment 17-9: SR 179 to Stoneman Lake Rd (MP 299 - 307)
Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Directional Truck PlanningTime Index
2013 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
TRUCK PLANNING TIME INDEX
UNINTERRUPTED (Segments 1 - 12)
GOOD < 1.30
FAIR 1.30 - 1.50
POOR > 1.50

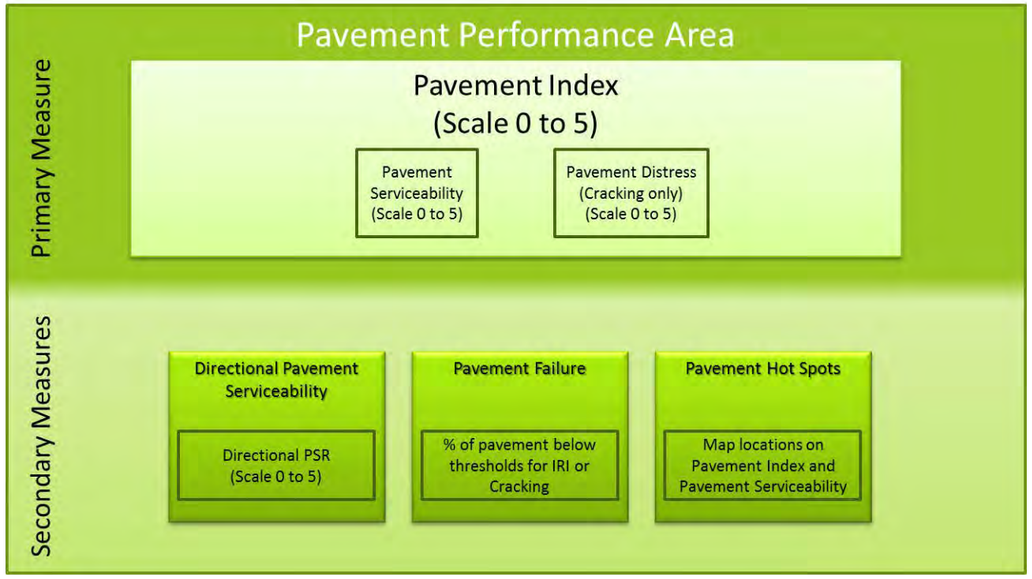

Southbound
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
Phoenix
Scottsdale
Cave Creek
New River
Black Canyon City
Cordes Junction
Cottonwood
Camp Verde
Sedona
Munds Park
Fort Tuthill
MARICOPA
YAVAPAI
COCONINO
Northbound
I-17 Corridor Segments:
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Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Closure Duration
2013 - 2014 Data
N
MILES
0 5 10 20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
CLOSURE DURATION
(min/miles/year)
ABOVE AVERAGE PERFORMANCE < 44.2
AVERAGE PERFORMANCE 44.2 - 124.9
BELOW AVERAGE PERFORMANCE > 124.9


Peoria
MP235.94 Table Mesa Road
TI UP (SB)
Segment 17-1
Segment 17-2
Segment 17-3
Segment 17-4
Segment 17-5
Segment 17-6
Segment 17-7
Segment 17-8
Segment 17-9
Segment 17-10
Segment 17-11
Segment 17-12
New River
Black Canyon
City
Cordes
Junction
Prescott
Dewey
Humboldt
Prescott
Valley
Cottonwood
Phoenix
Cave Creek
Scottsdale
Camp Verde
MP293.26 McGuireville
TI UP (SB)
Sedona
Munds Park
Fort Tuthill
Flagstaff
MARICOPA
YAVAPAI
COCONINO
GILA
MP 220
MP 230
MP 240
MP 250
MP 260
MP 270
MP 280
MP 290
MP 300
MP 310
MP 320
MP 330
MP 340
I-17 Corridor Segments:
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Segment 17-3: New River Rd to Black Canyon City (MP 232 - 245)
Segment 17-4: Black Canyon City to Sunset Point (MP 245 - 253)
Segment 17-5: Sunset point to SR 69 (MP 253 - 263)
Segment 17-6: SR 69 to SR 169/Cherry Rd (MP 263 - 279)
Segment 17-7: SR 169 to SR 260 (MP 279 - 288)
Segment 17-8: SR 260 to SR 179 (MP 288 - 299)
Segment 17-9: SR 179 to Stoneman Lake Rd (MP 299 - 307)
Segment 17-10: Stoneman Lake Rd to Rocky Park Rd (MP 307 - 316)
Segment 17-11: Rocky Park Rd to Munds Park (MP 316 - 323)
Segment 17-12: Munds Park to I-40 (MP 323-340)
I-17 Corridor Profile Study: SR101L to Junction I-40
Bridge Vertical Clearance
2013 - 2014 Data
N
MILES
0
5
10
20
Corridor Segment
US Hwy/State Route
County Boundary
City Boundary
BRIDGE VERTICAL CLEARANCE
GOOD > 16.5
FAIR 16.0 - 16.5
POOR < 16.0
NO UP
BRIDGE HOTSPOT
Bridges with Vertical Clearance < 16.5' and No Ramp

Appendix B: Performance Area Detailed Calculation Methodologies

Pavement Performance Area Calculation Methodologies

The section summarizes the approach for developing the primary and secondary performance measures in the Pavement Performance Area as shown in the following graphic.



This performance area is used to evaluate mainline pavement condition. Pavement condition data for ramps, frontage roads, crossroads, etc. was not included in the evaluation.

Primary Measure:
The Pavement Index is calculated based on the use of two pavement condition ratings from the ADOT Pavement Database. The two ratings are the International Roughness Index (IRI) and the Cracking Rating. The calculation of the Pavement Index uses a combination of these two ratings.

The IRI is a measurement of the pavement roughness based on field-measured longitudinal roadway profiles. To facilitate the calculation of the index, the IRI rating was converted to a Pavement Serviceability Rating (PSR) using the following equation:

$$PSR = 5 * e^{-0.0038*IRI}$$

The Cracking Rating is a measurement of the amount of surface cracking based on a field-measured area of 1,000 square feet that serves as a sample for each mile. To facilitate the calculation of the index, the Cracking Rating was converted to a Pavement Distress Index (PDI) using the following equation:

$$PDI = 5 - (0.345 * C^{0.66})$$

Both the PSR and PDI use a 0 to 5 scale with 0 representing the lowest performance and 5 representing the highest performance. The performance thresholds shown in the tables below were used for the PSR and PDI.

Table 1 - Performance Thresholds for Interstates

Performance Level	IRI (PSR)	Cracking (PDI)
Good	<75 (>3.75)	<7 (>3.75)
Fair	75 - 117 (3.20 - 3.75)	7 - 12 (3.22 - 3.75)
Poor	>117 (<3.20)	>12 (<3.22)

Table 2 - Performance Thresholds for Non-Interstates

Performance Level	IRI (PSR)	Cracking (PDI)
Good	<94 (>3.5)	<9 (>3.5)
Fair	94 - 142 (2.9 - 3.5)	9 - 15 (2.9 - 3.5)
Poor	>142 (<2.9)	>15 (<2.9)

The PSR and PDI are calculated for each 1-mile section of roadway. If PSR or PDI falls into a poor rating (<3.2 for Interstates, for example) for a 1-mile section, then the score for that 1-mile section is entirely (100%) based on the lower score (either PSR or PDI). If neither PSR or PDI fall into a poor rating for a 1-mile section, then the score for that 1-mile section is based on a combination of the lower rating (70% weight) and the higher rating (30% weight). The end result is a score between 0 and 5 for each direction of travel of each mile of roadway based on a combination of both the PSR and the PDI.

The project corridor has been divided into segments. 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 a section with fewer travel lanes.

The resulting Pavement Index (good/fair/poor) for each segment will be presented on a corridor map. In addition, the calculated Pavement Index for each segment will be presented in tabular format.

Secondary Measures:
Three secondary measures will be evaluated:

- Directional Pavement Serviceability
- Pavement Failure
- Pavement Hot Spots

Directional Pavement Serviceability: Similar to the Pavement Index, the Directional Pavement Serviceability will be calculated as a weighted average (based on number of lanes) for each segment. However, this rating will only utilize the PSR and will be calculated separately for each direction of travel. The PSR uses a 0 to 5 scale with 0 representing the lowest performance and 5 representing the highest performance. The resulting Directional Pavement Serviceability (good/fair/poor) for each direction of each segment will be presented on a corridor map. In addition, the calculated Directional Pavement Serviceability for each segment will be presented in tabular format.

The Directional Serviceability map will identify locations that have an IRI rating above 105 for Interstates or above 142 for non-Interstates by displaying a symbol and labeling the location. A single symbol will be used to represent consecutive/adjacent sections. However, if there is a gap between the sections, then a second symbol will be displayed on the map.

Pavement Failure: The percentage of pavement area rated above the failure thresholds for IRI or Cracking will be calculated for each segment. The calculated percentage for each segment will be presented in a table. In addition, the Standard score (z-score) will be calculated for each segment.

The Standard score (z-score) is the number of standard deviations above or below the mean. Therefore, a Standard score between -0.5 and +0.5 is “average”, less than -0.5 is lower (better) than average, and higher than +0.5 is above (worse) average. The resulting Standard Score (better/average/worse) for each segment will be presented on a corridor map. The thresholds for this performance measure have been established based on the first six corridors.

Pavement Hot Spots: The Pavement Index map will identify locations that have an IRI rating or Cracking rating that fall above the failure threshold as identified by ADOT Pavement Group. For Interstates, an IRI rating above 105 or a Cracking rating above 15 will be used as the thresholds which are slightly different than the ratings shown in the table above. For non-Interstates, an IRI rating above 142 or a Cracking rating above 15 will be used as the thresholds. The locations will be identified by displaying a symbol on the map. A single symbol will be used to represent consecutive/adjacent sections. However, if there is a gap between the sections, then a second symbol will be displayed on the map.

Performance Level	Pavement Index	
	Interstates	Non-Interstates
Good	>3.75	>3.5
Fair	3.2 - 3.75	2.9 - 3.5
Poor	<3.2	<2.9

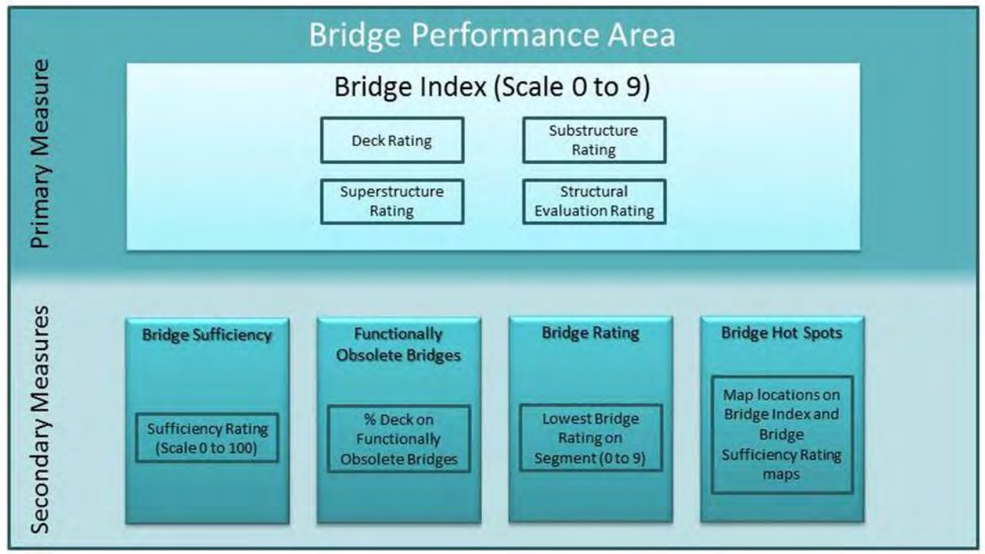
Performance Level	Directional Pavement Serviceability	
	Interstates	Non-Interstates
Good	>3.75	>3.5
Fair	3.2 - 3.75	2.9 - 3.5
Poor	<3.2	<2.9

Performance Level	% Pavement Failure
Good	< 5%
Fair	5% – 20%
Poor	>20%

Scoring:

Bridge Performance Area Calculation Methodologies

The section summarizes the approach for developing the primary and secondary performance measures in the Bridge Performance Area as shown in the following graphic.



This performance area is used to evaluate mainline bridges. Bridges on ramps (that do not cross the mainline), frontage roads, etc. should not be included in the evaluation. Basically, any bridge that carries mainline traffic or carries traffic over the mainline should be included and bridges that do not carry mainline traffic, run parallel to the mainline (frontage roads), or do not cross the mainline should not be included.

Primary Measure:
The Bridge Index is calculated based on the use of four 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 (N58), Substructure Rating (N60), Superstructure Rating (N59), and Structural Evaluation Rating (N67). The calculation of the Bridge Index uses the lowest of these four ratings.

Each of the four condition ratings use a 0 to 9 scale with 0 representing the lowest performance and 9 representing the highest performance.

The project corridor has been divided into segments and the bridges are grouped together according to the segment definitions. In order to report the Bridge Index for each corridor segment, the Bridge Index for each segment is a weighted average based on the deck area for each bridge. Therefore, the condition of a larger bridge will have a greater influence on the resulting segment Bridge Index than a smaller bridge.

The resulting Bridge Index (good/fair/poor) for each segment will be presented on a corridor map. In addition, the calculated Bridge Index for each segment will be presented in tabular format.

Secondary Measures:
Four secondary measures will be evaluated:

- Bridge Sufficiency Rating
- Bridge Rating
- Functionally Obsolete Bridges
- Bridge Hot Spots

Bridge Sufficiency Rating: Similar to the Bridge Index, the Bridge Sufficiency Rating will be calculated as a weighted average (based on deck area) for each segment. The Sufficiency Rating is a scale of 0 to 100 with 0 representing the lowest performance and 100 representing the highest performance. A rating of 80 or above represents “good” performance, a rating between 50 and 80 represents “fair” performance, and a rating below 50 represents “poor” performance. The resulting Sufficiency Rating (good/fair/poor) for each segment will be presented on a corridor map. The calculated Sufficiency Rating for each segment will be presented in tabular format.

Bridge Rating: The Bridge Rating will simply identify the lowest bridge rating on each segment. This performance measure is not an average and therefore is not weighted based on the deck area. The Bridge Index identifies the lowest rating for each bridge, as described above. This secondary performance measure will simply identify the lowest rating on each segment. Each of the four condition ratings use a 0 to 9 scale with 0 representing the lowest performance and 9 representing the highest performance. The resulting Bridge Rating (good/fair/poor) for each segment will be presented on a corridor map. The Bridge Rating for each segment will be presented in tabular format.

Functionally Obsolete Bridges: The percentage of deck area on functionally obsolete bridges will be calculated for each segment. The deck area for each bridge within each segment that has been identified as functionally obsolete will be totaled and divided by the total deck area for the segment to calculate the percentage of deck area on functionally obsolete bridges for each segment. The calculated percentage for each segment will be presented in tabular format.

The thresholds for this performance measure were determined based on the Standard score (z-score). The Standard score (z-score) is the number of standard deviations above or below the mean. Therefore, a Standard score between -0.5 and +0.5 is “average”, less than -0.5 is lower (better) than average, and higher than +0.5 is above (worse) average. The resulting performance (better/average/worse) for each segment will be presented on a corridor map. The thresholds for this performance measure have been established based on the first 6 corridors.

Bridge Hot Spot: The Bridge Index map will identify individual bridge locations that are identified as Hot Spots in the excel file by displaying a symbol and labeling the location. Hot Spots are bridges that have a single rating of 4 in any of the 4 ratings, or multiple ratings of 5 in the deck, substructure or superstructure ratings.

The Sufficiency Rating map will identify individual bridge locations that have a Sufficiency Rating less than 50 by displaying a symbol and labeling the location.

Scoring:

Performance Level	Bridge Index
Good	>6.5
Fair	5.0-6.5
Poor	<5.0

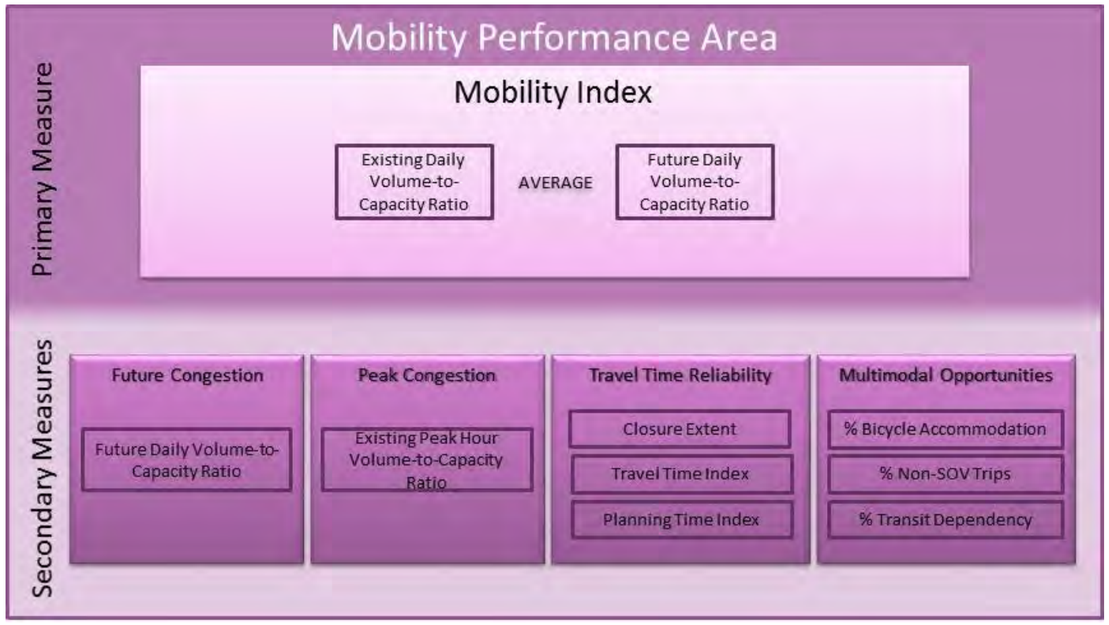
Performance Level	Sufficiency Rating
Good	>80
Fair	50-80
Poor	<50

Performance Level	Bridge Rating
Good	>6
Fair	5-6
Poor	<5

Performance Level	% Functionally Obsolete
Good	< 12%
Fair	12%-40%
Poor	>40%

Mobility Performance Area Calculation Methodologies

This section summarizes the approach for developing the primary and secondary performance measures in the Mobility Performance Area as shown in the following graphic.



Primary Measure

The primary Mobility Index is an average of the current volume to capacity (V/C) ratios and the projected future V/C ratios for each segment throughout the corridor.

Existing Daily V/C: The existing daily V/C ratio for each segment is calculated by dividing the 2014 Annual Average Daily Traffic (AADT) volume for each segment by the total Level of Service (LOS) E capacity volume for that segment

The capacity (C) is calculated using the HERS Procedures for Estimating Highway Capacity[1]. The HERS procedure incorporates HCM 2010 methodologies. The methodology includes capacity estimation procedures for multiple facility types including freeways, rural two-lane highways, multilane highways, and signalized and non-signalized urban sections.

The segment capacity is defined as a function of the number of mainline lanes, shoulder width, interrupted or uninterrupted flow facilities, terrain type, percent of truck traffic, and the designated urban or rural environment.

[1] HERS Support – 2011, Task 6: Procedures for Estimating Highway Capacity, draft Technical Memorandum. Cambridge Systematics. Prepared for the Federal Highway Administration. March 2013.

The AADT for each segment is calculated by applying a weighted average across the length of the segment based on the individual 24 hour volumes and distances associated with each HPMS count station within each segment.

The following example equation was used to determine the weighted average of a segment with two HPMS count locations within the corridor

((HPMS 1 Distance x HPMS 1 Volume) + (HPMS 2 Distance x HPMS 2 Volume))/Total Segment Length

For specific details regarding the HERS methodology used, refer to the *Procedures for Estimating Highway Capacity, draft Technical Memorandum.*

Future Daily V/C: The future V/C ratio for each segment is calculated by dividing the 2035 AADT volume for each segment by the 2013 LOS E capacity. The capacity volume used in this calculation is the same as was utilized in the current V/C equation.

The future AADT volumes are generated by applying an annual compound growth rate (ACGR) to each 2013 AADT segment volume. The following equation was used to apply an annual compound growth rate:

2035 AADT = 2013 AADT x ((1+ACGR)^22)

The ACGR for each segment was defined by comparing the total volumes in the 2010 Arizona Travel Demand Model (AZTDM2) to the 2035 AZTDM2 traffic volumes at each existing HPMS count station location throughout the corridor. Each 2010 and 2035 segment volume was defined using the same weighted average equation described in the *Current V/*C section above then summing the directional volumes for each location. The following equation was used to determine the ACGR for each segment:

ACGR = ((2035 Volume/2010 Volume)^(1/25))-1

Secondary Measures

Four secondary measures are evaluated:

- Peak Congestion
- Future Congestion
- Travel Time Reliability
  - Closure Extent
  - Directional Travel Time Index
  - Directional Planning Time Index
- Multimodal Opportunities
  - % Bicycle Accommodation
  - % Non-Single Occupancy Vehicle (SOV) Trips
  - % Transit Dependency

Peak Congestion: Peak Congestion has been defined as the peak hour V/C ratio in both directions of the corridor. The peak hour V/C ratio is calculated using the HERS method as described above. The Peak Hour volume utilizes the directional AADT for each segment which is calculated by applying a weighted average across the length of the segment based on the individual directional 24 hour volumes and distances associated with each HPMS count station within each segment. The segment capacity is defined based on the characteristics of each segment including Number of Lanes, Terrain Type, and Environment, similar to the 24 hour volumes using the HERS method.

The same thresholds identified for the 24hr V/C ratios were applied to the Peak Congestion V/C values.

Future Congestion: The future V/C ratios for each segment in the corridor that were calculated and used in the Primary Mobility Index as part of the overall average between Current V/C and Future V/C were applied independently as a secondary measure. The methods to calculate the Future V/C can be referenced in the Primary Mobility Index section.

Closure Extent: The number of times a roadway is closed is documented through the HCRS dataset. Closure Extent is defined as the average number of times a particular milepost of the corridor is closed per year per mile in a specific direction of travel. The weighted average of each occurrence takes into account the distance over which a specific occurrence spans.

Thresholds that determine levels of good, fair, and poor are based on the average number of closures per mile per year within each of the identified statewide significant corridors by ADOT. The thresholds shown at the end of this section represent statewide averages across those corridors.

Directional Travel Time and Planning Time Index: In terms of overall mobility, the TTI is the relationship of the mean peak period travel time in a specific section of the corridor to the free-flow travel time in the same location. The PTI is the relationship of the 95th percentile highest travel time to the free-flow travel time (based on the posted speed limit) in a specific section of the corridor. The TTI and PTI can be converted into speed-based indices by recognizing that speed is equal to distance traveled divided by travel time. The inverse relationship between travel time and speed means that the 95th percentile highest travel time corresponds to the 5th percentile lowest speed.

Using HERE data provided by ADOT, four time periods for each data point were collected throughout the day (AM peak, mid-day, PM peak, and off-peak). Using the mean speeds and 5th percentile lowest mean speeds collected over 2014 for these time periods for each data location, four TTI and PTI calculations were made using the following formulas:

TTI = Posted Speed Limit/Mean Peak Hour Speed

PTI = Posted Speed Limit/5th Percentile Lowest Speed

The highest value of the four time periods calculation is defined as the TTI for that data point. The average TTI is calculated within each segment based on the number of data points collected. The value of the average TTI across each entry is used as the TTI for each respective segment within the corridor.

Multimodal Opportunities: Three multimodal opportunity indicators reflect the characteristics of the corridor that promote alternate modes to a single occupancy vehicle (SOV) for trips along the corridor. The three indicators include the percent bicycle accommodation, non-SOV trips, and transit dependency along the corridor.

Percent Bicycle Accommodation: For this secondary performance evaluation, outside shoulder widths are evaluated considering the roadway's context and conditions. This requires use of the roadway data that includes right shoulder widths, shoulder surface types, and speed limits, all of which are available in the following ADOT geographic information system (GIS) data sets:

- Right Shoulder Widths
- Left Shoulder Widths (for undivided roadways)
- Shoulder Surface Type (Both Left/Right)
- Speed Limit

Additionally, each segment's average AADT, estimated earlier in the Mobility performance area methodology, is used for the criteria to determine if the existing shoulder width meets the effective width.

The criteria for screening if a shoulder segment meets the recommended width criteria are as followed:

(1) If AADT <= 1500 OR Speed Limit <= 25 miles per hour (mph):
The segment's general purpose lane can be shared with bicyclists (no effective shoulder width required)

(2) If AADT > 1500 AND Speed Limit between (25 - 50 mph) AND Pavement Surface is Paved:
Effective shoulder width required is 4 feet or greater

(3) If AADT > 1500 AND Speed Limit >= 50 mph and Pavement Surface is Paved:
Effective shoulder width required is 6 feet or greater

The summation of the length of the shoulder sections that meet the defined effective width criteria, based on criteria above, is divided by the segment's total length to estimate the percent of the segment that accommodates bicycles as illustrated at the end of this section. If shoulder data is not available or appears erroneous, field measurements can substitute for the shoulder data.

Percent Non-SOV Trips: The percentage of non-SOV trips over distances less than 50 miles gives an indication of travel patterns along a section of the corridor that could benefit from additional multimodal options in the future.

Thresholds that determine levels of good, fair, and poor are based on the percent non-SOV trips within each of the identified statewide significant corridors by ADOT. The thresholds shown at the end of this section represent statewide averages across those corridors.

Percent Transit Dependency: 2008-2012 U.S. Census American Community Survey tract and state level geographic data and attributes from the tables B08201 (Number of Vehicles Available by Household Size) and B17001 (Population in Poverty within the Last 12 Months) were downloaded with margins of error included from the Census data retrieval application Data Ferret. Population ranges for each tract were determined by adding and subtracting the margin of error to each estimate in excel. The tract level attribute data was then joined to geographic tract data in GIS. Only tracts within a one mile buffer of each corridor are considered for this evaluation.

Tracts that have a statistically significantly larger number of either people in poverty or households with only one or no vehicles available than the state average are considered potentially transit dependent.

Example: The state average for zero or one vehicles households (HHs) is between 44.1% and 45.0%. Tracts which have the lower bound of their range above the upper bound of the state range have a greater percentage of zero/one vehicle HHs than the state average. Tracts that have their upper bound beneath the lower bound of the state range have a lesser percentage of zero/one vehicles HHs than the state average. All other tracts that have one of their bounds overlapping with the state average cannot be considered statistically significantly different because there is a chance the value is actually the same.

In addition to transit dependency, the following attributes are added to the Multimodal Opportunities map based on available data.

- Shoulder width throughout the corridor based on 'Shoulder Width' GIS dataset provided by ADOT
- Intercity bus routes
- Multiuse paths within the corridor right-of-way, if applicable

Scoring:

Volume-to-Capacity Ratios		
Urban and Fringe Urban		
Good - LOS A-C	V/C ≤ 0.71	*Note - ADOT Roadway Design Standards indicate Urban and Fringe Urban roadways should be designed to level of service C or better
Fair - LOS D	V/C > 0.71 & ≤ 0.89	
Poor - LOS E or less	V/C > 0.89	
Rural		
Good - LOS A-B	V/C ≤ 0.56	*Note - ADOT Roadway Design Standards indicate Rural roadways should be designed to level of service B or better
Fair - LOS C	V/C > 0.56 & ≤ 0.76	
Poor - LOS D or less	V/C > 0.76	

Performance Level	Closure Extent
Good	≤ 0.22
Fair	> 0.22 & ≤ 0.62
Poor	V/C > 0.62

Performance Level	TTI on Uninterrupted Flow Facilities
Good	< 1.15
Fair	≥ 1.15 & < 1.33
Poor	≥ 1.33

Performance Level	TTI on Interrupted Flow Facilities
Good	< 1.30
Fair	≥ 1.30 & < 1.2.00
Poor	≥ 2.00

Performance Level	PTI on Uninterrupted Flow Facilities
Good	< 1.30
Fair	≥ 1.30 & < 1.50
Poor	≥ 1.50

Performance Level	PTI Interrupted Flow Facilities
Good	< 3.00
Fair	≥ 3.00 & < 6.00
Poor	≥ 6.00

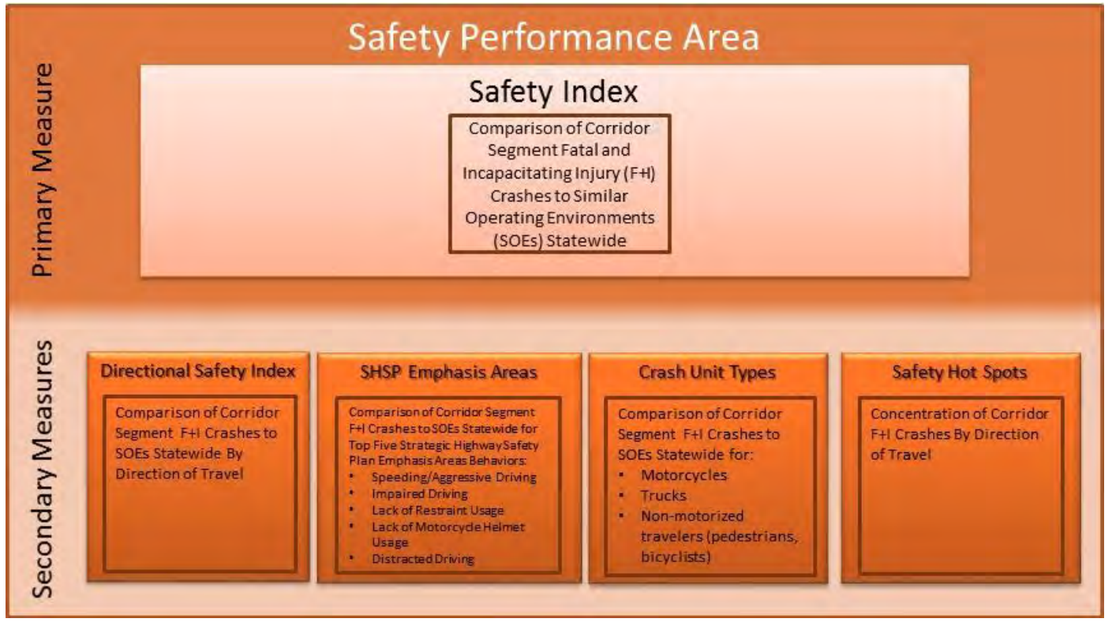
Performance Level	Percent Bicycle Accommodation
Good	≥ 90%
Fair	> 60% & ≤ 90%
Poor	< 60%

Performance Level	Percent Non-SOV Trips
Good	≥ 17%
Fair	> 11% & ≤ 17%
Poor	< 11%

Performance Level	Percent Transit Dependency
Good	Tracts with both zero and one vehicle household population in poverty percentages below the statewide average
Fair	Tracts with either zero and one vehicle household or population in poverty percentages below the statewide average
Poor	Tracts with both zero and one vehicle household and population in poverty percentages above the statewide average

Safety Performance Area Calculation Methodologies

This section summarizes the approach for developing the primary and secondary performance measures in the Safety Performance Area as shown in the following graphic.



Primary Measure

The Safety Index is a safety performance measure based on the bi-directional (i.e., both directions combined) 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).

The Combined Safety Score (CSS) is an interim measure that combines fatal and serious injury crashes into a single value. The CSS is calculated using the following generalized formula:

*CSS = 14.5 * (Normalized Fatal Crash Rate + Frequency) + (Normalized Incapacitating Injury Crash Rate + Frequency)*

Because crashes vary depending on the operating environment of a particular roadway, statewide CSS values were developed for similar operating environments defined by functional classification, urban vs. rural setting, number of travel lanes, and traffic volumes. To determine the Safety Index of a particular segment, the segment CSS was compared to the average statewide CSS for the similar statewide operating environment.

The Safety Index is calculated using the following formula:

Safety Index = Segment CSS / Statewide Similar Operating Environment CSS

The average annual Safety Index for a segment is compared to the statewide similar operating environment annual average, with one standard deviation from the statewide average forming the scale break points.

The more a particular segment's Safety Index value is below the statewide similar operating environment average, the better the safety performance is for that particular segment as a lower value represents fewer crashes.

The scale for rating the Safety Index depends on the operating environments selected, as shown in the table below.

Similar Operating Environment	Safety Index (Overall & Directional)	
	Lower Limit of Average*	Upper Limit of Average*
2 or 3 Lane Undivided Highway	0.94	1.06
2 or 3 or 4 Lane Divided Highway	0.77	1.23
4 or 5 Lane Undivided Highway	0.80	1.20
6 Lane Highway	0.56	1.44
Rural 4 Lane Freeway with Daily Volume < 25,000	0.73	1.27
Rural 4 Lane Freeway with Daily Volume > 25,000	0.68	1.32
Urban 4 Lane Freeway	0.79	1.21
Urban or Rural 6 Lane Freeway	0.82	1.18
Urban > 6 Lane Freeway	0.80	1.20

** Lower/upper limit of Average calculated as one standard deviation below/above the Mean*

Some corridor segments may have a very low number of total fatal and incapacitating injury crashes. Low crash frequencies (i.e., a small sample size) can translate into performance ratings that can be unstable. In some cases, a change in crash frequency of one crash (one additional crash or one less crash) could result in a change in segment performance of two levels. To avoid reliance on performance ratings where small changes in crash frequency result in large changes in performance, the following two criteria were developed to identify segments with "insufficient data" for assessing performance for the Safety Index. Both of these criteria must be met for a segment to have "insufficient data" to reliably rate the Safety Index performance:

- If the crash sample size (total fatal plus incapacitating injury crashes) for a given segment is less than five crashes over the five-year analysis period; AND
- If a change in one crash results in a change in segment performance by two levels (i.e., a change from below average to above average performance or a change from above average to below average frequency), the segment has "insufficient data" and Safety Index performance ratings are unreliable.

Secondary Measures

The Safety Performance Area has four secondary measures related to fatal and incapacitating injury crashes:

- Directional Safety Index
- Strategic Highway Safety Plan (SHSP) Behavior Emphasis Areas
- SHSP Crash Unit Type
- Safety Hot Spots

- Safety Hot Spots

Directional Safety Index: The Direction Safety Index shares the same calculation procedure and thresholds as the Safety Index. However, the measure is based on the directional frequency and rate of fatal and incapacitating injury crashes.

Similar to the Safety Index, the segment CSS is compared to the average statewide CSS for the similar statewide operating environment. The Directional Safety Index follows the lead of the Safety Index in terms of "insufficient data" status. If the Safety Index meets both criteria for "insufficient data", the Directional Safety Index should also be changed to "insufficient data". If the Safety Index does not meet both criteria for "insufficient data", the Directional Safety Index would also not change to say "insufficient data"

SHSP Behavior Emphasis Areas: ADOT's 2014 SHSP identifies several emphasis areas for reducing fatal and incapacitating injury crashes. The top five SHSP emphasis areas relate to the following driver behaviors:

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

To develop a performance measure that reflects these five emphasis areas, the percentage of total fatal and incapacitating injury crashes that involves at least one of the emphasis area driver behaviors on a particular segment is compared to the statewide average percentage of crashes involving at least one of the emphasis area driver behaviors on roads with similar operating environments in a process similar to how the Safety Index is developed.

To increase the crash sample size for this performance measure, the five behavior emphasis areas are combined to identify fatal and incapacitating injury crashes that exhibit one or more of the behavior emphasis areas.

The SHSP behavior emphasis areas performance is calculated using the following formula:

% Crashes Involving SHSP Behavior Emphasis Areas = Segment Crashes Involving SHSP Behavior Emphasis Areas / Total Segment Crashes

The percentage of total crashes involving SHSP behavior emphasis areas for a segment is compared to the statewide percentages on roads with similar operating environments. One standard deviation from the statewide average percentage forms the scale break points.

When assessing the performance of the SHSP behavior emphasis areas, the more the frequency of crashes involving SHSP behavior emphasis areas is below the statewide average implies better levels of segment performance. Thus, lower values are better, similar to the Safety Index.

Scoring:

The scale for rating the SHSP behavior emphasis areas performance depends on the crash history on similar statewide operating environments, as shown in the table below:

Similar Operating Environment	Crashes in SHSP Top 5 Emphasis Areas	
	Lower Limit of Average*	Upper Limit of Average*
2 or 3 Lane Undivided Highway	51.2%	57.5%
2 or 3 or 4 Lane Divided Highway	44.4%	54.4%
4 or 5 Lane Undivided Highway	42.4%	51.1%
6 Lane Highway	35.3%	46.5%
Rural 4 Lane Freeway with Daily Volume < 25,000	42.8%	52.9%
Rural 4 Lane Freeway with Daily Volume > 25,000	40.8%	57.1%
Urban 4 Lane Freeway	49.1%	59.4%
Urban or Rural 6 Lane Freeway	33.5%	57.2%
Urban > 6 Lane Freeway	42.6%	54.8%

** Lower/upper limit of Average calculated as one standard deviation below/above the Mean*

The SHSP behavior emphasis areas secondary safety performance measure for the Safety performance area includes proportions of specific types of crashes within the total fatal and incapacitating injury crash frequencies. This more detailed categorization of fatal and incapacitating injury crashes can result in low crash frequencies (i.e., a small sample size) that translate into performance ratings that can be unstable. In some cases, a change in crash frequency of one crash (one additional crash or one less crash) could result in a change in segment performance of two levels. To avoid reliance on performance ratings where small changes in crash frequency result in large changes in performance, the following criteria were developed to identify segments with "insufficient data" for assessing performance for the SHSP behavior emphasis areas secondary safety performance measure. If any of these criteria are met for a segment, that segment has "insufficient data" to reliably rate the SHSP behavior emphasis areas performance:

- If the crash sample size (total fatal plus incapacitating injury crashes) for a given segment is less than five crashes over the five-year analysis period, the segment has “insufficient data” and performance ratings are unreliable. OR
- If a change in one crash results in a change in segment performance by two levels (i.e., a change from below average to above average performance or a change from above average to below average frequency), the segment has “insufficient data” and performance ratings are unreliable. OR
- If the corridor average segment crash frequency for the SHSP behavior emphasis areas performance measure is less than two crashes over the five-year analysis period, the entire SHSP behavior emphasis areas performance measure has “insufficient data” and performance ratings are unreliable.

Crash Unit Type Emphasis Areas: ADOT’s SHSP also identifies emphasis areas that relate to the following “unit-involved” crashes:

- Heavy vehicle (trucks)-involved crashes
- Motorcycle-involved crashes
- Non-motorized traveler (pedestrians and bicyclists)-involved crashes

To develop a performance measure that reflects the aforementioned crash unit type emphasis areas, the percentage of total fatal and incapacitating injury crashes that involves a given crash unit type emphasis area on a particular segment is compared to the statewide average percentage of crashes involving that same crash unit type emphasis area on roads with similar operating environments in a process similar to how the Safety Index is developed.

The SHSP crash unit type emphasis areas performance is calculated using the following formula:

% Crashes Involving Crash Unit Type = Segment Crashes Involving Crash Unit Type / Total Segment Crashes

The percentage of total crashes involving crash unit types for a segment is compared to the statewide percentages on roads with similar operating environments. One standard deviation from the statewide average percentage forms the scale break points.

When assessing the performance of the crash unit types, the more the frequency of crashes involving crash unit types is below the statewide average implies better levels of segment performance. Thus, lower values are better, similar to the Safety Index. The scale for rating the unit-involved crash performance depends on the crash history on similar statewide operating environments, as shown in the following tables.

Scoring:

Similar Operating Environment	Crashes Involving Trucks	
	Lower Limit of Average*	Upper Limit of Average*
2 or 3 Lane Undivided Highway	5.2%	7.1%
2 or 3 or 4 Lane Divided Highway	3.5%	7.3%
4 or 5 Lane Undivided Highway	6.1%	9.6%
6 Lane Highway	0.3%	8.7%
Rural 4 Lane Freeway with Daily Volume < 25,000	13.2%	17.0%
Rural 4 Lane Freeway with Daily Volume > 25,000	7.2%	12.9%
Urban 4 Lane Freeway	6.8%	10.9%
Urban or Rural 6 Lane Freeway	6.2%	11.0%
Urban > 6 Lane Freeway	2.5%	6.0%

** Lower/upper limit of Average calculated as one standard deviation below/above the Mean*

Similar Operating Environment	Crashes Involving Motorcycles	
	Lower Limit of Average*	Upper Limit of Average*
2 or 3 Lane Undivided Highway	18.5%	26.5%
2 or 3 or 4 Lane Divided Highway	16.3%	26.3%
4 or 5 Lane Undivided Highway	6.4%	9.4%
6 Lane Highway	0.0%	20.0%
Rural 4 Lane Freeway with Daily Volume < 25,000	5.0%	8.5%
Rural 4 Lane Freeway with Daily Volume > 25,000	7.7%	17.1%
Urban 4 Lane Freeway	9.3%	11.5%
Urban or Rural 6 Lane Freeway	6.7%	12.9%
Urban > 6 Lane Freeway	12.6%	20.5%

** Lower/upper limit of Average calculated as one standard deviation below/above the Mean*

Similar Operating Environment	Crashes Involving Non-Motorized Travelers	
	Lower Limit of Average*	Upper Limit of Average*
2 or 3 Lane Undivided Highway	2.2%	4.2%
2 or 3 or 4 Lane Divided Highway	2.4%	4.5%
4 or 5 Lane Undivided Highway	4.7%	7.9%
6 Lane Highway	8.4%	17.4%
Rural 4 Lane Freeway with Daily Volume < 25,000	1.7%	2.5%
Rural 4 Lane Freeway with Daily Volume > 25,000	0.0%	0.0%
Urban 4 Lane Freeway	4.8%	10.3%
Urban or Rural 6 Lane Freeway	0.9%	6.7%
Urban > 6 Lane Freeway	0.5%	1.5%

** Lower/upper limit of Average calculated as one standard deviation below/above the Mean*

The crash unit types have the same "insufficient data" criteria as the SHSP behavior emphasis areas.

Safety Hot Spots: A hot spot analysis was conducted that identified abnormally high concentrations of fatal and incapacitating injury crashes along the study corridor by direction of travel. The identification of crash concentrations involves a GIS-based function known as "kernel density analysis". This measure is mapped for graphical display purposes with the Directional Safety Index but is not included in the Safety performance area rating calculations.

Freight Performance Area Calculation Methodologies

The section summarizes the approach for developing the primary and secondary performance measures in the Freight Performance Area as shown in the following graphic.



Primary Measure

The Freight Index is a reliability performance measure based on the planning time index for truck travel. The industry standard definition for the Truck Planning Time Index (TPTI) is the ratio of total travel time needed for 95% on-time arrival to free-flow 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.

The TPTI can be converted into a speed-based index by recognizing that speed is equal to distance traveled divided by travel time. The inverse relationship between travel time and speed means that the 95th percentile highest travel time corresponds to the 5th percentile lowest speed. The speed-based TPTI is calculated using the following formula:

TPTI = Free-Flow Truck Speed / Observed 5th Percentile Lowest Truck Speed

Observed 5th percentile lowest truck speeds are available in the 2014 American Digital Cartography, Inc. HERE (formerly NAVTEQ) database to which ADOT has access. The free-flow truck speed is assumed to be 65 miles per hour or the posted speed, whichever is less. This upper limit of 65 mph accounts for governors that trucks often have that restrict truck speeds to no more than 65 mph, even when the speed limit may be higher.

For each corridor segment, the TPTI is calculated for each direction of travel and then averaged to create a bi-directional TPTI. When assessing performance using TPTI, the higher the TPTI value is above 1.0, the more buffer time is needed to ensure on-time delivery.

The Freight Index can be calculated using the following formula to invert the overall TPTI:

Freight Index = 1 / Bi-directional TPTI

This inversion of the TPTI allows the Freight Index to have a scale where the higher the value, the better the performance, which is similar to the directionality of the scales of most of the other Primary Measures. This Freight Index scale is based on inverted versions of TPTI scales created previously by ADOT.

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 TTTI)
- Non-Recurring Delay (Directional TPTI)
- Closure Duration
- Bridge Vertical Clearance
- Bridge Vertical Clearance Hot Spots

Recurring Delay (Directional TTTI): The performance measure for recurring delay is the Directional Truck Travel Time Index (TTTI). The industry standard definition for TTTI is the ratio of average peak period travel time to free-flow travel time. The TTTI reflects the extra time spent in traffic during peak times due to recurring delay. Recurring delay refers to expected or normal delay due to roadway capacity constraints or traffic control devices.

Similar to the TPTI, the TTTI can be converted into a speed-based index by recognizing that speed is equal to distance traveled divided by travel time. The speed-based TTTI can be calculated using the following formula:

TTTI = Free-Flow Truck Speed / Observed Average Peak Period Truck Speed

Observed average peak period truck speeds are available in the 2014 American Digital Cartography, Inc. HERE (formerly NAVTEQ) database to which ADOT has access. The free-flow truck speed is assumed to be 65 mph or the posted speed, whichever is less.

For each corridor segment, the TTTI is calculated for each direction of travel. With the TTTI, the higher the TTTI value is above 1.0, the more time is spent in traffic during peak times. TTTI values are generally lower than TPTI values. The Directional TTTI scale is based on TTTI scales created previously by ADOT.

Non-Recurring Delay (Directional TPTI): The performance measure for non-recurring delay is the Directional TPTI. Directional TPTI is calculated as described previously as an interim step in the development of the Freight Index.

For each corridor segment, the TPTI is calculated for each direction of travel. With the TPTI, the higher the TPTI value is above 1.0, the more buffer time is needed to ensure on-time delivery.

Closure Duration: This performance measure related to road closures is average roadway closure (i.e., full lane closure) duration time in minutes. There are three main components to full closures that affect reliability – frequency, duration, and extent. In the freight industry, closure duration is the most important component because trucks want to minimize travel time and delay.

Data on the frequency, duration, and extent of full roadway closures on the ADOT State Highway System is available for 2010-2014 in the HCRS database that is managed and updated by ADOT.

The average closure duration in a segment – in terms of the average time a milepost is closed per mile per year on a given segment – is calculated using the following formula:

*Closure Duration = Sum of Segment (Closure Clearance Time * Closure Extent) / Segment Length*

The segment closure duration time in minutes can then be compared to statewide averages for closure duration in minutes, with one-half standard deviation from the average forming the scale break points. The scale for rating closure duration in minutes is found at the end of this section.

Bridge Vertical Clearance: This performance measure uses the vertical clearance information from the ADOT Bridge Database to identify locations with low vertical clearance. The minimum vertical clearance for all underpass structures (i.e., structures under which mainline traffic passes) is determined for each segment.

Bridge Vertical Clearance Hot Spots: This performance measure related to truck restrictions is the locations, or hot spots, where bridge vertical clearance issues restrict truck travel. Sixteen feet three inches (16.25') is the minimum standard vertical clearance value for state highway bridges over travel lanes.

Locations with lower vertical clearance values than the minimum standard are categorized by the ADOT Intermodal Transportation Department Engineering Permits Section as either locations where ramps exist that allow the restriction to be avoided or locations where ramps do not exist and the restriction cannot be avoided. The locations with vertical clearances below the minimum standard that cannot be ramped around are considered hot spots. This measure is mapped for graphical display purposes with the bridge vertical clearance map but is not included in the Freight performance area rating calculations.

Performance Level	Freight Index	
	Uninterrupted Flow Facilities	Interrupted Flow Facilities
Good	> 0.77	> 0.33
Fair	0.67 – 0.77	0.17 – 0.33
Poor	< 0.67	< 0.17

Performance Level	TTTI	
	Uninterrupted Flow Facilities	Interrupted Flow Facilities
Good	< 1.15	< 1.30
Fair	1.15 – 1.33	1.30 – 2.00
Poor	> 1.33	> 2.00

Performance Level	TPTI	
	Uninterrupted Flow Facilities	Interrupted Flow Facilities
Good	< 1.30	< 3.00
Fair	1.30 – 1.50	3.00 – 6.00
Poor	> 1.50	> 6.00

Performance Level	Closure Duration (minutes)
Good	< 44.18
Fair	44.18 – 124.86
Poor	> 124.86

Performance Level	Bridge Vertical Clearance
Good	> 16.5'
Fair	16.0' – 16.5'
Poor	< 16.0'

Appendix C: Performance Area Data

Pavement Performance Area Data

				Northbound			Southbound			NB		SB		Composite			% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	NB	SB	Pavement Index	NB	SB
Segment 1																		
Mile 1	215	to	216	4	47.51	0.1	4	57.82	0.1	4.17	-	4.01	-	4.17	4.01		0	0
Mile 2	216	to	217	5	38.16	0.1	5	43.91	0.1	4.33	-	4.23	-	4.33	4.23		0	0
Mile 3	217	to	218	4	33.17	0.1	4	42.89	0.1	4.41	-	4.25	-	4.41	4.25		0	0
Mile 4	218	to	219	4	39.49	0.1	4	49.63	0.1	4.30	-	4.14	-	4.30	4.14		0	0
Mile 5	219	to	220	4	42.10	0.1	4	47.61	0.1	4.26	-	4.17	-	4.26	4.17		0	0
Mile 6	220	to	221	4	43.80	0.1	4	49.94	0.1	4.23	-	4.14	-	4.23	4.14		0	0
Mile 7	221	to	222	4	62.00	0.1	4	58.76	0.1	3.95	-	4.00	-	3.95	4.00		0	0
			Total	29			29											0
			Weighted Average							4.24	0.00	4.14	0.00	4.24	4.14			
			Factor							1.00		1.00						
			Indicator Score							**4.24**		**4.14**						**0.0%**
			Pavement Index													**4.19**		
Segment 2																		
Mile 1	222	to	223	4	52.52	0.1	4	56.08	0.1	4.10	-	4.04	-	4.10	4.04		0	0
Mile 2	223	to	224	4	43.79	0.1	4	43.26	0.1	4.23	-	4.24	-	4.23	4.24		0	0
Mile 3	224	to	225	3	61.63	0.1	3	54.29	0.1	3.96	-	4.07	-	3.96	4.07		0	0
Mile 4	225	to	226	3	48.96	0.1	3	42.22	0.1	4.15	-	4.26	-	4.15	4.26		0	0
Mile 5	226	to	227	3	57.37	0.1	3	51.38	0.1	4.02	-	4.11	-	4.02	4.11		0	0
Mile 6	227	to	228	3	54.76	0.1	3	42.67	0.1	4.06	-	4.25	-	4.06	4.25		0	0
Mile 7	228	to	229	3	48.86	0.1	3	47.05	0.1	4.15	-	4.18	-	4.15	4.18		0	0
Mile 8	229	to	230	2	44.89	5	2	53.47	5	4.22	4.0	4.08	4.0	4.07	4.03		0	0
Mile 9	230	to	231	2	36.06	0	2	44.82	3	4.36	5.0	4.22	4.3	4.55	4.24		0	0
Mile 10	231	to	232	2	50.09	0	2	54.43	2	4.13	5.0	4.07	4.5	4.39	4.18		0	0
			Total	29			29											0
			Weighted Average							4.13	0.97	4.15	0.88	4.15	4.16			
			Factor							1.00		1.00						
			Indicator Score							**4.13**		**4.15**						**0.0%**
			Pavement Index													**4.16**		
Segment 3																		
Mile 1	232	to	233	2	64.09	0	2	62.37	3	3.92	5.0	3.94	4.3	4.24	4.05		0	0
Mile 2	233	to	234	2	71.69	9	2	51.96	6	3.81	3.5	4.10	3.9	3.61	3.94		0	0
Mile 3	234	to	235	2	72.37	9	2	64.53	5	3.80	3.5	3.91	4.0	3.61	3.94		0	0
Mile 4	235	to	236	2	77.24	5	2	78.43	5	3.73	4.0	3.71	4.0	3.81	3.80		0	0

		Northbound			Southbound			NB		SB		Composite		Pavement Index	% Pavement Failure	
		# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	NB	SB		NB	SB
Mile 5	236 to 237	2	58.01	20	2	81.14	8	4.01	2.5	3.67	3.6	2.51	3.65		2	0
Mile 6	237 to 238	2	56.89	4	2	67.09	10	4.03	4.1	3.87	3.4	4.06	3.56		0	0
Mile 7	238 to 239	2	66.30	1	2	86.40	15	3.89	4.7	3.60	2.9	4.12	2.94		0	0
Mile 8	239 to 240	2	66.37	4	2	82.24	1	3.89	4.1	3.66	4.7	3.96	3.96		0	0
Mile 9	240 to 241	2	53.50	5	2	51.55	1	4.08	4.0	4.11	4.7	4.03	4.27		0	0
Mile 10	241 to 242	2	48.17	4	2	54.13	4	4.16	4.1	4.07	4.1	4.15	4.09		0	0
Mile 11	242 to 243	2	53.94	3	2	55.03	1	4.07	4.3	4.06	4.7	4.14	4.24		0	0
Mile 12	243 to 244	2	69.08	6	2	75.10	4	3.85	3.9	3.76	4.1	3.85	3.87		0	0
Mile 13	244 to 245	2	77.66	3	2	79.21	5	3.72	4.3	3.70	4.0	3.89	3.79		0	0
	Total	26			26											2
	Weighted Average							3.92	4.01	3.86	4.03	3.84	3.85			
	Factor							1.00		1.00						
	Indicator Score							**3.92**		**3.86**						**3.8%**
	Pavement Index													**3.85**		
Segment 4																
Mile 1	245 to 246	2	82.31	0	2	36.56	0	3.66	5.0	4.35	5.0	4.06	4.55		0	0
Mile 2	246 to 247	2	70.11	0	2	41.39	0	3.83	5.0	4.27	5.0	4.18	4.49		0	0
Mile 3	247 to 248	2	81.83	0	2	38.76	0	3.66	5.0	4.32	5.0	4.06	4.52		0	0
Mile 4	248 to 249	2	83.79	0	2	37.40	0	3.64	5.0	4.34	5.0	4.05	4.54		0	0
Mile 5	249 to 250	2	82.60	0	2	37.35	0	3.65	5.0	4.34	5.0	4.06	4.54		0	0
Mile 6	250 to 251	2	95.71	0	2	42.87	0	3.48	5.0	4.25	5.0	3.93	4.47		0	0
Mile 7	251 to 252	2	86.84	2	2	43.21	0	3.59	4.5	4.24	5.0	3.85	4.47		0	0
Mile 8	252 to 253	2	81.24	0	2	66.87	0	3.67	5.0	3.88	5.0	4.07	4.21		0	0
	Total	16			16											0
	Weighted Average							3.65	4.93	4.25	5.00	4.03	4.47			
	Factor							1.00		1.00						
	Indicator Score							**3.65**		**4.25**						**0.0%**
	Pavement Index													**4.25**		
Segment 5																
Mile 1	253 to 254	2	62.38	2	2	64.61	6	3.94	4.5	3.91	3.9	4.10	3.89		0	0
Mile 2	254 to 255	2	55.99	1	2	82.61	6	4.04	4.7	3.65	3.9	4.23	3.72		0	0
Mile 3	255 to 256	2	46.23	2	2	72.34	6	4.19	4.5	3.80	3.9	4.27	3.82		0	0
Mile 4	256 to 257	2	59.68	4	2	56.95	0	3.99	4.1	4.03	5.0	4.03	4.32		0	0
Mile 5	257 to 258	2	53.74	0	2	48.89	0	4.08	5.0	4.15	5.0	4.35	4.41		0	0
Mile 6	258 to 259	2	48.46	0	2	53.04	0	4.16	5.0	4.09	5.0	4.41	4.36		0	0
Mile 7	259 to 260	2	65.82	0	2	55.15	0	3.89	5.0	4.05	5.0	4.23	4.34		0	0

		Northbound			Southbound			NB		SB		Composite			% Pavement Failure	
		# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	NB	SB	Pavement Index	NB	SB
Mile 8	260 to 261	2	46.07	0	2	45.91	0	4.20	5.0	4.20	5.0	4.44	4.44		0	0
Mile 9	261 to 262	2	47.97	0	2	48.81	0	4.17	5.0	4.15	5.0	4.42	4.41		0	0
Mile 10	262 to 263	2	42.48	0	2	50.29	0	4.25	5.0	4.13	5.0	4.48	4.39		0	0
	Total	20			20											0
	Weighted Average							4.09	4.77	4.02	4.66	4.30	4.21			
	Factor							1.00		1.00						
	Indicator Score							**4.09**		**4.02**						**0.0%**
	Pavement Index													**4.25**		
Segment 6																
Mile 1	263 to 264	2	48.56	0	2	51.86	0	4.16	5.0	4.11	5.0	4.41	4.37		0	0
Mile 2	264 to 265	2	51.93	0	2	50.88	0	4.10	5.0	4.12	5.0	4.37	4.38		0	0
Mile 3	265 to 266	2	58.70	0	2	62.20	0	4.00	5.0	3.95	5.0	4.30	4.26		0	0
Mile 4	266 to 267	2	41.21	0	2	47.37	0	4.28	5.0	4.18	5.0	4.49	4.42		0	0
Mile 5	267 to 268	2	42.86	0	2	70.02	0	4.25	5.0	3.83	5.0	4.47	4.18		0	0
Mile 6	268 to 269	2	53.39	4	2	64.60	0	4.08	4.1	3.91	5.0	4.10	4.24		0	0
Mile 7	269 to 270	2	60.49	0	2	55.68	1	3.97	5.0	4.05	4.7	4.28	4.23		0	0
Mile 8	270 to 271	2	61.54	0	2	65.30	1	3.96	5.0	3.90	4.7	4.27	4.13		0	0
Mile 9	271 to 272	2	60.07	0	2	54.76	3	3.98	5.0	4.06	4.3	4.29	4.13		0	0
Mile 10	272 to 273	2	46.31	5	2	55.49	2	4.19	4.0	4.05	4.5	4.06	4.17		0	0
Mile 11	273 to 274	2	55.74	1	2	53.77	1	4.05	4.7	4.08	4.7	4.23	4.25		0	0
Mile 12	274 to 275	2	52.04	4	2	52.03	0	4.10	4.1	4.10	5.0	4.11	4.37		0	0
Mile 13	275 to 276	2	48.15	1	2	57.77	0	4.16	4.7	4.01	5.0	4.31	4.31		0	0
Mile 14	276 to 277	2	70.26	0	2	59.13	4	3.83	5.0	3.99	4.1	4.18	4.04		0	0
Mile 15	277 to 278	2	55.11	1	2	63.88	0	4.06	4.7	3.92	5.0	4.24	4.25		0	0
Mile 16	278 to 279	2	52.12	2	2	54.24	2	4.10	4.5	4.07	4.5	4.21	4.18		0	0
	Total	32			32											0
	Weighted Average							4.08	4.73	4.02	4.77	4.27	4.25			
	Factor							1.00		1.00						
	Indicator Score							**4.08**		**4.02**						**0.0%**
	Pavement Index													**4.26**		
Segment 7																
Mile 1	279 to 280	2	46.99	2	2	71.18	2	4.18	4.5	3.82	4.5	4.26	4.01		0	0
Mile 2	280 to 281	2	82.52	0	2	71.30	1	3.65	5.0	3.81	4.7	4.06	4.07		0	0
Mile 3	281 to 282	2	123.62	6	2	119.96	6	3.13	3.9	3.17	3.9	3.13	3.17		2	2
Mile 4	282 to 283	2	66.04	0	2	35.94	4	3.89	5.0	4.36	4.1	4.22	4.21		0	0

				Northbound			Southbound			NB		SB		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	NB	SB		NB	SB
Mile 5	283	to	284	2	79.02	2	2	39.95	1	3.70	4.5	4.30	4.7	3.93	4.40		0	0
Mile 6	284	to	285	2	49.58	3	2	50.48	7	4.14	4.3	4.13	3.8	4.19	3.87		0	0
Mile 7	285	to	286	2	73.18	1	2	48.68	1	3.79	4.7	4.16	4.7	4.05	4.31		0	0
Mile 8	286	to	287	2	74.66	20	2	70.51	1	3.76	2.5	3.82	4.7	2.51	4.07		2	0
Mile 9	287	to	288	2	76.55	1	2	71.66	0	3.74	4.7	3.81	5.0	4.01	4.17		0	0
			Total	18			18											6
			Weighted Average							3.78	4.32	3.93	4.43	3.82	4.03			
			Factor							1.00		1.00						
			Indicator Score							**3.78**		**3.93**						**16.7%**
			Pavement Index													**3.92**		
Segment 8																		
Mile 1	288	to	289	2	85.28	0	2	47.52	2	3.62	5.0	4.17	4.5	4.03	4.26		0	0
Mile 2	289	to	290	2	124.55	5	2	53.49	0	3.11	4.0	4.08	5.0	3.11	4.36		2	0
Mile 3	290	to	291	2	88.31	0	2	48.25	1	3.57	5.0	4.16	4.7	4.00	4.31		0	0
Mile 4	291	to	292	2	54.04	0	2	43.32	1	4.07	5.0	4.24	4.7	4.35	4.37		0	0
Mile 5	292	to	293	2	51.26	0	2	48.98	0	4.11	5.0	4.15	5.0	4.38	4.41		0	0
Mile 6	293	to	294	2	51.11	0	2	71.39	0	4.12	5.0	3.81	5.0	4.38	4.17		0	0
Mile 7	294	to	295	2	38.99	0	2	40.33	0	4.31	5.0	4.29	5.0	4.52	4.50		0	0
Mile 8	295	to	296	2	40.47	0	2	44.76	0	4.29	5.0	4.22	5.0	4.50	4.45		0	0
Mile 9	296	to	297	2	36.31	0	2	40.17	0	4.36	5.0	4.29	5.0	4.55	4.50		0	0
Mile 10	297	to	298	2	39.79	0	2	32.43	0	4.30	5.0	4.42	5.0	4.51	4.59		0	0
Mile 11	298	to	299	2	41.82	0	2	56.29	0	4.27	5.0	4.04	5.0	4.49	4.33		0	0
			Total	22			22											2
			Weighted Average							4.01	4.91	4.17	4.89	4.26	4.39			
			Factor							1.00		1.00						
			Indicator Score							**4.01**		**4.17**						**4.5%**
			Pavement Index													**4.32**		
Segment 9																		
Mile 1	299	to	300	2	40.94	0	2	66.74	0	4.28	5.0	3.88	5.0	4.50	4.22		0	0
Mile 2	300	to	301	2	45.64	0	2	50.49	0	4.20	5.0	4.13	5.0	4.44	4.39		0	0
Mile 3	301	to	302	2	93.78	0	2	46.65	0	3.50	5.0	4.19	5.0	3.95	4.43		0	0
Mile 4	302	to	303	2	128.10	0	2	41.12	0	3.07	5.0	4.28	5.0	3.07	4.49		2	0
Mile 5	303	to	304	2	139.53	0	2	42.55	0	2.94	5.0	4.25	5.0	2.94	4.48		2	0
Mile 6	304	to	305	2	105.96	0	2	43.18	0	3.34	5.0	4.24	5.0	3.84	4.47		2	0
Mile 7	305	to	306	2	33.18	0	2	42.34	0	4.41	5.0	4.26	5.0	4.59	4.48		0	0
Mile 8	306	to	307	2	34.77	0	2	46.04	0	4.38	5.0	4.20	5.0	4.57	4.44		0	0

				Northbound			Southbound			NB		SB		Composite			% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	NB	SB	Pavement Index	NB	SB
			Total	16			16											6
			Weighted Average							3.77	5.00	4.18	5.00	3.99	4.42			
			Factor							1.00		1.00						
			Indicator Score							**3.77**		**4.18**						**18.8%**
			Pavement Index													**4.21**		
Segment 10																		
Mile 1	307	to	308	2	33.84	0	2	45.50	0	4.40	5.0	4.21	5.0	4.58	4.44		0	0
Mile 2	308	to	309	2	29.38	0	2	49.41	0	4.47	5.0	4.14	5.0	4.63	4.40		0	0
Mile 3	309	to	310	2	38.17	0	2	43.72	0	4.32	5.0	4.23	5.0	4.53	4.46		0	0
Mile 4	310	to	311	2	35.38	0	2	49.26	0	4.37	5.0	4.15	5.0	4.56	4.40		0	0
Mile 5	311	to	312	2	56.71	0	2	50.29	0	4.03	5.0	4.13	5.0	4.32	4.39		0	0
Mile 6	312	to	313	2	59.71	7	2	55.64	4	3.98	3.8	4.05	4.1	3.82	4.07		0	0
Mile 7	313	to	314	2	103.22	1	2	67.39	9	3.38	4.7	3.87	3.5	3.76	3.63		0	0
Mile 8	314	to	315	2	94.12	1	2	74.25	7	3.50	4.7	3.77	3.8	3.84	3.76		0	0
Mile 9	315	to	316	2	84.67	3	2	62.15	6	3.62	4.3	3.95	3.9	3.82	3.90		0	0
			Total	18			18											0
			Weighted Average							4.01	4.71	4.06	4.48	4.21	4.16			
			Factor							1.00		1.00						
			Indicator Score							**4.01**		**4.06**						**0.0%**
			Pavement Index													**4.19**		
Segment 11																		
Mile 1	316	to	317	2	106.23	4	2	73.32	3	3.34	4.1	3.78	4.3	3.58	3.94		2	0
Mile 2	317	to	318	2	94.80	9	2	80.32	5	3.49	3.5	3.68	4.0	3.50	3.78		0	0
Mile 3	318	to	319	2	54.08	4	2	84.47	9	4.07	4.1	3.63	3.5	4.09	3.56		0	0
Mile 4	319	to	320	2	77.80	9	2	72.64	9	3.72	3.5	3.79	3.5	3.59	3.61		0	0
Mile 5	320	to	321	2	122.17	6	2	60.15	7	3.14	3.9	3.98	3.8	3.14	3.82		2	0
Mile 6	321	to	322	2	114.02	2	2	54.60	6	3.24	4.5	4.06	3.9	3.61	3.93		2	0
Mile 7	322	to	323	2	95.97	0	2	69.38	1	3.47	5.0	3.84	4.7	3.93	4.09		0	0
			Total	14			14											6
			Weighted Average							3.50	4.09	3.82	3.95	3.63	3.82			
			Factor							1.00		1.00						
			Indicator Score							**3.50**		**3.82**						**21.4%**
			Pavement Index													**3.73**		
Segment 12																		
Mile 1	323	to	324	2	41.23	0	2	89.53	3	4.27	5.0	3.56	4.3	4.49	3.78		0	0

				Northbound			Southbound			NB		SB		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	NB	SB		NB	SB
Mile 2	324	to	325	2	48.75	0	2	69.43	9	4.15	5.0	3.84	3.5	4.41	3.62		0	0
Mile 3	325	to	326	2	102.62	9	2	64.72	7	3.39	3.5	3.91	3.8	3.43	3.80		0	0
Mile 4	326	to	327	2	113.36	6	2	51.71	7	3.25	3.9	4.11	3.8	3.44	3.86		2	0
Mile 5	327	to	328	2	75.59	2	2	75.26	8	3.75	4.5	3.76	3.6	3.96	3.67		0	0
Mile 6	328	to	329	2	113.81	7	2	85.87	7	3.24	3.8	3.61	3.8	3.40	3.65		2	0
Mile 7	329	to	330	2	105.93	5	2	73.96	5	3.34	4.0	3.77	4.0	3.54	3.84		2	0
Mile 8	330	to	331	2	86.69	5	2	62.47	8	3.60	4.0	3.94	3.6	3.72	3.73		0	0
Mile 9	331	to	332	2	102.54	5	2	55.51	8	3.39	4.0	4.05	3.6	3.57	3.76		0	0
Mile 10	332	to	333	2	123.06	4	2	65.08	6	3.13	4.1	3.90	3.9	3.13	3.88		2	0
Mile 11	333	to	334	2	116.65	6	2	50.78	5	3.21	3.9	4.12	4.0	3.41	4.04		2	0
Mile 12	334	to	335	2	101.07	4	2	74.00	3	3.41	4.1	3.77	4.3	3.63	3.93		0	0
Mile 13	335	to	336	2	95.39	3	2	83.49	4	3.48	4.3	3.64	4.1	3.72	3.79		0	0
Mile 14	336	to	337	2	96.06	0	2	62.06	7	3.47	5.0	3.95	3.8	3.93	3.81		0	0
Mile 15	337	to	338	2	94.26	4	2	55.30	5	3.49	4.1	4.05	4.0	3.69	4.02		0	0
Mile 16	338	to	339	2	97.07	25	2	71.48	3	3.46	2.1	3.81	4.3	2.11	3.95		2	0
Mile 17	339	to	340	3	107.00	7	3	108.81	0	3.33	3.8	3.31	5.0	3.46	3.81		3	3
			Total	35			35											18
			Weighted Average							3.49	4.05	3.82	3.99	3.59	3.82			
			Factor							1.00		1.00						
			Indicator Score							**3.49**		**3.82**						**25.7%**
			Pavement Index													**3.70**		

Bridge Performance Area Data

Structure Name (A209)	Structure # (N8)	Milepost (A232)	Area (A225)	Bridge Sufficiency	Bridge Index					Functionally Obsolete Bridges	Bridge Rating
				Sufficiency Rating	Deck (N58)	Super (N59)	Sub (N60)	Eval (N67)	Lowest	Deck Area on Func Obsolete	
Segment 1 215-222											
I-17 OP @ Frontage Rd (SB)	2180	215.00	11,976	93.54	7	7	7	7	7.0	0	
I-17 OP @ Frontage Rd (NB)	2181	215.00	12,264	93.54	7	7	7	7	7.0	0	
Rose Garden Ln TI UP	2136	215.48	25,071	79.79	7	7	7	7	7.0	0	
Deer Valley Rd TI OP	2222	215.97	39,374	96.00	8	8	7	7	7.0	0	
Pinnacle Peak TI UP	821	217.10	11,232	78.20	5	6	6	6	5.0	11,232	
Happy Valley TI UP	822	218.01	7,902	77.70	5	6	7	6	5.0	7,902	
Jomax RD TI UP	2872	218.91	31,428	99.39	8	8	8	8	8.0	0	
Skunk Creek Bridge	2706	219.11	45,229	90.74	7	7	7	7	7.0	0	
CAP Bridge	1400	220.38	13,000	85.00	6	8	8	8	6.0	0	
Dixileta Drive TI UP	2874	220.94	15,727	97.69	8	8	8	8	8.0	0	
Lone Mountain RD TI OP SB	2878	221.94	17,929	94.00	8	7	8	7	7.0	17,929	
Lone Mountain RD TI OP NB	2877	221.94	23,700	94.00	8	7	8	7	7.0	23,700	
Total			254,832								
Weighted Average				91.52					6.98	23.84%	
Factor				1.00					1.00	1.00	
Indicator Score				**91.52**						**23.84%**	**5**
Bridge Index									**6.98**		
Segment 2 222-232											
I17 SB Over Ramp EN	2876	222.07	29,614	94.85	8	8	7	7	7.0	0	
I17 NB Over Ramp EN	2875	222.11	33,896	94.81	8	8	7	7	7.0	0	
Sonoran Blvd TI UP	2314	222.97	42,050	88.75	7	8	8	8	7.0	0	
Carefree TI UP	2845	224.00	38,048	93.12	7	7	7	7	7.0	38,048	
Pioneer TI UP	1289	225.50	7,974	94.67	6	6	7	6	6.0	0	
Deadman Wash Br SB	304	226.95	8,190	88.98	6	6	6	6	6.0	0	
Deadman Wash Br NB	905	226.95	7,930	95.60	6	6	6	6	6.0	0	
Daisy Mtn Drive UP	2694	227.00	30,879	98.12	7	7	7	7	7.0	0	
Anthem Way TI UP	2537	229.00	31,284	87.02	7	8	7	7	7.0	0	
New River Bridge SB	1291	231.40	15,719	96.65	6	6	6	6	6.0	0	
New River Bridge NB	1290	231.40	15,719	90.27	6	6	6	6	6.0	0	
Total			261,303								
Weighted Average				92.73					6.79	14.56%	
Factor				1.00					1.00	1.00	
Indicator Score				**92.73**						**14.56%**	**6**
Bridge Index									**6.79**		
Segment 3 232-245											

Structure Name (A209)	Structure # (N8)	Milepost (A232)	Area (A225)	Bridge Sufficiency	Bridge Index					Functionally Obsolete Bridges	Bridge Rating
				Sufficiency Rating	Deck (N58)	Super (N59)	Sub (N60)	Eval (N67)	Lowest	Deck Area on Func Obsolete	
New River TI OP NB	1292	232.00	6,455	91.48	6	7	7	7	6.0	6,455	
New River TI OP SB	1293	232.00	5,887	91.48	7	6	7	7	6.0	5,887	
Table Mesa TI UP NB	1295	235.94	5,442	95.69	7	7	7	7	7.0	5,442	
Table Mesa TI UP SB	1294	235.94	5,104	95.87	7	6	7	6	6.0	5,104	
Moores Gulch Br NB	967	238.60	7,898	84.99	7	7	6	6	6.0	0	
Moores Gulch Br SB	339	238.60	6,230	68.41	5	5	7	5	5.0	6,230	
Lit Squaw Crk Br NB	968	239.20	11,214	81.31	5	7	7	7	5.0	0	
Little Squaw Crk Br SB	2965	239.55	13,550	90.12	9	9	9	9	9.0	0	
Rock Spring TI UP NB	969	242.15	4,643	97.23	7	7	7	7	7.0	0	
Rock Spring TI UP SB	970	242.15	4,643	97.23	7	7	7	7	7.0	0	
Mud Springs UP	863	242.98	7,459	89.25	6	7	6	6	6.0	0	
Agua Fria Rvr Br NB	1807	243.34	16,408	96.91	7	7	6	6	6.0	0	
Agua Fria Rvr Br SB	1808	243.34	16,408	96.95	7	8	6	6	6.0	0	
Coldwater Cyn TI OP SB	765	244.37	4,190	94.00	7	7	7	7	7.0	4,190	
Coldwater Cyn TI OP NB	764	244.37	4,190	94.00	7	7	7	7	7.0	4,190	
Total			119,721								
Weighted Average				91.10					6.39	31.32%	
Factor				1.00					1.00	1.00	
Indicator Score				**91.10**						**31.32%**	**5**
Bridge Index									**6.39**		
Segment 4	245-253										
Bumble Bee TI OP NB	1171	248.40	6,488	90.40	5	7	7	7	5.0	6,488	
Bumble Bee TI UP SB	1170	248.40	7,035	95.98	6	6	7	6	6.0	7,035	
Sunset Pt TI OP NB	1237	252.50	4,344	95.00	6	6	7	6	6.0	0	
Sunset Pt TI OP SB	1352	252.50	4,344	95.00	6	6	7	6	6.0	0	
Total			22,211								
Weighted Average				93.97					5.71	60.88%	
Factor				1.00					1.00	1.00	
Indicator Score				**93.97**						**60.88%**	**5**
Bridge Index									**5.71**		
Segment 5	253-263										
Badger Spgs TI OP SB	750	255.90	3,802	94.00	6	6	7	6	6.0	3,802	
Badger Spgs TI OP NB	749	256.05	3,888	94.00	6	6	7	6	6.0	3,888	
Bloody Basin TI OP NB	751	259.43	3,888	93.00	6	6	7	6	6.0	3,888	
Bloody Basin TI OP SB	752	259.43	3,888	94.00	6	6	7	6	6.0	3,888	
Big Bug Br NB	20027	262.05	29,433	96.95	7	8	8	8	7.0	0	
Big Bug Br SB	20028	262.05	17,163	96.95	8	8	7	7	7.0	0	
Ramp N-N Over I-17	2938	262.64	17,233	95.51	8	8	8	8	8.0	0	

Structure Name (A209)	Structure # (N8)	Milepost (A232)	Area (A225)	Bridge Sufficiency	Bridge Index					Functionally Obsolete Bridges	Bridge Rating
				Sufficiency Rating	Deck (N58)	Super (N59)	Sub (N60)	Eval (N67)	Lowest	Deck Area on Func Obsolete	
Cordes Lakes Rd UP	2941	262.68	12,345	97.92	8	8	8	8	8.0	0	
Total			91,640								
Weighted Average				96.27					7.15	16.88%	
Factor				1.00					1.00	1.00	
Indicator Score				**96.27**						**16.88%**	**6**
Bridge Index									**7.15**		
Segment 6 263-279											
Arcosanti Rd TI UP	2939	263.00	16,763	99.92	8	8	8	8	8.0	0	
Agua Fria Riv Br SB	766	265.34	10,486	97.29	6	7	6	6	6.0	0	
Agua Fria Riv Br NB	382	265.34	12,440	97.29	6	6	7	6	6.0	0	
Dugas Rd TI OP NB	753	268.75	3,888	94.00	6	6	7	6	6.0	3,888	
Dugas Rd TI OP SB	1080	268.75	3,888	94.00	6	6	7	6	6.0	3,888	
Ash Creek Br SB	389	269.11	11,150	87.44	6	6	7	5	5.0	0	
Ash Creek Br NB	754	269.11	9,849	89.70	6	6	7	6	6.0	0	
Cienega Cr Br SB	1353	277.93	5,668	97.31	7	7	7	7	7.0	0	
Cienega Creek Br NB	428	277.93	6,556	96.27	7	7	6	6	6.0	0	
SR 169 TI UP	1734	278.40	10,394	92.24	5	7	7	7	5.0	0	
Total			91,082								
Weighted Average				94.82					6.19	8.54%	
Factor				1.00					1.00	1.00	
Indicator Score				**94.82**						**8.54%**	**5**
Bridge Index									**6.19**		
Segment 7 279-288											
Gen Crook Trl TI OP NB	1663	285.47	6,467	97.00	6	7	7	7	6.0	0	
Gen Crook Trl TI OP SB	1662	285.47	9,367	97.00	6	7	7	7	6.0	0	
SR 260 TI UP	2575	287.27	28,046	78.83	7	8	8	8	7.0	0	
Verde River Br NB	1731	287.88	23,370	97.02	6	6	7	6	6.0	0	
Verde River Br SB	505	287.93	23,730	97.02	7	6	7	6	6.0	0	
Total			90,980								
Weighted Average				91.41					6.31	0.00%	
Factor				1.00					1.00	1.00	
Indicator Score				**91.41**						**0.00%**	**6**
Bridge Index									**6.31**		
Segment 8 288-299											
Arena Del Loma UP	1732	288.89	11,084	99.79	7	7	7	7	7.0	0	
Middle Verde TI UP	1733	289.97	12,722	98.17	6	7	7	7	6.0	0	
McGuireville TI UP	652	293.26	8,995	42.64	7	4	7	4	4.0	0	
Dry Beaver Crk Br NB	653	293.40	14,124	97.25	8	7	7	7	7.0	0	

Structure Name (A209)	Structure # (N8)	Milepost (A232)	Area (A225)	Bridge Sufficiency	Bridge Index					Functionally Obsolete Bridges	Bridge Rating
				Sufficiency Rating	Deck (N58)	Super (N59)	Sub (N60)	Eval (N67)	Lowest	Deck Area on Func Obsolete	
Dry Beaver Crk Br SB	654	293.40	11,770	97.25	8	7	7	6	6.0	0	
SR 179 TI OP SB	1061	298.96	4,601	82.00	5	5	7	5	5.0	4,601	
SR 179 TI OP NB	633	298.96	4,601	91.78	6	6	7	6	6.0	4,601	
Total			67,897								
Weighted Average				89.20					6.04	13.55%	
Factor				1.00					1.00	1.00	
Indicator Score				**89.20**						**13.55%**	**4**
Bridge Index									**6.04**		
Segment 9 299-307											
Stoneman Lk TI OP SB	1047	306.30	1,175	93.00	7	7	6	6	6.0	1,175	
Stoneman Lk TI OP NB	536	306.30	1,175	93.00	7	7	6	6	6.0	1,175	
Total			2,350								
Weighted Average				93.00					6.00	100.00%	
Factor				1.00					1.00	1.00	
Indicator Score				**93.00**						**100.00%**	**6**
Bridge Index									**6.00**		
Segment 10 307-316											
Rocky Park TI OP SB	1653	315.58	1,291	94.00	7	7	7	7	7.0	1,291	
Rocky Park TI OP NB	626	315.58	1,175	94.00	7	7	6	6	6.0	1,175	
Total			2,466								
Weighted Average				94.00					6.52	100.00%	
Factor				1.00					1.00	1.00	
Indicator Score				**94.00**						**100.00%**	**6**
Bridge Index									**6.52**		
Segment 11 316-323											
Woods Canyon Br SB	1654	317.01	8,482	97.36	7	7	7	7	7.0	0	
Woods Canyon Br NB	617	317.03	8,046	97.36	7	7	7	7	7.0	0	
Woods Canyon TI UP	1655	317.86	6,178	87.91	6	7	5	5	5.0	0	
Schnebly Rd TI OP SB	1054	320.50	1,175	94.00	7	7	7	7	7.0	1,175	
Schnebly Rd TI OP NB	627	320.50	1,175	94.00	7	7	7	7	7.0	1,175	
Munds Canyon Br SB	1656	322.00	14,406	97.40	7	7	7	7	7.0	0	
Munds Canyon Br NB	1657	322.01	17,082	97.40	7	7	7	7	7.0	0	
Munds Park TI OP SB	2937	322.72	6,221	98.00	7	8	8	8	7.0	0	
Munds Park TI OP NB	2936	322.72	6,240	97.40	8	8	8	8	8.0	0	
Total			69,005								
Weighted Average				96.48					6.91	3.41%	
Factor				1.00					1.00	1.00	
Indicator Score				**96.48**						**3.41%**	**5**

Structure Name (A209)	Structure # (N8)	Milepost (A232)	Area (A225)	Bridge Sufficiency	Bridge Index					Functionally Obsolete Bridges	Bridge Rating
				Sufficiency Rating	Deck (N58)	Super (N59)	Sub (N60)	Eval (N67)	Lowest	Deck Area on Func Obsolete	
Bridge Index									**6.91**		
Segment 12 323-340											
Willard SPR TI OP NB	1583	326.20	4,312	82.00	5	5	7	5	5.0	4,312	
Willard SPR TI OP SB	1584	326.20	4,323	94.00	6	6	7	6	6.0	4,323	
Newman Pk TI OP SB	1056	328.76	1,384	88.86	6	6	6	6	6.0	1,384	
Newman Pk TI OP NB	629	328.76	1,384	86.50	7	6	6	6	6.0	1,384	
Kelly Canyon TI UP	1585	331.20	6,406	98.98	6	6	6	6	6.0	0	
Kachina Blvd TI OP NB	2090	333.87	7,865	98.00	6	7	7	7	6.0	0	
Kachina Blvd TI OP SB	2091	333.87	7,865	98.00	6	7	7	7	6.0	0	
Airport Rd TI UP	632	337.39	7,280	74.33	6	5	5	5	5.0	7,280	
Lake Mary TI OP NB	2555	339.37	9,986	94.00	6	7	7	7	6.0	9,986	
Lake Mary TI OP SB	2556	339.37	7,885	94.00	6	7	7	7	6.0	7,885	
Total			58,690								
Weighted Average				92.00					5.80	62.28%	
Factor				1.00					1.00	1.00	
Indicator Score				**92.00**						**62.28%**	**5**
Bridge Index									**5.80**		

Mobility Performance Area Data

Segment	Begin MP	End MP	Length (mi)	Facility Type	Flow Type	Terrain	No. of Lanes	Capacity Environment Type	Lane Width (feet)	Posted Speed Limit (mph)	Divided or Undivided
17-1	215	222	7	Urban	Uninterrupted	Level	6.6	Freeway Segment	12.00	65	Divided
17-2	222	232	10	Fringe Urban	Uninterrupted	Level	5.4	Freeway Segment	12.00	75	Divided
17-3	232	245	13	Rural	Uninterrupted	Rolling	4	Freeway Segment	12.00	75	Divided
17-4	245	253	8	Rural	Uninterrupted	Mountainous	4	Freeway Segment	12.00	65	Divided
17-5	253	263	10	Rural	Uninterrupted	Mountainous	4	Freeway Segment	12.00	75	Divided
17-6	263	279	16	Rural	Uninterrupted	Rolling	4	Freeway Segment	12.00	75	Divided
17-7	279	288	9	Rural	Uninterrupted	Mountainous	4	Freeway Segment	12.00	65	Divided
17-8	288	299	11	Rural	Uninterrupted	Rolling	4	Freeway Segment	12.00	75	Divided
17-9	299	307	8	Rural	Uninterrupted	Mountainous	4	Freeway Segment	12.00	75	Divided
17-10	307	316	9	Rural	Uninterrupted	Mountainous	4	Freeway Segment	12.00	75	Divided
17-11	316	323	7	Rural	Uninterrupted	Rolling	4	Freeway Segment	12.00	75	Divided
17-12	323	340	17	Fringe Urban	Uninterrupted	Rolling	4	Freeway Segment	12.00	75	Divided

TTI and PTI – Southbound

Segment	TMC	Time Period	Week Type	Road Number	Road Dir	Cars Mean Speed	Trucks Mean Speed	Cars 5th Perct Speed	Trucks 5th Perct Speed	Assumed Car Free-Flow Speed	Assumed Truck Free-Flow Speed	Cars TTI	Cars PTI	Trucks TTI	Trucks PTI	Cars Peak TTI	Cars Peak PTI	Trucks Peak TTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Cars PTI	Segment Average Trucks TTI	Segment Average Trucks PTI
1	115N04122	1 AM Peak	Weekday	I-17	SB	66.3	60.7	63.0	58.0	65	65	1.00	1.03	1.07	1.12	1.00	1.03	1.07	1.12	1.00	1.03	1.05	1.09
	115N04122	2 Mid Day	Weekday	I-17	SB	65.7	60.9	63.0	58.0	65	65	1.00	1.03	1.07	1.12								
	115N04122	3 PM Peak	Weekday	I-17	SB	65.8	60.7	63.0	58.0	65	65	1.00	1.03	1.07	1.12								
	115N04122	4 Off Peak	Weekday	I-17	SB	66.0	61.1	63.0	58.0	65	65	1.00	1.03	1.06	1.12								
	115N04123	1 AM Peak	Weekday	I-17	SB	65.5	59.5	62.0	57.0	65	65	1.00	1.05	1.09	1.14	1.00	1.05	1.10	1.14				
	115N04123	2 Mid Day	Weekday	I-17	SB	65.5	59.6	62.0	57.0	65	65	1.00	1.05	1.09	1.14								
	115N04123	3 PM Peak	Weekday	I-17	SB	66.3	59.9	63.0	57.0	65	65	1.00	1.03	1.08	1.14								
	115N04123	4 Off Peak	Weekday	I-17	SB	66.0	59.3	63.0	57.0	65	65	1.00	1.03	1.10	1.14								
	115N04124	1 AM Peak	Weekday	I-17	SB	68.5	63.9	66.0	61.0	65	65	1.00	1.00	1.02	1.07	1.00	1.02	1.02	1.07				
	115N04124	2 Mid Day	Weekday	I-17	SB	67.8	63.5	65.0	61.0	65	65	1.00	1.00	1.02	1.07								
	115N04124	3 PM Peak	Weekday	I-17	SB	68.5	63.8	65.0	62.0	65	65	1.00	1.00	1.02	1.05								
	115N04124	4 Off Peak	Weekday	I-17	SB	67.5	64.0	64.0	61.0	65	65	1.00	1.02	1.02	1.07								
	115N11111	1 AM Peak	Weekday	I-17	SB	68.8	64.0	65.0	62.0	65	65	1.00	1.00	1.02	1.05	1.00	1.02	1.02	1.05				
	115N11111	2 Mid Day	Weekday	I-17	SB	68.2	63.8	65.0	62.0	65	65	1.00	1.00	1.02	1.05								
	115N11111	3 PM Peak	Weekday	I-17	SB	69.0	63.8	65.0	62.0	65	65	1.00	1.00	1.02	1.05								
	115N11111	4 Off Peak	Weekday	I-17	SB	67.7	63.9	64.0	62.0	65	65	1.00	1.02	1.02	1.05								
2	115N04125	1 AM Peak	Weekday	I-17	SB	69.5	64.4	65.0	62.0	65	65	1.00	1.00	1.01	1.05	1.00	1.00	1.01	1.05	1.05	1.11	1.01	1.05

Segment	TMC	Time Period	Week Type	Road Number	Road Dir	Cars Mean Speed	Trucks Mean Speed	Cars 5th Perct Speed	Trucks 5th Perct Speed	Assumed Car Free-Flow Speed	Assumed Truck Free-Flow Speed	Cars TTI	Cars PTI	Trucks TTI	Trucks PTI	Cars Peak TTI	Cars Peak PTI	Trucks Peak TTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Cars PTI	Segment Average Trucks TTI	Segment Average Trucks PTI
	115N04125	2 Mid Day	Weekday	I-17	SB	69.2	64.1	65.0	62.0	65	65	1.00	1.00	1.01	1.05								
	115N04125	3 PM Peak	Weekday	I-17	SB	70.4	64.3	66.0	62.0	65	65	1.00	1.00	1.01	1.05								
	115N04125	4 Off Peak	Weekday	I-17	SB	68.9	64.2	65.0	62.0	65	65	1.00	1.00	1.01	1.05								
	115N04663	1 AM Peak	Weekday	I-17	SB	71.0	64.7	66.0	63.0	75	65	1.06	1.14	1.00	1.03	1.07	1.15	1.01	1.05				
	115N04663	2 Mid Day	Weekday	I-17	SB	70.3	64.4	66.0	62.0	75	65	1.07	1.14	1.01	1.05								
	115N04663	3 PM Peak	Weekday	I-17	SB	71.6	64.6	67.0	63.0	75	65	1.05	1.12	1.01	1.03								
	115N04663	4 Off Peak	Weekday	I-17	SB	70.2	64.7	65.0	63.0	75	65	1.07	1.15	1.01	1.03								
	115N04664	1 AM Peak	Weekday	I-17	SB	71.0	64.8	67.0	63.0	75	65	1.06	1.12	1.00	1.03	1.06	1.14	1.01	1.05				
	115N04664	2 Mid Day	Weekday	I-17	SB	71.5	64.2	67.0	62.0	75	65	1.05	1.12	1.01	1.05								
	115N04664	3 PM Peak	Weekday	I-17	SB	72.2	64.5	68.0	62.0	75	65	1.04	1.10	1.01	1.05								
	115N04664	4 Off Peak	Weekday	I-17	SB	71.0	64.6	66.0	63.0	75	65	1.06	1.14	1.01	1.03								
	115N04665	1 AM Peak	Weekday	I-17	SB	71.5	64.4	67.0	62.0	75	65	1.05	1.12	1.01	1.05	1.06	1.14	1.01	1.05				
	115N04665	2 Mid Day	Weekday	I-17	SB	71.8	64.1	67.0	62.0	75	65	1.04	1.12	1.01	1.05								
	115N04665	3 PM Peak	Weekday	I-17	SB	72.3	64.2	68.0	62.0	75	65	1.04	1.10	1.01	1.05								
	115N04665	4 Off Peak	Weekday	I-17	SB	70.7	64.4	66.0	63.0	75	65	1.06	1.14	1.01	1.03								
	115N11119	1 AM Peak	Weekday	I-17	SB	71.3	64.1	67.0	63.0	75	65	1.05	1.12	1.01	1.03	1.06	1.14	1.02	1.05				
	115N11119	2 Mid Day	Weekday	I-17	SB	71.1	63.8	67.0	62.0	75	65	1.05	1.12	1.02	1.05								
	115N11119	3 PM Peak	Weekday	I-17	SB	72.2	63.8	68.0	62.0	75	65	1.04	1.10	1.02	1.05								
	115N11119	4 Off Peak	Weekday	I-17	SB	70.5	64.0	66.0	63.0	75	65	1.06	1.14	1.02	1.03								
3	115N04666	1 AM Peak	Weekday	I-17	SB	69.3	64.8	64.0	63.0	75	65	1.08	1.17	1.00	1.03	1.12	1.21	1.01	1.05	1.11	1.20	1.01	1.05
	115N04666	2 Mid Day	Weekday	I-17	SB	69.0	64.5	65.0	62.0	75	65	1.09	1.15	1.01	1.05								
	115N04666	3 PM Peak	Weekday	I-17	SB	68.9	64.7	65.0	63.0	75	65	1.09	1.15	1.00	1.03								
	115N04666	4 Off Peak	Weekday	I-17	SB	67.0	64.7	62.0	63.0	75	65	1.12	1.21	1.00	1.03								
	115N04667	1 AM Peak	Weekday	I-17	SB	71.4	64.5	65.0	63.0	75	65	1.05	1.15	1.01	1.03	1.08	1.15	1.01	1.05				
	115N04667	2 Mid Day	Weekday	I-17	SB	71.6	64.4	65.0	62.0	75	65	1.05	1.15	1.01	1.05								
	115N04667	3 PM Peak	Weekday	I-17	SB	71.3	64.5	65.0	63.0	75	65	1.05	1.15	1.01	1.03								
	115N04667	4 Off Peak	Weekday	I-17	SB	69.4	64.6	65.0	63.0	75	65	1.08	1.15	1.01	1.03								
	115N05087	1 AM Peak	Weekday	I-17	SB	71.6	64.7	68.0	63.0	75	65	1.05	1.10	1.01	1.03	1.07	1.19	1.01	1.03				
	115N05087	2 Mid Day	Weekday	I-17	SB	71.9	64.5	68.0	63.0	75	65	1.04	1.10	1.01	1.03								
	115N05087	3 PM Peak	Weekday	I-17	SB	71.7	64.6	68.0	63.0	75	65	1.05	1.10	1.01	1.03								
	115N05087	4 Off Peak	Weekday	I-17	SB	69.9	64.8	63.0	63.0	75	65	1.07	1.19	1.00	1.03								
	115N05088	1 AM Peak	Weekday	I-17	SB	70.1	66.0	65.0	63.0	75	65	1.07	1.15	1.00	1.03	1.11	1.19	1.00	1.03				
	115N05088	2 Mid Day	Weekday	I-17	SB	70.0	66.0	66.0	63.0	75	65	1.07	1.14	1.00	1.03								
	115N05088	3 PM Peak	Weekday	I-17	SB	70.0	66.1	66.0	63.0	75	65	1.07	1.14	1.00	1.03								
	115N05088	4 Off Peak	Weekday	I-17	SB	67.6	65.8	63.0	63.0	75	65	1.11	1.19	1.00	1.03								

Segment	TMC	Time Period	Week Type	Road Number	Road Dir	Cars Mean Speed	Trucks Mean Speed	Cars 5th Perct Speed	Trucks 5th Perct Speed	Assumed Car Free-Flow Speed	Assumed Truck Free-Flow Speed	Cars TTI	Cars PTI	Trucks TTI	Trucks PTI	Cars Peak TTI	Cars Peak PTI	Trucks Peak TTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Cars PTI	Segment Average Trucks TTI	Segment Average Trucks PTI
	115N05089	1 AM Peak	Weekday	I-17	SB	66.8	63.7	62.0	60.0	75	65	1.12	1.21	1.02	1.08	1.15	1.25	1.03	1.08				
	115N05089	2 Mid Day	Weekday	I-17	SB	67.2	63.7	63.0	60.0	75	65	1.12	1.19	1.02	1.08								
	115N05089	3 PM Peak	Weekday	I-17	SB	67.4	63.4	64.0	60.0	75	65	1.11	1.17	1.02	1.08								
	115N05089	4 Off Peak	Weekday	I-17	SB	65.0	63.2	60.0	60.0	75	65	1.15	1.25	1.03	1.08								
4	115N05090	1 AM Peak	Weekday	I-17	SB	66.3	60.3	61.0	57.0	65	65	1.00	1.07	1.08	1.14	1.00	1.08	1.08	1.14	1.00	1.07	1.08	1.18
	115N05090	2 Mid Day	Weekday	I-17	SB	66.5	60.3	62.0	57.0	65	65	1.00	1.05	1.08	1.14								
	115N05090	3 PM Peak	Weekday	I-17	SB	66.9	60.6	63.0	57.0	65	65	1.00	1.03	1.07	1.14								
	115N05090	4 Off Peak	Weekday	I-17	SB	64.8	60.1	60.0	57.0	65	65	1.00	1.08	1.08	1.14								
	115N05091	1 AM Peak	Weekday	I-17	SB	69.9	61.0	65.0	54.0	65	65	1.00	1.00	1.06	1.20	1.00	1.05	1.09	1.23				
	115N05091	2 Mid Day	Weekday	I-17	SB	69.1	60.0	64.0	53.0	65	65	1.00	1.02	1.08	1.23								
	115N05091	3 PM Peak	Weekday	I-17	SB	69.2	59.9	65.0	53.0	65	65	1.00	1.00	1.09	1.23								
	115N05091	4 Off Peak	Weekday	I-17	SB	67.5	60.2	62.0	53.0	65	65	1.00	1.05	1.08	1.23								
	115N05092	1 AM Peak	Weekday	I-17	SB	71.8	63.7	68.0	62.0	75	65	1.04	1.10	1.02	1.05	1.07	1.15	1.03	1.05				
	115N05092	2 Mid Day	Weekday	I-17	SB	71.3	63.7	67.0	62.0	75	65	1.05	1.12	1.02	1.05								
	115N05092	3 PM Peak	Weekday	I-17	SB	71.2	63.6	67.0	62.0	75	65	1.05	1.12	1.02	1.05								
	115N05092	4 Off Peak	Weekday	I-17	SB	70.2	63.3	65.0	62.0	75	65	1.07	1.15	1.03	1.05								
	115N05093	1 AM Peak	Weekday	I-17	SB	68.7	58.0	65.0	53.0	75	65	1.09	1.15	1.12	1.23	1.16	1.23	1.14	1.25				
5	115N05093	2 Mid Day	Weekday	I-17	SB	68.5	58.0	65.0	53.0	75	65	1.09	1.15	1.12	1.23					1.14	1.21	1.06	1.13
	115N05093	3 PM Peak	Weekday	I-17	SB	68.7	57.9	65.0	53.0	75	65	1.09	1.15	1.12	1.23								
	115N05093	4 Off Peak	Weekday	I-17	SB	64.6	57.2	61.0	52.0	75	65	1.16	1.23	1.14	1.25								
	115N05094	1 AM Peak	Weekday	I-17	SB	66.1	63.8	63.0	61.0	75	65	1.13	1.19	1.02	1.07	1.18	1.25	1.03	1.08				
	115N05094	2 Mid Day	Weekday	I-17	SB	67.4	63.6	63.0	61.0	75	65	1.11	1.19	1.02	1.07								
	115N05094	3 PM Peak	Weekday	I-17	SB	68.6	63.6	65.0	60.0	75	65	1.09	1.15	1.02	1.08								
	115N05094	4 Off Peak	Weekday	I-17	SB	63.5	63.4	60.0	60.0	75	65	1.18	1.25	1.03	1.08								
	115N05095	1 AM Peak	Weekday	I-17	SB	67.1	65.2	63.0	62.0	75	65	1.12	1.19	1.00	1.05	1.19	1.29	1.01	1.07				
	115N05095	2 Mid Day	Weekday	I-17	SB	70.1	65.1	66.0	61.0	75	65	1.07	1.14	1.00	1.07								
	115N05095	3 PM Peak	Weekday	I-17	SB	71.1	65.3	67.0	62.0	75	65	1.06	1.12	1.00	1.05								
	115N05095	4 Off Peak	Weekday	I-17	SB	63.0	64.5	58.0	61.0	75	65	1.19	1.29	1.01	1.07								
6	115N05096	1 AM Peak	Weekday	I-17	SB	53.3	40.8	44.0	29.0	75	65	1.41	1.70	1.59	2.24	1.56	2.08	1.60	2.24	1.38	1.69	1.30	1.65
	115N05096	2 Mid Day	Weekday	I-17	SB	56.6	42.4	49.0	30.0	75	65	1.32	1.53	1.53	2.17								
	115N05096	3 PM Peak	Weekday	I-17	SB	57.6	43.9	50.0	31.0	75	65	1.30	1.50	1.48	2.10								
	115N05096	4 Off Peak	Weekday	I-17	SB	48.0	40.7	36.0	29.0	75	65	1.56	2.08	1.60	2.24								
	115N05097	1 AM Peak	Weekday	I-17	SB	54.6	42.7	47.0	33.0	65	65	1.19	1.38	1.52	1.97	1.25	1.48	1.58	2.03				
7	115N05097	2 Mid Day	Weekday	I-17	SB	56.3	44.4	50.0	35.0	65	65	1.15	1.30	1.46	1.86					1.15	1.31	1.29	1.54
	115N05097	3 PM Peak	Weekday	I-17	SB	57.1	45.6	51.0	35.0	65	65	1.14	1.27	1.43	1.86								

Segment	TMC	Time Period	Week Type	Road Number	Road Dir	Cars Mean Speed	Trucks Mean Speed	Cars 5th Perct Speed	Trucks 5th Perct Speed	Assumed Car Free-Flow Speed	Assumed Truck Free-Flow Speed	Cars TTI	Cars PTI	Trucks TTI	Trucks PTI	Cars Peak TTI	Cars Peak PTI	Trucks Peak TTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Cars PTI	Segment Average Trucks TTI	Segment Average Trucks PTI
	115N05097	4 Off Peak	Weekday	I-17	SB	51.9	41.1	44.0	32.0	65	65	1.25	1.48	1.58	2.03								
	115N05098	1 AM Peak	Weekday	I-17	SB	64.3	64.9	59.0	63.0	65	65	1.01	1.10	1.00	1.03	1.04	1.14	1.00	1.05				
	115N05098	2 Mid Day	Weekday	I-17	SB	64.2	65.0	59.0	62.0	65	65	1.01	1.10	1.00	1.05								
	115N05098	3 PM Peak	Weekday	I-17	SB	64.9	65.0	60.0	62.0	65	65	1.00	1.08	1.00	1.05								
	115N05098	4 Off Peak	Weekday	I-17	SB	62.5	65.0	57.0	63.0	65	65	1.04	1.14	1.00	1.03								
8	115N05099	1 AM Peak	Weekday	I-17	SB	67.5	64.5	62.0	63.0	75	65	1.11	1.21	1.01	1.03	1.13	1.23	1.01	1.05	1.13	1.24	1.02	1.07
	115N05099	2 Mid Day	Weekday	I-17	SB	67.9	64.6	63.0	62.0	75	65	1.10	1.19	1.01	1.05								
	115N05099	3 PM Peak	Weekday	I-17	SB	68.7	64.6	64.0	63.0	75	65	1.09	1.17	1.01	1.03								
	115N05099	4 Off Peak	Weekday	I-17	SB	66.4	64.5	61.0	63.0	75	65	1.13	1.23	1.01	1.03								
	115N05100	1 AM Peak	Weekday	I-17	SB	67.6	65.3	62.0	63.0	75	65	1.11	1.21	1.00	1.03	1.12	1.21	1.00	1.03				
	115N05100	2 Mid Day	Weekday	I-17	SB	68.7	65.4	64.0	63.0	75	65	1.09	1.17	1.00	1.03								
	115N05100	3 PM Peak	Weekday	I-17	SB	69.9	65.6	65.0	63.0	75	65	1.07	1.15	1.00	1.03								
	115N05100	4 Off Peak	Weekday	I-17	SB	67.2	65.3	62.0	63.0	75	65	1.12	1.21	1.00	1.03								
	115N05101	1 AM Peak	Weekday	I-17	SB	67.1	61.6	62.0	59.0	75	65	1.12	1.21	1.05	1.10	1.14	1.27	1.06	1.12				
	115N05101	2 Mid Day	Weekday	I-17	SB	68.4	61.6	63.0	59.0	75	65	1.10	1.19	1.05	1.10								
	115N05101	3 PM Peak	Weekday	I-17	SB	69.5	61.5	65.0	58.0	75	65	1.08	1.15	1.06	1.12								
	115N05101	4 Off Peak	Weekday	I-17	SB	65.8	61.6	59.0	59.0	75	65	1.14	1.27	1.06	1.10								
9	115N05102	1 AM Peak	Weekday	I-17	SB	67.5	63.7	61.0	61.0	75	65	1.11	1.23	1.02	1.07	1.13	1.23	1.02	1.07	1.12	1.22	1.02	1.07
	115N05102	2 Mid Day	Weekday	I-17	SB	68.8	63.6	63.0	61.0	75	65	1.09	1.19	1.02	1.07								
	115N05102	3 PM Peak	Weekday	I-17	SB	69.9	63.6	65.0	61.0	75	65	1.07	1.15	1.02	1.07								
	115N05102	4 Off Peak	Weekday	I-17	SB	66.5	63.8	61.0	61.0	75	65	1.13	1.23	1.02	1.07								
	115N05103	1 AM Peak	Weekday	I-17	SB	68.3	63.4	63.0	61.0	75	65	1.10	1.19	1.02	1.07	1.12	1.21	1.02	1.07				
	115N05103	2 Mid Day	Weekday	I-17	SB	69.9	63.6	65.0	61.0	75	65	1.07	1.15	1.02	1.07								
	115N05103	3 PM Peak	Weekday	I-17	SB	70.8	63.7	66.0	62.0	75	65	1.06	1.14	1.02	1.05								
	115N05103	4 Off Peak	Weekday	I-17	SB	67.2	63.7	62.0	62.0	75	65	1.12	1.21	1.02	1.05								
10	115N05104	1 AM Peak	Weekday	I-17	SB	67.3	61.4	61.0	58.0	75	65	1.11	1.23	1.06	1.12	1.13	1.25	1.07	1.14	1.13	1.25	1.07	1.14
	115N05104	2 Mid Day	Weekday	I-17	SB	69.1	60.9	64.0	57.0	75	65	1.09	1.17	1.07	1.14								
	115N05104	3 PM Peak	Weekday	I-17	SB	69.9	61.0	65.0	57.0	75	65	1.07	1.15	1.07	1.14								
	115N05104	4 Off Peak	Weekday	I-17	SB	66.1	61.7	60.0	58.0	75	65	1.13	1.25	1.05	1.12								
11	115N05105	1 AM Peak	Weekday	I-17	SB	71.2	63.1	66.0	62.0	75	65	1.05	1.14	1.03	1.05	1.06	1.14	1.04	1.07	1.08	1.16	1.04	1.07
	115N05105	2 Mid Day	Weekday	I-17	SB	72.1	62.3	68.0	61.0	75	65	1.04	1.10	1.04	1.07								
	115N05105	3 PM Peak	Weekday	I-17	SB	73.0	63.1	69.0	62.0	75	65	1.03	1.09	1.03	1.05								
	115N05105	4 Off Peak	Weekday	I-17	SB	70.4	64.1	66.0	62.0	75	65	1.06	1.14	1.01	1.05								
	115N05106	1 AM Peak	Weekday	I-17	SB	68.5	62.7	63.0	60.0	75	65	1.09	1.19	1.04	1.08	1.10	1.19	1.04	1.08				
	115N05106	2 Mid Day	Weekday	I-17	SB	69.4	62.6	64.0	60.0	75	65	1.08	1.17	1.04	1.08								

Segment	TMC	Time Period	Week Type	Road Number	Road Dir	Cars Mean Speed	Trucks Mean Speed	Cars 5th Perct Speed	Trucks 5th Perct Speed	Assumed Car Free-Flow Speed	Assumed Truck Free-Flow Speed	Cars TTI	Cars PTI	Trucks TTI	Trucks PTI	Cars Peak TTI	Cars Peak PTI	Trucks Peak TTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Cars PTI	Segment Average Trucks TTI	Segment Average Trucks PTI
	115N05106	3 PM Peak	Weekday	I-17	SB	70.6	63.0	66.0	61.0	75	65	1.06	1.14	1.03	1.07								
	115N05106	4 Off Peak	Weekday	I-17	SB	67.9	63.0	63.0	62.0	75	65	1.10	1.19	1.03	1.05								
12	115N05107	1 AM Peak	Weekday	I-17	SB	67.7	63.7	63.0	62.0	75	65	1.11	1.19	1.02	1.05	1.11	1.19	1.02	1.05	1.05	1.11	1.04	1.10
	115N05107	2 Mid Day	Weekday	I-17	SB	68.6	63.9	64.0	62.0	75	65	1.09	1.17	1.02	1.05								
	115N05107	3 PM Peak	Weekday	I-17	SB	69.7	64.0	65.0	62.0	75	65	1.08	1.15	1.02	1.05								
	115N05107	4 Off Peak	Weekday	I-17	SB	68.1	63.6	64.0	62.0	75	65	1.10	1.17	1.02	1.05								
	115N05108	1 AM Peak	Weekday	I-17	SB	70.2	63.1	66.0	61.0	75	65	1.07	1.14	1.03	1.07	1.07	1.14	1.03	1.07				
	115N05108	2 Mid Day	Weekday	I-17	SB	71.2	63.6	66.0	62.0	75	65	1.05	1.14	1.02	1.05								
	115N05108	3 PM Peak	Weekday	I-17	SB	72.4	63.9	68.0	62.0	75	65	1.04	1.10	1.02	1.05								
	115N05108	4 Off Peak	Weekday	I-17	SB	69.8	63.1	66.0	61.0	75	65	1.07	1.14	1.03	1.07								
	115N05109	1 AM Peak	Weekday	I-17	SB	70.5	64.8	66.0	60.0	75	65	1.06	1.14	1.00	1.08	1.08	1.15	1.00	1.08				
	115N05109	2 Mid Day	Weekday	I-17	SB	71.2	65.4	67.0	62.0	75	65	1.05	1.12	1.00	1.05								
	115N05109	3 PM Peak	Weekday	I-17	SB	71.9	65.7	68.0	62.0	75	65	1.04	1.10	1.00	1.05								
	115N05109	4 Off Peak	Weekday	I-17	SB	69.6	64.8	65.0	61.0	75	65	1.08	1.15	1.00	1.07								
	115N05110	1 AM Peak	Weekday	I-17	SB	69.3	58.6	64.0	53.0	75	65	1.08	1.17	1.11	1.23	1.10	1.17	1.11	1.23				
	115N05110	2 Mid Day	Weekday	I-17	SB	70.3	58.8	66.0	54.0	75	65	1.07	1.14	1.11	1.20								
	115N05110	3 PM Peak	Weekday	I-17	SB	71.4	59.6	67.0	55.0	75	65	1.05	1.12	1.09	1.18								
	115N05110	4 Off Peak	Weekday	I-17	SB	68.4	59.0	64.0	54.0	75	65	1.10	1.17	1.10	1.20								
	115N05111	1 AM Peak	Weekday	I-17	SB	68.3	64.4	63.0	61.0	65	65	1.00	1.03	1.01	1.07	1.00	1.03	1.01	1.07				
	115N05111	2 Mid Day	Weekday	I-17	SB	69.6	65.0	65.0	62.0	65	65	1.00	1.00	1.00	1.05								
	115N05111	3 PM Peak	Weekday	I-17	SB	70.2	65.5	66.0	62.0	65	65	1.00	1.00	1.00	1.05								
	115N05111	4 Off Peak	Weekday	I-17	SB	67.8	64.4	63.0	61.0	65	65	1.00	1.03	1.01	1.07								
	115N05112	1 AM Peak	Weekday	I-17	SB	67.6	59.4	64.0	55.0	65	65	1.00	1.02	1.09	1.18	1.00	1.02	1.09	1.18				
	115N05112	2 Mid Day	Weekday	I-17	SB	68.5	59.6	65.0	55.0	65	65	1.00	1.00	1.09	1.18								
	115N05112	3 PM Peak	Weekday	I-17	SB	69.0	59.8	65.0	56.0	65	65	1.00	1.00	1.09	1.16								
	115N05112	4 Off Peak	Weekday	I-17	SB	67.2	59.4	64.0	55.0	65	65	1.00	1.02	1.09	1.18								
	115N05113	1 AM Peak	Weekday	I-17	SB	64.8	65.7	61.0	63.0	65	65	1.00	1.07	1.00	1.03	1.01	1.07	1.00	1.03				
	115N05113	2 Mid Day	Weekday	I-17	SB	65.3	66.1	62.0	63.0	65	65	1.00	1.05	1.00	1.03								
	115N05113	3 PM Peak	Weekday	I-17	SB	65.5	66.2	63.0	63.0	65	65	1.00	1.03	1.00	1.03								
	115N05113	4 Off Peak	Weekday	I-17	SB	64.4	65.5	61.0	63.0	65	65	1.01	1.07	1.00	1.03								

TTI and PTI – Northbound

Segment	TMC	Time Period	Week Type	Road Number	Road Direction	Cars Mean Speed	Trucks Mean Speed	Cars 5th Perct Speed	Trucks 5th Perct Speed	Assumed Car Free-Flow Speed	Assumed Truck Free-Flow Speed	Cars TTI	Cars PTI	Trucks TTI	Trucks PTI	Cars Peak TTI	Cars Peak PTI	Trucks Peak TTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Cars PTI	Segment Average Trucks TTI	Segment Average Trucks PTI
1	115P04122	1 AM Peak	Weekday	I-17	NB	66.5	63.4	64.0	61.0	65	65	1.00	1.02	1.03	1.07	1.00	1.02	1.03	1.07	1.00	1.03	1.02	1.05
	115P04122	2 Mid Day	Weekday	I-17	NB	66.9	63.8	64.0	61.0	65	65	1.00	1.02	1.02	1.07								
	115P04122	3 PM Peak	Weekday	I-17	NB	66.7	63.9	64.0	62.0	65	65	1.00	1.02	1.02	1.05								
	115P04122	4 Off Peak	Weekday	I-17	NB	66.6	63.4	64.0	62.0	65	65	1.00	1.02	1.02	1.05								
	115P04123	1 AM Peak	Weekday	I-17	NB	66.1	63.6	63.0	62.0	65	65	1.00	1.03	1.02	1.05	1.00	1.05	1.02	1.05				
	115P04123	2 Mid Day	Weekday	I-17	NB	67.1	64.2	63.0	62.0	65	65	1.00	1.03	1.01	1.05								
	115P04123	3 PM Peak	Weekday	I-17	NB	65.6	64.3	62.0	62.0	65	65	1.00	1.05	1.01	1.05								
	115P04123	4 Off Peak	Weekday	I-17	NB	66.1	63.7	62.0	62.0	65	65	1.00	1.05	1.02	1.05								
	115P04124	1 AM Peak	Weekday	I-17	NB	66.3	63.8	63.0	62.0	65	65	1.00	1.03	1.02	1.05	1.00	1.03	1.02	1.05				
	115P04124	2 Mid Day	Weekday	I-17	NB	67.1	64.4	63.0	62.0	65	65	1.00	1.03	1.01	1.05								
	115P04124	3 PM Peak	Weekday	I-17	NB	66.0	64.4	63.0	63.0	65	65	1.00	1.03	1.01	1.03								
	115P04124	4 Off Peak	Weekday	I-17	NB	66.3	63.7	63.0	62.0	65	65	1.00	1.03	1.02	1.05								
	115P11111	1 AM Peak	Weekday	I-17	NB	66.9	63.9	64.0	62.0	65	65	1.00	1.02	1.02	1.05	1.00	1.02	1.02	1.05				
	115P11111	2 Mid Day	Weekday	I-17	NB	67.8	64.2	65.0	62.0	65	65	1.00	1.00	1.01	1.05								
	115P11111	3 PM Peak	Weekday	I-17	NB	67.7	64.4	65.0	62.0	65	65	1.00	1.00	1.01	1.05								
	115P11111	4 Off Peak	Weekday	I-17	NB	66.9	63.8	64.0	62.0	65	65	1.00	1.02	1.02	1.05								
2	115P04125	1 AM Peak	Weekday	I-17	NB	67.0	61.9	64.0	59.0	65	65	1.00	1.02	1.05	1.10	1.00	1.02	1.05	1.10	1.08	1.15	1.04	1.07
	115P04125	2 Mid Day	Weekday	I-17	NB	67.7	62.4	64.0	60.0	65	65	1.00	1.02	1.04	1.08								
	115P04125	3 PM Peak	Weekday	I-17	NB	67.6	62.6	64.0	61.0	65	65	1.00	1.02	1.04	1.07								
	115P04125	4 Off Peak	Weekday	I-17	NB	66.9	62.1	64.0	60.0	65	65	1.00	1.02	1.05	1.08								
	115P04663	1 AM Peak	Weekday	I-17	NB	68.3	62.9	64.0	62.0	75	65	1.10	1.17	1.03	1.05	1.11	1.19	1.03	1.05				
	115P04663	2 Mid Day	Weekday	I-17	NB	69.1	63.0	65.0	62.0	75	65	1.09	1.15	1.03	1.05								
	115P04663	3 PM Peak	Weekday	I-17	NB	69.1	63.1	65.0	62.0	75	65	1.09	1.15	1.03	1.05								
	115P04663	4 Off Peak	Weekday	I-17	NB	67.9	63.0	63.0	62.0	75	65	1.11	1.19	1.03	1.05								
	115P04664	1 AM Peak	Weekday	I-17	NB	69.1	63.6	64.0	62.0	75	65	1.08	1.17	1.02	1.05	1.10	1.19	1.03	1.05				
	115P04664	2 Mid Day	Weekday	I-17	NB	69.7	63.9	66.0	62.0	75	65	1.08	1.14	1.02	1.05								
	115P04664	3 PM Peak	Weekday	I-17	NB	69.7	64.0	66.0	62.0	75	65	1.08	1.14	1.02	1.05								
	115P04664	4 Off Peak	Weekday	I-17	NB	68.2	63.3	63.0	62.0	75	65	1.10	1.19	1.03	1.05								
	115P04665	1 AM Peak	Weekday	I-17	NB	69.4	63.7	65.0	61.0	75	65	1.08	1.15	1.02	1.07	1.10	1.19	1.03	1.07				
	115P04665	2 Mid Day	Weekday	I-17	NB	70.0	63.5	66.0	61.0	75	65	1.07	1.14	1.02	1.07								
	115P04665	3 PM Peak	Weekday	I-17	NB	69.8	63.6	65.0	61.0	75	65	1.08	1.15	1.02	1.07								
	115P04665	4 Off Peak	Weekday	I-17	NB	68.4	63.0	63.0	61.0	75	65	1.10	1.19	1.03	1.07								
	115P11119	1 AM Peak	Weekday	I-17	NB	70.1	63.0	66.0	62.0	75	65	1.07	1.14	1.03	1.05	1.08	1.17	1.04	1.07				

Segment	TMC	Time Period	Week Type	Road Number	Road Direction	Cars Mean Speed	Trucks Mean Speed	Cars 5th Perct Speed	Trucks 5th Perct Speed	Assumed Car Free-Flow Speed	Assumed Truck Free-Flow Speed	Cars TTI	Cars PTI	Trucks TTI	Trucks PTI	Cars Peak TTI	Cars Peak PTI	Trucks Peak TTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Cars PTI	Segment Average Trucks TTI	Segment Average Trucks PTI
	115P11119	2 Mid Day	Weekday	I-17	NB	70.9	62.4	67.0	62.0	75	65	1.06	1.12	1.04	1.05								
	115P11119	3 PM Peak	Weekday	I-17	NB	71.2	62.4	67.0	61.0	75	65	1.05	1.12	1.04	1.07								
	115P11119	4 Off Peak	Weekday	I-17	NB	69.7	62.9	64.0	61.0	75	65	1.08	1.17	1.03	1.07								
3	115P04666	1 AM Peak	Weekday	I-17	NB	69.7	62.7	66.0	61.0	75	65	1.08	1.14	1.04	1.07	1.10	1.19	1.04	1.07	1.09	1.17	1.01	1.05
	115P04666	2 Mid Day	Weekday	I-17	NB	69.8	62.8	66.0	62.0	75	65	1.07	1.14	1.03	1.05								
	115P04666	3 PM Peak	Weekday	I-17	NB	70.3	62.8	66.0	61.0	75	65	1.07	1.14	1.04	1.07								
	115P04666	4 Off Peak	Weekday	I-17	NB	68.4	62.8	63.0	62.0	75	65	1.10	1.19	1.04	1.05								
	115P04667	1 AM Peak	Weekday	I-17	NB	70.9	64.2	67.0	63.0	75	65	1.06	1.12	1.01	1.03	1.08	1.15	1.01	1.05				
	115P04667	2 Mid Day	Weekday	I-17	NB	70.9	64.4	67.0	63.0	75	65	1.06	1.12	1.01	1.03								
	115P04667	3 PM Peak	Weekday	I-17	NB	71.4	64.2	67.0	62.0	75	65	1.05	1.12	1.01	1.05								
	115P04667	4 Off Peak	Weekday	I-17	NB	69.5	64.2	65.0	63.0	75	65	1.08	1.15	1.01	1.03								
	115P05087	1 AM Peak	Weekday	I-17	NB	69.4	66.0	66.0	63.0	75	65	1.08	1.14	1.00	1.03	1.08	1.14	1.00	1.03				
	115P05087	2 Mid Day	Weekday	I-17	NB	70.3	66.1	66.0	63.0	75	65	1.07	1.14	1.00	1.03								
	115P05087	3 PM Peak	Weekday	I-17	NB	71.1	65.8	66.0	63.0	75	65	1.06	1.14	1.00	1.03								
	115P05087	4 Off Peak	Weekday	I-17	NB	69.4	66.1	66.0	63.0	75	65	1.08	1.14	1.00	1.03								
	115P05088	1 AM Peak	Weekday	I-17	NB	71.0	64.7	66.0	63.0	75	65	1.06	1.14	1.00	1.03	1.07	1.17	1.01	1.05				
	115P05088	2 Mid Day	Weekday	I-17	NB	71.9	64.4	66.0	63.0	75	65	1.04	1.14	1.01	1.03								
	115P05088	3 PM Peak	Weekday	I-17	NB	72.1	64.4	66.0	62.0	75	65	1.04	1.14	1.01	1.05								
	115P05088	4 Off Peak	Weekday	I-17	NB	69.9	64.7	64.0	63.0	75	65	1.07	1.17	1.00	1.03								
	115P05089	1 AM Peak	Weekday	I-17	NB	69.8	64.8	65.0	63.0	75	65	1.07	1.15	1.00	1.03	1.11	1.19	1.01	1.05				
	115P05089	2 Mid Day	Weekday	I-17	NB	70.3	64.4	66.0	63.0	75	65	1.07	1.14	1.01	1.03								
	115P05089	3 PM Peak	Weekday	I-17	NB	70.5	64.1	66.0	62.0	75	65	1.06	1.14	1.01	1.05								
	115P05089	4 Off Peak	Weekday	I-17	NB	67.5	64.7	63.0	63.0	75	65	1.11	1.19	1.01	1.03								
4	115P05090	1 AM Peak	Weekday	I-17	NB	59.2	49.1	51.0	37.0	65	65	1.10	1.27	1.32	1.76	1.27	1.71	1.45	2.03	1.21	1.61	1.40	1.97
	115P05090	2 Mid Day	Weekday	I-17	NB	58.5	47.3	49.0	36.0	65	65	1.11	1.33	1.37	1.81								
	115P05090	3 PM Peak	Weekday	I-17	NB	58.1	44.8	48.0	32.0	65	65	1.12	1.35	1.45	2.03								
	115P05090	4 Off Peak	Weekday	I-17	NB	51.3	46.6	38.0	33.0	65	65	1.27	1.71	1.39	1.97								
	115P05091	1 AM Peak	Weekday	I-17	NB	61.9	52.6	54.0	40.0	65	65	1.05	1.20	1.24	1.63	1.16	1.51	1.36	1.91				
	115P05091	2 Mid Day	Weekday	I-17	NB	61.1	49.8	52.0	37.0	65	65	1.06	1.25	1.30	1.76								
	115P05091	3 PM Peak	Weekday	I-17	NB	60.5	47.8	50.0	34.0	65	65	1.08	1.30	1.36	1.91								
	115P05091	4 Off Peak	Weekday	I-17	NB	56.1	51.2	43.0	37.0	65	65	1.16	1.51	1.27	1.76								
5	115P05092	1 AM Peak	Weekday	I-17	NB	70.5	64.2	66.0	60.0	75	65	1.06	1.14	1.01	1.08	1.10	1.19	1.05	1.12	1.20	1.34	1.11	1.23
	115P05092	2 Mid Day	Weekday	I-17	NB	70.9	63.1	66.0	60.0	75	65	1.06	1.14	1.03	1.08								
	115P05092	3 PM Peak	Weekday	I-17	NB	70.7	61.7	66.0	58.0	75	65	1.06	1.14	1.05	1.12								
	115P05092	4 Off Peak	Weekday	I-17	NB	68.0	64.1	63.0	60.0	75	65	1.10	1.19	1.01	1.08								

Segment	TMC	Time Period	Week Type	Road Number	Road Direction	Cars Mean Speed	Trucks Mean Speed	Cars 5th Perct Speed	Trucks 5th Perct Speed	Assumed Car Free-Flow Speed	Assumed Truck Free-Flow Speed	Cars TTI	Cars PTI	Trucks TTI	Trucks PTI	Cars Peak TTI	Cars Peak PTI	Trucks Peak TTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Cars PTI	Segment Average Trucks TTI	Segment Average Trucks PTI
	115P05093	1 AM Peak	Weekday	I-17	NB	66.9	57.9	60.0	51.0	75	65	1.12	1.25	1.12	1.27	1.19	1.36	1.18	1.35				
	115P05093	2 Mid Day	Weekday	I-17	NB	67.4	56.8	61.0	50.0	75	65	1.11	1.23	1.14	1.30								
	115P05093	3 PM Peak	Weekday	I-17	NB	67.0	55.3	60.0	48.0	75	65	1.12	1.25	1.18	1.35								
	115P05093	4 Off Peak	Weekday	I-17	NB	63.1	57.6	55.0	50.0	75	65	1.19	1.36	1.13	1.30								
	115P05094	1 AM Peak	Weekday	I-17	NB	64.6	60.2	59.0	55.0	75	65	1.16	1.27	1.08	1.18	1.30	1.47	1.10	1.23				
	115P05094	2 Mid Day	Weekday	I-17	NB	65.7	59.9	60.0	55.0	75	65	1.14	1.25	1.08	1.18								
	115P05094	3 PM Peak	Weekday	I-17	NB	65.3	59.6	60.0	55.0	75	65	1.15	1.25	1.09	1.18								
	115P05094	4 Off Peak	Weekday	I-17	NB	57.8	59.3	51.0	53.0	75	65	1.30	1.47	1.10	1.23								
6	115P05095	1 AM Peak	Weekday	I-17	NB	70.8	64.3	66.0	62.0	75	65	1.06	1.14	1.01	1.05	1.10	1.17	1.02	1.05	1.13	1.23	1.01	1.05
	115P05095	2 Mid Day	Weekday	I-17	NB	71.3	64.3	67.0	62.0	75	65	1.05	1.12	1.01	1.05								
	115P05095	3 PM Peak	Weekday	I-17	NB	70.8	64.0	66.0	62.0	75	65	1.06	1.14	1.02	1.05								
	115P05095	4 Off Peak	Weekday	I-17	NB	68.3	64.5	64.0	62.0	75	65	1.10	1.17	1.01	1.05								
	115P05096	1 AM Peak	Weekday	I-17	NB	67.7	64.6	63.0	63.0	75	65	1.11	1.19	1.01	1.03	1.17	1.29	1.01	1.05				
	115P05096	2 Mid Day	Weekday	I-17	NB	68.7	64.4	64.0	63.0	75	65	1.09	1.17	1.01	1.03								
	115P05096	3 PM Peak	Weekday	I-17	NB	68.6	64.1	63.0	62.0	75	65	1.09	1.19	1.01	1.05								
	115P05096	4 Off Peak	Weekday	I-17	NB	64.2	64.6	58.0	63.0	75	65	1.17	1.29	1.01	1.03								
7	115P05097	1 AM Peak	Weekday	I-17	NB	63.4	57.3	58.0	51.0	65	65	1.03	1.12	1.13	1.27	1.18	1.51	1.23	1.51	1.09	1.27	1.12	1.29
	115P05097	2 Mid Day	Weekday	I-17	NB	64.8	58.1	61.0	53.0	65	65	1.00	1.07	1.12	1.23								
	115P05097	3 PM Peak	Weekday	I-17	NB	64.2	57.2	59.0	53.0	65	65	1.01	1.10	1.14	1.23								
	115P05097	4 Off Peak	Weekday	I-17	NB	55.0	52.9	43.0	43.0	65	65	1.18	1.51	1.23	1.51								
	115P05098	1 AM Peak	Weekday	I-17	NB	69.8	65.2	65.0	62.0	65	65	1.00	1.00	1.00	1.05	1.00	1.03	1.01	1.07				
	115P05098	2 Mid Day	Weekday	I-17	NB	69.5	64.7	65.0	61.0	65	65	1.00	1.00	1.00	1.07								
	115P05098	3 PM Peak	Weekday	I-17	NB	69.3	64.5	65.0	61.0	65	65	1.00	1.00	1.01	1.07								
	115P05098	4 Off Peak	Weekday	I-17	NB	68.3	65.2	63.0	62.0	65	65	1.00	1.03	1.00	1.05								
8	115P05099	1 AM Peak	Weekday	I-17	NB	69.3	61.9	64.0	58.0	75	65	1.08	1.17	1.05	1.12	1.12	1.21	1.05	1.12	1.14	1.27	1.09	1.17
	115P05099	2 Mid Day	Weekday	I-17	NB	68.4	61.8	63.0	59.0	75	65	1.10	1.19	1.05	1.10								
	115P05099	3 PM Peak	Weekday	I-17	NB	68.6	61.8	63.0	59.0	75	65	1.09	1.19	1.05	1.10								
	115P05099	4 Off Peak	Weekday	I-17	NB	67.2	61.9	62.0	58.0	75	65	1.12	1.21	1.05	1.12								
	115P05100	1 AM Peak	Weekday	I-17	NB	69.7	62.2	65.0	59.0	75	65	1.08	1.15	1.05	1.10	1.11	1.23	1.05	1.10				
	115P05100	2 Mid Day	Weekday	I-17	NB	69.4	62.1	65.0	59.0	75	65	1.08	1.15	1.05	1.10								
	115P05100	3 PM Peak	Weekday	I-17	NB	68.9	62.2	63.0	59.0	75	65	1.09	1.19	1.05	1.10								
	115P05100	4 Off Peak	Weekday	I-17	NB	67.4	62.3	61.0	59.0	75	65	1.11	1.23	1.04	1.10								
	115P05101	1 AM Peak	Weekday	I-17	NB	66.7	55.6	60.0	50.0	75	65	1.13	1.25	1.17	1.30	1.20	1.36	1.17	1.30				
	115P05101	2 Mid Day	Weekday	I-17	NB	66.8	56.7	61.0	52.0	75	65	1.12	1.23	1.15	1.25								
	115P05101	3 PM Peak	Weekday	I-17	NB	65.8	56.8	58.0	52.0	75	65	1.14	1.29	1.14	1.25								

Segment	TMC	Time Period	Week Type	Road Number	Road Direction	Cars Mean Speed	Trucks Mean Speed	Cars 5th Perct Speed	Trucks 5th Perct Speed	Assumed Car Free-Flow Speed	Assumed Truck Free-Flow Speed	Cars TTI	Cars PTI	Trucks TTI	Trucks PTI	Cars Peak TTI	Cars Peak PTI	Trucks Peak TTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Cars PTI	Segment Average Trucks TTI	Segment Average Trucks PTI
	115P05101	4 Off Peak	Weekday	I-17	NB	62.5	56.0	55.0	50.0	75	65	1.20	1.36	1.16	1.30								
9	115P05102	1 AM Peak	Weekday	I-17	NB	67.9	60.2	62.0	56.0	75	65	1.11	1.21	1.08	1.16	1.14	1.25	1.09	1.16	1.30	1.61	1.31	1.60
	115P05102	2 Mid Day	Weekday	I-17	NB	67.2	60.5	62.0	57.0	75	65	1.12	1.21	1.08	1.14								
	115P05102	3 PM Peak	Weekday	I-17	NB	66.1	59.6	60.0	57.0	75	65	1.13	1.25	1.09	1.14								
	115P05102	4 Off Peak	Weekday	I-17	NB	66.0	61.1	60.0	58.0	75	65	1.14	1.25	1.06	1.12								
	115P05103	1 AM Peak	Weekday	I-17	NB	56.1	42.3	44.0	32.0	75	65	1.34	1.70	1.54	2.03	1.47	1.97	1.54	2.03				
	115P05103	2 Mid Day	Weekday	I-17	NB	54.4	44.3	41.0	34.0	75	65	1.38	1.83	1.47	1.91								
	115P05103	3 PM Peak	Weekday	I-17	NB	52.0	44.0	38.0	34.0	75	65	1.44	1.97	1.48	1.91								
	115P05103	4 Off Peak	Weekday	I-17	NB	51.0	44.3	39.0	34.0	75	65	1.47	1.92	1.47	1.91								
10	115P05104	1 AM Peak	Weekday	I-17	NB	63.5	51.3	55.0	40.0	75	65	1.18	1.36	1.27	1.63	1.29	1.60	1.27	1.63	1.29	1.60	1.27	1.63
	115P05104	2 Mid Day	Weekday	I-17	NB	63.3	52.2	55.0	42.0	75	65	1.18	1.36	1.24	1.55								
	115P05104	3 PM Peak	Weekday	I-17	NB	61.5	52.1	51.0	42.0	75	65	1.22	1.47	1.25	1.55								
	115P05104	4 Off Peak	Weekday	I-17	NB	58.0	51.8	47.0	41.0	75	65	1.29	1.60	1.25	1.59								
11	115P05105	1 AM Peak	Weekday	I-17	NB	70.7	64.4	66.0	62.0	75	65	1.06	1.14	1.01	1.05	1.10	1.17	1.02	1.05	1.10	1.18	1.02	1.05
	115P05105	2 Mid Day	Weekday	I-17	NB	71.2	64.4	67.0	62.0	75	65	1.05	1.12	1.01	1.05								
	115P05105	3 PM Peak	Weekday	I-17	NB	70.7	63.9	66.0	62.0	75	65	1.06	1.14	1.02	1.05								
	115P05105	4 Off Peak	Weekday	I-17	NB	68.4	64.2	64.0	62.0	75	65	1.10	1.17	1.01	1.05								
	115P05106	1 AM Peak	Weekday	I-17	NB	70.3	63.8	66.0	62.0	75	65	1.07	1.14	1.02	1.05	1.10	1.19	1.02	1.05				
	115P05106	2 Mid Day	Weekday	I-17	NB	70.9	64.0	66.0	62.0	75	65	1.06	1.14	1.02	1.05								
	115P05106	3 PM Peak	Weekday	I-17	NB	70.4	63.7	65.0	62.0	75	65	1.06	1.15	1.02	1.05								
	115P05106	4 Off Peak	Weekday	I-17	NB	68.1	63.8	63.0	62.0	75	65	1.10	1.19	1.02	1.05								
12	115P05107	1 AM Peak	Weekday	I-17	NB	69.5	62.5	64.0	60.0	75	65	1.08	1.17	1.04	1.08	1.10	1.19	1.04	1.08	1.06	1.13	1.05	1.10
	115P05107	2 Mid Day	Weekday	I-17	NB	69.6	62.8	64.0	60.0	75	65	1.08	1.17	1.03	1.08								
	115P05107	3 PM Peak	Weekday	I-17	NB	69.7	62.4	64.0	60.0	75	65	1.08	1.17	1.04	1.08								
	115P05107	4 Off Peak	Weekday	I-17	NB	68.0	62.7	63.0	60.0	75	65	1.10	1.19	1.04	1.08								
	115P05108	1 AM Peak	Weekday	I-17	NB	69.2	63.6	64.0	62.0	75	65	1.08	1.17	1.02	1.05	1.10	1.17	1.03	1.05				
	115P05108	2 Mid Day	Weekday	I-17	NB	69.6	63.8	64.0	62.0	75	65	1.08	1.17	1.02	1.05								
	115P05108	3 PM Peak	Weekday	I-17	NB	69.5	63.4	64.0	62.0	75	65	1.08	1.17	1.03	1.05								
	115P05108	4 Off Peak	Weekday	I-17	NB	68.1	63.5	64.0	62.0	75	65	1.10	1.17	1.02	1.05								
	115P05109	1 AM Peak	Weekday	I-17	NB	68.8	64.1	63.0	62.0	75	65	1.09	1.19	1.01	1.05	1.13	1.21	1.02	1.05				
	115P05109	2 Mid Day	Weekday	I-17	NB	69.5	64.2	65.0	62.0	75	65	1.08	1.15	1.01	1.05								
	115P05109	3 PM Peak	Weekday	I-17	NB	68.8	63.8	63.0	62.0	75	65	1.09	1.19	1.02	1.05								
	115P05109	4 Off Peak	Weekday	I-17	NB	66.6	64.1	62.0	62.0	75	65	1.13	1.21	1.01	1.05								
	115P05110	1 AM Peak	Weekday	I-17	NB	71.1	63.0	67.0	62.0	75	65	1.05	1.12	1.03	1.05	1.08	1.15	1.03	1.07				
	115P05110	2 Mid Day	Weekday	I-17	NB	71.8	62.9	67.0	61.0	75	65	1.04	1.12	1.03	1.07								

Segment	TMC	Time Period	Week Type	Road Number	Road Direction	Cars Mean Speed	Trucks Mean Speed	Cars 5th Perct Speed	Trucks 5th Perct Speed	Assumed Car Free-Flow Speed	Assumed Truck Free-Flow Speed	Cars TTI	Cars PTI	Trucks TTI	Trucks PTI	Cars Peak TTI	Cars Peak PTI	Trucks Peak TTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Cars PTI	Segment Average Trucks TTI	Segment Average Trucks PTI
	115P05110	3 PM Peak	Weekday	I-17	NB	71.4	62.9	66.0	62.0	75	65	1.05	1.14	1.03	1.05								
	115P05110	4 Off Peak	Weekday	I-17	NB	69.6	63.5	65.0	62.0	75	65	1.08	1.15	1.02	1.05								
	115P05111	1 AM Peak	Weekday	I-17	NB	70.0	62.2	65.0	59.0	65	65	1.00	1.00	1.04	1.10	1.00	1.03	1.05	1.10				
	115P05111	2 Mid Day	Weekday	I-17	NB	70.7	62.2	66.0	59.0	65	65	1.00	1.00	1.04	1.10								
	115P05111	3 PM Peak	Weekday	I-17	NB	70.3	62.2	65.0	60.0	65	65	1.00	1.00	1.04	1.08								
	115P05111	4 Off Peak	Weekday	I-17	NB	67.7	62.1	63.0	60.0	65	65	1.00	1.03	1.05	1.08								
	115P05112	1 AM Peak	Weekday	I-17	NB	68.7	57.5	63.0	54.0	65	65	1.00	1.03	1.13	1.20	1.00	1.07	1.14	1.23				
	115P05112	2 Mid Day	Weekday	I-17	NB	69.2	57.3	64.0	54.0	65	65	1.00	1.02	1.13	1.20								
	115P05112	3 PM Peak	Weekday	I-17	NB	68.9	57.3	63.0	54.0	65	65	1.00	1.03	1.13	1.20								
	115P05112	4 Off Peak	Weekday	I-17	NB	66.1	56.8	61.0	53.0	65	65	1.00	1.07	1.14	1.23								
	115P05113	1 AM Peak	Weekday	I-17	NB	67.2	61.3	63.0	58.0	65	65	1.00	1.03	1.06	1.12	1.00	1.07	1.06	1.12				
	115P05113	2 Mid Day	Weekday	I-17	NB	67.7	61.5	63.0	59.0	65	65	1.00	1.03	1.06	1.10								
	115P05113	3 PM Peak	Weekday	I-17	NB	67.0	61.6	63.0	60.0	65	65	1.00	1.03	1.06	1.08								
	115P05113	4 Off Peak	Weekday	I-17	NB	65.4	61.9	61.0	59.0	65	65	1.00	1.07	1.05	1.10								

Closure Data

			Mobility						Freight	
			Total miles of closures		Avg Occurances/Mile/Year		Total minutes of closures		Avg Mins/Mile/Year	
Segment	Length (miles)	# of closures	NB	SB	NB	SB	NB	SB	NB	SB
17-1	7	14	14.5	1.0	0.41	0.03	4689.4	157.0	133.98	4.49
17-2	10	19	20.6	0.0	0.41	0.00	5423.4	0.0	108.47	0.00
17-3	13	37	51.0	7.0	0.78	0.11	13639.0	1282.0	209.83	19.72
17-4	8	29	29.9	24.3	0.75	0.61	7760.8	7010.1	194.02	175.25
17-5	10	25	21.0	14.0	0.42	0.28	5998.0	2469.0	119.96	49.38
17-6	16	16	4.0	12.0	0.05	0.15	1086.0	1989.0	13.57	24.86
17-7	9	17	12.0	5.0	0.27	0.11	2878.0	933.0	63.96	20.73
17-8	11	19	8.0	12.0	0.15	0.22	1798.0	2431.0	32.69	44.20
17-9	8	15	14.0	8.0	0.35	0.20	4901.0	4280.0	122.53	107.00
17-10	9	12	8.9	13.0	0.20	0.29	1876.7	5456.0	41.70	121.24
17-11	7	4	0.0	10.0	0.00	0.29	0.0	4355.0	0.00	124.43
17-12	17	15	6.0	26.1	0.07	0.31	1073.0	10396.7	12.62	122.31

	ITIS Category Description									
	Incidents/Accidents		Incidents/Crashes		Obstruction Hazards		Winds		Winter Storm Codes	
Segment	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
17-1	13	1	0	0	0	0	0	0	0	0
17-2	19	0	0	0	0	0	0	0	0	0
17-3	30	5	0	0	1	1	0	0	0	0
17-4	13	12	0	0	3	1	0	0	0	0
17-5	11	11	0	0	0	3	0	0	0	0
17-6	4	12	0	0	0	0	0	0	0	0
17-7	11	5	0	0	0	0	0	0	1	0
17-8	7	11	0	0	0	0	0	0	0	1
17-9	12	0	0	0	0	0	0	0	2	1
17-10	7	4	0	0	0	0	0	0	0	1
17-11	0	3	0	0	0	0	0	0	0	1
17-12	6	8	0	0	0	0	0	0	0	1

HPMS Data

SEGMENT	MP_FROM	MP_TO	WEIGHTED AVERAGE NB/EB AADT	WEIGHTED AVERAGE SB/WB AADT	WEIGHTED AVERAGE AADT	2014 AADT	2014 NB/EB AADT	2014 SB/WB AADT	K Factor	D-Factor	T-Factor
17-1	215	222	50562	50576	101139	106366	53174	53192	9	50	8
17-2	222	232	29756	30433	60190	62065	30397	31667	10	51	10
17-3	232	245	16908	16650	33558	33072	16599	16473	9	51	13
17-4	245	253	14158	14158	28316	29683	14841	14841	8	50	13
17-5	253	263	13845	13718	27564	27138	13181	13958	9	51	13
17-6	263	279	9891	9832	19724	20208	10175	10033	12	50	15
17-7	279	288	12572	12652	25225	25470	12609	12859	12	51	13
17-8	288	299	10782	10682	21464	22377	11219	11157	12	50	14
17-9	299	307	8849	8849	17698	18951	9476	9476	10	50	14
17-10	307	316	7957	7754	15710	16031	8057	7974	10	50	14
17-11	316	323	7959	7862	15821	16244	8490	7754	10	52	16
17-12	323	340	9361	9320	18681	18978	9511	9467	8	50	14

SEGMENT	Loc ID	BMP	EMP	Length	Pos Dir AADT	Neg Dir AADT	Corrected Pos Dir AADT	Corrected Neg Dir AADT	2014 AADT	K Factor	D-Factor	D-Factor Adjusted	T-Factor
17-1	100356	214.95	215.49	0.54	0	0	63950	63950	127900	9	55	50	8
	100357	215.49	215.99	0.50	0	0	60000	60000	120000	9	55	50	8
	100358	215.99	217.10	1.11	0	0	59500	59500	119000	9	55	50	8
	100359	217.10	218.02	0.92	0	0	51293	51293	102586	9	56	50	8
	100392	218.02	218.91	0.89	52819	53490	52819	53490	106309	9	56	50	8
	100393	218.91	220.94	2.03	49174	48811	49174	48811	97985	9	56	50	8
	100394	220.94	221.94	1.00	47087	47353	47087	47353	94440	9	59	50	8
17-2	100395	221.94	222.97	1.03	41388	47857	41388	47857	89245	9	52	54	8
	100396	222.97	223.99	1.02	45427	47581	45427	47581	93008	9	56	51	8
	100397	223.99	225.54	1.55	34403	34938	34403	34938	69341	9	56	50	9
	100398	225.54	227.00	1.46	33507	35460	33507	35460	68968	9	54	51	9
	100399	227.00	229.10	2.10	27477	27414	27477	27414	54891	10	56	50	9
	100400	229.10	232.03	2.93	19725	19865	19725	19865	39590	11	54	50	13
17-3	100365	232.03	236.01	3.98	18318	18889	18318	18889	37207	10	71	51	13
	100366	236.01	242.11	6.10	16134	15691	16134	15691	31826	9	65	51	13
	100367	242.11	244.38	2.27	14832	14341	14832	14341	29173	8	62	51	13
17-4	100368	244.38	248.41	4.03	14813	0	14803	14803	29606	8	59	50	13
	100369	248.41	252.53	4.12	14789	0	14879	14879	29758	8	57	50	13
17-5	100370	252.53	256.03	3.50	12054	14290	12054	14290	26343	8	62	54	13
	100371	256.03	259.37	3.34	0	0	13600	13600	27200	9	57	50	13
	100372	259.37	262.61	3.24	0	0	13967	13967	27934	10	57	50	13
17-6	100373	262.61	268.94	6.33	11202	11250	11202	11250	22453	12	65	50	17

SEGMENT	Loc ID	BMP	EMP	Length	Pos Dir AADT	Neg Dir AADT	Corrected Pos Dir AADT	Corrected Neg Dir AADT	2014 AADT	K Factor	D-Factor	D-Factor Adjusted	T-Factor
	100374	268.94	278.41	9.47	9489	9219	9489	9219	18708	12	50	51	14
17-7	100375	278.41	285.54	7.13	13532	13321	13532	13321	26854	12	53	50	11
	100376	285.54	287.29	1.75	0	10922	10922	10922	21844	11	53	50	12
	100377	287.29	289.98	2.69	11262	12896	11262	12896	24159	11	70	53	17
17-8	100378	289.98	293.27	3.29	0	10996	10996	10996	21992	11	52	50	13
	100379	293.27	298.99	5.72	11347	11250	11347	11250	22598	12	53	50	14
17-9	100380	298.99	306.30	7.31	0	0	9476	9476	18951	10	55	50	14
17-10	100381	306.30	315.58	9.28	8057	7974	8057	7974	16031	10	57	50	14
17-11	100382	315.58	317.87	2.29	7844	6955	7844	6955	14800	10	58	53	14
	100383	317.87	320.50	2.63	9478	8228	9478	8228	17706	10	55	54	17
	100384	320.50	322.72	2.22	7985	8016	7985	8016	16001	9	56	50	17
17-12	100385	322.72	326.20	3.48	8491	8617	8491	8617	17109	9	58	50	14
	100386	326.20	328.76	2.56	8585	8578	8585	8578	17163	9	54	50	14
	100387	328.76	331.10	2.34	8562	8098	8562	8098	16660	7	58	51	14
	100388	331.10	333.85	2.75	0	0	7016	7016	14032	7	57	50	14
	100389	333.85	337.39	3.54	11694	11666	11694	11666	23360	8	60	50	12
	100390	337.39	339.76	2.37	0	0	12314	12314	24628	9	56	50	12
	100391	339.76	340.05	0.29	0	0	11680	11680	23360	8	60	50	12

Bicycle Accommodation Data

Segment	BMP	EMP	Divided or Non	NB/EB Right Shoulder Width	SB/WB Right Shoulder Width	NB/EB Effective Length of Shoulder	SB/WB Effective Length of Shoulder	% Bicycle Accommodation
17-1	215	222	Divided	9.7	9.7	7.0	6.8	99%
17-2	222	232	Divided	9.9	10.0	10.0	10.0	100%
17-3	232	245	Divided	10.0	10.0	13.0	13.0	100%
17-4	245	253	Divided	9.7	9.8	7.6	7.8	97%
17-5	253	263	Divided	10.0	10.0	10.0	10.0	100%
17-6	263	279	Divided	10.0	10.0	16.0	16.0	100%
17-7	279	288	Divided	9.9	10.1	9.0	8.6	98%
17-8	288	299	Divided	10.0	9.9	11.0	11.0	100%
17-9	299	307	Divided	10.0	10.0	8.0	8.0	100%
17-10	307	316	Divided	10.0	10.0	9.0	9.0	100%
17-11	316	323	Divided	10.2	10.4	7.0	7.0	100%
17-12	323	340	Divided	9.4	9.7	15.9	16.0	94%

AZTDM Data

SEGMENT	Growth Rate	% Non-SOV
17-1	2.09%	10.7%
17-2	1.73%	12.3%
17-3	2.12%	12.0%
17-4	2.17%	12.3%
17-5	2.21%	15.5%
17-6	2.18%	7.7%
17-7	2.19%	7.7%
17-8	1.91%	14.1%
17-9	1.85%	6.6%
17-10	1.83%	6.3%
17-11	1.83%	6.2%
17-12	1.77%	17.9%

HERS Capacity Calculation Data

Segment	Facility Type	Terrain	Lane Width (Rounded, feet)	NB/EB Rt. Shoulder	SB/WB Rt. Shoulder	F_{lw} or f_w or f_{LS}	NB/EB F_{lc}	SB/WB F_{lc}	Total Ramp Density	PHF	E_T	f_{HV}	f_M	f_A	g/C^2	f_G	f_{NP}	Nm	f_p	NB/EB FFS	SB/WB FFS	NB/EB Peak-Hour Capacity	SB/WB Peak-Hour Capacity	Daily Capacity
17-1	Urban	Level	12.00	9.75	9.69	0.0	0	0	1.52	0.94	1.5	0.962	N/A							70.82	70.82	7164	7164	136,463
17-2	Fringe Urban	Level	12.00	9.95	9.96	0.0	0	0	1.4	0.94	1.5	0.953	N/A							71.13	71.13	5803	5803	110,540
17-3	Rural	Rolling	12.00	10.00	10.00	0.0	0	0	0	0.94	2.5	0.840	N/A							75.40	75.40	3790	3790	72,191
17-4	Rural	Mountainous	12.00	9.73	9.80	0.0	0	0	0	0.94	4.5	0.692	N/A							75.40	75.40	3124	3124	59,497
17-5	Rural	Mountainous	12.00	9.97	9.96	0.0	0	0	0	0.94	4.5	0.692	N/A							75.40	75.40	3124	3124	59,497
17-6	Rural	Rolling	12.00	10.00	10.00	0.0	0	0	0	0.94	2.5	0.814	N/A							75.40	75.40	3672	3672	69,952
17-7	Rural	Mountainous	12.00	9.89	10.11	0.0	0	0	0	0.94	4.5	0.692	N/A							75.40	75.40	3121	3121	59,439
17-8	Rural	Rolling	12.00	9.96	9.93	0.0	0	0	0	0.94	2.5	0.826	N/A							75.40	75.40	3725	3725	70,948
17-9	Rural	Mountainous	12.00	10.00	10.00	0.0	0	0	0	0.94	4.5	0.664	N/A							75.40	75.40	2996	2996	57,063
17-10	Rural	Mountainous	12.00	10.00	10.00	0.0	0	0	0	0.94	4.5	0.664	N/A							75.40	75.40	2996	2996	57,063
17-11	Rural	Rolling	12.00	10.16	10.35	0.0	0	0	0	0.94	2.5	0.806	N/A							75.40	75.40	3637	3637	69,275
17-12	Fringe Urban	Rolling	12.00	9.40	9.70	0.0	0	0	1.4	0.94	1.5	0.936	N/A							71.13	71.13	4225	4225	80,471

Safety Performance Area Data

Segment	Operating Environment	Segment Length (miles)	NB Fatal Crashes 2009-2013	SB Fatal Crashes 2009-2013	NB Incapacitating Injury Crashes 2009-2013	SB Incapacitating Injury Crashes 2090-2013	Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors
17-1	Urban > 6 Lane Freeway	7	3	4	15	12	0
17-2	Urban or Rural 6 Lane Freeway	10	5	6	10	14	11
17-3	Rural 4 Lane Freeway with Daily Volume > 25,000	13	4	3	11	11	20
17-4	Rural 4 Lane Freeway with Daily Volume > 25,000	8	1	5	8	3	6
17-5	Rural 4 Lane Freeway with Daily Volume > 25,000	10	5	2	5	8	7
17-6	Rural 4 Lane Freeway with Daily Volume < 25,000	16	3	4	3	8	10
17-7	Rural 4 Lane Freeway with Daily Volume > 25,000	9	3	2	4	6	7
17-8	Rural 4 Lane Freeway with Daily Volume < 25,000	11	6	4	4	5	11
17-9	Rural 4 Lane Freeway with Daily Volume < 25,000	8	3	2	5	11	10
17-10	Rural 4 Lane Freeway with Daily Volume < 25,000	9	1	1	3	5	5
17-11	Rural 4 Lane Freeway with Daily Volume < 25,000	7	2	0	8	4	4
17-12	Rural 4 Lane Freeway with Daily Volume < 25,000	17	1	4	9	10	8

Segment	Operating Environment	Fatal + Incapacitating Injury Crashes Involving Trucks	Fatal + Incapacitating Injury Crashes Involving Motorcycles	Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers	Weighted 5-Year (2010-2014) Average NB/EB AADT	Weighted 5-Year (2010-2014) Average SB/WB AADT	Weighted 5-Year (2010-2014) Average Total AADT
17-1	Urban > 6 Lane Freeway	2	4	0	50562	50576	101139
17-2	Urban or Rural 6 Lane Freeway	4	3	0	29756	30433	60190
17-3	Rural 4 Lane Freeway with Daily Volume > 25,000	3	5	0	16908	16650	33558
17-4	Rural 4 Lane Freeway with Daily Volume > 25,000	2	5	1	14158	14158	28316
17-5	Rural 4 Lane Freeway with Daily Volume > 25,000	2	3	0	13845	13718	27564
17-6	Rural 4 Lane Freeway with Daily Volume < 25,000	1	3	0	9891	9832	19724
17-7	Rural 4 Lane Freeway with Daily Volume > 25,000	1	2	0	12572	12652	25225
17-8	Rural 4 Lane Freeway with Daily Volume < 25,000	3	1	0	10782	10682	21464
17-9	Rural 4 Lane Freeway with Daily Volume < 25,000	2	0	0	8849	8849	17698
17-10	Rural 4 Lane Freeway with Daily Volume < 25,000	2	0	0	7957	7754	15710
17-11	Rural 4 Lane Freeway with Daily Volume < 25,000	1	1	1	7959	7862	15821
17-12	Rural 4 Lane Freeway with Daily Volume < 25,000	1	2	0	9361	9320	18681

HPMS Data

2010-2014 Weighted Average						2014			2013			2012			2011			2010		
SEGMENT	MP_FROM	MP_TO	WEIGHTED AVERAGE NB/EB AADT	WEIGHTED AVERAGE SB/WB AADT	WEIGHTED AVERAGE AADT	NB/EB AADT	SB/WB AADT	2014 AADT	NB/EB AADT	SB/WB AADT	2013 AADT	NB/EB AADT	SB/WB AADT	2012 AADT	NB/EB AADT	SB/WB AADT	2011 AADT	NB/EB AADT	SB/WB AADT	2010 AADT
17-1	215	222	50563	50576	101139	53174	53192	106366	51069	51069	102137	49663	49714	99378	48791	48791	97581	50116	50116	100231
17-2	222	232	29756	30433	60190	30397	31667	62065	30163	30539	60703	29834	30430	60265	29449	30028	59477	28937	29502	58439
17-3	232	245	16909	16649	33558	16599	16473	33072	16642	16581	33223	17019	16819	33838	17415	16506	33920	16868	16868	33736
17-4	245	253	14158	14158	28316	14841	14841	29683	14158	14158	28317	13743	13743	27487	13797	13797	27595	14250	14250	28500
17-5	253	263	13845	13718	27563	13181	13958	27138	13893	13893	27786	13704	13333	27037	14192	13325	27517	14256	14083	28339
17-6	263	279	9891	9833	19723	10175	10033	20208	9960	9861	19821	9732	9700	19433	10086	10069	20155	9500	9500	19000
17-7	279	288	12572	12652	25225	12609	12859	25470	12439	12681	25121	12520	12504	25024	12518	12518	25035	12776	12700	25476
17-8	288	299	10782	10682	21464	11219	11157	22377	10697	10550	21247	11186	10902	22088	10627	10617	21243	10183	10183	20365
17-9	299	307	8849	8849	17698	9476	9476	18951	8949	8949	17898	8730	8730	17459	8591	8591	17182	8500	8500	17000
17-10	307	316	7957	7754	15710	8057	7974	16031	7664	6893	14553	8044	7883	15927	8019	8019	16037	8000	8000	16000
17-11	316	323	7959	7863	15822	8490	7754	16244	7207	7611	14819	7646	7497	15143	8014	8014	16029	8437	8437	16873
17-12	323	340	9361	9320	18681	9511	9467	18978	8475	8776	17251	9547	9467	19015	9553	9287	18841	9718	9604	19322

Freight Performance Area Data

See the Mobility Performance Area Data section for Freight related data

Appendix D: Needs Analysis Contributing Factors and Scores

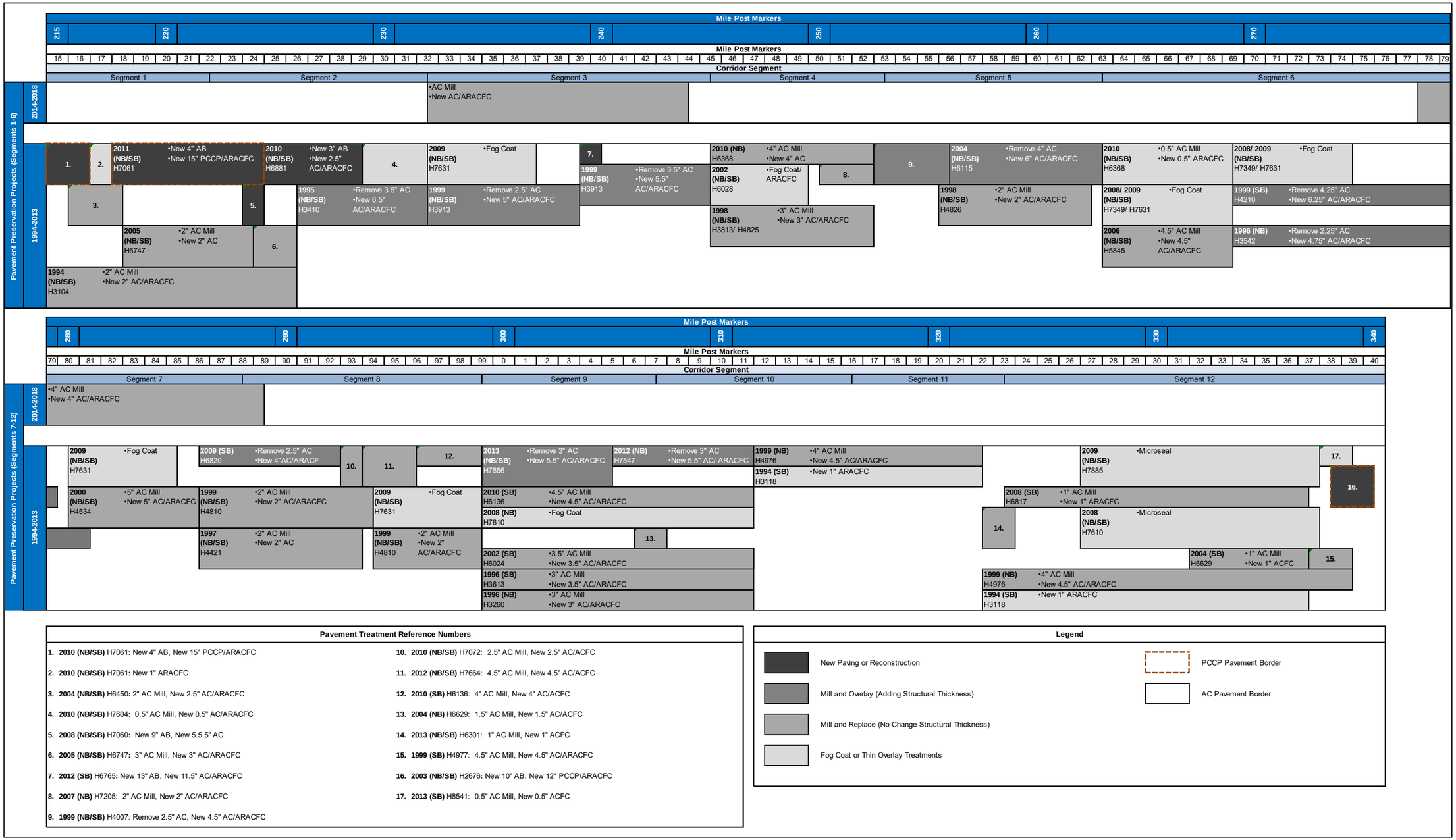
Pavement Performance Area - Needs Analysis Step 1

Segment	Segment Length (miles)	Segment Mileposts (MP)	Facility Type	Pavement Index			Directional PSR					% Pavement Failure			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
							NB	SB		NB	SB				
17-1	7	215 - 222	Interstate	4.19	Fair or Better	None	4.24	4.14	Fair or Better	None	None	0.00%	Fair or Better	None	None
17-2	10	222 - 232	Interstate	4.16	Fair or Better	None	4.13	4.15	Fair or Better	None	None	0.00%	Fair or Better	None	None
17-3	13	232 - 245	Interstate	3.85	Fair or Better	None	3.92	3.86	Fair or Better	None	None	3.80%	Fair or Better	None	None
17-4	8	245 - 253	Interstate	4.25	Fair or Better	None	3.65	4.25	Fair or Better	None	None	0.00%	Fair or Better	None	None
17-5	10	253 - 263	Interstate	4.25	Fair or Better	None	4.09	4.02	Fair or Better	None	None	0.00%	Fair or Better	None	None
17-6	16	263 - 279	Interstate	4.26	Fair or Better	None	4.08	4.02	Fair or Better	None	None	0.00%	Fair or Better	None	None
17-7	9	279 - 288	Interstate	3.92	Fair or Better	None	3.78	3.93	Fair or Better	None	None	16.70%	Fair or Better	Medium	Low
17-8	11	288 - 299	Interstate	4.32	Fair or Better	None	4.01	4.17	Fair or Better	None	None	4.50%	Fair or Better	None	None
17-9	8	299 - 307	Interstate	4.21	Fair or Better	None	3.77	4.18	Fair or Better	None	None	18.80%	Fair or Better	Medium	Low
17-10	9	307 - 316	Interstate	4.19	Fair or Better	None	4.01	4.06	Fair or Better	None	None	0.00%	Fair or Better	None	None
17-11	7	316-323	Interstate	3.73	Fair or Better	None	3.50	3.82	Fair or Better	Low	None	21.40%	Fair or Better	Medium	Low
17-12	17	323-340	Interstate	3.70	Fair or Better	None	3.49	3.82	Fair or Better	Low	None	25.70%	Fair or Better	High	Low
Emphasis Area?	No	Weighted Average		4.07	Fair or Better	None									

Pavement Performance Area - Needs Analysis Step 2

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Need Adjustments		Final Need	Comments (may include programmed projects or issues from previous reports)
				Hot Spots	Previous Projects (which supersede condition data)		
17-1	7	215 - 222	None	-	-	None	Recent projects repaved this area with PCCP
17-2	10	222 - 232	None	-	-	None	Recent projects repaved this area with PCCP
17-3	13	232 - 245	None	NB MP 236-237	-	Low	Presence of Hotspot elevated Need from None to Low; Project is programmed in FY 17
17-4	8	245 - 253	None	-	-	None	
17-5	10	253 - 263	None	-	-	None	
17-6	16	263 - 279	None	-	-	None	
17-7	9	279 - 288	Low	NB MP 281-282 and 286-287, SB MP 281-282	Pavement preservation project is currently under construction	None	Project is currently under construction so need was eliminated
17-8	11	288 - 299	None	NB MP 289-290	Pavement preservation project is currently under construction	None	Project is currently under construction so need was eliminated
17-9	8	299 - 307	Low	NB MP 302-305	Recent pavement preservation project	None	Final DCR (2012) stated that the most severe cracks were located in NB near MP 301. Need eliminated due to recent preservation project
17-10	9	307 - 316	None	-	-	None	
17-11	7	316-323	Low	NB MP 316-317 and 320-322	-	Low	
17-12	17	323-340	Low	NB MP 326-327, 328-330, 332-334, 339-340, and SB MP 339-340	-	Low	Project is programmed in FY 19

Pavement History



Pavement Treatment Reference Numbers

1. **2010 (NB/SB)** H7061**:** New 4" AB, New 15" PCCP/ARACFC
2. **2010 (NB/SB)** H7061**:** New 1" ARACFC
3. **2004 (NB/SB)** H6450**:** 2" AC Mill, New 2.5" AC/ARACFC
4. **2010 (NB/SB)** H7604**:** 0.5" AC Mill, New 0.5" AC/ARACFC
5. **2008 (NB/SB)** H7060**:** New 9" AB, New 5.5.5" AC
6. **2005 (NB/SB)** H6747**:** 3" AC Mill, New 3" AC/ARACFC
7. **2012 (SB)** H6765**:** New 13" AB, New 11.5" AC/ARACFC
8. **2007 (NB)** H7205: 2" AC Mill, New 2" AC/ARACFC
9. **1999 (NB/SB)** H4007: Remove 2.5" AC, New 4.5" AC/ARACFC
10. **2010 (NB/SB)** H7072: 2.5" AC Mill, New 2.5" AC/ACFC
11. **2012 (NB/SB)** H7664: 4.5" AC Mill, New 4.5" AC/ACFC
12. **2010 (SB)** H6136: 4" AC Mill, New 4" AC/ACFC
13. **2004 (NB)** H6629: 1.5" AC Mill, New 1.5" AC/ACFC
14. **2013 (NB/SB)** H6301: 1" AC Mill, New 1" ACFC
15. **1999 (SB)** H4977: 4.5" AC Mill, New 4.5" AC/ARACFC
16. **2003 (NB/SB)** H2676**:** New 10" AB, New 12" PCCP/ARACFC
17. **2013 (SB)** H8541: 0.5" AC Mill, New 0.5" ACFC

Legend

- New Paving or Reconstruction
- Mill and Overlay (Adding Structural Thickness)
- Mill and Replace (No Change Structural Thickness)
- Fog Coat or Thin Overlay Treatments
- PCCP Pavement Border
- AC Pavement Border

Cost Value	Level	I-17 Segment Number																					
		1		2		3		4		5		6		7		8		9		10		11		12	
		Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir
1	L1		10%		30%		30%		50%				30%		50%		50%	100%		50%		70%		80%	70%
1													30%							50%		10%			70%
1													30%												
1																									
1																									
3	L2		30%		30%			100%	100%		70%		30%		50%	30%	30%	100%		50%		70%		80%	
3			50%		30%			30%							30%		50%	100%		50%		10%		10%	
3			100%		50%										30%		50%	100%		50%		10%		50%	
3																	50%	100%		50%				90%	
3																				50%					
4	L3				70%		50%				70%	60%		30%		50%		30%	70%	50%					
4							50%				30%	60%		20%											
4																									
4																									
4																									
6	L4		30%		70%	10%																			10%
6			50%		10%																				
6																									
6																									
6																									
Sub-Total		0	10.3	0	11.2	0.6	4.3	3.9	3.5	0	6.1	4.8	1.8	2	3.8	2.9	5.9	14.2	2.8	10.5	0	3.5	0	7.7	2
Total		10.3		11.2		4.6		5.45		6.1		4.2		4.8		7.35		9.9		5.25		1.75		5.85	

Pavement Historical Investment

Segment	Segment Mileposts (MP)	Segment Length (miles)	Pavement History Value (bid projects)	Pavement History Score (bid projects)	Pavement History (bid projects)	PeCos ($/mile/yr)	PeCos Score	PeCos Investment History	Resulting Historical Investment
1	215 - 222	7	10.30	2.25	High	$9,913.24	0.96	High	High
2	222 - 232	10	11.20	2.66	High	$3,210.24	-0.03	Medium	High
3	232 - 245	13	4.60	-0.30	Medium	$570.71	-0.42	Low	Medium
4	245 - 253	8	5.45	0.08	Medium	$1,176.27	-0.33	Medium	Medium
5	253 - 263	10	6.10	0.37	Medium	$4,957.17	0.23	High	High
6	263 - 279	16	4.20	-0.48	Low	$1,053.48	-0.35	Low	Low
7	279 - 288	9	4.80	-0.21	Medium	$240.84	-0.47	Low	Medium
8	288 - 299	11	7.35	0.93	High	$1,998.15	-0.21	Medium	High
9	299 - 307	8	9.90	2.07	High	$1,669.66	-0.26	Medium	High
10	307 - 316	9	5.25	-0.01	Medium	$7,112.25	0.55	High	High
11	316-323	7	1.75	-1.57	Low	$7,585.24	0.62	High	Medium
12	323-340	17	5.85	0.26	Medium	$8,064.31	0.69	High	High

Pavement Performance Area - Needs Analysis Step 3

Segment	Segment Length (miles)	Segment Mileposts (MP)	Final Need	Bid History Investment	PeCos History Investment	Resulting Historical Investment	Contributing Factors and Comments
17-1	7	215 - 222	None	High	High	High	
17-2	10	222 - 232	None	High	Medium	High	
17-3	13	232 - 245	Low	Medium	Low	Medium	Failure hot spot on NB (MP 236-237); Project is programmed in FY 17 (MP 232-240); should mitigate issues
17-4	8	245 - 253	None	Medium	Medium	Medium	
17-5	10	253 - 263	None	Medium	High	High	
17-6	16	263 - 279	None	Low	Low	Low	
17-7	9	279 - 288	None	Medium	Low	Medium	
17-8	11	288 - 299	None	High	Medium	High	
17-9	8	299 - 307	None	High	Medium	High	
17-10	9	307 - 316	None	Medium	High	High	
17-11	7	316-323	Low	Low	High	Medium	Issues likely due to lack of recent investment; Failure hotspots on NB MP 316-317 and 320-322
17-12	17	323-340	Low	Medium	High	High	Several miles of failure (25% of segment); pavement failing with high level of previous investment; lower performance on NB than on SB; According to Flagstaff District, NB MP 334 to 337 center line is unraveling due to not being treating by leveling micro-seal treatment, and SB was placed on concrete and the concrete is failing

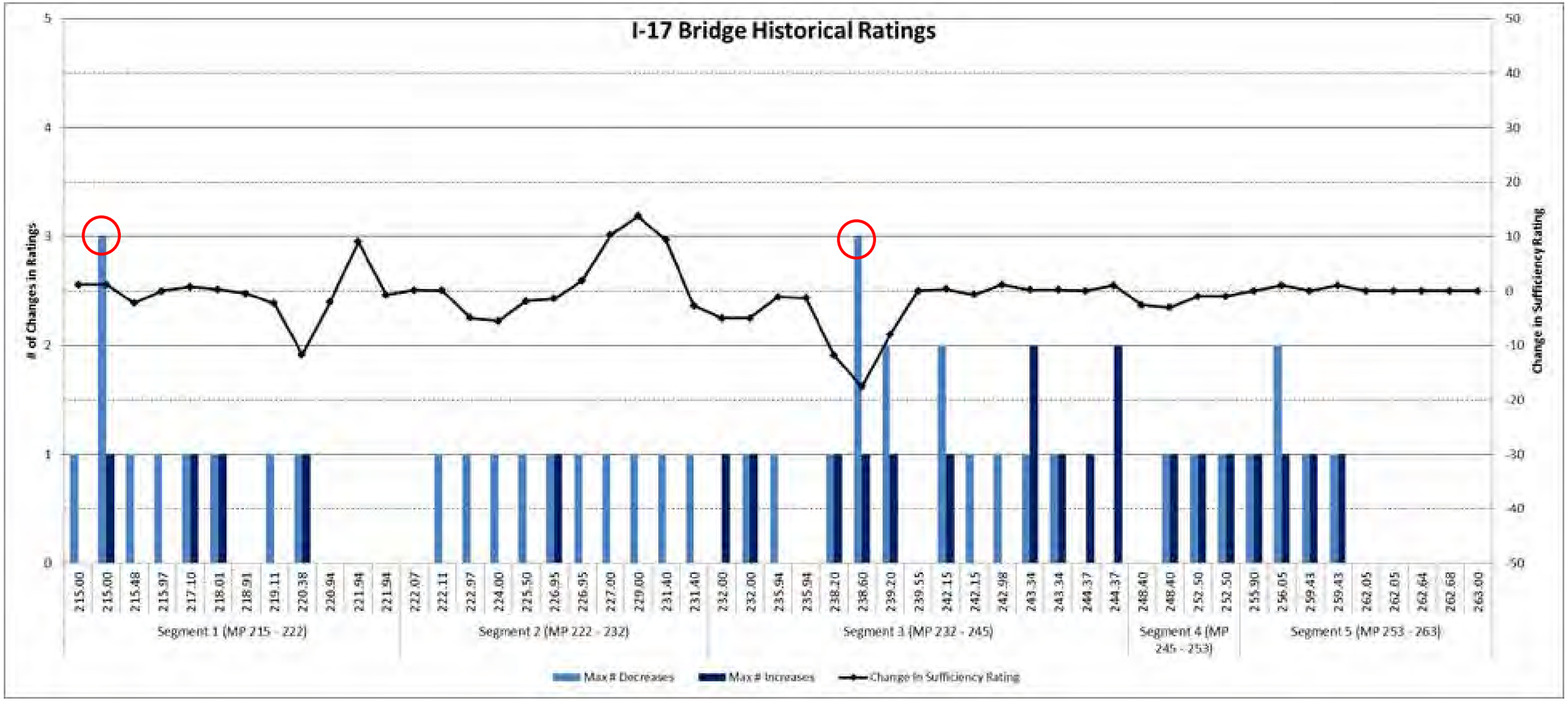
Bridge Performance Area - Needs Analysis Step 1

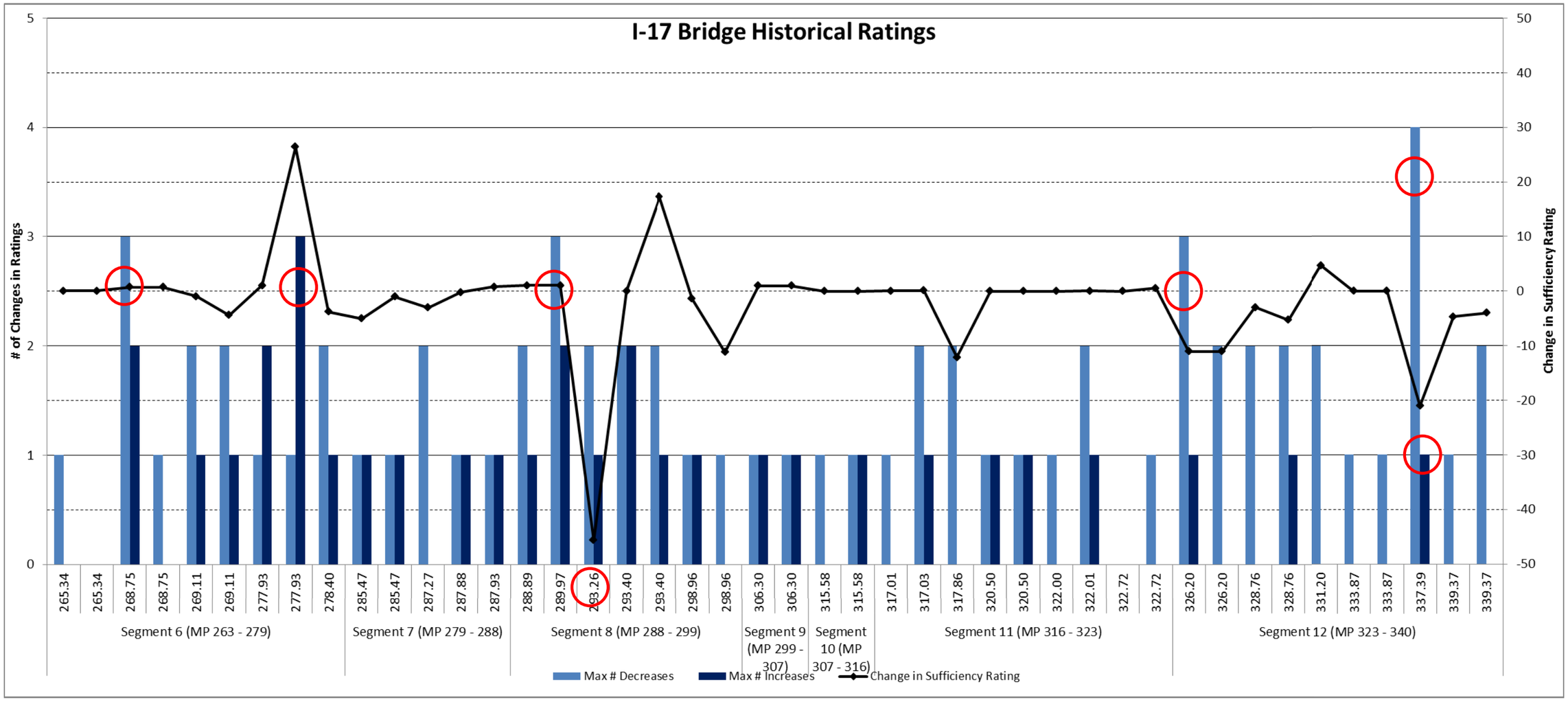
Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Bridge Index			Bridge Rating			Bridge Sufficiency			% Functionally Obsolete Bridges			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	
17-1	7	215 - 222	13	6.98	Fair or Better	None	5	Fair or Better	Low	91.5	Fair or Better	None	23.8%	Fair or Better	Low	Low
17-2	10	222 - 232	11	6.79	Fair or Better	None	6	Fair or Better	None	92.7	Fair or Better	None	14.6%	Fair or Better	None	None
17-3	13	232 - 245	15	6.39	Fair or Better	None	5	Fair or Better	Low	91.1	Fair or Better	None	31.3%	Fair or Better	Medium	Low
17-4	8	245 - 253	4	5.71	Fair or Better	Low	5	Fair or Better	Low	94.0	Fair or Better	None	60.9%	Fair or Better	High	Medium
17-5	10	253 - 263	10	7.15	Fair or Better	None	6	Fair or Better	None	96.3	Fair or Better	None	16.9%	Fair or Better	None	None
17-6	16	263 - 279	10	6.19	Fair or Better	None	5	Fair or Better	Low	94.8	Fair or Better	None	8.5%	Fair or Better	None	Low
17-7	9	279 - 288	5	6.31	Fair or Better	None	6	Fair or Better	None	91.4	Fair or Better	None	0.0%	Fair or Better	None	None
17-8	11	288 - 299	7	6.04	Fair or Better	None	4	Fair or Better	Medium	89.2	Fair or Better	None	13.6%	Fair or Better	None	Low
17-9	8	299 - 307	2	6.00	Fair or Better	None	6	Fair or Better	None	93.0	Fair or Better	None	100.0%	Fair or Better	High	Low
17-10	9	307 - 316	2	6.52	Fair or Better	None	6	Fair or Better	None	94.0	Fair or Better	None	100.0%	Fair or Better	High	Low
17-11	7	316 - 323	9	6.91	Fair or Better	None	5	Fair or Better	Low	96.5	Fair or Better	None	3.4%	Fair or Better	None	Low
17-12	17	323-340	10	5.80	Fair or Better	Low	5	Fair or Better	Low	92.0	Fair or Better	None	62.3%	Fair or Better	High	Medium
Emphasis Area?	No	Weighted Average		6.34	Fair or Better	None										

Bridge Performance Area - Needs Analysis Step 2

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Initial Need	Need Adjustments		Final Need	Historical Review	# Functionally Obsolete Bridges	Comments
					Hot Spots (Rating of 4 or multiple 5's)	Previous Projects (which supersede condition data)				
17-1	7	215 - 222	13	Low	-	-	Low	I-17 OP @ Frt Rd SB	4	I-17 OP at Frt Rd SB, Pinnacle Peak TI, and Happy Valley TI; Pinnacle Peak and Happy Valley were identified for replacement in Final DCR (2004); Likely to be programmed in future MAG update
17-2	10	222 - 232	11	None	-	-	None	-	1	No bridges with current ratings of 4 or 5 and no historical issues
17-3	13	232 - 245	15	Low	Moores Gulch SB	-	Low	Moores Gulch SB	7	Moores Gulch SB and Little Squaw Creek NB; Little Squaw Creek NB was identified as Structurally Deficient in Final DCR (2004); Moores Gulch SB programmed in FY 17
17-4	8	245 - 253	4	Medium	-	-	Medium	-	2	Bumble Bee TI NB
17-5	10	253 - 263	10	None	-	-	None	-	4	No bridges with current ratings of 4 or 5 and no historical issues
17-6	16	263 - 279	10	Low	-	-	Low	Dugas Rd TI SB and Cienga Creek NB	2	Ash Creek SB, SR 169 TI, Dugas Rd TI SB, Cienga Creek NB
17-7	9	279 - 288	5	None	-	-	None	-	0	No bridges with current ratings of 4 or 5 and no historical issues
17-8	11	288 - 299	7	Low	McGuireville TI and SR 179 TI SB	-	Low	McGuireville TI and Middle Verde Rd TI	2	McGuireville TI, Middle Verde TI, SR 179 TI SB; McGuireville TI programmed in FY 15
17-9	8	299 - 307	2	Low	-	-	Low	-	2	No bridges with current ratings of 4 or 5 and no historical issues
17-10	9	307 - 316	2	Low	-	-	Low	-	2	No bridges with current ratings of 4 or 5 and no historical issues
17-11	7	316 - 323	9	Low	-	-	Low	-	2	Woods Canyon TI (Fox Ranch Rd TI)
17-12	17	323-340	10	Medium	Willard Springs TI NB and Airport Rd TI	-	Medium	Willard Springs TI NB and Airport Rd TI	7	Willard Springs TI NB and Airport Rd TI; Willard Springs TI identified for deck and superstructure replacement in Final DCR (2012); JW Powell TI identified for replacement in Final DCR (2012); Willard Springs TI programmed in FY 17

Bridge Rating History




I-17 Bridge Historical Ratings
# of Changes in Ratings
Change in Sufficiency Rating
5
4
3
2
1
0
50
40
30
20
10
0
-10
-20
-30
-40
-50
265.34
265.34
268.75
268.75
269.11
269.11
277.93
277.93
278.40
285.47
285.47
287.27
287.88
287.93
288.89
289.97
293.26
293.40
293.40
298.96
298.96
306.30
306.30
315.58
315.58
317.01
317.03
317.86
320.50
320.50
322.00
322.01
322.72
322.72
326.20
326.20
328.76
328.76
331.20
333.87
333.87
337.39
339.37
339.37
Segment 6 (MP 263 - 279)
Segment 7 (MP 279 - 288)
Segment 8 (MP 288 - 299)
Segment 9 (MP 299 - 307)
Segment 10 (MP 307 - 316)
Segment 11 (MP 316 - 323)
Segment 12 (MP 323 - 340)
Max # Decreases
Max # Increases
Change in Sufficiency Rating

Bridge Performance Area - Needs Analysis Step 3

Segment	Segment Length (Miles)	Segment Mileposts (MP)	Number of Bridges in Segment	# Functionally Obsolete Bridges	Final Need	Contributing Factors			Comments
						Bridge	Current Ratings	Historical Review	
17-1	7	215 - 222	13	4	Low	I-17 OP @ Frt Rd SB (#2180)(MP 215.00)	2014 No Ratings less than 6	Could have a repetitive investment issue	
						Pinnacle Peak TI (#821)(MP 217.10)	2014 Deck Rating of 5	This structure was not identified in historical review	Likely to be replaced to facilitate mainline widening; will be included in updated MAG program; currently in DCR phase
						Happy Valley TI (#822)(MP 218.01)	2014 Deck Rating of 5	This structure was not identified in historical review	
17-2	10	222 - 232	11	1	None	No bridges with current ratings less than 6 and no historical issues			
17-3	13	232 - 245	15	7	Low	Moores Gulch SB (#339)(MP 238.60)	2012 Deck and Superstructure ratings of 5	Could have a repetitive investment issue	Project is programmed in FY 17
						Little Squaw Creek NB (#968)(MP 239.20)	2012 Deck Rating of 5	This structure was not identified in historical review	
17-4	8	245 - 253	4	2	Medium	Bumble Bee TI NB (#1171)(MP 248.40)	2012 Deck Rating of 5	This structure was not identified in historical review	
17-5	10	253 - 263	10	4	None	No bridges with current ratings less than 6 and no historical issues			
17-6	16	263 - 279	10	2	Low	Dugas Rd TI SB (#1080)(MP 268.75)	2012 No Ratings less than 6	Could have a repetitive investment issue	
						Ash Creek SB (#389)(MP 269.11)	2012 Structural Evaluation Rating of 5	This structure was not identified in historical review	
						Cienga Creek NB (#428)(MP 277.93)	2012 No Current Ratings less than 6	Could have a repetitive investment issue	
						SR 169 TI (#1734)(MP 278.40)	2012 Deck Rating of 5	This structure was not identified in historical review	
17-7	9	279 - 288	5	0	None	No bridges with current ratings less than 6 and no historical issues			
17-8	11	288 - 299	7	2	Low	Middle Verde Rd TI (#1733)(MP 289.97)	2012 No Current Ratings less than 6	Could have a repetitive investment issue	
						McGuireville TI (#652)(MP 293.26)	2012 Superstructure Rating of 4	Could have a repetitive investment issue	Project in programmed in FY 15
						SR 179 TI SB (#1061)(MP 298.96)	2012 Deck and Superstructure Ratings of 5	This structure was not identified in historical review	
17-9	8	299 - 307	2	2	Low	No bridges with current ratings less than 6 and no historical issues			Due to # of functionally obsolete bridges
17-10	9	307 - 316	2	2	Low	No bridges with current ratings less than 6 and no historical issues			Due to # of functionally obsolete bridges
17-11	7	316 - 323	9	2	Low	Woods Canyon TI (Fox Ranch Rd)(#1655) (MP 317.86)	2012 Substructure Rating of 5	This structure was not identified in historical review	
17-12	17	323-340	10	7	Medium	Willard Springs TI NB (#1583) (MP 326.20)	2012 Deck and Superstructure Ratings of 5	Could have a repetitive investment issue	Project is programmed in FY 17
						Airport Rd TI (#632) (MP 337.39)	2012 Substructure and Superstructure Ratings of 5	Could have a repetitive investment issue	

Mobility Performance Area - Needs Analysis Step 1

Segment	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Mobility Index			Future Daily V/C			Existing Peak Hour V/C					Closure Extent (occurrences/year/mile)				
					Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
											NB	SB		NB	SB	NB	SB		NB	SB
17-1	215 - 222	7	Urban	Uninterrupted	0.90	Fair or Better	Medium	1.09	Fair or Better	High	0.67	0.67	Fair or Better	None	None	0.41	0.03	Fair or Better	Low	None
17-2	222 - 232	10	Urban	Uninterrupted	0.68	Fair or Better	None	0.80	Fair or Better	Low	0.51	0.53	Fair or Better	None	None	0.41	0.00	Fair or Better	Low	None
17-3	232 - 245	13	Rural	Uninterrupted	0.58	Fair or Better	None	0.71	Fair or Better	Medium	0.40	0.40	Fair or Better	None	None	0.78	0.11	Fair or Better	High	None
17-4	245 - 253	8	Rural	Uninterrupted	0.64	Fair or Better	Low	0.78	Fair or Better	Medium	0.38	0.38	Fair or Better	None	None	0.75	0.61	Fair or Better	Medium	Medium
17-5	253 - 263	10	Rural	Uninterrupted	0.59	Fair or Better	None	0.72	Fair or Better	Medium	0.38	0.40	Fair or Better	None	None	0.42	0.28	Fair or Better	Low	None
17-6	263 - 279	16	Rural	Uninterrupted	0.37	Fair or Better	None	0.45	Fair or Better	None	0.33	0.33	Fair or Better	None	None	0.05	0.15	Fair or Better	None	None
17-7	279 - 288	9	Rural	Uninterrupted	0.55	Fair or Better	None	0.68	Fair or Better	Low	0.47	0.48	Fair or Better	None	None	0.27	0.11	Fair or Better	None	None
17-8	288 - 299	11	Rural	Uninterrupted	0.39	Fair or Better	None	0.47	Fair or Better	None	0.35	0.35	Fair or Better	None	None	0.15	0.22	Fair or Better	None	None
17-9	299 - 307	8	Rural	Uninterrupted	0.41	Fair or Better	None	0.49	Fair or Better	None	0.32	0.32	Fair or Better	None	None	0.35	0.20	Fair or Better	None	None
17-10	307 - 316	9	Rural	Uninterrupted	0.35	Fair or Better	None	0.41	Fair or Better	None	0.27	0.27	Fair or Better	None	None	0.20	0.29	Fair or Better	None	None
17-11	316-323	7	Rural	Uninterrupted	0.29	Fair or Better	None	0.34	Fair or Better	None	0.23	0.21	Fair or Better	None	None	0.00	0.29	Fair or Better	None	None
17-12	323-340	17	Urban	Uninterrupted	0.29	Fair or Better	None	0.34	Fair or Better	None	0.18	0.18	Fair or Better	None	None	0.07	0.31	Fair or Better	None	None
Mobility Emphasis Area		Yes	Weighted Average		0.47	Good	None													

Segment	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Directional TTI (all vehicles)					Directional PTI (all vehicles)					Bicycle Accommodation			Initial Need
					Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
					NB	SB		NB	SB	NB	SB		NB	SB				
17-1	215 - 222	7	Urban	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.03	1.03	Fair or Better	None	None	99%	Fair or Better	None	High
17-2	222 - 232	10	Urban	Uninterrupted	1.08	1.05	Fair or Better	None	None	1.15	1.11	Fair or Better	None	None	100%	Fair or Better	None	Low
17-3	232 - 245	13	Rural	Uninterrupted	1.09	1.11	Fair or Better	None	None	1.17	1.20	Fair or Better	None	None	100%	Fair or Better	None	Low
17-4	245 - 253	8	Rural	Uninterrupted	1.21	1.00	Fair or Better	None	None	1.61	1.07	Fair or Better	High	None	97%	Fair or Better	None	Medium
17-5	253 - 263	10	Rural	Uninterrupted	1.20	1.14	Fair or Better	None	None	1.34	1.21	Fair or Better	None	None	100%	Fair or Better	None	Low
17-6	263 - 279	16	Rural	Uninterrupted	1.13	1.38	Fair or Better	None	Medium	1.23	1.69	Fair or Better	None	High	100%	Fair or Better	None	Low
17-7	279 - 288	9	Rural	Uninterrupted	1.09	1.15	Fair or Better	None	None	1.27	1.31	Fair or Better	None	None	98%	Fair or Better	None	Low
17-8	288 - 299	11	Rural	Uninterrupted	1.14	1.13	Fair or Better	None	None	1.27	1.24	Fair or Better	None	None	100%	Fair or Better	None	None
17-9	299 - 307	8	Rural	Uninterrupted	1.30	1.12	Fair or Better	Medium	None	1.61	1.22	Fair or Better	High	None	100%	Fair or Better	None	Low
17-10	307 - 316	9	Rural	Uninterrupted	1.29	1.13	Fair or Better	Medium	None	1.60	1.25	Fair or Better	High	None	100%	Fair or Better	None	Low
17-11	316-323	7	Rural	Uninterrupted	1.10	1.08	Fair or Better	None	None	1.18	1.16	Fair or Better	None	None	100%	Fair or Better	None	None
17-12	323-340	17	Urban	Uninterrupted	1.06	1.05	Fair or Better	None	None	1.13	1.11	Fair or Better	None	None	94%	Fair or Better	None	None

Mobility Performance Area - Needs Analysis Step 2

Segment	Segment Mileposts (MP)	Segment Length (miles)	Initial Need	Need Adjustments Recent Projects Since 2013	Final Need	Planned and Programmed Future Projects
17-1	215 - 222	7	High	None	High	Planned: Widen the mainline to five lanes and one HOV lane each direction
17-2	222 - 232	10	Low	None	Low	Planned: Widen the mainline to four lanes and one HOV lane in each direction
17-3	232 - 245	13	Low	None	Low	Planned: Widen the mainline to four lanes in each direction; SB climbing lane 238-240
17-4	245 - 253	8	Medium	None	Medium	Planned: Widen the mainline to three lanes southbound and four lanes northbound
17-5	253 - 263	10	Low	None	Low	Planned: Widen the mainline to three lanes in each direction; NB climbing lane MP 255-256
17-6	263 - 279	16	Low	None	Low	Planned: Widen the mainline to three lanes each direction; NB climbing lane MP 270-275
17-7	279 - 288	9	Low	None	Low	Planned: Widen the mainline to three lanes each direction; SB climbing lanes MP 281-285 and 284-286
17-8	288 - 299	11	None	None	None	Planned: Widen the mainline three lanes each direction; climbing lanes NB MP 294-298 and SB MP 293-295
17-9	299 - 307	8	Low	None	Low	Planned: Widen the mainline to three lanes each direction; NB climbing lane MP 299-305
17-10	307 - 316	9	Low	None	Low	Planned: Widen the mainline to three lanes each direction; NB climbing lane MP 307-311
17-11	316-323	7	None	None	None	Planned: Widen the mainline to three lanes each direction; SB climbing lanes MP 316-318
17-12	323-340	17	None	None	None	Planned: Widen the mainline to three lanes each direction

Mobility Performance Area - Needs Analysis Step 3

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Roadway Variables								Traffic Variables					Relevant Mobility Related Existing Infrastructure
				Functional Classification	Environmental Type (Urban/Rural)	Terrain	# of Lanes/ Direction	Speed Limit	Aux Lanes	Divided/ Non-Divided	% No Passing	Existing LOS	Future 2035 LOS	% Trucks	NB Buffer Index (PTI-TTI)	SB Buffer Index (PTI-TTI)	
17-1	215 - 222	7	High	Interstate	Urban	Level	4	65	Yes	Divided	0%	A-C	E/F	8%	0.03	0.03	SB DMS MP 216.5; NB DMS MP 221.8
17-2	222 - 232	10	Low	Interstate	Fringe Urban	Level	3	75	No	Divided	0%	A-C	D	10%	0.07	0.06	SB DMS MP 228.5
17-3	232 - 245	13	Low	Interstate	Rural	Rolling	2	75	No	Divided	0%	A/B	C	13%	0.08	0.09	
17-4	245 - 253	8	Medium	Interstate	Rural	Mountainous	2	65	No	Divided	0%	A/B	D-F	13%	0.40	0.07	NB DMS MP 252; Sunset Point Rest Area MP 252
17-5	253 - 263	10	Low	Interstate	Rural	Mountainous	2	75	No	Divided	0%	A/B	C	13%	0.14	0.07	
17-6	263 - 279	16	Low	Interstate	Rural	Rolling	2	75	No	Divided	0%	A/B	A/B	15%	0.10	0.31	
17-7	279 - 288	9	Low	Interstate	Rural	Mountainous	2	65	No	Divided	0%	A/B	C	13%	0.18	0.16	SB climbing lane MP 280-282
17-8	288 - 299	11	None	Interstate	Rural	Rolling	2	75	No	Divided	0%	A/B	A/B	14%	0.13	0.11	NB DMS MP 297.4; McGuireville Rest Area MP 297
17-9	299 - 307	8	Low	Interstate	Rural	Mountainous	2	75	No	Divided	0%	A/B	A/B	14%	0.31	0.10	
17-10	307 - 316	9	Low	Interstate	Rural	Mountainous	2	75	No	Divided	0%	A/B	A/B	14%	0.31	0.12	
17-11	316-323	7	None	Interstate	Rural	Rolling	2	75	No	Divided	0%	A/B	A/B	16%	0.08	0.08	
17-12	323-340	17	None	Interstate	Fringe Urban	Rolling	2	75	No	Divided	0%	A/B	A/B	14%	0.07	0.06	NB DMS MP 334.5; SB DMS MP 338

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related		
17-1	0	7	High	14	14	100%	0	0%	0	0%		• Deficiencies identified in future (2035) traffic operations and closures. • Projected future travel demand is anticipated to exceed current capacity. • Projected increase in travel demand likely influenced by new SR 303L TI • Percentage of closures related to Incidents/accidents is higher than statewide average (100% to 96%)
17-2	0	10	Low	19	19	100%	0	0%	0	0%		• Deficiencies identified in closures. • Percentage of closures related to Incidents/accidents is higher than statewide average (100% to 96%)
17-3	0	13	Low	37	35	95%	2	5%	0	0%		• Deficiency identified in future (2035) traffic operations and closures. • Projected future travel demand is anticipated to exceed current capacity. • Percentage of closures related to obstructions/hazards is higher than statewide average (5% to 3%)
17-4	0	8	Medium	29	25	86%	4	14%	0	0%		• Deficiencies identified in future (2035) traffic operations, closures, and PTI/Reliability. • Projected future travel demand is anticipated to exceed current capacity. • Future LOS issues are primarily related to grades/terrain • NB Buffer Index is 0.40 which is highest on corridor and could be classified as “Poor” Reliability. • Issues with PTI and Reliability are likely related to uphill grades in NB direction. • Closures are higher in the SB direction. Percentage of closures related to hazard/obstruction is higher than statewide average (14% to 3%)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related		
17-5	0	10	Low	25	22	88%	3	12%	0	0%		• Deficiency identified in future (2035) traffic operations and closures. • Projected future travel demand is anticipated to exceed current capacity. • Future LOS issues are primarily related to grades/terrain • Percentage of closures related to hazard/obstruction is higher than statewide average (12% to 3%)
17-6	0	16	Low	16	16	100%	0	0%	0	0%		• Deficiencies primarily related to TTI/PTI in SB direction • SB Buffer Index is 0.31 which is 2nd highest on corridor and could be classified as "Poor" Reliability. • 7 weeks of SB lane restrictions due to construction likely elevated deficiency with TTI/PTI • Percentage of closures related to Incidents/accidents is higher than statewide average (100% to 96%)
17-7	0	9	Low	17	16	94%	0	0%	1	6%		• Deficiencies primarily related to future (2035) traffic operations. • Projected future travel demand is anticipated to exceed current capacity. • Future LOS issues are primarily related to grades/terrain • Percentage of closures related to weather is higher than statewide average (6% to 1%)
17-8	0	11	None	19	18	95%	0	0%	1	5%		No identified performance deficiencies.
17-9	0	8	Low	15	12	80%	0	0%	3	20%		• Deficiencies primarily related to TTI/PTI in NB direction. • NB Buffer Index is 0.31 which is 2nd highest on corridor and could be classified as "Poor" Reliability. • Issues with TTI/PTI and Reliability are likely related to uphill grades in NB direction. • Percentage of closures related to weather is higher than statewide average (20% to 1%)
17-10	0	9	Low	12	11	92%	0	0%	1	8%		• Deficiencies primarily related to TTI/PTI in NB direction. • NB Buffer Index is 0.31 which is 2nd highest on corridor and could be classified as "Poor" Reliability. • Issues with TTI/PTI and Reliability are likely related to uphill grades in NB direction. • Percentage of closures related to weather is higher than statewide average (8% to 1%)
17-11	0	7	None	4	3	75%	0	0%	1	25%		No identified performance deficiencies.
17-12	0	17	None	15	14	93%	0	0%	1	7%		No identified performance deficiencies.

Safety Performance Area - Needs Analysis Step 1

Segment	Operating Environment		Segment Length (miles)	Segment Mileposts (MP)	Safety Index			Directional Safety Index					% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors		
					Performance Score	Performance Objective	Level of Need	NB/EB Directional Safety Index	SB/WB Directional Safety Index	Performance Objective	NB/EB Level of Need	SB/WB Level of Need	Performance Score	Performance Objective	Level of Need
17-1	Urban > 6 Lane Freeway		7	215-222	1.13	Average or Better	Medium	1.03	1.24	Average or Better	Low	Medium	0%	Average or Better	None
17-2	Urban or Rural 6 Lane Freeway		10	222-232	1.67	Average or Better	High	1.51	1.83	Average or Better	High	High	31%	Average or Better	None
17-3	Rural 4 Lane Freeway with Daily Volume > 25,000		13	232-245	0.75	Average or Better	None	0.84	0.67	Average or Better	None	None	69%	Average or Better	High
17-4	Rural 4 Lane Freeway with Daily Volume > 25,000		8	245-253	1.06	Average or Better	Low	0.49	1.64	Average or Better	None	High	35%	Average or Better	None
17-5	Rural 4 Lane Freeway with Daily Volume > 25,000		10	253-263	1.01	Average or Better	Low	1.36	0.65	Average or Better	Medium	None	35%	Average or Better	None
17-6	Rural 4 Lane Freeway with Daily Volume < 25,000		16	263-279	1.32	Average or Better	Medium	1.09	1.55	Average or Better	Medium	High	56%	Average or Better	High
17-7	Rural 4 Lane Freeway with Daily Volume > 25,000		9	279-288	0.85	Average or Better	None	0.98	0.72	Average or Better	Low	None	47%	Average or Better	Low
17-8	Rural 4 Lane Freeway with Daily Volume < 25,000		11	288-299	2.54	Average or Better	High	3.00	2.08	Average or Better	High	High	58%	Average or Better	High
17-9	Rural 4 Lane Freeway with Daily Volume < 25,000		8	299-307	2.18	Average or Better	High	2.39	1.97	Average or Better	High	High	48%	Average or Better	Low
17-10	Rural 4 Lane Freeway with Daily Volume < 25,000		9	307-316	0.86	Average or Better	None	0.81	0.91	Average or Better	None	None	50%	Average or Better	Medium
17-11	Rural 4 Lane Freeway with Daily Volume < 25,000		7	316-323	1.21	Average or Better	Medium	2.19	0.24	Average or Better	High	None	29%	Average or Better	None
17-12	Rural 4 Lane Freeway with Daily Volume < 25,000		17	323-340	1.04	Average or Better	Low	0.53	1.54	Average or Better	None	High	33%	Average or Better	None
Safety Emphasis Area?		Yes	Weighted Average		1.29	Above Average	High								

Safety Performance Area - Needs Analysis Step 1 continued

Segment	Operating Environment	Segment Length (miles)	Segment Mileposts (MP)	% of Fatal + Incapacitating Injury Crashes Involving Trucks			% of Fatal + Incapacitating Injury Crashes Involving Motorcycles			% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	
17-1	Urban > 6 Lane Freeway	7	215-222	6%	Average or Better	Medium	12%	Average or Better	None	Insufficient Data	Average or Better	N/A	High
17-2	Urban or Rural 6 Lane Freeway	10	222-232	11%	Average or Better	Medium	9%	Average or Better	None	Insufficient Data	Average or Better	N/A	High
17-3	Rural 4 Lane Freeway with Daily Volume > 25,000	13	232-245	10%	Average or Better	Low	17%	Average or Better	Medium	Insufficient Data	Average or Better	N/A	Low
17-4	Rural 4 Lane Freeway with Daily Volume > 25,000	8	245-253	12%	Average or Better	Medium	29%	Average or Better	High	Insufficient Data	Average or Better	N/A	Medium
17-5	Rural 4 Lane Freeway with Daily Volume > 25,000	10	253-263	10%	Average or Better	Low	15%	Average or Better	Medium	Insufficient Data	Average or Better	N/A	Medium
17-6	Rural 4 Lane Freeway with Daily Volume < 25,000	16	263-279	6%	Average or Better	None	17%	Average or Better	High	Insufficient Data	Average or Better	N/A	High
17-7	Rural 4 Lane Freeway with Daily Volume > 25,000	9	279-288	Insufficient Data	Average or Better	N/A	13%	Average or Better	Low	Insufficient Data	Average or Better	N/A	Low
17-8	Rural 4 Lane Freeway with Daily Volume < 25,000	11	288-299	16%	Average or Better	Medium	5%	Average or Better	None	Insufficient Data	Average or Better	N/A	High
17-9	Rural 4 Lane Freeway with Daily Volume < 25,000	8	299-307	10%	Average or Better	None	0%	Average or Better	None	Insufficient Data	Average or Better	N/A	High
17-10	Rural 4 Lane Freeway with Daily Volume < 25,000	9	307-316	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Insufficient Data	Average or Better	N/A	Low
17-11	Rural 4 Lane Freeway with Daily Volume < 25,000	7	316-323	7%	Average or Better	None	7%	Average or Better	Medium	Insufficient Data	Average or Better	N/A	High
17-12	Rural 4 Lane Freeway with Daily Volume < 25,000	17	323-340	4%	Average or Better	None	8%	Average or Better	Medium	Insufficient Data	Average or Better	N/A	Medium

Safety Performance Area - Needs Analysis Step 2

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Hot Spots	Relevant Recently Completed or Under Construction Projects (which supersede performance data)*	Final Need	Comments (may include tentatively programmed projects with potential to address need or other relevant issues identified in previous reports)
17-1	7	215-222	High	NB crash concentration MP 216-221 SB crash concentration MP 218-221	Recent reconstruction may have addressed issues	High	
17-2	10	222-232	High	NB crash concentration MP 222-224 SB crash concentration MP 224-228 SB crash concentration MP 231-232	Recent reconstruction may have addressed issues	High	
17-3	13	232-245	Low	NB crash concentration MP 238-240 SB crash concentration MP 232-235		Low	
17-4	8	245-253	Medium			Medium	
17-5	10	253-263	Medium			Medium	
17-6	16	263-279	High			High	
17-7	9	279-288	Low		Recent SB climbing lane (MP 280-282) Recent SB auxiliary lane (MP 286-287)	Low	
17-8	11	288-299	High	SB crash concentration MP 297-299		High	
17-9	8	299-307	High	SB crash concentration MP 299-302		High	
17-10	9	307-316	Low	SB crash concentration MP 311		Low	
17-11	7	316-323	High	NB crash concentration MP 317	Recent Munds Park TI (MP 322.5-323)	High	
17-12	17	323-340	Medium			Medium	

Safety Performance Area - Needs Analysis Step 3

Segment		17-1	17-2	17-3	17-4	17-5	17-6	17-7	17-8	17-9	17-10	17-11	17-12	Corridor-Wide Crash Characteristics
Mileposts		215-222	222-232	232-245	245-253	253-263	263-279	279-288	288-299	299-307	307-316	316-323	323-340	
Final Need		High	High	Low	Medium	Medium	High	Low	High	High	Low	High	Medium	
Segment Crash Overview		7 Crashes were fatal 27 Crashes had incapacitating injuries 2 Crashes involve trucks 4 Crashes involve Motorcycles	11 Crashes were fatal 24 Crashes had incapacitating injuries 3 Crashes involve trucks 3 Crashes involve Motorcycles	7 Crashes were fatal 22 Crashes had incapacitating injuries 3 Crashes involve trucks 5 Crashes involve Motorcycles	6 Crashes were fatal 11 Crashes had incapacitating injuries 2 Crashes involve trucks 5 Crashes involve Motorcycles	7 Crashes were fatal 13 Crashes had incapacitating injuries 2 Crashes involve trucks 3 Crashes involve Motorcycles	7 Crashes were fatal 11 Crashes had incapacitating injuries 1 Crashes involve trucks 3 Crashes involve Motorcycles	5 Crashes were fatal 10 Crashes had incapacitating injuries 1 Crashes involve trucks 2 Crashes involve Motorcycles	10 Crashes were fatal 9 Crashes had incapacitating injuries 3 Crashes involve trucks 1 Crashes involve Motorcycles	5 Crashes were fatal 16 Crashes had incapacitating injuries 2 Crashes involve trucks	2 Crashes were fatal 8 Crashes had incapacitating injuries 2 Crashes involve trucks	2 Crashes were fatal 12 Crashes had incapacitating injuries 1 Crashes involve trucks 1 Crashes involve Motorcycles	5 Crashes were fatal 19 Crashes had incapacitating injuries 1 Crashes involve trucks 2 Crashes involve Motorcycles	74 Crashes were fatal 182 Crashes had incapacitating injuries 23 Crashes involve trucks 29 Crashes involve Motorcycles
Segment Crash Summaries (Fatal and Serious Injury Crashes)	First Harmful Event Type	56% Involve Collision with Motor Vehicle 32% Involve Collision with Fixed Object 9% Involve Overturning	43% Involve Collision with Motor Vehicle 37% Involve Overturning 11% Involve Collision with Fixed Object	45% Involve Overturning 38% Involve Collision with Fixed Object 7% Involve Collision with Motor Vehicle	35% Involve Collision with Fixed Object 29% Involve Collision with Motor Vehicle 29% Involve Overturning	55% Involve Overturning 25% Involve Collision with Motor Vehicle 10% Involve Collision with Fixed Object	67% Involve Overturning 17% Involve Other Non-Collision** 6% Involve Collision with Motor Vehicle	40% Involve Collision with Fixed Object 33% Involve Overturning 27% Involve Collision with Motor Vehicle	32% Involve Overturning 21% Involve Collision with Motor Vehicle 21% Involve Other Non-Collision**	33% Involve Collision with Fixed Object 33% Involve Other Non-Collision** 19% Involve Collision with Motor Vehicle	50% Involve Overturning 20% Involve Collision with Motor Vehicle 20% Involve Collision with Fixed Object	50% Involve Overturning 14% Involve Collision with Motor Vehicle 14% Involve Collision with Fixed Object	78% Involve Overturning 9% Involve Collision with Fixed Object 4% Involve Collision with Motor Vehicle	40% Involve Overturning 25% Involve Collision with Motor Vehicle 22% Involve Collision with Fixed Object
	Collision Type	35% Involve Single Vehicle 24% Involve Rear End	51% Involve Single Vehicle 23% Involve Rear End	86% Involve Single Vehicle 10% Involve Rear End	59% Involve Single Vehicle 18% Involve Rear End	65% Involve Single Vehicle 10% Involve Head On	94% Involve Single Vehicle 6% Involve Angle	67% Involve Single Vehicle 13% Involve Rear End	68% Involve Single Vehicle 16% Involve Head On	81% Involve Single Vehicle 10% Involve Rear End	80% Involve Single Vehicle 10% Involve Head On	64% Involve Single Vehicle 21% Involve Other	92% Involve Single Vehicle 8% Involve Other	68% Involve Single Vehicle 11% Involve Rear End

Segment		17-1	17-2	17-3	17-4	17-5	17-6	17-7	17-8	17-9	17-10	17-11	17-12	Corridor-Wide Crash Characteristics
Mileposts		215-222	222-232	232-245	245-253	253-263	263-279	279-288	288-299	299-307	307-316	316-323	323-340	
Final Need		High	High	Low	Medium	Medium	High	Low	High	High	Low	High	Medium	
		18% Involve Angle	11% Involve Sideswipe (same)	3% Involve Other	12% Involve Head On	10% Involve Sideswipe (same)	0% Involve Left Turn	7% Involve Head On	11% Involve Other	5% Involve Angle	10% Involve Sideswipe (same)	7% Involve Angle	0% Involve Angle	7% Involve Other
	Violation or Behavior	29% Involve Inattention/Distraction	26% Involve Inattention/Distraction	31% Involve Inattention/Distraction	31% Involve Speed too Fast for Conditions	30% Involve No Improper Action	56% Involve Speed too Fast for Conditions	47% Involve Speed too Fast for Conditions	21% Involve inattention/Distraction	24% Involve Speed too Fast for Conditions	40% Involve Inattention/Distraction	43% Involve Speeds too Fast for Conditions	25% Involve Speed too Fast for Conditions	30% Involve Speed too Fast for Conditions
		15% Involve Speed too Fast for Conditions	23% Involve Speed too Fast for Conditions	17% Involve Speed too Fast for Conditions	19% Involve No Improper Action	20% Involve Speed too Fast for Conditions	17% Involve No Improper Action	20% Involve Unknown	16% Involve Drove in Opposing Lane	24% Involve Unknown	20% Involve Failure to Keep in Proper Lane	43% Involve No Improper Action	21% Involve Other	21% Involve Inattention/Distraction
		15% Involve Unsafe Lane Change	14% Involve No Improper Action	17% Involve No Improper Action	19% Involve Unknown	15% Involve Unknown	11% Involve Inattention/Distraction	13% Involve No Improper Action	16% Involve Speed too Fast for Conditions	19% Involve Failure to Keep in Proper Lane	10% Involve No Improper Action	7% Involve Failure to Keep in Proper Lane	13% Involve No Improper Action	18% Involve No Improper Action
	Lighting Conditions	56% Occur in Daylight Conditions	57% Occur in Daylight Conditions	72% Occur in Daylight Conditions	71% Occur in Daylight Conditions	65% Occur in Daylight Conditions	61% Occur in Daylight Conditions	53% Occur in Daylight Conditions	79% Occur in Daylight Conditions	62% Occur in Daylight Conditions	50% Occur in Dark-Unlighted Conditions	57% Occur in Daylight Conditions	54% Occur in Daylight Conditions	61% Occur in Daylight Conditions
		35% Occur in Dark-Lighted Conditions	20% Occur in Dark-Lighted Conditions	28% Occur in Dark-Unlighted Conditions	29% Occur in Dark-Unlighted Conditions	25% Occur in Dark-Unlighted Conditions	33% Occur in Dark-Unlighted Conditions	47% Occur in Dark-Unlighted Conditions	16% Occur in Dark-Unlighted Condition	14% Occur in Dawn Conditions	40% Occur in Daylight Conditions	36% Occur in Dark-Unlighted Conditions	38% Occur in Dark-Unlighted Conditions	24% Occur in Dark-Unlighted Conditions
		6% Occur in Dawn Conditions	14% Occur in Dark-Unlighted Conditions	0% Occur in Dawn Conditions	0% Occur in Dawn Conditions	5% Occur in Dusk Conditions	6% Occur in Dawn Conditions	0% Occur in Dawn Conditions	5% Occur in Dusk Condition	14% Occur in Dark-Unlighted Conditions	10% Occur in Dark-Unknown Lighting Conditions	7% Occur in Dusk Conditions	8% Occur in Dark-Lighted Conditions	9% Occur in Dark-Lighted Conditions
	Surface Conditions	97% Involve Dry Conditions	97% Involve Dry Conditions	93% Involve Dry Conditions	100% Involve Dry Conditions	85% Involve Dry Conditions	89% Involve Dry Conditions	87% Involve Dry Conditions	95% Involve Dry Conditions	95% Involve Dry Conditions	80% Involve Dry Conditions	50% Involve Dry Conditions	75% Involve Dry Conditions	89% Involve Dry Conditions
		3% Involve Wet Conditions	3% Involve Ice/Frost Conditions	3% Involve Wet Conditions	0% Involve Wet Conditions	15% Involve Wet Conditions	6% Involve Wet Conditions	7% Involve Wet Conditions	5% Involve Wet Conditions	5% Involve Wet Conditions	10% Involve Snow Conditions	21% Involve Snow Conditions	13% Involve Wet Conditions	5% Involve Wet Conditions
		0% Involve Snow Conditions	0% Involve Wet Conditions	3% Involve Water (standing or moving) Conditions	0% Involve Wet Conditions	0% Involve Snow Conditions	6% Involve Slush Conditions	7% Involve Ice/Frost Conditions	0% Involve Snow Conditions	0% Involve Snow Conditions	0% Involve Wet Conditions	21% Involve Ice/Frost Conditions	4% Involve Snow Conditions	2% Involve Snow Conditions
	First Unit Event	50% Involve a first unit event of Motor Vehicle in Transport	40% Involve a first unit event of Motor Vehicle in Transport	34% Involve a first unit event of Ran Off the Road (Left)	41% Involve a first unit event of Ran Off the Road (Left)	45% Involve a first unit event of Ran Off the Road (Left)	50% Involve a first unit event of Ran Off the Road (Left)	33% Involve a first unit event of Ran Off the Road (Right)	42% Involve a first unit event of Other Non-Collision	38% Involve a first unit event of Ran Off the Road (Right)	40% Involve a first unit event of Ran Off the Road (Right)	21% Involve a first unit event of Ran Off the Road (Right)	46% Involve a first unit event of Ran Off the Road (Left)	30% Involve a first unit event of Ran Off the Road (Left)
		18% Involve a first unit event of Ran Off the Road (Right)	20% Involve a first unit event of Ran Off the Road (Right)	14% Involve a first unit event of Ran Off the Road (Right)	35% Involve a first unit event of Motor Vehicle in Transport	25% Involve a first unit event of Motor Vehicle in Transport	22% Involve a first unit event of Ran Off the Road (Right)	27% Involve a first unit event of Ran Off the Road (Left)	21% Involve a first unit event of Ran Off the Road (Right)	24% Involve a first unit event of Ran Off the Road (Left)	30% Involve a first unit event of Ran Off the Road (Left)	21% Involve a first unit event of Overturn	29% Involve a first unit event of Ran Off the Road (Right)	23% Involve a first unit event of Motor Vehicle in Transport
		9% Involve a first unit event of Ran Off the Road (Left)	17% Involve a first unit event of Ran Off the Road (Left)	14% Involve a first unit event of Collision with Fixed Object	18% Involve a first unit event of Ran Off the Road (Right)	15% Involve a first unit event of Equipment Failure	11% Involve a first unit event of Equipment Failure	20% Involve a first unit event of Motor Vehicle in Transport	21% Involve a first unit event of Equipment Failure	19% Involve a first unit event of Motor Vehicle in Transport	10% Involve a first unit event of Crossed Centerline	14% Involve a first unit event of Equipment Failure	4% Involve a first unit event of Collision with Fixed Object	22% Involve a first unit event of Ran Off the Road (Right)
Driver Physical Condition		62% No Apparent Influence	60% No Apparent Influence	62% No Apparent Influence	47% No Apparent Influence	55% No Apparent Influence	56% No Apparent Influence	53% No Apparent Influence	53% No Apparent Influence	43% No Apparent Influence	50% No Apparent Influence	79% No Apparent Influence	46% No Apparent Influence	56% No Apparent Influence
		26% Under the Influence of Drugs or Alcohol	14% Under the Influence of Drugs or Alcohol	17% Unknown	29% Under the Influence of Drugs or Alcohol	25% Under the Influence of Drugs or Alcohol	22% Unknown	20% Under the Influence of Drugs or Alcohol	26% Under the Influence of Drugs or Alcohol	24% Under the Influence of Drugs or Alcohol	30% Under the Influence of Drugs or Alcohol	7% Under the Influence of Drugs or Alcohol	29% Under the Influence of Drugs or Alcohol	21% Under the Influence of Drugs or Alcohol
		9% Unknown	14% Unknown	14% Under the Influence of Drugs or Alcohol	18% Unknown	15% Unknown	17% Under the Influence of Drugs or Alcohol	20% Unknown	16% Fatigued/Fell Asleep	14% Unknown	20% Unknown	7% Fatigued/Fell Asleep	13% Fatigued/Fell Asleep	13% Unknown

Segment	17-1	17-2	17-3	17-4	17-5	17-6	17-7	17-8	17-9	17-10	17-11	17-12	Corridor-Wide Crash Characteristics
Mileposts	215-222	222-232	232-245	245-253	253-263	263-279	279-288	288-299	299-307	307-316	316-323	323-340	
Final Need	High	High	Low	Medium	Medium	High	Low	High	High	Low	High	Medium	
Safety Device Usage	62% Shoulder and Lap Belt 24% None Used 6% Unknown	61% Shoulder and Lap Belt 27% None Used 6% Unknown	55% Shoulder and Lap Belt 31% None Used 7% Helmet Used	29% Shoulder and Lap Belt 29% Helmet Used 24% None Used	30% None Used 25% Shoulder and Lap Belt 20% Air Bag Deployed/Shoulder-Lap Belt	50% Shoulder and Lap Belt 39% None Used 6% Helmet Used	40% Shoulder and Lap Belt 20% Air Bag Deployed/Shoulder-Lap Belt 20% None Used	42% Shoulder and Lap Belt 26% None Used 16% Air Bag Deployed/Shoulder-Lap Belt	62% Shoulder and Lap Belt 19% None Used 10% Air Bag Deployed/Shoulder-Lap Belt	50% Shoulder and Lap Belt 40% Air Bag Deployed/Shoulder-Lap Belt 10% None Used	50% Shoulder and Lap Belt 21% None Used 14% Helmet Used	63% Shoulder and Lap Belt 21% None Used 8% Helmet Used	51% Shoulder and Lap Belt 25% None Used 9% Air Bag Deployed/Shoulder-Lap Belt
Hot Spot Crash Summaries	Hot Spots from MP 216 to MP 221: 7 Fatalities and 22 Incapacitating Injuries. All but one crashes occurred in dry conditions, with majority being passenger vehicles crashes.	Hot Spots at MP 223 - 227, and MP 230 - 232: 8 Fatalities and 25 Incapacitating Injuries. 50% involve single vehicle crashes in dry conditions.	Hot Spots from MP 232 to MP 235 (SB) and 237 to MP 240 (NB): 5 Fatalities and 14 Incapacitating Injuries. Over 70% involve single vehicle crashes in dry conditions.					Hot Spots at MP 292 (NB) and MP 297 (SB): 4 Fatalities and 2 Incapacitating Injuries. All fatal crashes were related to wrong side drivers.	Hot Spot at MP 306.5 (NB) and MP 300 to MP 301 (SB): 4 Fatalities and 10 Incapacitating Injuries. Over 80% involve single vehicle crashes in dry conditions.	Hot Spot at MP 311 (NB) and MP 310 (SB): 6 Incapacitating Injuries. All crashes at this location were related to single vehicle rollovers.	Hot Spot at MP 317 (NB): 1 Fatal and 4 Incapacitating Injuries. 50% of the crashes involve overturning.		
Historic Projects	Recent reconstruction projects may have alleviated some contributing factors	Recent reconstruction projects may have alleviated some contributing factors	No substantial ones noted	No substantial ones noted	No substantial ones noted	No substantial ones noted	No substantial ones noted; SB Climbing Lane MP 280-282 was recently completed	No substantial ones noted	No substantial ones noted	No substantial ones noted	No substantial ones noted		
District Input				Significant crash issues in Segment 4						High number of crashes occur at MP 312 (NB) and MP 313 (NB and SB)	High number of crashes occur at MP 317 (NB)		
Contributing Factors	• Urban operating conditions • Higher traffic volume operating conditions • Improper lane changes • Driver inattention/distraction • Poor nighttime visibility or lighting • Roadside design • Inadequate signs, delineators, guardrail, or pavement markings Comment: Recent reconstruction projects may have alleviated some contributing factors	• Poor nighttime visibility or lighting • Urban operating conditions • Driver inattention/distraction Comment: Recent reconstruction projects may have alleviated some contributing factors	• Driver inattention/distraction • Roadside design • Inadequate roadway shoulders • Inadequate roadway geometry • Inadequate signs, delineators, guardrail, or pavement markings	• Roadside design • Inadequate roadway geometry • Improper lane changes • Inadequate roadway shoulders • Inadequate signs, delineators, guardrail, or pavement markings Comment: Mountainous terrain creates speed differentials between vehicle and driver types. 2-lane segment does not supply ample passing opportunities	• Roadside design • Inadequate roadway geometry • Improper lane changes • Inadequate roadway shoulders • Improper lane changes Comment: Mountainous terrain creates speed differentials between vehicle and driver types. 2-lane segment does not supply ample passing opportunities	• Speed too fast for conditions • Poor nighttime visibility or lighting • Roadside design • Inadequate roadway geometry • Inadequate roadway shoulders	• Speed too fast for conditions • Poor nighttime visibility or lighting • Roadside design • Inadequate roadway shoulders • Improper lane changes • Inadequate roadway geometry • Inadequate signs, delineators, guardrail, or pavement markings Comment: Mountainous terrain creates speed differentials between vehicle and driver types. 2-lane segment does not supply ample passing opportunities	• Driver inattention/distraction • Inadequate median width/barrier • Inadequate signing	• Roadside design • Inadequate roadway shoulders • Inadequate roadway geometry • Improper lane changes • Inadequate signs, delineators, guardrail, or pavement markings Comment: Mountainous terrain creates speed differentials between vehicle and driver types. 2-lane segment does not supply ample passing opportunities	• Poor nighttime visibility or lighting • Inadequate roadway geometry • Inadequate roadway shoulders • Roadside design Comment: Mountainous terrain creates speed differentials between vehicle and driver types. 2-lane segment does not supply ample passing opportunities	• Speed too fast for conditions • Poor nighttime visibility or lighting • Inadequate roadway geometry • Roadside design • Inadequate roadway shoulders	N/A	

Freight Performance Area - Needs Analysis Step 1

Segment	Facility Operations	Segment Mileposts (MP)	Segment Length (miles)	Freight Index			Directional TTI (trucks only)					Directional PTI (trucks only)					Closure Duration (hours/mile/year)				
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
							NB	SB		NB	SB	NB	SB		NB	SB	NB	SB		NB/EB	SB/WB
17-1	Uninterrupted	215 - 222	7	0.94	Fair or Better	None	1.03	1.03	Fair or Better	None	None	1.07	1.07	Fair or Better	None	None	133.98	4.49	Fair or Better	Medium	None
17-2	Uninterrupted	222 - 232	10	0.95	Fair or Better	None	1.02	1.00	Fair or Better	None	None	1.06	1.04	Fair or Better	None	None	108.47	0.00	Fair or Better	Medium	None
17-3	Uninterrupted	232 - 245	13	0.94	Fair or Better	None	1.01	1.03	Fair or Better	None	None	1.04	1.09	Fair or Better	None	None	209.83	19.72	Fair or Better	High	None
17-4	Uninterrupted	245 - 253	8	0.67	Fair or Better	Medium	1.34	1.07	Fair or Better	Medium	None	1.81	1.16	Fair or Better	High	None	194.02	175.25	Fair or Better	High	High
17-5	Uninterrupted	253 - 263	10	0.88	Fair or Better	None	1.09	1.02	Fair or Better	None	None	1.20	1.07	Fair or Better	None	None	119.96	49.38	Fair or Better	Medium	None
17-6	Uninterrupted	263 - 279	16	0.74	Fair or Better	None	1.03	1.27	Fair or Better	None	Low	1.08	1.61	Fair or Better	None	High	13.57	24.86	Fair or Better	None	None
17-7	Uninterrupted	279 - 288	9	0.75	Fair or Better	None	1.07	1.27	Fair or Better	None	Low	1.15	1.52	Fair or Better	None	Medium	63.96	20.73	Fair or Better	None	None
17-8	Uninterrupted	288 - 299	11	0.88	Fair or Better	None	1.08	1.05	Fair or Better	None	None	1.15	1.11	Fair or Better	None	None	32.69	44.20	Fair or Better	None	None
17-9	Uninterrupted	299 - 307	8	0.75	Fair or Better	None	1.29	1.06	Fair or Better	Medium	None	1.55	1.13	Fair or Better	Medium	None	122.53	107.00	Fair or Better	Medium	Medium
17-10	Uninterrupted	307 - 316	9	0.74	Fair or Better	None	1.25	1.07	Fair or Better	Low	None	1.57	1.15	Fair or Better	High	None	41.70	121.24	Fair or Better	None	Medium
17-11	Uninterrupted	316 - 323	7	0.94	Fair or Better	None	1.03	1.02	Fair or Better	None	None	1.07	1.06	Fair or Better	None	None	0.00	124.43	Fair or Better	None	Medium
17-12	Uninterrupted	323 - 340	17	0.93	Fair or Better	None	1.05	1.03	Fair or Better	None	None	1.10	1.06	Fair or Better	None	None	12.62	122.31	Fair or Better	None	Medium
Emphasis Area?	No	Weighted Average		0.85	Fair or Better	None															

Segment	Facility Operations	Segment Mileposts (MP)	Segment Length (miles)	Bridge Clearance (feet)			Initial Need
				Performance Score	Performance Objective	Level of Need	
17-1	Uninterrupted	215 - 222	7	16.80	Fair or Better	None	Low
17-2	Uninterrupted	222 - 232	10	16.23	Fair or Better	Low	Low
17-3	Uninterrupted	232 - 245	13	16.01	Fair or Better	Medium	Low
17-4	Uninterrupted	245 - 253	8	16.29	Fair or Better	Low	High
17-5	Uninterrupted	253 - 263	10	18.22	Fair or Better	None	Low
17-6	Uninterrupted	263 - 279	16	16.85	Fair or Better	None	Low
17-7	Uninterrupted	279 - 288	9	16.91	Fair or Better	None	Low
17-8	Uninterrupted	288 - 299	11	15.18	Fair or Better	High	Low
17-9	Uninterrupted	299 - 307	8	No UP	Fair or Better	None	Low
17-10	Uninterrupted	307 - 316	9	No UP	Fair or Better	None	Low
17-11	Uninterrupted	316 - 323	7	16.87	Fair or Better	None	Low
17-12	Uninterrupted	323 - 340	17	16.51	Fair or Better	None	Low

Freight Performance Area - Needs Analysis Step 2

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Truck Height Restriction Hot Spots (Clearance < 16.25')	Relevant Recently Completed or Under Construction Projects (which supersede performance data)*	Final Need	Comments (may include tentatively programmed projects with potential to address needs or other relevant issues identified in previous reports)
17-1	7	215 - 222	Low			Low	
17-2	10	222 - 232	Low			Low	
17-3	13	232 - 245	Low	Table Mesa Rd TI UP (MP 235.94 SB) - 15'-10" vertical clearance; Exit ramp after structure; cannot be bypassed		Low	
17-4	8	245 - 253	High			High	
17-5	10	253 - 263	Low			Low	
17-6	16	263 - 279	Low			Low	
17-7	9	279 - 288	Low		SB Climbing Lane MP 280-282	Low	Addition of climbing lane will likely have minor effect due to extent of grade
17-8	11	288 - 299	Low	McGuireville TI UP (MP 293.26 SB) - 14'-8" vertical clearance; Exit ramp after structure; cannot be bypassed		Low	
17-9	8	299 - 307	Low			Low	
17-10	9	307 - 316	Low			Low	
17-11	7	316 - 323	Low			Low	
17-12	17	323 - 340	Low			Low	

Freight Performance Area - Needs Analysis Step 3

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Roadway Variables								Traffic Variables					Relevant Mobility Related Existing Infrastructure
				Functional Classification	Environmental Type (Urban/Rural)	Terrain	# of Lanes/ Direction	Speed Limit	Aux Lanes	Divided/ Non-Divided	% No Passing	Existing LOS	Future 2035 LOS	% Trucks	NB Buffer Index (TPTI-TTTI)	SB Buffer Index (TPTI-TTTI)	
17-1	215 - 222	7	Low	Interstate	Urban	Level	4	65	Yes	Divided	0%	A-C	E/F	8%	0.03	0.04	SB DMS MP 216.5; NB DMS MP 221.8
17-2	222 - 232	10	Low	Interstate	Fringe Urban	Level	3	75	No	Divided	0%	A-C	D	10%	0.04	0.04	SB DMS MP 228.5
17-3	232 - 245	13	Low	Interstate	Rural	Rolling	2	75	No	Divided	0%	A/B	C	13%	0.03	0.05	
17-4	245 - 253	8	High	Interstate	Rural	Mountainous	2	65	No	Divided	0%	A/B	D-F	13%	0.47	0.09	NB DMS MP 252; Sunset Point Rest Area MP 252
17-5	253 - 263	10	Low	Interstate	Rural	Mountainous	2	75	No	Divided	0%	A/B	C	13%	0.11	0.05	
17-6	263 - 279	16	Low	Interstate	Rural	Rolling	2	75	No	Divided	0%	A/B	A/B	15%	0.05	0.34	
17-7	279 - 288	9	Low	Interstate	Rural	Mountainous	2	65	No	Divided	0%	A/B	C	13%	0.08	0.25	SB climbing lane MP 280-282
17-8	288 - 299	11	Low	Interstate	Rural	Rolling	2	75	No	Divided	0%	A/B	A/B	14%	0.08	0.06	NB DMS MP 297.4; McGuireville Rest Area MP 297
17-9	299 - 307	8	Low	Interstate	Rural	Mountainous	2	75	No	Divided	0%	A/B	A/B	14%	0.26	0.07	
17-10	307 - 316	9	Low	Interstate	Rural	Mountainous	2	75	No	Divided	0%	A/B	A/B	14%	0.32	0.07	
17-11	316-323	7	Low	Interstate	Rural	Rolling	2	75	No	Divided	0%	A/B	A/B	16%	0.04	0.04	
17-12	323-340	17	Low	Interstate	Fringe Urban	Rolling	2	75	No	Divided	0%	A/B	A/B	14%	0.05	0.04	NB DMS MP 334.5; SB DMS MP 338

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Duration							Non-Actionable Conditions	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related		
17-1	0	7	Low	14	14	100%	0	0%	0	0%		• Percentage of closures related to Incidents/accidents is higher than statewide average (100% to 96%) • Closure duration exceeds the statewide average
17-2	0	10	Low	19	19	100%	0	0%	0	0%		• Deficiencies identified in closures. • Percentage of closures related to Incidents/accidents is higher than statewide average (100% to 96%) • Closure duration exceeds the statewide average
17-3	0	13	Low	37	35	95%	2	5%	0	0%		• Deficiency identified in closures and vertical clearance. • Table Mesa Rd TI UP (MP 235.94 SB) - 15'-10" vertical clearance; Exit ramp after structure; cannot be bypassed. • Percentage of closures related to obstructions/hazards is higher than statewide average (5% to 3%) • Closure duration exceeds the statewide average
17-4	0	8	High	29	25	86%	4	14%	0	0%		• Deficiencies identified in closures, and PTI/Reliability. • NB Buffer Index is 0.47 which is highest on corridor and could be classified as “Poor” Reliability. • Issues with PTI and Reliability are likely related to uphill grades in NB direction. • Closure duration exceeds the statewide average • Percentage of closures related to hazard/obstruction is higher than statewide average (14% to 3%)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Duration							Non-Actionable Conditions	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related		
17-5	0	10	Low	25	22	88%	3	12%	0	0%		• Percentage of closures related to hazard/obstruction is higher than statewide average (12% to 3%) • Closure duration exceeds the statewide average
17-6	0	16	Low	16	16	100%	0	0%	0	0%		• Deficiencies primarily related to TTI/PTI in SB direction • SB Buffer Index is 0.34 which is 2nd highest on corridor • 7 weeks of SB lane restrictions due to construction likely elevated deficiency with TTI/PTI
17-7	0	9	Low	17	16	94%	0	0%	1	6%		• Deficiencies primarily related to TTI/PTI in SB direction • SB Buffer Index is 0.25 • Issues with TTI/PTI and Reliability are likely related to uphill grades in SB direction
17-8	0	11	Low	19	18	95%	0	0%	1	5%		• McGuireville TI UP (MP 293.26 SB) - 14'-8" vertical clearance; Exit ramp after structure; cannot be bypassed
17-9	0	8	Low	15	12	80%	0	0%	3	20%		• Deficiencies primarily related to TTI/PTI in NB direction. • NB Buffer Index is 0.26 • Issues with TTI/PTI and Reliability are likely related to uphill grades in NB direction. • Closure duration exceeds the statewide average and percentage of closures related to weather is higher than the statewide average (20% to 1%)
17-10	0	9	Low	12	11	92%	0	0%	1	8%		• Deficiencies primarily related to TTI/PTI in NB direction. • NB Buffer Index is 0.32 which is 3rd highest on corridor. • Issues with TTI/PTI and Reliability are likely related to uphill grades in NB direction. • Closure duration exceeds the statewide average and percentage of closures related to weather is higher than the statewide average (8% to 1%)
17-11	0	7	Low	4	3	75%	0	0%	1	25%		• Deficiency identified in closures. • Closure duration exceeds the statewide average and percentage of closures related to weather is higher than the statewide average (25% to 1%)
17-12	0	17	Low	15	14	93%	0	0%	1	7%		• Deficiency identified in closures. • Closure duration exceeds the statewide average and percentage of closures related to weather is higher than the statewide average (7% to 1%)

Appendix E: Life-Cycle Cost Analysis & Benefit Cost Analysis

MCGUIREVILLE TI (#652) / I-17 / MP 293.26

Bridge Information	
Bridge Deck Area (A225)	8995 SF
Year Built (N27)	1961
Exp Service Life	75 YR
Total Bridge Length (N49)	257 LF
Number of Spans (N45+N46)	4
Skew Angle (N34)	30 DEG
Average Elevation	3329 FT
Max Pier Height	23 FT
* Amount of Widening for Bridge	12 FT
Revised Deck Area (Bridge Replace)	12079 FT
**Scour Critical Rating (N113)	N/A

Deterioration Slope

Item	Deterioration Line Equation			Year Drop
	Slope =	Days	Years	
Substr	y =	-0.000137x	-0.050x	20.00
Superstr	y =	-0.000996x	-0.364x	2.75
Deck	y =	-0.000268x	-0.098x	10.22

*Input 0 if no widening. Input should include widening on both sides of bridge if applicable.

**If scour critical rating is 3 or lower, Option 2 should consider the implementation of scour countermeasures.

Notes:

1. Widening is intended only to correct lane and/or shoulder width deficiencies. It is not intended for adding traffic capacity (i.e. adding general purpose lanes).

Cost Multipliers		
Elevation > 4000ft	3329	1.00
Pier Height > 30ft	23	1.00
Length to # span ratio	64.25	1.1
Skew > 30degrees	30.00	1.00

L to # Span Multiplier

L/ # Span Ratio	Multiplier
=>100	1.00
=>60	1.10
<60	1.25

Skew Multiplier

Skew	Multiplier
<30	1.00
=>30	1.10

Adjusted Bridge Replace Cost	
Base Bridge Replacement Cost (Per SF)	$280.00
Bridge Replacement Cost w/ Multipliers (Per SF)	$308.00

Elevation Multiplier

Elev	Multiplier
<4000	1.00
=>4000	1.25

Pier H Multiplier

Pier H	Multiplier
<30	1.00
=>30	1.10

User input cell

Only manipulate cell value after consulting with team

Bridge History (Inspections/As-builts)

Description	Category	Year
1. Bridge was originally constructed in 1961 (I 17-2(16)).		1961
2. Bridge has been impacted several times (posted vertical clearance is 14'-8"). Multiple repairs have been carried out:		
a. 1973, 17-2-503 - miscellaneous repair including deck/curb replacement over 114' and replacement of steel girder within limits.	Repair (Deck)	1973
	Replace (Supr - Stl)	
b. 1976, I-17-2-912 - steel girder repair including web straightening and flange replacement of existing steel girder.	Replace (Supr - Stl)	1976
c. 1984, I-17-2(918) - miscellaneous repair including deck/curb replacement over 114' and replacement of steel girder within limits.	Repair (Deck)	1984
	Replace (Supr - Stl)	
d. 2011, 017-B(002)A - weld/joint repairs with concrete deck repair/epoxy overlay.	Rehab (Deck Epoxy Overlay)	2011
	Repair (Supr - Stl)	
e. 2014, NH-IM-017-B(228)T - numerous repairs including flame straightening of girders (impact), cracked weld repairs, splice repairs, replacing missing bolts/nuts at diaphragms/stiffeners, missing nuts at anchor bolts, miscellaneous paint work, and deck joint replacement.	Repair (Deck)	2014
	Replace (Supr - Stl)	
3. Epoxy overlay in 2012 bridge inspection report was noted in good condition. Inspection reports have noted scrape marks likely due to impacts in the past.		
4. 2014 inspection report was completed prior to the latest set of as-builts noted; it's not immediately clear if all items have been addressed.		

Replace / Rehab / Repair Information

BRIDGE DECK

ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Deck)	Full Deck Replacement	$154.00	25	Rating = 8
Rehab (Deck Concrete Overlay)	Overlay (Concrete)	$22.00	15	+ 2
Rehab (Deck Epoxy Overlay)	Overlay (Epoxy)	$11.00	10	+ 1
Repair (Deck)	Patch Spalls / Seal Cracks	$6.60	See Deterioration Slope	+ 0
Replace (Bridge)	Full Bridge Replacement	$308.00	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	$6.60	20	+ 0
Repair (After Rehab)	Patch Spalls / Seal Cracks	$6.60	10	+ 0

SUPERSTRUCTURE - STEEL

ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Stl)	Full SuperStr Replacement	$154.00	50	Rating = 8
Rehab (Supr - Stl)	Weld New Structural Components	$77.00	15	+ 2
Repair (Supr - Stl)	Weld Repair / Crack Relief	$11.00	See Deterioration Slope	+ 1

SUPERSTRUCTURE - CONCRETE

ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Conc)	Full SuperStr Replacement	$154.00	50	Rating = 8
Rehab (Supr - Conc)	Replace Structural Component	$77.00	15	+ 2
Repair (Supr - Conc)	Patch Spalls / Seal Cracks	$11.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	$308.00	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	$6.60	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	$6.60	10	+ 1

SUBSTRUCTURE - STRUCTURAL

ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Substr)	Full SubStr Replacement	$154.00	75	Rating = 8
Rehab (Substr)	Replace Structural Component	$77.00	50	+ 2
Repair (Substr)	Patch Spalls / Seal Cracks	$11.00	See Deterioration Slope	+ 1

SUBSTRUCTURE - SCOUR

ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Rehab (Substr - Scour)	Add scour protection slabs	$77.00	50	+ 2
Repair (Substr - Scour)	Patch Spalls / Seal Cracks	$11.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	$308.00	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	$6.60	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	$6.60	10	+ 1

Notes:

1. Individual replacements assume 50% of total bridge replacement costs

2. Individual rehabs (in cells that are not highlighted) assume 25% of total bridge replacement costs

3. When superstructure replacement is selected, either deck replacement or deck rehab should be selected as well.

MCGUIREVILLE TI (#652) / I-17 / MP 293.26

Option 1 - Replace Bridge Now

Bridge Deck Area =	8995 SF
Widen Deck Area =	12079 SF
Year Built =	1961
Exp Service Life =	75 YR

Notes:

1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.
2. When superstructure replacement is selected, deck replacement should be selected as well.
3. Deck Rehab does not account for any deck widening during replacement.
4. Widened deck area applies to bridge replacement only.
5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years.

Item	Deterioration Line Equation Slope =	Days	Years	Year Drop
Substr	y =	-0.000137x	-0.050x	20.00
Superstr	y =	-0.000996x	-0.364x	2.75
Deck	y =	-0.000268x	-0.098x	10.22

		Substructure						*Superstructure*						*Deck*						*Summary*			
	Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year	Present Value at 3%	Present Value at 7%
0	2015	7						4						7									
1	2016	7						4						7									
2	2017	7	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					4	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					7	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
3	2018	7						4						7									
4	2019	7						4						7									
5	2020	7						4						7									
6	2021	8	Replace (Bridge)	$308.00	$3,720,332.00	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	$3,720,332.00	$3,115,719.48	$2,479,014.30
7	2022	8						8						8						8			
8	2023	8						8						8						8			
9	2024	8						8						8						8			
10	2025	8						8						8						8			
11	2026	8						8						8						8			
12	2027	8						8						8						8			
13	2028	8						8						8						8			
14	2029	8						8						8						8			
15	2030	8						8						8						8			
16	2031	7						7						7						7			
17	2032	7						7						7						7			
18	2033	7						7						7						7			
19	2034	7						7						7						7			
20	2035	7						7						7						7			
21	2036	7						7						7						7			
22	2037	7						7						7						7			
23	2038	7						7						7						7			
24	2039	7						7						7						7			
25	2040	6						6						6						6			
26	2041	7	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 1	7	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 1	7	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 0	7	$239,164.20	$110,899.18	$41,183.00
27	2042	7						7						7						7			
28	2043	7						7						7						7			
29	2044	7						7						7						7			
30	2045	7						7						7						7			
31	2046	7						7						7						7			
32	2047	7						7						7						7			
33	2048	7						7						7						7			
34	2049	7						7						7						7			
35	2050	7						7						7						7			
36	2051	6						6						6						6			
37	2052	6						6						6						6			
38	2053	6						6						6						6			
39	2054	6						6						6						6			
40	2055	6						6						6						6			
41	2056	6						6						6						6			
42	2057	6						6						6						6			
43	2058	6						6						6						6			
44	2059	6						6						6						6			
45	2060	5						5						5						5			
46	2061	6	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 1	6	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 1	6	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 0	6	$239,164.20	$61,402.19	$10,642.47
47	2062	6						6						6						6			
48	2063	6						6						6						6			
49	2064	6						6						6						6			
50	2065	6						6						6						6			
51	2066	6						6						6						6			
52	2067	6						6						6						6			
53	2068	6						6						6						6			
54	2069	6						6						6						6			
55	2070	5						5						5						5			
56	2071	5						5						5						5			
57	2072	5						5						5						5			
58	2073	5						5						5						5			
59	2074	5						5						5						5			
60	2075	5						5						5						5			
61	2076	5						5						5						5			
62	2077	5						5						5						5			
63	2078	5						5						5						5			
64	2079	5						5						5						5			
65	2080	5						5						5						5			
																				Total Cost =	**$4,198,660.40**	**$3,288,020.84**	**$2,530,839.76**

Average Rating =	6.45
End Rating =	5

Comments:

MCGUIREVILLE TI (#652) / I-17 / MP 293.26

Option 2 - Perform Bridge Rehabilitiation Then Replace

Bridge Deck Area =	8995 SF
Widen Deck Area =	12079 SF
Year Built =	1961
Exp Service Life =	75 YR

Notes:

1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.
2. When superstructure replacement is selected, deck replacement should be selected as well.
3. Deck Rehab does not account for any deck widening during replacement.
4. Widened deck area applies to bridge replacement only.
5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.)
6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.

Item	Deterioration Line Equation			Year Drop
	Slope =	Days	Years	
Substr	y =	-0.000137x	-0.050x	20.00
Superstr	y =	-0.000996x	-0.364x	2.75
Deck	y =	-0.000268x	-0.098x	10.22

		Substructure						*Superstructure*						*Deck*						*Summary*			
	Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year	Present Value at 3%	Present Value at 7%
0	2015	7						4						7									
1	2016	7						4						7									
2	2017	7	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					4	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					7	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
3	2018	7						4						7									
4	2019	7						4						7									
5	2020	7						4						7									
6	2021	7	Repair (Substr)	$11.00	$98,945.00	20	+ 1	8	Replace (Supr - Stl)	$154.00	$1,385,230.00	50	Rating = 8	8	Replace (Deck)	$154.00	$1,385,230.00	25	Rating = 8	7	$2,869,405.00	$2,403,081.51	$1,912,005.71
7	2022	7						8						8						7			
8	2023	7						8						8						7			
9	2024	6						8						8						6			
10	2025	6						8						8						6			
11	2026	6						8						8						6			
12	2027	6						8						8						6			
13	2028	6						8						8						6			
14	2029	6						8						8						6			
15	2030	6						8						8						6			
16	2031	6						7						7						6			
17	2032	6						7						7						6			
18	2033	6						7						7						6			
19	2034	5						7						7						5			
20	2035	5						7						7						5			
21	2036	5						7						7						5			
22	2037	5						7						7						5			
23	2038	5						7						7						5			
24	2039	5						7						7						5			
25	2040	5						7						7						5			
26	2041	5						6						6						5			
27	2042	5						6						6						5			
28	2043	5						6						6						5			
29	2044	4						6						6						4			
30	2045	8	Replace (Bridge)	$308.00	$3,720,332.00	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	$3,720,332.00	$1,532,727.53	$488,729.29
31	2046	8						8						8						8			
32	2047	8						8						8						8			
33	2048	8						8						8						8			
34	2049	8						8						8						8			
35	2050	8						8						8						8			
36	2051	8						8						8						8			
37	2052	8						8						8						8			
38	2053	8						8						8						8			
39	2054	8						8						8						8			
40	2055	7						7						7						7			
41	2056	7						7						7						7			
42	2057	7						7						7						7			
43	2058	7						7						7						7			
44	2059	7						7						7						7			
45	2060	7						7						7						7			
46	2061	7						7						7						7			
47	2062	7						7						7						7			
48	2063	7						7						7						7			
49	2064	6						6						6						6			
50	2065	7	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 1	7	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 1	7	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 0	7	$239,164.20	$54,555.05	$8,119.09
51	2066	7						7						7						7			
52	2067	7						7						7						7			
53	2068	7						7						7						7			
54	2069	7						7						7						7			
55	2070	7						7						7						7			
56	2071	7						7						7						7			
57	2072	7						7						7						7			
58	2073	7						7						7						7			
59	2074	7						7						7						7			
60	2075	6						6						6						6			
61	2076	6						6						6						6			
62	2077	6						6						6						6			
63	2078	6						6						6						6			
64	2079	6						6						6						6			
65	2080	6						6						6						6			
																				Total Cost =	**$6,828,901.20**	**$3,990,364.09**	**$2,408,854.09**

Average Rating =	6.50
End Rating =	6

Comments:

1. Given history of girder impacts/repairs, this option assumes that bearing pedestals would be provided along with a replaced superstructure to provide ample clearance. Deck replacement included as well. Superstructure replacement may only require jacking/new pedestals.

MCGUIREVILLE TI (#652) / I-17 / MP 293.26

Option 3 - Perform Minimum Repairs Then Replace

Bridge Deck Area =	8995 SF
Widen Deck Area =	12079 SF
Year Built =	1961
Exp Service Life =	75 YR

Notes:

1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.
2. When superstructure replacement is selected, deck replacement should be selected as well.
3. Deck Rehab does not account for any deck widening during replacement.
4. Widened deck area applies to bridge replacement only.
5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.
6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.

Item	Deterioration Line Equation			Year Drop
	Slope =	Days	Years	
Substr	y =	-0.000137x	-0.050x	20.00
Superstr	y =	-0.000996x	-0.364x	2.75
Deck	y =	-0.000268x	-0.098x	10.22

		Substructure						*Superstructure*						*Deck*						*Summary*			
	Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year	Present Value at 3%	Present Value at 7%
0	2015	7						4						7									
1	2016	7						4						7									
2	2017	7	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					4	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					7	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
3	2018	7						4						7									
4	2019	7						4						7									
5	2020	7						4						7									
6	2021	7						5	Repair (Supr - Stl)	$11.00	$98,945.00	3	+ 1	7						5	$98,945.00	$82,864.88	$65,931.23
7	2022	7						5						7						5			
8	2023	7						4						7						4			
9	2024	6						5	Repair (Supr - Stl)	$11.00	$98,945.00	3	+ 1	7						5	$98,945.00	$75,833.10	$53,819.52
10	2025	6						5						6						5			
11	2026	6						4						6						4			
12	2027	6						5	Repair (Supr - Stl)	$11.00	$98,945.00	3	+ 1	6						5	$98,945.00	$69,398.03	$43,932.76
13	2028	6						5						6						5			
14	2029	6						4						6						4			
15	2030	6						5	Repair (Supr - Stl)	$11.00	$98,945.00	3	+ 1	6						5	$98,945.00	$63,509.03	$35,862.22
16	2031	6						5						6						5			
17	2032	6						4						6						4			
18	2033	6						5	Repair (Supr - Stl)	$11.00	$98,945.00	3	+ 1	6						5	$98,945.00	$58,119.76	$29,274.26
19	2034	6						5						6						5			
20	2035	6						4						5						4			
21	2036	8	Replace (Bridge)	$308.00	$3,720,332.00	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	$3,720,332.00	$1,999,861.77	$898,508.87
22	2037	8						8						8						8			
23	2038	8						8						8						8			
24	2039	8						8						8						8			
25	2040	8						8						8						8			
26	2041	8						8						8						8			
27	2042	8						8						8						8			
28	2043	8						8						8						8			
29	2044	8						8						8						8			
30	2045	8						8						8						8			
31	2046	7						7						7						7			
32	2047	7						7						7						7			
33	2048	7						7						7						7			
34	2049	7						7						7						7			
35	2050	7						7						7						7			
36	2051	7						7						7						7			
37	2052	7						7						7						7			
38	2053	7						7						7						7			
39	2054	7						7						7						7			
40	2055	6						6						6						6			
41	2056	7	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 1	7	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 1	7	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 0	7	$239,164.20	$71,181.96	$14,926.61
42	2057	7						7						7						7			
43	2058	7						7						7						7			
44	2059	7						7						7						7			
45	2060	7						7						7						7			
46	2061	7						7						7						7			
47	2062	7						7						7						7			
48	2063	7						7						7						7			
49	2064	7						7						7						7			
50	2065	7						7						7						7			
51	2066	6						6						6						6			
52	2067	6						6						6						6			
53	2068	6						6						6						6			
54	2069	6						6						6						6			
55	2070	6						6						6						6			
56	2071	6						6						6						6			
57	2072	6						6						6						6			
58	2073	6						6						6						6			
59	2074	6						6						6						6			
60	2075	5						5						5						5			
61	2076	6	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 1	6	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 1	6	Repair (After Bridge Replace)	$6.60	$79,721.40	20	+ 0	6	$239,164.20	$39,411.73	$3,857.32
62	2077	6						6						6						6			
63	2078	6						6						6						6			
64	2079	6						6						6						6			
65	2080	6						6						6						6			
																				Total Cost =	**$4,693,385.40**	**$2,460,180.27**	**$1,146,112.79**

Average Rating =	6.30
End Rating =	6

Comments:

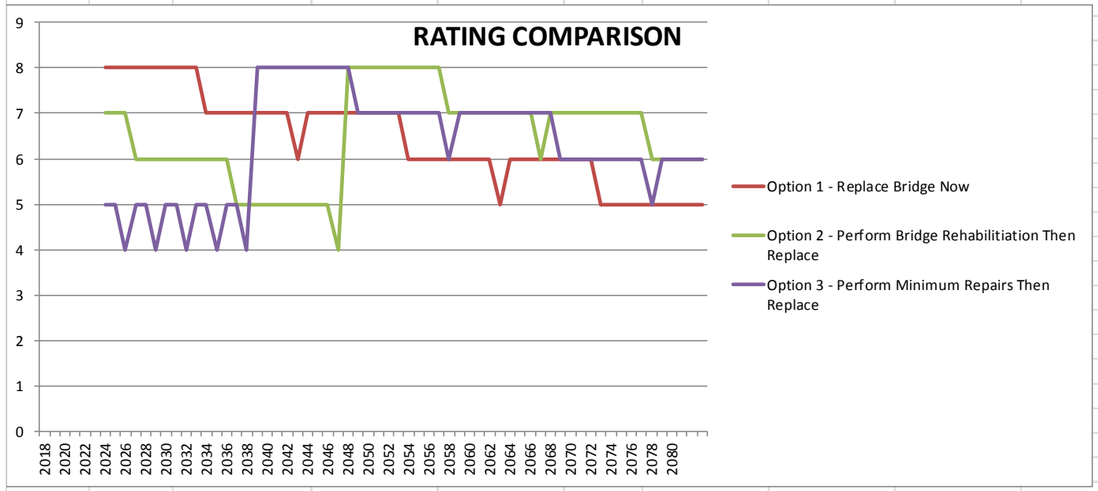
1. Repairs carried out in 2014...not reflected in current inspection. Evaluation assumes, however, that girder impacts/repairs are likely to continue with posted vertical clearance of 14'-8".

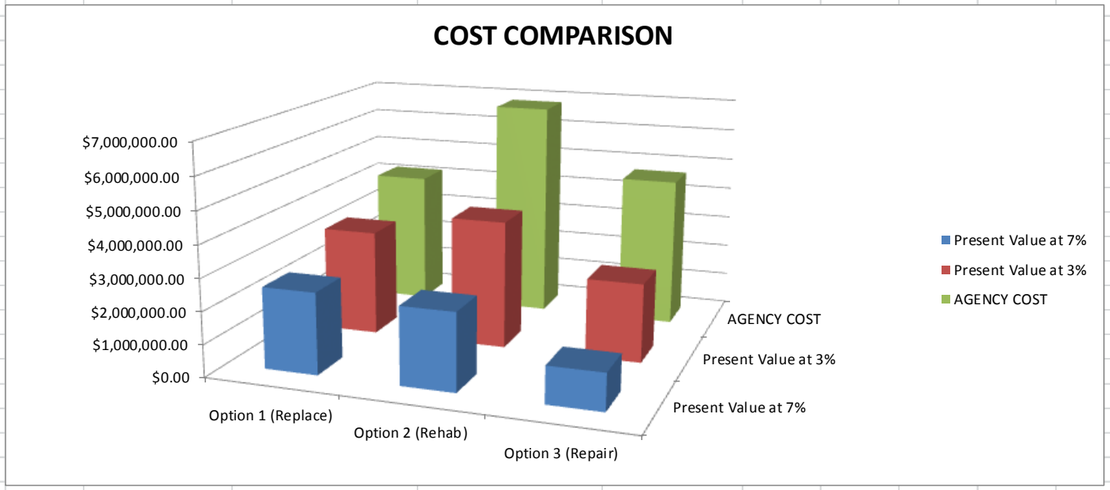
MCGUIREVILLE TI (#652) / I-17 / MP 293.26

COST COMPARISON Present Value Dollars			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	$ 4,198,660.40	$3,288,020.84	$2,530,839.76
Option 2 (Rehab)	$ 6,828,901.20	$3,990,364.09	$2,408,854.09
Option 3 (Repair)	$ 4,693,385.40	$2,460,180.27	$1,146,112.79

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	61.48%	82.40%	105.06%
3 (Repair)	89.46%	133.65%	220.82%

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	5
Option 2 (Rehab)	6.50	6
Option 3 (Repair)	6.30	6





	Present Value at 7%	Present Value at 3%	AGENCY COST
Option 1 (Replace)	$2,530,839.76	$3,288,020.84	$ 4,198,660.40
Option 2 (Rehab)	$2,408,854.09	$3,990,364.09	$ 6,828,901.20
Option 3 (Repair)	$1,146,112.79	$2,460,180.27	$ 4,693,385.40

AIRPORT ROAD TI (#632) / I-17 / MP 337.39

Bridge Information	
Bridge Deck Area (A225)	7010 SF
Year Built (N27)	1959
Exp Service Life	75 YR
Total Bridge Length (N49)	209 LF
Number of Spans (N45+N46)	5
Skew Angle (N34)	4 DEG
Average Elevation	7008 FT
Max Pier Height	16 FT
* Amount of Widening for Bridge	12 FT
Revised Deck Area (Bridge Replace)	9518 FT
**Scour Critical Rating (N113)	N/A

Deterioration Slope

Item	Deterioration Line Equation			Year Drop
	Slope =	Days	Years	
Substr	y =	-0.000913x	-0.333x	3.00
Superstr	y =	-0.000769x	-0.281x	3.56
Deck	y =	-0.000687x	-0.251x	3.99

*Input 0 if no widening. Input should include widening on both sides of bridge if applicable.

**If scour critical rating is 3 or lower, Option 2 should consider the implementation of scour countermeasures.

Notes:

1. Widening is intended only to correct lane and/or shoulder width deficiencies. It is not intended for adding traffic capacity (i.e. adding general purpose lanes).

Cost Multipliers		
Elevation > 4000ft	7008	1.25
Pier Height > 30ft	16	1.00
Length to # span ratio	41.80	1.25
Skew > 30degrees	4.00	1.00

L to # Span Multiplier

L/ # Span Ratio	Multiplier
=>100	1.00
=>60	1.10
<60	1.25

Skew Multiplier

Skew	Multiplier
<30	1.00
=>30	1.10

Adjusted Bridge Replace Cost	
Base Bridge Replacement Cost (Per SF)	$280.00
Bridge Replacement Cost w/ Multipliers (Per SF)	$437.50

Elevation Multiplier

Elev	Multiplier
<4000	1.00
=>4000	1.25

Pier H Multiplier

Pier H	Multiplier
<30	1.00
=>30	1.10

User input cell

Only manipulate cell value after consulting with team

Bridge History (Inspections/As-builts)		
Description	**Category**	**Year**
Original bridge was built in 1959 (18-2(9)138RD).		
Bridge was rehabilitated in 2011 (BR-017-B(213)A). Bridge rehabilitation consisted of:		
a. Methacrylate deck sealant/new concrete overlay (with reinforcement).	Rehab (Deck Concrete Overlay)	2011
b. Abutment corner repairs (dowels/fresh concrete) / pier cap repairs (shotcrete).	Repair (Substr)	2011
c. Precast box beam repairs.	Repair (Supr - Conc)	2011
Latest deck inspection shows that deck top has heavy density hairline to narrow sized longitudinal, transverse, and map cracks. Also, barriers		
have scaling/spalls. Box beams have impact scrapes, spalls, and cut strands. 2 interior box beams have large spalls.		
All pier caps have wide cracks, delaminations, and spalls with scaling at end caps. Columns have scaling, spalls, and rust coloration.		

Replace / Rehab / Repair Information

BRIDGE DECK

ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Deck)	Full Deck Replacement	$218.75	25	Rating = 8
Rehab (Deck Concrete Overlay)	Overlay (Concrete)	$22.00	15	+ 2
Rehab (Deck Epoxy Overlay)	Overlay (Epoxy)	$11.00	10	+ 1
Repair (Deck)	Patch Spalls / Seal Cracks	$6.60	See Deterioration Slope	+ 0
Replace (Bridge)	Full Bridge Replacement	$437.50	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	$6.60	20	+ 0
Repair (After Rehab)	Patch Spalls / Seal Cracks	$6.60	10	+ 0

SUPERSTRUCTURE - STEEL

ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Stl)	Full SuperStr Replacement	$218.75	50	Rating = 8
Rehab (Supr - Stl)	Weld New Structural Components	$109.38	15	+ 2
Repair (Supr - Stl)	Weld Repair / Crack Relief	$11.00	See Deterioration Slope	+ 1

SUPERSTRUCTURE - CONCRETE

ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Conc)	Full SuperStr Replacement	$218.75	50	Rating = 8
Rehab (Supr - Conc)	Replace Structural Component	$109.38	15	+ 2
Repair (Supr - Conc)	Patch Spalls / Seal Cracks	$11.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	$437.50	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	$6.60	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	$6.60	10	+ 1

SUBSTRUCTURE - STRUCTURAL

ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Substr)	Full SubStr Replacement	$218.75	75	Rating = 8
Rehab (Substr)	Replace Structural Component	$109.38	50	+ 2
Repair (Substr)	Patch Spalls / Seal Cracks	$11.00	See Deterioration Slope	+ 1

SUBSTRUCTURE - SCOUR

ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Rehab (Substr - Scour)	Add scour protection slabs	$109.38	50	+ 2
Repair (Substr - Scour)	Patch Spalls / Seal Cracks	$11.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	$437.50	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	$6.60	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	$6.60	10	+ 1

Notes:

1. Individual replacements assume 50% of total bridge replacement costs

2. Individual rehabs (in cells that are not highlighted) assume 25% of total bridge replacement costs

3. When superstructure replacement is selected, either deck replacement or deck rehab should be selected as well.

AIRPORT ROAD TI (#632) / I-17 / MP 337.39

Option 1 - Replace Bridge Now

Bridge Deck Area =	7010 SF
Widen Deck Area =	9518 SF
Year Built =	1959
Exp Service Life =	75 YR

Notes:

1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.
2. When superstructure replacement is selected, deck replacement should be selected as well.
3. Deck Rehab does not account for any deck widening during replacement.
4. Widened deck area applies to bridge replacement only.
5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years.

Item	Deterioration Line Equation Slope =	Days	Years	Year Drop
Substr	y =	-0.000913x	-0.333x	3.00
Superstr	y =	-0.000769x	-0.281x	3.56
Deck	y =	-0.000687x	-0.251x	3.99

		Substructure						*Superstructure*						*Deck*						*Summary*			
	Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year	Present Value at 3%	Present Value at 7%
0	2015	5						5						6									
1	2016	5						5						6									
2	2017	5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
3	2018	4						4						6									
4	2019	4						4						5									
5	2020	4						4						5									
6	2021	8	Replace (Bridge)	$437.50	$4,164,125.00	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	$4,164,125.00	$3,487,389.13	$2,774,732.31
7	2022	8						8						8						8			
8	2023	8						8						8						8			
9	2024	8						8						8						8			
10	2025	8						8						8						8			
11	2026	8						8						8						8			
12	2027	8						8						8						8			
13	2028	8						8						8						8			
14	2029	8						8						8						8			
15	2030	8						8						8						8			
16	2031	7						7						7						7			
17	2032	7						7						7						7			
18	2033	7						7						7						7			
19	2034	7						7						7						7			
20	2035	7						7						7						7			
21	2036	7						7						7						7			
22	2037	7						7						7						7			
23	2038	7						7						7						7			
24	2039	7						7						7						7			
25	2040	6						6						6						6			
26	2041	7	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+ 1	7	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+ 1	7	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+ 0	7	$188,456.40	$87,386.24	$32,451.34
27	2042	7						7						7						7			
28	2043	7						7						7						7			
29	2044	7						7						7						7			
30	2045	7						7						7						7			
31	2046	7						7						7						7			
32	2047	7						7						7						7			
33	2048	7						7						7						7			
34	2049	7						7						7						7			
35	2050	7						7						7						7			
36	2051	6						6						6						6			
37	2052	6						6						6						6			
38	2053	6						6						6						6			
39	2054	6						6						6						6			
40	2055	6						6						6						6			
41	2056	6						6						6						6			
42	2057	6						6						6						6			
43	2058	6						6						6						6			
44	2059	6						6						6						6			
45	2060	5						5						5						5			
46	2061	6	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+ 1	6	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+ 1	6	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+ 0	6	$188,456.40	$48,383.64	$8,386.04
47	2062	6						6						6						6			
48	2063	6						6						6						6			
49	2064	6						6						6						6			
50	2065	6						6						6						6			
51	2066	6						6						6						6			
52	2067	6						6						6						6			
53	2068	6						6						6						6			
54	2069	6						6						6						6			
55	2070	5						5						5						5			
56	2071	5						5						5						5			
57	2072	5						5						5						5			
58	2073	5						5						5						5			
59	2074	5						5						5						5			
60	2075	5						5						5						5			
61	2076	5						5						5						5			
62	2077	5						5						5						5			
63	2078	5						5						5						5			
64	2079	5						5						5						5			
65	2080	5						5						5						5			
																				Total Cost =	**$4,541,037.80**	**$3,623,159.01**	**$2,815,569.70**

Average Rating =	6.45
End Rating =	5

Comments:

AIRPORT ROAD TI (#632) / I-17 / MP 337.39

Option 2 - Perform Bridge Rehabilitiation Then Replace

Bridge Deck Area =	7010 SF
Widen Deck Area =	9518 SF
Year Built =	1959
Exp Service Life =	75 YR

Notes:

1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.
2. When superstructure replacement is selected, deck replacement should be selected as well.
3. Deck Rehab does not account for any deck widening during replacement.
4. Widened deck area applies to bridge replacement only.
5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.)
6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.

Item	Deterioration Line Equation			Year Drop
	Slope =	Days	Years	
Substr	y =	-0.000913x	-0.333x	3.00
Superstr	y =	-0.000769x	-0.281x	3.56
Deck	y =	-0.000687x	-0.251x	3.99

		Substructure						*Superstructure*						*Deck*						*Summary*			
	Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year	Present Value at 3%	Present Value at 7%
0	2015	5						5						6									
1	2016	5						5						6									
2	2017	5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
3	2018	4						4						6									
4	2019	4						4						5									
5	2020	4						4						5									
6	2021	5	Repair (Substr)	$11.00	$77,110.00	3	+1	5	Repair (Supr - Conc)	$11.00	$77,110.00	4	+1	5						5	$154,220.00	$129,156.82	$102,763.30
7	2022	5						5						5						5			
8	2023	5						5						4						4			
9	2024	4						4						6	Rehab (Deck Concrete Overlay)	$22.00	$154,220.00	15	+2	4	$154,220.00	$118,196.79	$83,885.46
10	2025	5	Repair (Substr)	$11.00	$77,110.00	3	+1	5	Repair (Supr - Conc)	$11.00	$77,110.00	4	+1	6						5	$154,220.00	$114,754.16	$78,397.63
11	2026	5						5						6						5			
12	2027	5						5						6						5			
13	2028	4						4						6						4			
14	2029	5	Repair (Substr)	$11.00	$77,110.00	3	+1	5	Repair (Supr - Conc)	$11.00	$77,110.00	4	+1	6						5	$154,220.00	$101,957.59	$59,809.17
15	2030	5						5						6						5			
16	2031	5						5						5						5			
17	2032	4						4						5						4			
18	2033	5	Repair (Substr)	$11.00	$77,110.00	3	+1	5	Repair (Supr - Conc)	$11.00	$77,110.00	4	+1	5						5	$154,220.00	$90,588.00	$45,628.13
19	2034	8	Replace (Bridge)	$437.50	$4,164,125.00	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	$4,164,125.00	$2,374,742.30	$1,151,415.26
20	2035	8						8						8						8			
21	2036	8						8						8						8			
22	2037	8						8						8						8			
23	2038	8						8						8						8			
24	2039	8						8						8						8			
25	2040	8						8						8						8			
26	2041	8						8						8						8			
27	2042	8						8						8						8			
28	2043	8						8						8						8			
29	2044	7						7						7						7			
30	2045	7						7						7						7			
31	2046	7						7						7						7			
32	2047	7						7						7						7			
33	2048	7						7						7						7			
34	2049	7						7						7						7			
35	2050	7						7						7						7			
36	2051	7						7						7						7			
37	2052	7						7						7						7			
38	2053	6						6						6						6			
39	2054	7	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+1	7	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+1	7	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+0	7	$188,456.40	$59,505.78	$13,466.15
40	2055	7						7						7						7			
41	2056	7						7						7						7			
42	2057	7						7						7						7			
43	2058	7						7						7						7			
44	2059	7						7						7						7			
45	2060	7						7						7						7			
46	2061	7						7						7						7			
47	2062	7						7						7						7			
48	2063	7						7						7						7			
49	2064	6						6						6						6			
50	2065	6						6						6						6			
51	2066	6						6						6						6			
52	2067	6						6						6						6			
53	2068	6						6						6						6			
54	2069	6						6						6						6			
55	2070	6						6						6						6			
56	2071	6						6						6						6			
57	2072	6						6						6						6			
58	2073	5						5						5						5			
59	2074	6	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+1	6	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+1	6	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+0	6	$188,456.40	$32,946.91	$3,479.91
60	2075	6						6						6						6			
61	2076	6						6						6						6			
62	2077	6						6						6						6			
63	2078	6						6						6						6			
64	2079	6						6						6						6			
65	2080	6						6						6						6			
																				Total Cost =	**$5,312,137.80**	**$3,021,848.34**	**$1,538,845.02**

Average Rating =	6.35
End Rating =	6

Comments:

AIRPORT ROAD TI (#632) / I-17 / MP 337.39

Option 3 - Perform Minimum Repairs Then Replace

Bridge Deck Area =	7010 SF
Widen Deck Area =	9518 SF
Year Built =	1959
Exp Service Life =	75 YR

Notes:

1. Red fill in "Year" column means current bridge is nearing the end of its expected service life.
2. When superstructure replacement is selected, deck replacement should be selected as well.
3. Deck Rehab does not account for any deck widening during replacement.
4. Widened deck area applies to bridge replacement only.
5. Repair deck (after bridge replace) should provide a deck deterioration of 1 point every 20 years. Repair (Deck) should maintain deck rating for life of repair, if the rating would otherwise drop a point (i.e., if the rating would drop from a "5" to a "4", Repair Deck would maintain a "5" at that year.
6. For other repair items, the "+" value rating should be applied to improve the bridge rating's value for that year.

Item	Deterioration Line Equation Slope =	Days	Years	Year Drop
Substr	y =	-0.000913x	-0.333x	3.00
Superstr	y =	-0.000769x	-0.281x	3.56
Deck	y =	-0.000687x	-0.251x	3.99

		Substructure						*Superstructure*						*Deck*						*Summary*			
	Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year	Present Value at 3%	Present Value at 7%
0	2015	5						5						6									
1	2016	5						5						6									
2	2017	5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
3	2018	4						4						6									
4	2019	4						4						5									
5	2020	4						4						5									
6	2021	5	Repair (Substr)	$11.00	$77,110.00	3	+ 1	5	Repair (Supr - Conc)	$11.00	$77,110.00	4	+ 1	5						5	$154,220.00	$129,156.82	$102,763.30
7	2022	5						5						5						5			
8	2023	4						5						5	Repair (Deck)	$6.60	$46,266.00	4	+ 0	4	$46,266.00	$36,522.81	$26,927.23
9	2024	5	Repair (Substr)	$11.00	$77,110.00	3	+ 1	4						5						4	$77,110.00	$59,098.39	$41,942.73
10	2025	5						5	Repair (Supr - Conc)	$11.00	$77,110.00	4	+ 1	5						5	$77,110.00	$57,377.08	$39,198.81
11	2026	4						5						5						4			
12	2027	5	Repair (Substr)	$11.00	$77,110.00	3	+ 1	5						5	Repair (Deck)	$6.60	$46,266.00	4	+ 0	5	$123,376.00	$86,533.44	$54,780.42
13	2028	5						4						5						4			
14	2029	4						5	Repair (Supr - Conc)	$11.00	$77,110.00	4	+ 1	5						4	$77,110.00	$50,978.79	$29,904.59
15	2030	5	Repair (Substr)	$11.00	$77,110.00	3	+ 1	5						5						5	$77,110.00	$49,493.97	$27,948.21
16	2031	5						5						5	Repair (Deck)	$6.60	$46,266.00	4	+ 0	5	$46,266.00	$28,831.44	$15,671.89
17	2032	4						4						5						4			
18	2033	5	Repair (Substr)	$11.00	$77,110.00	3	+ 1	5	Repair (Supr - Conc)	$11.00	$77,110.00	4	+ 1	5						5	$154,220.00	$90,588.00	$45,628.13
19	2034	8	Replace (Bridge)	$437.50	$4,164,125.00	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	$4,164,125.00	$2,374,742.30	$1,151,415.26
20	2035	8						8						8						8			
21	2036	8						8						8						8			
22	2037	8						8						8						8			
23	2038	8						8						8						8			
24	2039	8						8						8						8			
25	2040	8						8						8						8			
26	2041	8						8						8						8			
27	2042	8						8						8						8			
28	2043	8						8						8						8			
29	2044	7						7						7						7			
30	2045	7						7						7						7			
31	2046	7						7						7						7			
32	2047	7						7						7						7			
33	2048	7						7						7						7			
34	2049	7						7						7						7			
35	2050	7						7						7						7			
36	2051	7						7						7						7			
37	2052	7						7						7						7			
38	2053	6						6						6						6			
39	2054	7	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+ 1	7	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+ 1	7	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+ 0	7	$188,456.40	$59,505.78	$13,466.15
40	2055	7						7						7						7			
41	2056	7						7						7						7			
42	2057	7						7						7						7			
43	2058	7						7						7						7			
44	2059	7						7						7						7			
45	2060	7						7						7						7			
46	2061	7						7						7						7			
47	2062	7						7						7						7			
48	2063	7						7						7						7			
49	2064	6						6						6						6			
50	2065	6						6						6						6			
51	2066	6						6						6						6			
52	2067	6						6						6						6			
53	2068	6						6						6						6			
54	2069	6						6						6						6			
55	2070	6						6						6						6			
56	2071	6						6						6						6			
57	2072	6						6						6						6			
58	2073	5						5						5						5			
59	2074	6	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+ 1	6	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+ 1	6	Repair (After Bridge Replace)	$6.60	$62,818.80	20	+ 0	6	$188,456.40	$32,946.91	$3,479.91
60	2075	6						6						6						6			
61	2076	6						6						6						6			
62	2077	6						6						6						6			
63	2078	6						6						6						6			
64	2079	6						6						6						6			
65	2080	6						6						6						6			
																				Total Cost =	**$5,373,825.80**	**$3,055,775.74**	**$1,553,126.65**

Average Rating =	6.32
End Rating =	6

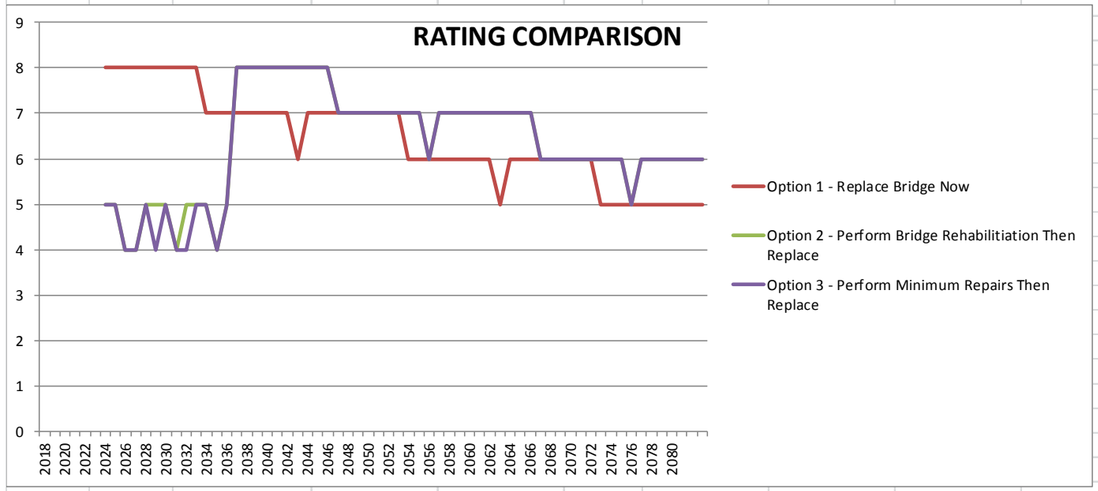
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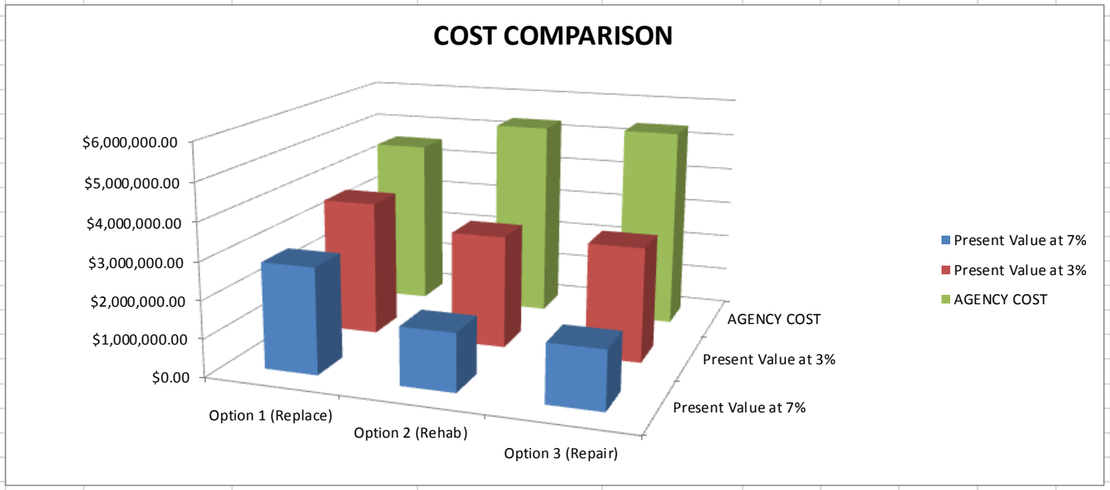
AIRPORT ROAD TI (#632) / I-17 / MP 337.39

COST COMPARISON Present Value Dollars			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	$ 4,541,037.80	$3,623,159.01	$2,815,569.70
Option 2 (Rehab)	$ 5,312,137.80	$3,021,848.34	$1,538,845.02
Option 3 (Repair)	$ 5,373,825.80	$3,055,775.74	$1,553,126.65

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	85.48%	119.90%	182.97%
3 (Repair)	84.50%	118.57%	181.28%

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	5
Option 2 (Rehab)	6.35	6
Option 3 (Repair)	6.32	6





	Present Value at 7%	Present Value at 3%	AGENCY COST
Option 1 (Replace)	$2,815,569.70	$3,623,159.01	$ 4,541,037.80
Option 2 (Rehab)	$1,538,845.02	$3,021,848.34	$ 5,312,137.80
Option 3 (Repair)	$1,553,126.65	$3,055,775.74	$ 5,373,825.80

Pavement Life-Cycle Cost Analysis Worksheet

Project Details	
Project Description	Life-Cycle Cost Analysis for I-17 Corridor Profile Study: MP 339-340
Location #	I-17, Segment 17-12
Milepost Begin	339
Milepost End	340

Roadway Characteristics			
Functional Classification	=	Interstate	
Surface Type	=	Concrete	‹‹Select from List
Traffic Directions	=	2	‹‹one-way or two-way traffic?
Number of Lanes [each direction]	=	2	
Width of Lanes (ft)	=	12	
Left shoulder width (ft)	=	4	
Right shoulder width (ft)	=	10	
Total Roadway Length (centerline miles)	=	1	
Current PSR Score	=	0	
Current Year	=	2015	
Roadway Width (ft) [each direction lanes & shoulders]	=	38	
Total Lane-Miles [Total traffic direction lanes & shoulders]	=	6.3	
Total Square Feet [Total traffic direction lanes & shoulders]	=	401,280	
Total Square Yards [Total traffic direction lanes & shoulders]	=	44,587	

LCCA Parameters		
Analysis Period (Years)	=	40
Year of Net Present Value	=	2016
First Year of Improvements	=	2020
Discount Rate (%) - Low	=	3%
Discount Rate (%) - High	=	7%
Number of Design Alternatives	=	6
Trigger Level for Rehabilitation (PSR)	=	3.4

Design Alternatives (DA)

Pavement Material Cost ($)

Treatment Type	Pavement Thickness	Typical Service Life	Lane-miles	Square Feet	Square Yards
Concrete Reconstruction	8"-12"	15-25	$350,000	$5.5	$50
Asphalt Reconstruction	8"-12"	10-20	$280,000	$4.4	$40
Concrete Medium Rehab	1"-3"	11-15	$75,000	$1.2	$11
Concrete Light Rehab	<1"	6-10	$50,000	$0.8	$7
Asphalt Medium Rehab	3"-8"	8-12	$105,000	$1.7	$15
Asphalt Light Rehab	<3"	3-7	$70,000	$1.1	$10

Reconstruction: Other Materials Cost Factor
1.60

Rehab: Other Materials Cost Factor
1.20

Total Cost Factor (e.g., includes design, mobilization, traffic control, contingency, etc.)
2.44

Total Unit Cost ($) [includes material costs and indirect costs] — **Total Bi-Directional Cost ($)**

Treatment Type	Pavement Thickness	Typical Service Life	Lane-miles	Square Feet	Square Yards	Total Cost
Concrete Reconstruction	8"-12"	15-25	$1,366,400	$21.6	$194	$8,653,867
Asphalt Reconstruction	8"-12"	10-20	$1,093,120	$17.3	$155	$6,923,093
Concrete Medium Rehab	1"-3"	11-15	$219,600	$3.5	$31	$1,390,800
Concrete Light Rehab	<1"	6-10	$146,400	$2.3	$21	$927,200
Asphalt Medium Rehab	3"-8"	8-12	$307,440	$4.9	$44	$1,947,120
Asphalt Light Rehab	<3"	3-7	$204,960	$3.2	$29	$1,298,080

Pavement LCCA - I-17 MP 339-340

Deterioration rates

Asphalt	Interstate	Desert Zone	-0.053
Asphalt	Interstate	Other	-0.071
Concrete	Interstate	Desert Zone	-0.027
Concrete	Interstate	Other	-0.033

**For Asphalt - based on Figures 5.5 and 5.8*
**For Concrete - assumed half the asphalt deterioration*
**Based on PMS report 494, developing separte deterioration models for the different traffic and thickness classes are not waranted.*

Enter Name of Design Alternative

		Concrete Reconstruction	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2015	None	$0	$0	$0
1	2016	None	$0	$0	$0
2	2017	None	$0	$0	$0
3	2018	None	$0	$0	$0
4	2019	None	$0	$0	$0
5	2020	Concrete Reconstruction	$8,653,867	$7,688,848	$6,601,993
6	2021	None	$0	$0	$0
7	2022	None	$0	$0	$0
8	2023	None	$0	$0	$0
9	2024	None	$0	$0	$0
10	2025	None	$0	$0	$0
11	2026	None	$0	$0	$0
12	2027	None	$0	$0	$0
13	2028	None	$0	$0	$0
14	2029	None	$0	$0	$0
15	2030	Concrete Light Rehab	$927,200	$612,988	$359,584
16	2031	None	$0	$0	$0
17	2032	None	$0	$0	$0
18	2033	None	$0	$0	$0
19	2034	None	$0	$0	$0
20	2035	None	$0	$0	$0
21	2036	None	$0	$0	$0
22	2037	None	$0	$0	$0
23	2038	None	$0	$0	$0
24	2039	None	$0	$0	$0
25	2040	Concrete Medium Rehab	$1,390,800	$684,181	$274,192
26	2041	None	$0	$0	$0
27	2042	None	$0	$0	$0
28	2043	None	$0	$0	$0
29	2044	None	$0	$0	$0
30	2045	None	$0	$0	$0
31	2046	None	$0	$0	$0
32	2047	None	$0	$0	$0
33	2048	None	$0	$0	$0
34	2049	None	$0	$0	$0
35	2050	Concrete Light Rehab	$927,200	$339,397	$92,923
36	2051	None	$0	$0	$0
37	2052	None	$0	$0	$0
38	2053	None	$0	$0	$0
39	2054	None	$0	$0	$0
40	2055	None	$0	$0	$0
41	2056	None	$0	$0	$0
42	2057	None	$0	$0	$0
43	2058	None	$0	$0	$0
44	2059	None	$0	$0	$0
45	2060	Concrete Medium Rehab	$1,390,800	$378,815	$70,856
46		None	$0	#VALUE!	#VALUE!
47		None	$0	#VALUE!	#VALUE!
48		None	$0	#VALUE!	#VALUE!
49		None	$0	#VALUE!	#VALUE!
50		None	$0	#VALUE!	#VALUE!
	2060	Concrete Medium Rehab	$1,390,800	$378,815	$70,856

Pick Last Improvement to calculate Remaining Service Life ››
Remaining Service Life Cost ››
Enter Year of Last Improvement ››
2060

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$9,325,415	$7,328,692
AGENCY COST	$11,899,067	

Pavement LCCA - I-17 MP 339-340

Deterioration rates

Asphalt	Interstate	Desert Zone	-0.053
Asphalt	Interstate	Other	-0.071
Concrete	Interstate	Desert Zone	-0.027
Concrete	Interstate	Other	-0.033

**For Asphalt - based on Figures 5.5 and 5.8*

**For Concrete - assumed half the asphalt deterioration*

**Based on PMS report 494, developing separte deterioration models for the different traffic and thickness classes are not waranted.*

Enter Name of Design Alternative

		Asphalt Reconstruction	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2015	None	$0	$0	$0
1	2016	None	$0	$0	$0
2	2017	None	$0	$0	$0
3	2018	None	$0	$0	$0
4	2019	None	$0	$0	$0
5	2020	Asphalt Reconstruction	$6,923,093	$6,151,079	$5,281,595
6	2021	None	$0	$0	$0
7	2022	None	$0	$0	$0
8	2023	None	$0	$0	$0
9	2024	None	$0	$0	$0
10	2025	None	$0	$0	$0
11	2026	None	$0	$0	$0
12	2027	None	$0	$0	$0
13	2028	None	$0	$0	$0
14	2029	None	$0	$0	$0
15	2030	Asphalt Light Rehab	$1,298,080	$858,184	$503,418
16	2031	None	$0	$0	$0
17	2032	None	$0	$0	$0
18	2033	None	$0	$0	$0
19	2034	None	$0	$0	$0
20	2035	None	$0	$0	$0
21	2036	None	$0	$0	$0
22	2037	None	$0	$0	$0
23	2038	None	$0	$0	$0
24	2039	None	$0	$0	$0
25	2040	Asphalt Medium Rehab	$1,947,120	$957,854	$383,868
26	2041	None	$0	$0	$0
27	2042	None	$0	$0	$0
28	2043	None	$0	$0	$0
29	2044	None	$0	$0	$0
30	2045	None	$0	$0	$0
31	2046	None	$0	$0	$0
32	2047	None	$0	$0	$0
33	2048	None	$0	$0	$0
34	2049	None	$0	$0	$0
35	2050	Asphalt Light Rehab	$1,298,080	$475,156	$130,093
36	2051	None	$0	$0	$0
37	2052	None	$0	$0	$0
38	2053	None	$0	$0	$0
39	2054	None	$0	$0	$0
40	2055	None	$0	$0	$0
41	2056	None	$0	$0	$0
42	2057	None	$0	$0	$0
43	2058	None	$0	$0	$0
44	2059	None	$0	$0	$0
45	2060	Asphalt Reconstruction	$6,923,093	$1,885,655	$352,707
46		None	$0	#VALUE!	#VALUE!
47		None	$0	#VALUE!	#VALUE!
48		None	$0	#VALUE!	#VALUE!
49		None	$0	#VALUE!	#VALUE!
50		None	$0	#VALUE!	#VALUE!

	2060	Pick Last Improvement to calculate Remaining Service Life ››	Asphalt Reconstruction	Remaining Service Life Cost ››	$6,923,093	$1,885,655	$352,707
		Enter Year of Last Improvement ››	2060				

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$8,442,272	$6,298,973
AGENCY COST	$11,466,373	

Pavement LCCA - I-17 MP 339-340

Deterioration rates

Asphalt	Interstate	Desert Zone	-0.053
Asphalt	Interstate	Other	-0.071
Concrete	Interstate	Desert Zone	-0.027
Concrete	Interstate	Other	-0.033

**For Asphalt - based on Figures 5.5 and 5.8*

**For Concrete - assumed half the asphalt deterioration*

**Based on PMS report 494, developing separte deterioration models for the different traffic and thickness classes are not waranted.*

Enter Name of Design Alternative

		Asphalt Medium Rehab Focus	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2015	None	$0	$0	$0
1	2016	None	$0	$0	$0
2	2017	None	$0	$0	$0
3	2018	None	$0	$0	$0
4	2019	None	$0	$0	$0
5	2020	Asphalt Medium Rehab	$1,947,120	$1,729,991	$1,485,449
6	2021	None	$0	$0	$0
7	2022	None	$0	$0	$0
8	2023	None	$0	$0	$0
9	2024	None	$0	$0	$0
10	2025	None	$0	$0	$0
11	2026	None	$0	$0	$0
12	2027	None	$0	$0	$0
13	2028	Asphalt Light Rehab	$1,298,080	$910,447	$576,363
14	2029	None	$0	$0	$0
15	2030	None	$0	$0	$0
16	2031	None	$0	$0	$0
17	2032	None	$0	$0	$0
18	2033	None	$0	$0	$0
19	2034	None	$0	$0	$0
20	2035	Asphalt Reconstruction	$6,923,093	$3,948,143	$1,914,293
21	2036	None	$0	$0	$0
22	2037	None	$0	$0	$0
23	2038	None	$0	$0	$0
24	2039	None	$0	$0	$0
25	2040	None	$0	$0	$0
26	2041	None	$0	$0	$0
27	2042	None	$0	$0	$0
28	2043	None	$0	$0	$0
29	2044	None	$0	$0	$0
30	2045	Asphalt Light Rehab	$1,298,080	$550,836	$182,462
31	2046	None	$0	$0	$0
32	2047	None	$0	$0	$0
33	2048	None	$0	$0	$0
34	2049	None	$0	$0	$0
35	2050	None	$0	$0	$0
36	2051	None	$0	$0	$0
37	2052	None	$0	$0	$0
38	2053	None	$0	$0	$0
39	2054	None	$0	$0	$0
40	2055	Asphalt Medium Rehab	$1,947,120	$614,810	$139,131
41	2056	None	$0	$0	$0
42	2057	None	$0	$0	$0
43	2058	None	$0	$0	$0
44	2059	None	$0	$0	$0
45	2060	None	$0	$0	$0
46		None	$0	#VALUE!	#VALUE!
47		None	$0	#VALUE!	#VALUE!
48		None	$0	#VALUE!	#VALUE!
49		None	$0	#VALUE!	#VALUE!
50		None	$0	#VALUE!	#VALUE!

	2060	Pick Last Improvement to calculate Remaining Service Life ››	Asphalt Medium Rehab	Remaining Service Life Cost ››	$0	$0	$0
		Enter Year of Last Improvement ››	2055				

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$7,754,227	$4,297,698
AGENCY COST	$13,413,493	

Pavement LCCA - I-17 MP 339-340

Deterioration rates

Asphalt	Interstate	Desert Zone	-0.053
Asphalt	Interstate	Other	-0.071
Concrete	Interstate	Desert Zone	-0.027
Concrete	Interstate	Other	-0.033

**For Asphalt - based on Figures 5.5 and 5.8*

**For Concrete - assumed half the asphalt deterioration*

**Based on PMS report 494, developing separte deterioration models for the different traffic and thickness classes are not waranted.*

		Project Description	Life-Cycle Cost Analysis for I-17 Corridor Profile Study: MP 339-340
		Location #	I-17, Segment 17-12
		Milepost Begin	339
		Milepost End	340

	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehab Focus	Asphalt Light Rehab Focus
Net Present Value - 3%	$9,325,415	$8,442,272	$7,754,227	$8,120,170
Net Present Value - 7%	$7,328,692	$6,298,973	$4,297,698	$4,435,673
Agency Cost	$11,899,067	$11,466,373	$13,413,493	$14,062,533

Enter Name of Design Alternative

		Asphalt Light Rehab Focus	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2015	None	$0	$0	$0
1	2016	None	$0	$0	$0
2	2017	None	$0	$0	$0
3	2018	None	$0	$0	$0
4	2019	None	$0	$0	$0
5	2020	Asphalt Light Rehab	$1,298,080	$1,153,327	$990,299
6	2021	None	$0	$0	$0
7	2022	None	$0	$0	$0
8	2023	None	$0	$0	$0
9	2024	None	$0	$0	$0
10	2025	Asphalt Light Rehab	$1,298,080	$994,870	$706,070
11	2026	None	$0	$0	$0
12	2027	None	$0	$0	$0
13	2028	None	$0	$0	$0
14	2029	None	$0	$0	$0
15	2030	Asphalt Light Rehab	$1,298,080	$858,184	$503,418
16	2031	None	$0	$0	$0
17	2032	None	$0	$0	$0
18	2033	None	$0	$0	$0
19	2034	None	$0	$0	$0
20	2035	Asphalt Reconstruction	$6,923,093	$3,948,143	$1,914,293
21	2036	None	$0	$0	$0
22	2037	None	$0	$0	$0
23	2038	None	$0	$0	$0
24	2039	None	$0	$0	$0
25	2040	None	$0	$0	$0
26	2041	None	$0	$0	$0
27	2042	None	$0	$0	$0
28	2043	None	$0	$0	$0
29	2044	None	$0	$0	$0
30	2045	Asphalt Light Rehab	$1,298,080	$550,836	$182,462
31	2046	None	$0	$0	$0
32	2047	None	$0	$0	$0
33	2048	None	$0	$0	$0
34	2049	None	$0	$0	$0
35	2050	None	$0	$0	$0
36	2051	None	$0	$0	$0
37	2052	None	$0	$0	$0
38	2053	None	$0	$0	$0
39	2054	None	$0	$0	$0
40	2055	Asphalt Medium Rehab	$1,947,120	$614,810	$139,131
41	2056	None	$0	$0	$0
42	2057	None	$0	$0	$0
43	2058	None	$0	$0	$0
44	2059	None	$0	$0	$0
45	2060	None	$0	$0	$0
46		None	$0	#VALUE!	#VALUE!
47		None	$0	#VALUE!	#VALUE!
48		None	$0	#VALUE!	#VALUE!
49		None	$0	#VALUE!	#VALUE!
50		None	$0	#VALUE!	#VALUE!
	2060	Asphalt Medium Rehab	$0	$0	$0

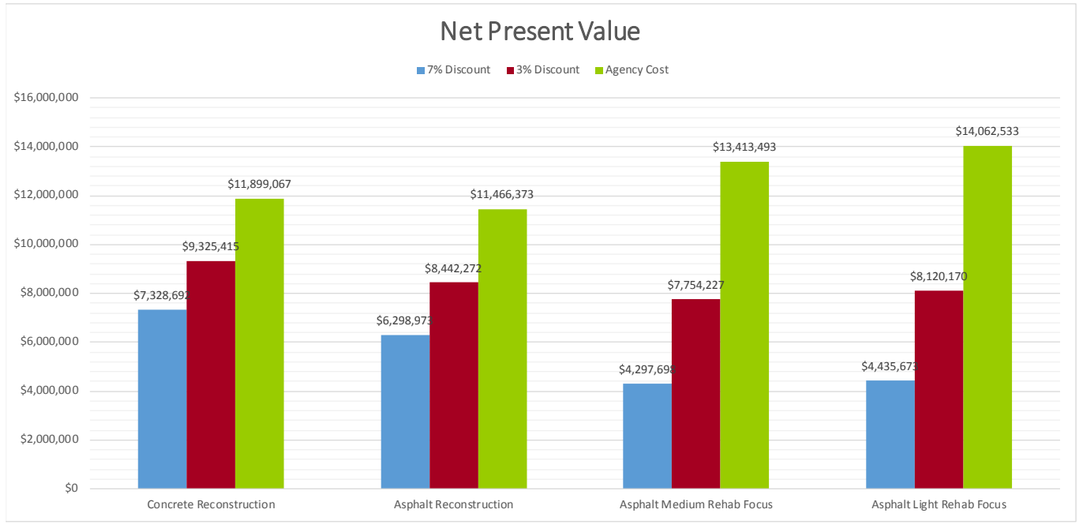
Pick Last Improvement to calculate Remaining Service Life ››

Remaining Service Life Cost ››

Enter Year of Last Improvement ›››

2055

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$8,120,170	$4,435,673
AGENCY COST	$14,062,533	



I-17 Pavement History, MP 339-340

Year	Project Number	Tracs No.	Traffic Directions	Treatment Type	Improvement Descriptionts	Thickness (inches)	Beg. MP	End MP	Length (miles)
1966		**PMS01395**	NS	Asphalt Reconstruction	Aggregate Base	4	339.4	339.8	0.40
					Bituminous Treated Surface	2			
1969		**PMS01403**	NS	Plain Portland Concrete	Plain PCCP	9	339.4	340.3	0.92
1991		**H02120**	NS	Rehab	AC with Asphaltic Rubber (AR-AC)	1.5	339.4	340.0	0.60
2003		**H2676**	N	Reconstruction	Aggregate Base	14	339.0	339.6	0.60
					Bituminous Treated Base	4			
					Asphaltic Concrete	9.5			
					ACFC With Asphaltic Rubber (AR-ACFC)	0.5			
					Aggregate Base	10	339.6	339.9	0.30
					Rubberized Membrane (Interlayer or Seal Coat)	4			
					Portland Cement Concrete [DOWELLED]	14			
2003		**H2676**	S	Reconstruction	Aggregate Base	10	338.8	339.8	1.02
					Rubberized Membrane (Interlayer or Seal Coat)	4			
					Portland Cement Concrete [DOWELLED]	14			
					Aggregate Base	14	339.9	340.1	0.20
					Bituminous Treated Base	4			
					Asphaltic Concrete	9.5			
					ACFC With Asphaltic Rubber (AR-ACFC)	0.5			

Life-Cycle Cost Analysis Worksheet

Project Details

Project Description	Life-Cycle Cost Analysis for I-17 Corridor Profile Study: MP 326-334
Location #	I-17, Segment 17-12
Milepost Begin	326
Milepost End	334

Roadway Characteristics

Functional Classification	=	Interstate	
Surface Type	=	Asphalt	‹‹Select from List
Traffic Directions	=	1	‹‹one-way or two-way traffic?
Number of Lanes [each direction]	=	2	
Width of Lanes (ft)	=	12	
Left shoulder width (ft)	=	4	
Right shoulder width (ft)	=	10	
Total Roadway Length (centerline miles)	=	8	
Current PSR Score	=	0	
Current Year	=	2015	
Roadway Width (ft) [each direction lanes & shoulders]	=	38	
Total Lane-Miles [Total traffic direction lanes & shoulders]	=	25.3	
Total Square Feet [Total traffic direction lanes & shoulders]	=	1,605,120	
Total Square Yards [Total traffic direction lanes & shoulders]	=	178,347	

LCCA Parameters

Analysis Period (Years)	=	40
Year of Net Present Value	=	2016
First Year of Improvements	=	2020
Discount Rate (%) - Low	=	3%
Discount Rate (%) - High	=	7%
Number of Design Alternatives	=	6
Trigger Level for Rehabilitation (PSR)	=	3.4

Design Alternatives (DA)

Pavement Material Cost ($)

Treatment Type	Pavement Thickness	Typical Service Life	Lane-miles	Square Feet	Square Yards
Concrete Reconstruction	8"-12"	15-25	$350,000	$5.5	$50
Asphalt Reconstruction	8"-12"	10-20	$280,000	$4.4	$40
Concrete Medium Rehab	1"-3"	11-15	$75,000	$1.2	$11
Concrete Light Rehab	<1"	6-10	$50,000	$0.8	$7
Asphalt Medium Rehab	3"-8"	8-12	$105,000	$1.7	$15
Asphalt Light Rehab	<3"	3-7	$70,000	$1.1	$10

Reconstruction: Other Materials Cost Factor

1.60

Rehab: Other Materials Cost Factor

1.20

Total Cost Factor (e.g., includes design, mobilization, traffic control, contingency, etc.)

2.44

Total Unit Cost ($) [includes material costs and indirect costs] — **Total Bi-Directional Cost ($)**

Treatment Type	Pavement Thickness	Typical Service Life	Lane-miles	Square Feet	Square Yards	Total Cost
Concrete Reconstruction	8"-12"	15-25	$1,366,400	$21.6	$194	$34,615,467
Asphalt Reconstruction	8"-12"	10-20	$1,093,120	$17.3	$155	$27,692,373
Concrete Medium Rehab	1"-3"	11-15	$219,600	$3.5	$31	$5,563,200
Concrete Light Rehab	<1"	6-10	$146,400	$2.3	$21	$3,708,800
Asphalt Medium Rehab	3"-8"	8-12	$307,440	$4.9	$44	$7,788,480
Asphalt Light Rehab	<3"	3-7	$204,960	$3.2	$29	$5,192,320

Pavement LCCA - I-17 MP 326-334

Deterioration rates

Asphalt	Interstate	Desert Zone	-0.053
Asphalt	Interstate	Other	-0.071
Concrete	Interstate	Desert Zone	-0.027
Concrete	Interstate	Other	-0.033

**For Asphalt - based on Figures 5.5 and 5.8*

**For Concrete - assumed half the asphalt deterioration*

**Based on PMS report 494, developing separte deterioration models for the different traffic and thickness classes are not waranted.*

Enter Name of Design Alternative

		Asphalt Reconstruction	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2015	None	$0	$0	$0
1	2016	None	$0	$0	$0
2	2017	None	$0	$0	$0
3	2018	None	$0	$0	$0
4	2019	None	$0	$0	$0
5	2020	Asphalt Reconstruction	$27,692,373	$24,604,315	$21,126,379
6	2021	None	$0	$0	$0
7	2022	None	$0	$0	$0
8	2023	None	$0	$0	$0
9	2024	None	$0	$0	$0
10	2025	None	$0	$0	$0
11	2026	None	$0	$0	$0
12	2027	None	$0	$0	$0
13	2028	Asphalt Light Rehab	$5,192,320	$3,641,789	$2,305,452
14	2029	None	$0	$0	$0
15	2030	None	$0	$0	$0
16	2031	None	$0	$0	$0
17	2032	None	$0	$0	$0
18	2033	None	$0	$0	$0
19	2034	None	$0	$0	$0
20	2035	None	$0	$0	$0
21	2036	Asphalt Medium Rehab	$7,788,480	$4,312,293	$2,012,691
22	2037	None	$0	$0	$0
23	2038	None	$0	$0	$0
24	2039	None	$0	$0	$0
25	2040	None	$0	$0	$0
26	2041	None	$0	$0	$0
27	2042	None	$0	$0	$0
28	2043	None	$0	$0	$0
29	2044	Asphalt Light Rehab	$5,192,320	$2,269,442	$780,936
30	2045	None	$0	$0	$0
31	2046	None	$0	$0	$0
32	2047	None	$0	$0	$0
33	2048	None	$0	$0	$0
34	2049	None	$0	$0	$0
35	2050	None	$0	$0	$0
36	2051	None	$0	$0	$0
37	2052	Asphalt Medium Rehab	$7,788,480	$2,687,278	$681,768
38	2053	None	$0	$0	$0
39	2054	None	$0	$0	$0
40	2055	None	$0	$0	$0
41	2056	None	$0	$0	$0
42	2057	None	$0	$0	$0
43	2058	None	$0	$0	$0
44	2059	None	$0	$0	$0
45	2060	Asphalt Reconstruction	$27,692,373	$7,542,621	$1,410,828
46		None	$0	#VALUE!	#VALUE!
47		None	$0	#VALUE!	#VALUE!
48		None	$0	#VALUE!	#VALUE!
49		None	$0	#VALUE!	#VALUE!
50		None	$0	#VALUE!	#VALUE!
	2060	Asphalt Reconstruction	Remaining Service Life Cost ››	$27,692,373	$7,542,621	$1,410,828

Pick Last Improvement to calculate Remaining Service Life ››

Enter Year of Last Improvement ›› 2060

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$37,515,117	$26,907,227
AGENCY COST	$53,653,973	

Pavement LCCA - I-17 MP 326-334

Deterioration rates

Asphalt	Interstate	Desert Zone	-0.053
Asphalt	Interstate	Other	-0.071
Concrete	Interstate	Desert Zone	-0.027
Concrete	Interstate	Other	-0.033

**For Asphalt - based on Figures 5.5 and 5.8*

**For Concrete - assumed half the asphalt deterioration*

**Based on PMS report 494, developing separte deterioration models for the different traffic and thickness classes are not waranted.*

Enter Name of Design Alternative

		Asphalt Medium Rehab Focus	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2015	None	$0	$0	$0
1	2016	None	$0	$0	$0
2	2017	None	$0	$0	$0
3	2018	None	$0	$0	$0
4	2019	None	$0	$0	$0
5	2020	Asphalt Medium Rehab	$7,788,480	$6,919,964	$5,941,794
6	2021	None	$0	$0	$0
7	2022	None	$0	$0	$0
8	2023	None	$0	$0	$0
9	2024	None	$0	$0	$0
10	2025	None	$0	$0	$0
11	2026	None	$0	$0	$0
12	2027	None	$0	$0	$0
13	2028	Asphalt Light Rehab	$5,192,320	$3,641,789	$2,305,452
14	2029	None	$0	$0	$0
15	2030	None	$0	$0	$0
16	2031	None	$0	$0	$0
17	2032	None	$0	$0	$0
18	2033	Asphalt Light Rehab	$5,192,320	$3,141,439	$1,643,756
19	2034	None	$0	$0	$0
20	2035	None	$0	$0	$0
21	2036	None	$0	$0	$0
22	2037	None	$0	$0	$0
23	2038	Asphalt Medium Rehab	$7,788,480	$4,064,749	$1,757,962
24	2039	None	$0	$0	$0
25	2040	None	$0	$0	$0
26	2041	None	$0	$0	$0
27	2042	None	$0	$0	$0
28	2043	None	$0	$0	$0
29	2044	None	$0	$0	$0
30	2045	None	$0	$0	$0
31	2046	Asphalt Reconstruction	$27,692,373	$11,408,891	$3,637,867
32	2047	None	$0	$0	$0
33	2048	None	$0	$0	$0
34	2049	None	$0	$0	$0
35	2050	None	$0	$0	$0
36	2051	None	$0	$0	$0
37	2052	None	$0	$0	$0
38	2053	None	$0	$0	$0
39	2054	Asphalt Light Rehab	$5,192,320	$1,688,678	$396,988
40	2055	None	$0	$0	$0
41	2056	None	$0	$0	$0
42	2057	None	$0	$0	$0
43	2058	None	$0	$0	$0
44	2059	None	$0	$0	$0
45	2060	None	$0	$0	$0
46		None	$0	#VALUE!	#VALUE!
47		None	$0	#VALUE!	#VALUE!
48		None	$0	#VALUE!	#VALUE!
49		None	$0	#VALUE!	#VALUE!
50		None	$0	#VALUE!	#VALUE!
	2060	Asphalt Light Rehab	Remaining Service Life Cost ››	$0	$0	$0

Pick Last Improvement to calculate Remaining Service Life ››

Enter Year of Last Improvement ›› 2054

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$30,865,510	$15,683,820
AGENCY COST	$58,846,293	

Pavement LCCA - I-17 MP 326-334

Deterioration rates

Asphalt	Interstate	Desert Zone	-0.053
Asphalt	Interstate	Other	-0.071
Concrete	Interstate	Desert Zone	-0.027
Concrete	Interstate	Other	-0.033

**For Asphalt - based on Figures 5.5 and 5.8*

**For Concrete - assumed half the asphalt deterioration*

**Based on PMS report 494, developing separte deterioration models for the different traffic and thickness classes are not waranted.*

Enter Name of Design Alternative

		Asphalt Light Rehab Focus	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2015	None	$0	$0	$0
1	2016	None	$0	$0	$0
2	2017	None	$0	$0	$0
3	2018	None	$0	$0	$0
4	2019	None	$0	$0	$0
5	2020	Asphalt Light Rehab	$5,192,320	$4,613,309	$3,961,196
6	2021	None	$0	$0	$0
7	2022	None	$0	$0	$0
8	2023	None	$0	$0	$0
9	2024	None	$0	$0	$0
10	2025	Asphalt Light Rehab	$5,192,320	$3,979,481	$2,824,278
11	2026	None	$0	$0	$0
12	2027	None	$0	$0	$0
13	2028	None	$0	$0	$0
14	2029	None	$0	$0	$0
15	2030	Asphalt Medium Rehab	$7,788,480	$5,149,103	$3,020,507
16	2031	None	$0	$0	$0
17	2032	None	$0	$0	$0
18	2033	None	$0	$0	$0
19	2034	None	$0	$0	$0
20	2035	None	$0	$0	$0
21	2036	None	$0	$0	$0
22	2037	None	$0	$0	$0
23	2038	Asphalt Light Rehab	$5,192,320	$2,709,833	$1,171,975
24	2039	None	$0	$0	$0
25	2040	None	$0	$0	$0
26	2041	None	$0	$0	$0
27	2042	None	$0	$0	$0
28	2043	Asphalt Reconstruction	$27,692,373	$12,466,803	$4,456,544
29	2044	None	$0	$0	$0
30	2045	None	$0	$0	$0
31	2046	None	$0	$0	$0
32	2047	None	$0	$0	$0
33	2048	None	$0	$0	$0
34	2049	None	$0	$0	$0
35	2050	None	$0	$0	$0
36	2051	Asphalt Light Rehab	$5,192,320	$1,845,264	$486,328
37	2052	None	$0	$0	$0
38	2053	None	$0	$0	$0
39	2054	None	$0	$0	$0
40	2055	None	$0	$0	$0
41	2056	None	$0	$0	$0
42	2057	None	$0	$0	$0
43	2058	None	$0	$0	$0
44	2059	Asphalt Medium Rehab	$7,788,480	$2,185,003	$424,571
45	2060	None	$0	$0	$0
46		None	$0	#VALUE!	#VALUE!
47		None	$0	#VALUE!	#VALUE!
48		None	$0	#VALUE!	#VALUE!
49		None	$0	#VALUE!	#VALUE!
50		None	$0	#VALUE!	#VALUE!
	2060	Asphalt Medium Rehab	Remaining Service Life Cost ››	$6,230,784	$1,697,090	$317,436

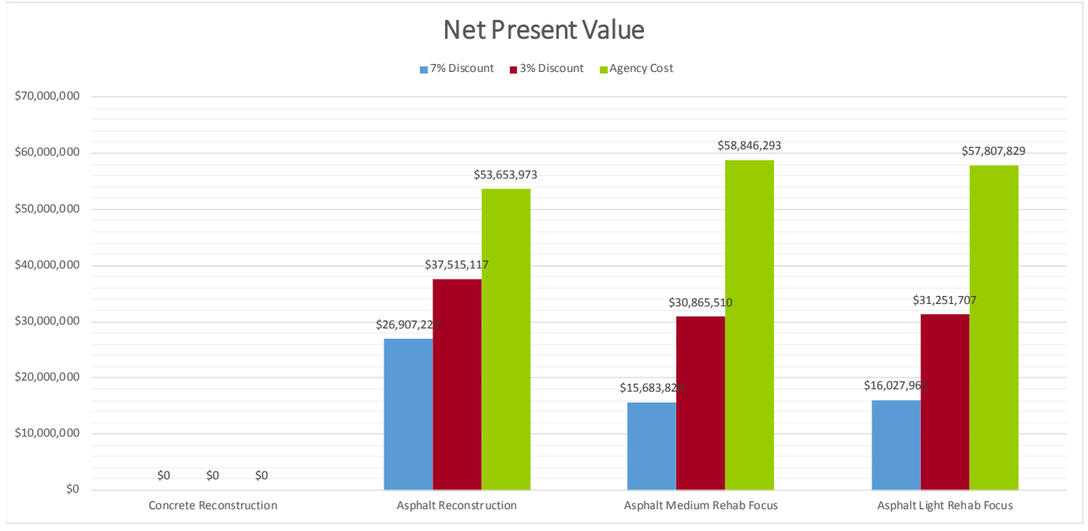
Pick Last Improvement to calculate Remaining Service Life ››

Enter Year of Last Improvement ›› 2059

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$31,251,707	$16,027,962
AGENCY COST	$57,807,829	

Project Description	Life-Cycle Cost Analysis for I-17 Corridor Profile Study: MP 326-334
Location #	I-17, Segment 17-12
Milepost Begin	326
Milepost End	334

	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehab Focus	Asphalt Light Rehab Focus
Net Present Value - 3%	#DIV/0!	$37,515,117	$30,865,510	$31,251,707
Net Present Value - 7%	#DIV/0!	$26,907,227	$15,683,820	$16,027,962
Agency Cost	#DIV/0!	$53,653,973	$58,846,293	$57,807,829



I-17 Pavement History, MP 326-334 Northbound

Year	Project Number	Tracs No.	Traffic Directions	Treatment Type	Improvement Descriptionts	Thickness (inches)	Beg. MP	End MP	Length (miles)
1961		**PMS01389**	N	Asphalt Reconstruction	Aggregate Base	9	325.9	334.3	8.45
					Bituminous Treated Surface	5	325.9	334.3	8.45
					Seal Coat - Cover Material With Emulsified Asphalt [0.3	2	325.9	334.3	8.45
1966		**PMS01401**	N	Asphalt Medium Rehab	Asphaltic Concrete	5.5	319.0	336.0	17.00
					Seal Coat - Cover Material With Emulsified Asphalt [0.3	0.3	319.0	336.0	17.00
1974		**PMS01394**	N	Asphalt Light Rehab	ACFC Asphaltic Concrete Friction Course	0.5	326.5	335.9	9.40
1988		**H02060**	N	Asphalt Medium Rehab	Remove Existing Material	3	324.0	334.6	10.58
					Asphaltic Concrete	3	324.0	334.6	10.58
					Asphaltic Concrete	1.5	324.0	334.6	10.58
					ACFC Asphaltic Concrete Friction Course	0.5	324.0	334.6	10.58
1999		**H4976**	N	Asphalt Medium Rehab	Remove Existing Material	4	312.0	339.0	27.00
					AC	4	312.0	339.0	27.00
					ACFC With Asphaltic Rubber (AR-ACFC) [0.5 to 1.0]	0.7	312.0	339.0	27.00
2008		**H7610**	N	Asphalt Light Rehab	Microseal		326.9	338.0	11.10
2009		**H77885**	N	Asphalt Light Rehab	Microseal		326.9	338.0	11.10

BENEFIT COST ANALYSIS

Introduction

The improvement alternatives evaluated in this Benefit Cost Analysis (BCA) would support the region's economy over the long-term by providing the highway users with improved capacity, generating travel time savings, incident time savings, auto and truck emissions reductions, and the reduced likelihood for accidents. In addition, the investments would have residual value that extends beyond the analysis period. The balance of this discussion describes the assumptions and methods used to develop the BCA and estimates the value of the long-term benefits generated by the investment.

All benefits are estimated in accordance with guidance provided by US Department of Transportation (USDOT) for BCAs. If no USDOT guidance was available for the estimate, the Project team consulted industry research for the best practice and information on which to base the assumptions and methods.

General Assumptions

A number of general assumptions were used throughout the analysis, including:

- Discount rates of 3% and 7% were used. Projects hoping to receive federal funds must show a 7% discount rate, and a 3% rate is shown for comparison as a representation of the economic climate of recent years.
- Construction takes place over 2020-2021
- Analysis period is 2020-2039, or 20 full years of operation
- All costs and benefits are discounted to 2016
- All values are in 2015 dollars
- Annualization factor to convert daily traffic volumes to annual volumes is assumed to be 270 days in one year

Travel Market Effects

The methodology for each of the travel market effects is described in this section. The travel market benefits include safety, travel time savings, incident delay savings, and emissions savings. Residual effects are discussed following the travel market effects.

Safety Benefits

It is anticipated that the improvement alternatives would result in a reduction in accidents along the segment being evaluated. The analysis considers the change in incapacitating injuries and fatalities that result from crashes involving single vehicles, sideswipes, rear end collisions, and other incidents.

The rates of crashes that result in fatalities and incapacitating injuries between the No Build and improvement alternatives were used to estimate the reduction in fatal and incapacitating crashes. The difference between the annual fatal and incapacitating injuries for the No Build and improvement alternatives are assumed to grow by a conservative 1% per year, indicating that these incidents are avoided by an increasing 1% of drivers. The 2014 existing value of crashes used for the No Build was escalated to 2020 by 1% per year to be comparable to the 2020 crashes for the improvement alternatives.

The total annual fatal and incapacitating injuries for the Black Canyon Hill location are shown in Table 1.

Table 1 – Black Canyon Hill Safety Data, 2020

	Avg. per year, fatal crashes	Avg. per year, Incapacitating crashes
Existing	1.27	1.27
Climbing Lane	0.92	0.90
2 Reversible Lanes	0.79	0.83
Shoulder Running	0.93	0.93

The total annual value for injury severity is based on USDOT guidance and the National Highway Safety Council estimates for the value of avoiding a crash. These estimates are applied to the number of crashes avoided to estimate the total value of crashes avoided. Table 2 provides the estimated cost of different types of injuries. Because the injuries from crashes are given as fatalities and incapacitating injuries, the value of incapacitating injuries is assumed to be MAIS 4, or severe, for this analysis. Per guidance,[1] the value of injuries avoided is escalated by 1.18% per year throughout the period of analysis.

Table 2 - Value of Injury Avoided, in $2015M

Value of Accidents Avoided	2015$ Millions
Value of Statistical Life, 2013	$9.67
MAIS 5 Critical (0.593) Fraction of VSL	$5.74
MAIS 4 Severe (0.266) Fraction of VSL	$ 2.57
MAIS 3 Serious (0.105) Fraction of VSL	$1.02
MAIS 2 Moderate (0.047) Fraction of VSL	$0.45
MAIS 1 Minor (0.003) Fraction of VSL	$0.03
No Injury, 2010	$0.00

Source: 2015 OST Guidance, see http://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

[1] Source: U.S. Department of Transportation. Guidance on Treatment of the Economic Value of a Statistical Life (VSL) in U.S. Department of Transportation Analyses – 2014 Adjustment from https://www.transportation.gov/sites/dot.gov/files/docs/VSL_Guidance_2014.pdf

Table 3 shows the total value of the reduction in highway fatalities and incapacitating injuries for each alternative in the Black Canyon Hill location.

Table 3 – Black Canyon Hill Safety Benefits, $2015M

	Discounted at 7%	Discounted at 3%
Climbing Lane	$ 56.13	$ 90.75
2 Reversible Lanes	$ 63.02	$ 101.89
Shoulder Running	$ 45.88	$ 74.18

Travel Time Savings

The improvement alternatives would result in slight speed increases during peak times at the Black Canyon Hill location, which would result in travel time savings for users.

The No Build travel time is estimated as the No Build speed divided by the effective distance of the improvement, which is 6 miles for each alternative. The same is done for the estimated speed for the alternatives. The difference between the travel time in the No Build and improvement alternatives is the time saved per vehicle.

Peak traffic volumes in the northbound and southbound direction were given for existing traffic in 2014 and for the improvement alternatives in 2035 from the travel demand model. The volumes were interpolated straight-line to get the in-between years, and are assumed to grow at a conservative 1% per year after 2035.

To calculate the travel time costs, the time was allocated by trip purpose (business or personal). It is assumed that all auto traffic is personal time, and all truck traffic is for business purposes. The value of time for truck and auto travel was based on USDOT guidance, and grows at 1.2% per year[2]. The value of time in 2020 is shown in Table 6.

Table 4 – Value of Time per Person per Hour by Mode, $2015

	2020
Truck	$28.18
Auto	$19.11

The shares of truck and auto traffic by alternative are shown in Table 5.

Table 5 – Shares of Truck and Auto Traffic for Black Canyon Hill

	Climbing Lane	2 Reversible Lanes	Shoulder Running
% Truck	13.0%	13.0%	13.0%
% Auto	87.0%	87.0%	87.0%

[2] Source: U.S. Department of Transportation. (2015). Revised Guidance on Valuation of Travel Time in Economic Analysis. Retrieved 2015, from https://www.transportation.gov/sites/dot.gov/files/docs/USDOT%20VOT%20Guidance%202014.pdf

Additionally, the number of people traveling in the vehicle must be factored into the value of the travel time savings because passengers also would benefit. The average auto occupancy used in the analysis is 1.55[3]. All peak auto trips, therefore, are multiplied by 1.55 to account for passengers in the vehicle. It is assumed that truck drivers travel alone, so the average truck occupancy rate is 1.0. Multiplying the peak travel time reduction by the value of time by mode, occupancy rates, and shares of truck and auto traffic yields the total travel time savings by alternative.

Table 6 shows the travel time savings for the Black Canyon Hill location.

Table 6 – Black Canyon Hill Travel Time Savings, $2015M

	Discounted at 7%	Discounted at 3%
Climbing Lane	$ 0.04	$ 0.06
2 Reversible Lanes	$ 0.06	$ 0.10
Shoulder Running	$ 0.04	$ 0.06

Incident Delay Savings

When incidents such as emergencies occur on the highway, delays occur for the other travelers on the segment. It is anticipated that users would experience fewer incident delays under the improvement alternatives than the No Build. This reduction in incidents experienced is travel time savings for the users. The hours of incidents avoided per year by alternative are shown in Table 7 for 2035. No incidents are avoided prior to 2020, and the hours are interpolated straight-line to get the annual hours of incident delay avoided over the analysis period. Benefits are assumed to start accruing in 2020 and grow by 1% per year after 2035.

Table 7 – Black Canyon Hill Hours of Incidents Avoided per Year in 2035

	Hours of Incidents Avoided
Climbing Lane	54,000
2 Reversible Lanes	286,000
Shoulder Running	53,000

Multiplying the annual hours of incident delay avoided by the share of truck and auto traffic and their respective values of time (as described in the Travel Time Savings section) results in the total value of incident delays avoided. The total incident delays avoided are shown in Table 8 for Black Hill Canyon.

[3] Average auto occupancy from the 2009 National Household Travel Survey for autos, from http://nhts.ornl.gov/tables09/fatcat/2009/avo_TRPTRANS_WHYTRP1S.html

Table 8 – Black Canyon Hill Value of Incident Delays Avoided, $2015M

	Discounted at 7%	Discounted at 3%
Climbing Lane	$11.58	$18.88
2 Reversible Lanes	$69.38	$113.41
Shoulder Running	$11.26	$18.40

Highway Emissions Benefits

The highway delays associated with incidents also cause idling vehicles to emit pollutants into the atmosphere. With the avoidance of incident delays as previously described, emissions would be reduced.

Decreased amounts of CO, NOx, PM2.5, PM10, VOC, CO2, and THC come from the US Environmental Protection Agency's (EPA) Office of Transportation and Air Quality published idle emissions factors for autos and trucks (g/hr.) for various pollutant types[4]. See Table 9 for the emissions rates used in the analysis.

Table 9 – Idle Emission Rates (Grams per Hour)

	CO	NOX	PM2.5	PM10	VOC	CO2	THC
LDGV (Auto)	71.225	3.515			2.683	8887	3.163
Heavy Duty Diesel, VIIIb (Truck)	34.473	42.345	1.114	1.211	4.218	10180	4.27

Source: US EPA, Office of Transportation and Air Quality, Idling Vehicle Emissions for Passenger Cars, Light-Duty Trucks, and Heavy-Duty Trucks, EPA420-F-08-025, October 2008, Table 1, http://www.epa.gov/otaq/consumer/420f08025.pdf

Since the emission rates are based on hours, the emission rate was multiplied by the annual hours saved for each alternative, consistent with the Incidents Avoided Benefit. The grams were converted to short tons and valued by applying the economic cost of air emissions to the reduction of CO, NOx, PM2.5, PM10, VOC, and CO2, as recommended in the US DOT 2015 TIGER BCA Resource Guide[5] and shown in Table 10. THC was valued using the default value in FRA's GradeDec.NET model for highway-rail grade crossing investment analysis[6].

Table 10 – Economic Cost of Air Emissions, 2015$

	2015$	Unit
Carbon Monoxide	$0	$/short ton
Volatile Organic Compounds	$1,865	$/short ton
Nitrogen Oxides	$7,354	$/short ton
Particulate Matter	$336,394	$/short ton
Carbon Dioxide*	*Varies, $56.40 (2020)*	$/metric ton
Hydrocarbons (THC)**	$2,040	$/short ton

Note: The Resource Guide converts these values into 2013 dollars. Escalated to 2015$ using the GDP Deflator
*CO2 value varies and is shown for 2020
**Hydrocarbons sourced from GradeDec default value
Source: Corporate Average Fuel Economy for MY2017-MY2025 Passenger Cars and Light Trucks (August 2012), page 922, http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/FRIA_2017-2025.pdf
TIGER 2015 BCA Resource Guide: http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

The results of the emissions reductions for the Black Canyon Hill location are shown in Table 11 followed by the CO2 reduction results, which are only discounted at 3%.

Table 11 – Black Canyon Hill Value of Emissions Avoided, $2015M

	Discounted at 7%	Discounted at 3%
Climbing Lane	$0.08	$0.13
2 Reversible Lanes	$0.42	$0.67
Shoulder Running	$0.08	$0.13

Table 12 – Black Canyon Hill Value of CO2 Avoided, $2015M

	Discounted at 3%
Climbing Lane	$0.39
2 Reversible Lanes	$2.09
Shoulder Running	$0.38

Residual Effects

Residual Value

Construction of the new highway and bridges associated with the road right of way would have residual value after the end of the 20-year analysis period, because the useful life of these elements is longer than 20 years. The useful life of highways and streets is 60 years. The values

[4] Source: US EPA, Office of Transportation and Air Quality, Idling Vehicle Emissions for Passenger Cars, Light-Duty Trucks, and Heavy-Duty Trucks, EPA420-F-08-025, October 2008, Table 1, http://www.epa.gov/otaq/consumer/420f08025.pdf

[5] TIGER Benefit-Cost Analysis Resource Guide (updated April 2, 2015), http://www.dot.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

[6] HC valued at $2,040 per ton, assumed to be 2015 dollars.

of the highway projects were depreciated straight-line over the 60 years[7], assuming that 60% of the total capital costs are for highway construction. The first 20 years of depreciation were excluded from the residual estimation as they are the basis of the benefits estimated elsewhere in the analysis; while, the remaining 40 years were discounted at 7% and 3%.

Finally, right of way does not depreciate, so the value of the right of way acquired for the alternatives, which is assumed to be 5% of the capital costs, was also included in the residual analysis.

The total residual results for the Black Canyon Hill location are shown in Table 13.

Table 13 – Black Canyon Hill Residual Benefit, 2015$M

	Discounted at 7%	Discounted at 3%
Climbing Lane	$ 4.56	$11.38
2 Reversible Lanes	$13.20	$32.94
Shoulder Running	$4.52	$11.28

Costs

Capital Costs

The capital costs for the alternatives include the costs for the local roadway modifications and bridges. The capital costs are applied over the two year construction period for the alternatives, assumed to begin January 2020 and ending December 2021 for all alternatives. Costs are assumed to be expended 50% in 2020 and 50% in 2021 for all alternatives. The costs for the Black Canyon Hill alternatives are shown in Table 14

Table 14 – Black Canyon Hill Capital Costs, 2015$

	Climbing Lane	2 Reversible Lanes	Shoulder Running
Total Project Costs	$51,420,000	$148,820,000	$50,960,000

Operating and Maintenance Costs

Each of the improvement alternatives requires annual and periodic operating and maintenance (O&M) costs to keep the roads and bridges up to code. It is assumed that the O&M for each alternative would cost 1% of the total capital cost per year for 2025-2039. It is assumed there are no O&M costs for 2020-2024. The annual O&M costs for Black Canyon Hill are shown in Table 15.

Table 15– Black Canyon Hill Annual O&M Costs, 2015$

	Annual O&M, $M
Climbing Lane	$0.51
2 Reversible Lanes	$1.49
Shoulder Running	$0.51

Summary

Table 16 summarizes the discounted value of the benefits discussed in this memorandum. Taken in total, the benefits – residual savings, safety savings, emissions savings, CO2 reductions, incident delay savings, and travel time savings –provide greater benefits than costs for all alternatives under all discount rates.

[7] BEA Rate of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wykoff Categories, http://www.bea.gov/scb/account_articles/national/wlth2594/tableC.htm

Table 16 – Black Canyon Hill Benefit Cost Analysis

	Climbing Lane		2 Reversible Lanes		Shoulder Running	
	20 Year Analysis Period (2020 -2039)					
	Values stated in 2015 $M					
	Discounted at 7%	Discounted at 3%	Discounted at 7%	Discounted at 3%	Discounted at 7%	Discounted at 3%
Costs						
Capital Costs	$37.94	$45.02	$109.82	$130.30	$37.61	$44.62
O&M Costs	$2.73	$4.85	$7.89	$14.02	$2.70	$4.80
Total Costs	***$40.67***	***$49.87***	***$117.71***	***$144.32***	***$40.31***	***$49.42***
Benefits						
Travel Market Effects						
Safety Savings	$56.13	$90.75	$63.02	$101.89	$45.88	$74.18
Emissions Savings	$0.08	$0.13	$0.42	$0.67	$0.08	$0.13
CO2 Reductions	$0.39	$0.39	$2.09	$2.09	$0.38	$0.38
Incident Delay Avoided	$11.58	$18.88	$69.38	$113.41	$11.26	$18.40
Travel Time Savings	$0.04	$0.06	$0.06	$0.10	$0.04	$0.06
Residual Effects						
Residual Value	$4.56	$11.38	$13.20	$32.94	$4.52	$11.28
Total Benefits	***$72.78***	***$121.60***	***$148.17***	***$251.12***	***$62.15***	***$104.43***
BC Ratio	**1.79**	**2.44**	**1.26**	**1.74**	**1.54**	**2.11**

*Climate Change (CO2) benefits are only discounted at 3% per Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, Feb 2010

Capital Costs

Discount Rates	3%
	7%
Discount year	2016

I-17 Location 1 Black Canyon Hill Inputs

Cost Category	Climbing Lane	2 Reversible Lanes	Shoulder Running
Total Project Costs	$ 51,420,000	$ 148,820,000	$ 50,960,000
Values in $2015			

Assumes all Alternatives have the same spending schedule	2020	2021	2022
Assumes the following distribution of costs across the years:	50%	50%	0%

I-17 Location 1 Black Canyon Hill Outputs

Climbing Lane

	2020	2021	2022
Total	**$ 25,710,000**	**$ 25,710,000**	**$ -**

Total	**$ 25,710,000**	**$ 25,710,000**	**$ -**
Discounted at 3%	$ 22,843,002	$ 22,177,672	$ -
Discounted at 7%	$ 19,614,036	$ 18,330,875	$ -

Capital Cost Summary	Total ($M)
Total	$ 51.42
Discounted at 3%	$ 45.02
Discounted at 7%	$ 37.94

2 Reversible Lanes

	2020	2021	2022
Total	**$ 74,410,000**	**$ 74,410,000**	**$ -**

Total	**$ 74,410,000**	**$ 74,410,000**	**$ -**
Discounted at 3%	$ 66,112,321	$ 64,186,720	$ -
Discounted at 7%	$ 56,767,033	$ 53,053,302	$ -

Capital Cost Summary	Total ($M)
Total	$ 148.82
Discounted at 3%	$ 130.30
Discounted at 7%	$ 109.82

Shoulder Running

	2020	2021	2022
Total	**$ 25,480,000**	**$ 25,480,000**	**$ -**

Total	**$ 25,480,000**	**$ 25,480,000**	**$ -**
Discounted at 3%	$ 22,638,650	$ 21,979,272	$ -
Discounted at 7%	$ 19,438,570	$ 18,166,888	$ -

Capital Cost Summary	Total ($M)
Total	$ 50.96
Discounted at 3%	$ 44.62
Discounted at 7%	$ 37.61

O&M Costs

Assume O&M is 1% of Capital, per year for 2025-2039. Assume no O&M costs for 2020-2025. Assumes no change over analysis period.

Discount	0.03
	0.07
Discount year	2016

I-17 Location 1 Black Canyon Hill

Climbing Lane 1%

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Annual O&M Costs (in millions of 2015$)	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
O&M Costs						$514,200	$514,200	$514,200	$514,200	$514,200	$514,200	$514,200	$514,200	$514,200	$514,200	$514,200	$514,200	$514,200	$514,200	$514,200
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$514,200**	**$514,200**	**$514,200**	**$514,200**	**$514,200**	**$514,200**	**$514,200**	**$514,200**	**$514,200**	**$514,200**	**$514,200**	**$514,200**	**$514,200**	**$514,200**	**$514,200**
Discounted 7%	$0	$0	$0	$0	$0	$279,691	$261,393	$244,293	$228,311	$213,375	$199,416	$186,370	$174,177	$162,783	$152,133	$142,181	$132,879	$124,186	$116,062	$108,469
Discounted 3%	$0	$0	$0	$0	$0	$394,091	$382,613	$371,469	$360,650	$350,145	$339,947	$330,045	$320,432	$311,099	$302,038	$293,241	$284,700	$276,408	$268,357	$260,541

	20 year Total (2020-2039)
Millions of 2015$	$7.71
Discounted 7%	$2.73
Discounted 3%	$4.85

2 Reversible Lanes 1%

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Annual O&M Costs (in millions of 2015$)	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
O&M Costs						$1,488,200	$1,488,200	$1,488,200	$1,488,200	$1,488,200	$1,488,200	$1,488,200	$1,488,200	$1,488,200	$1,488,200	$1,488,200	$1,488,200	$1,488,200	$1,488,200	$1,488,200
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$1,488,200**	**$1,488,200**	**$1,488,200**	**$1,488,200**	**$1,488,200**	**$1,488,200**	**$1,488,200**	**$1,488,200**	**$1,488,200**	**$1,488,200**	**$1,488,200**	**$1,488,200**	**$1,488,200**	**$1,488,200**	**$1,488,200**
Discounted 7%	$0	$0	$0	$0	$0	$809,482	$756,525	$707,033	$660,779	$617,550	$577,150	$539,392	$504,105	$471,126	$440,305	$411,500	$384,579	$359,420	$335,906	$313,931
Discounted 3%	$0	$0	$0	$0	$0	$1,140,581	$1,107,361	$1,075,107	$1,043,794	$1,013,392	$983,876	$955,219	$927,397	$900,385	$874,161	$848,700	$823,980	$799,981	$776,680	$754,059

	20 year Total (2020-2039)
Millions of 2015$	$22.32
Discounted 7%	$7.89
Discounted 3%	$14.02

Shoulder Running 1%

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Annual O&M Costs (in millions of 2015$)	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
O&M Costs						$509,600	$509,600	$509,600	$509,600	$509,600	$509,600	$509,600	$509,600	$509,600	$509,600	$509,600	$509,600	$509,600	$509,600	$509,600
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$509,600**	**$509,600**	**$509,600**	**$509,600**	**$509,600**	**$509,600**	**$509,600**	**$509,600**	**$509,600**	**$509,600**	**$509,600**	**$509,600**	**$509,600**	**$509,600**	**$509,600**
Discounted 7%	$0	$0	$0	$0	$0	$277,189	$259,055	$242,107	$226,268	$211,466	$197,632	$184,702	$172,619	$161,326	$150,772	$140,909	$131,690	$123,075	$115,023	$107,499
Discounted 3%	$0	$0	$0	$0	$0	$390,566	$379,190	$368,146	$357,423	$347,013	$336,906	$327,093	$317,566	$308,316	$299,336	$290,618	$282,153	$273,935	$265,956	$258,210

	20 year Total (2020-2039)
Millions of 2015$	$7.64
Discounted 7%	$2.70
Discounted 3%	$4.80

Residual Value

Discount	3%
	7%
Discount year	2016

Type of asset	Service life (years)	Hulten-Wykoff category
Highways and streets	60	C

Source: BEA Rate of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wykoff Categories
http://www.bea.gov/scb/account_articles/national/wlth2594/tableC.htm

I-17 Location 1 Black Canyon Hill

Climbing Lane

	2015 $		
ROW does not depreciate	$ 2,571,000	5%	Assumed percentage of capital costs for ROW
		2040	
Highways and streets	$ 30,852,000	60%	Assumed percentage of capital costs for highway construction
Total Value Remaining after 2039	$ 20,568,000	$ 23,139,000	
Discounted at 3%		$ 11,382,855	
Discounted at 7%		$ 4,561,776	

Residual Summary	Total ($M)
Total	$ 23.14
Discounted at 3%	$ 11.38
Discounted at 7%	$ 4.56

2 Reversible Lanes

	2015 $		
ROW does not depreciate	$ 7,441,000	5%	Assumed percentage of capital costs for ROW
		2040	
Highways and streets	$ 89,292,000	60%	Assumed percentage of capital costs for highway construction
Total Value Remaining after 2039	$ 59,528,000	$ 66,969,000	
Discounted at 3%		$ 32,944,310	
Discounted at 7%		$ 13,202,712	

Residual Summary	Total ($M)
Total	$ 66.97
Discounted at 3%	$ 32.94
Discounted at 7%	$ 13.20

Shoulder Running

	2015 $		
ROW does not depreciate	$ 2,548,000	5%	Assumed percentage of capital costs for ROW
		2040	
Highways and streets	$ 30,576,000	60%	Assumed percentage of capital costs for highway construction
Total Value Remaining after 2039	$ 20,384,000	$ 22,932,000	
Discounted at 3%		$ 11,281,024	
Discounted at 7%		$ 4,520,966	

Residual Summary	Total ($M)
Total	$ 22.93
Discounted at 3%	$ 11.28
Discounted at 7%	$ 4.52

Safety Costs Avoided

Value of accidents avoided

Value of Accidents Avoided	**2013$ Millions**	**2015$ Millions**	
Value of Statistical Life, 2013	$ 9.400	$ 9.672	Guidance on Treatment of the Economic Value of a Statistical Life in the US, Department of Transportation Analyses 2014
MAIS 5 Critical (0.593) Fraction of VSL	$ 5.574	$ 5.735	Guidance on Treatment of the Economic Value of a Statistical Life in the US, Department of Transportation Analyses 2014
MAIS 4 Severe (0.266) Fraction of VSL	$ 2.500	$ 2.573	Guidance on Treatment of the Economic Value of a Statistical Life in the US, Department of Transportation Analyses 2014

Source: VSL, 2013 -- Guidance on Treatment of the Economic Value of a Statistical Life (VSL) in USDOT Analyses

2015 OST Guidance, see http://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

Increase VSL by 1.18% per Year per Guidance 1.18%

Source: U.S. Department of Transportation. (2015). Guidance on Treatment of the Economic Value of a Statistical Life. Retrieved 2015, from http://www.transportation.gov/sites/dot.gov/files/docs/Revised%20Departmental%20Guidance%20on%20Valuation%20of%20Travel%20Time%20in%20Economic%20Analysis.pdf

$Millions of 2015 dollars

2015	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
VSL	$ 10.256	$ 10.377	$ 10.500	$ 10.624	$ 10.749	$ 10.876	$ 11.004	$ 11.134	$ 11.265	$ 11.398	$ 11.533	$ 11.669	$ 11.807	$ 11.946	$ 12.087	$ 12.229	$ 12.374	$ 12.520	$ 12.668	$ 12.817
MAIS 5 Critical (0.593) Fraction of VSL	$ 6.082	$ 6.154	$ 6.226	$ 6.300	$ 6.374	$ 6.449	$ 6.525	$ 6.602	$ 6.680	$ 6.759	$ 6.839	$ 6.920	$ 7.001	$ 7.084	$ 7.167	$ 7.252	$ 7.338	$ 7.424	$ 7.512	$ 7.600
MAIS 4 Severe (0.266) Fraction of VSL	$ 2.728	$ 2.760	$ 2.793	$ 2.826	$ 2.859	$ 2.893	$ 2.927	$ 2.962	$ 2.997	$ 3.032	$ 3.068	$ 3.104	$ 3.141	$ 3.178	$ 3.215	$ 3.253	$ 3.291	$ 3.330	$ 3.370	$ 3.409

Discount Rates		Discount Year
0.03	0.07	2016

I-17 Location 1 Black Canyon Hill

Climbing Lane

Baseline Safety

2020	
Average Annual Fatal	1.27
Average Annual Incapacitating	1.27

Note: assume incapacitating are MAIS 4 (severe) injuries

Future Safety

2020	
Average Annual Fatal	0.88
Average Annual Incapacitating	0.72

Note: assume incapacitating are MAIS 4 (severe) injuries

Annual growth factor for incidents (thus a reduction in incidents avoided) 1%

	2020	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Reduced Fatal Accidents	0.39	0.39	0.40	0.40	0.41	0.41	0.41	0.42	0.42	0.43	0.43	0.43	0.44	0.44	0.45	0.45	0.46	0.46	0.47	0.47
Reduced Incapacitating Accidents	0.55	0.56	0.56	0.57	0.57	0.58	0.58	0.59	0.60	0.60	0.61	0.61	0.62	0.63	0.63	0.64	0.64	0.65	0.66	0.66

Cost Savings from Accidents Avoided (2015$ M)	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
VSL	$ 4.00	$ 4.09	$ 4.18	$ 4.27	$ 4.36	$ 4.46	$ 4.55	$ 4.65	$ 4.76	$ 4.86	$ 4.97	$ 5.07	$ 5.19	$ 5.30	$ 5.42	$ 5.53	$ 5.66	$ 5.78	$ 5.91	$ 6.04
MAIS 4	$ 1.50	$ 1.53	$ 1.57	$ 1.60	$ 1.64	$ 1.67	$ 1.71	$ 1.75	$ 1.78	$ 1.82	$ 1.86	$ 1.90	$ 1.95	$ 1.99	$ 2.03	$ 2.08	$ 2.12	$ 2.17	$ 2.22	$ 2.26
Total	**$ 5.50**	**$ 5.62**	**$ 5.74**	**$ 5.87**	**$ 6.00**	**$ 6.13**	**$ 6.26**	**$ 6.40**	**$ 6.54**	**$ 6.68**	**$ 6.83**	**$ 6.98**	**$ 7.13**	**$ 7.29**	**$ 7.45**	**$ 7.61**	**$ 7.78**	**$ 7.95**	**$ 8.12**	**$ 8.30**
Discounted at 3%	$ 4.89	$ 4.85	$ 4.81	$ 4.77	$ 4.73	$ 4.70	$ 4.66	$ 4.62	$ 4.59	$ 4.55	$ 4.51	$ 4.48	$ 4.44	$ 4.41	$ 4.37	$ 4.34	$ 4.31	$ 4.27	$ 4.24	$ 4.21
Discounted at 7%	$ 4.19	$ 4.01	$ 3.83	$ 3.65	$ 3.49	$ 3.33	$ 3.18	$ 3.04	$ 2.90	$ 2.77	$ 2.65	$ 2.53	$ 2.42	$ 2.31	$ 2.20	$ 2.10	$ 2.01	$ 1.92	$ 1.83	$ 1.75

Climbing Lane	Total
Total	$ 136.17
Discounted at 3%	$ 90.75
Discounted at 7%	$ 56.13

2 Reversible Lanes

Baseline Safety

2020	
Average Annual Fatal	1.27
Average Annual Incapacitating	1.27

Note: assume incapacitating are MAIS 4 (severe) injuries

Future Safety

2020	
Average Annual Fatal	0.79
Average Annual Incapacitating	0.83

Note: assume incapacitating are MAIS 4 (severe) injuries

Annual growth factor for incidents (thus a reduction in incidents avoided) 1%

	2020	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Reduced Fatal Accidents	0.48	0.49	0.49	0.50	0.50	0.51	0.51	0.52	0.52	0.53	0.53	0.54	0.55	0.55	0.56	0.56	0.57	0.57	0.58	0.58
Reduced Incapacitating Accidents	0.44	0.45	0.45	0.46	0.46	0.47	0.47	0.48	0.48	0.49	0.49	0.50	0.50	0.51	0.51	0.52	0.52	0.53	0.53	0.54

Cost Savings from Accidents Avoided (2014$ M)	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
VSL	$ 4.96	$ 5.07	$ 5.18	$ 5.30	$ 5.41	$ 5.53	$ 5.65	$ 5.78	$ 5.90	$ 6.03	$ 6.16	$ 6.30	$ 6.44	$ 6.58	$ 6.72	$ 6.87	$ 7.02	$ 7.17	$ 7.33	$ 7.49
MAIS 4	$ 1.21	$ 1.24	$ 1.26	$ 1.29	$ 1.32	$ 1.35	$ 1.38	$ 1.41	$ 1.44	$ 1.47	$ 1.50	$ 1.54	$ 1.57	$ 1.61	$ 1.64	$ 1.68	$ 1.71	$ 1.75	$ 1.79	$ 1.83
Total	**$ 6.17**	**$ 6.31**	**$ 6.45**	**$ 6.59**	**$ 6.73**	**$ 6.88**	**$ 7.03**	**$ 7.18**	**$ 7.34**	**$ 7.50**	**$ 7.67**	**$ 7.84**	**$ 8.01**	**$ 8.18**	**$ 8.36**	**$ 8.55**	**$ 8.73**	**$ 8.92**	**$ 9.12**	**$ 9.32**
Discounted at 3%	$ 5.48	$ 5.44	$ 5.40	$ 5.36	$ 5.31	$ 5.27	$ 5.23	$ 5.19	$ 5.15	$ 5.11	$ 5.07	$ 5.03	$ 4.99	$ 4.95	$ 4.91	$ 4.87	$ 4.84	$ 4.80	$ 4.76	$ 4.72
Discounted at 7%	$ 4.71	$ 4.50	$ 4.30	$ 4.10	$ 3.92	$ 3.74	$ 3.57	$ 3.41	$ 3.26	$ 3.11	$ 2.97	$ 2.84	$ 2.71	$ 2.59	$ 2.47	$ 2.36	$ 2.26	$ 2.16	$ 2.06	$ 1.97

2 Reversible Lanes	Total
Total	$ 152.89
Discounted at 3%	$ 101.89
Discounted at 7%	$ 63.02

Shoulder Running

Baseline Safety

	2020
Average Annual Fatal	1.27
Average Annual Incapacitating	1.27

Note: assume incapacitating are MAIS 4 (severe) injuries

Future Safety

	2020
Average Annual Fatal	0.93
Average Annual Incapacitating	0.93

Annual growth factor for incidents (thus a reduction in incidents avoided) 1%

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Reduced Fatal Accidents	0.35	0.35	0.35	0.36	0.36	0.37	0.37	0.37	0.38	0.38	0.38	0.39	0.39	0.40	0.40	0.40	0.41	0.41	0.42	0.42
Reduced Incapacitating Accidents	0.34	0.34	0.35	0.35	0.35	0.36	0.36	0.36	0.37	0.37	0.38	0.38	0.38	0.39	0.39	0.39	0.40	0.40	0.41	0.41

Cost Savings from Accidents Avoided (2014$ M)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
VSL	$ 3.57	$ 3.65	$ 3.73	$ 3.81	$ 3.89	$ 3.98	$ 4.06	$ 4.15	$ 4.24	$ 4.34	$ 4.43	$ 4.53	$ 4.63	$ 4.73	$ 4.83	$ 4.94	$ 5.05	$ 5.16	$ 5.27	$ 5.39
MAIS 4	$ 0.93	$ 0.95	$ 0.97	$ 0.99	$ 1.01	$ 1.03	$ 1.06	$ 1.08	$ 1.10	$ 1.13	$ 1.15	$ 1.18	$ 1.20	$ 1.23	$ 1.26	$ 1.28	$ 1.31	$ 1.34	$ 1.37	$ 1.40
Total	**$ 4.49**	**$ 4.59**	**$ 4.69**	**$ 4.80**	**$ 4.90**	**$ 5.01**	**$ 5.12**	**$ 5.23**	**$ 5.35**	**$ 5.46**	**$ 5.58**	**$ 5.70**	**$ 5.83**	**$ 5.96**	**$ 6.09**	**$ 6.22**	**$ 6.36**	**$ 6.50**	**$ 6.64**	**$ 6.79**
Discounted at 3%	$ 3.99	$ 3.96	$ 3.93	$ 3.90	$ 3.87	$ 3.84	$ 3.81	$ 3.78	$ 3.75	$ 3.72	$ 3.69	$ 3.66	$ 3.63	$ 3.60	$ 3.58	$ 3.55	$ 3.52	$ 3.49	$ 3.47	$ 3.44
Discounted at 7%	$ 3.43	$ 3.27	$ 3.13	$ 2.99	$ 2.85	$ 2.72	$ 2.60	$ 2.49	$ 2.37	$ 2.27	$ 2.17	$ 2.07	$ 1.97	$ 1.89	$ 1.80	$ 1.72	$ 1.64	$ 1.57	$ 1.50	$ 1.43

Shoulder Running	Total
Total	$ 111.31
Discounted at 3%	$ 74.18
Discounted at 7%	$ 45.88

Travel Time Savings

Peak users save time due to average speed increases on the segment

I-17 Location 1 Black Canyon Hill

	Climbing Lane	2 Reversible Lanes	Shoulder Running
% Truck	13.0%	13.0%	13.0%
% Auto	87.0%	87.0%	87.0%

*Holds share constant across build and no build, and is equal for northbound and southbound

Trip Purpose	Business	Personal
Truck	100%	0%
Auto	0%	100%

Hourly Rates	$2013 Value of Time	$2015 Value of Time	
Truck	$ 25.80	$ 26.55	National Average
Auto	$ 17.50	$ 18.01	Personal Intercity Travel

Source: TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE, 2015

http://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

Value of Time 1.20% Annual Increase

	2015	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Truck	$ 26.55	$ 28.18	$ 28.52	$ 28.86	$ 29.20	$ 29.55	$ 29.91	$ 30.27	$ 30.63	$ 31.00	$ 31.37	$ 31.75	$ 32.13	$ 32.51	$ 32.90	$ 33.30	$ 33.70	$ 34.10	$ 34.51	$ 34.93
Auto	$ 18.01	$ 19.11	$ 19.34	$ 19.57	$ 19.81	$ 20.05	$ 20.29	$ 20.53	$ 20.78	$ 21.03	$ 21.28	$ 21.53	$ 21.79	$ 22.05	$ 22.32	$ 22.59	$ 22.86	$ 23.13	$ 23.41	$ 23.69

Annualization factor	270
Avg Auto Occ Rate	1.55
Discount rates	3%
	7%
Discount Year	2016

I-17 Location 1 Black Canyon Hill

PEAK Traffic	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Climbing Lane																				
Northbound	372,688	381,388	390,087	398,787	407,487	416,186	424,886	433,586	442,285	450,985	459,685	468,384	477,084	485,783	494,483	503,183	508,215	513,297	518,430	523,614
Southbound	372,688	381,388	390,087	398,787	407,487	416,186	424,886	433,586	442,285	450,985	459,685	468,384	477,084	485,783	494,483	503,183	508,215	513,297	518,430	523,614
Note: Assume 1% growth rate	1% annual AADT growth after 2035																			
2 Reversible Lanes																				
Northbound	372,688	381,388	390,087	398,787	407,487	416,186	424,886	433,586	442,285	450,985	459,685	468,384	477,084	485,783	494,483	503,183	508,215	513,297	518,430	523,614
Southbound	372,688	381,388	390,087	398,787	407,487	416,186	424,886	433,586	442,285	450,985	459,685	468,384	477,084	485,783	494,483	503,183	508,215	513,297	518,430	523,614
Note: Assume 1% growth rate	1% annual AADT growth after 2035																			
Shoulder Running																				
Northbound	372,688	381,388	390,087	398,787	407,487	416,186	424,886	433,586	442,285	450,985	459,685	468,384	477,084	485,783	494,483	503,183	508,215	513,297	518,430	523,614
Southbound	372,688	381,388	390,087	398,787	407,487	416,186	424,886	433,586	442,285	450,985	459,685	468,384	477,084	485,783	494,483	503,183	508,215	513,297	518,430	523,614
Note: Assume 1% growth rate	1% annual AADT growth after 2035																			

Climbing Lane	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Truck																				
Northbound	$ 441	$ 457	$ 473	$ 489	$ 506	$ 523	$ 540	$ 558	$ 576	$ 594	$ 613	$ 632	$ 652	$ 671	$ 692	$ 712	$ 728	$ 744	$ 761	$ 777
Southbound	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Auto																				
Northbound	$ 3,104	$ 3,214	$ 3,327	$ 3,442	$ 3,559	$ 3,679	$ 3,801	$ 3,925	$ 4,052	$ 4,181	$ 4,313	$ 4,447	$ 4,584	$ 4,724	$ 4,866	$ 5,011	$ 5,122	$ 5,236	$ 5,351	$ 5,470
Southbound	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ 3,545	$ 3,671	$ 3,800	$ 3,931	$ 4,065	$ 4,202	$ 4,341	$ 4,483	$ 4,628	$ 4,776	$ 4,926	$ 5,080	$ 5,236	$ 5,395	$ 5,558	$ 5,724	$ 5,850	$ 5,980	$ 6,112	$ 6,247
Discounted at 3%	$ 3,149	$ 3,167	$ 3,182	$ 3,196	$ 3,209	$ 3,220	$ 3,230	$ 3,239	$ 3,246	$ 3,252	$ 3,257	$ 3,260	$ 3,263	$ 3,264	$ 3,265	$ 3,264	$ 3,239	$ 3,214	$ 3,190	$ 3,165
Discounted at 7%	$ 2,704	$ 2,617	$ 2,532	$ 2,448	$ 2,366	$ 2,285	$ 2,207	$ 2,130	$ 2,055	$ 1,982	$ 1,910	$ 1,841	$ 1,774	$ 1,708	$ 1,644	$ 1,583	$ 1,512	$ 1,444	$ 1,380	$ 1,318

Climbing Lane	Total
Total, $M	$ 0.10
Discounted at 3%	$ 0.06
Discounted at 7%	$ 0.04

2 Reversible Lanes	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Truck																				
Northbound	$ 358	$ 370	$ 383	$ 397	$ 410	$ 424	$ 438	$ 452	$ 467	$ 482	$ 497	$ 512	$ 528	$ 544	$ 561	$ 577	$ 590	$ 603	$ 617	$ 630
Southbound	$ 358	$ 370	$ 383	$ 397	$ 410	$ 424	$ 438	$ 452	$ 467	$ 482	$ 497	$ 512	$ 528	$ 544	$ 561	$ 577	$ 590	$ 603	$ 617	$ 630
Auto																				
Northbound	$ 2,516	$ 2,606	$ 2,697	$ 2,790	$ 2,885	$ 2,982	$ 3,081	$ 3,182	$ 3,285	$ 3,390	$ 3,496	$ 3,605	$ 3,716	$ 3,829	$ 3,945	$ 4,062	$ 4,152	$ 4,244	$ 4,338	$ 4,434
Southbound	$ 2,516	$ 2,606	$ 2,697	$ 2,790	$ 2,885	$ 2,982	$ 3,081	$ 3,182	$ 3,285	$ 3,390	$ 3,496	$ 3,605	$ 3,716	$ 3,829	$ 3,945	$ 4,062	$ 4,152	$ 4,244	$ 4,338	$ 4,434
Total	$ 5,747	$ 5,952	$ 6,161	$ 6,374	$ 6,591	$ 6,812	$ 7,038	$ 7,268	$ 7,503	$ 7,743	$ 7,987	$ 8,235	$ 8,489	$ 8,748	$ 9,011	$ 9,280	$ 9,485	$ 9,695	$ 9,909	$ 10,128
Discounted at 3%	$ 5,106	$ 5,134	$ 5,159	$ 5,182	$ 5,203	$ 5,221	$ 5,237	$ 5,251	$ 5,263	$ 5,272	$ 5,280	$ 5,286	$ 5,290	$ 5,292	$ 5,293	$ 5,292	$ 5,252	$ 5,211	$ 5,171	$ 5,132
Discounted at 7%	$ 4,384	$ 4,243	$ 4,105	$ 3,969	$ 3,836	$ 3,705	$ 3,578	$ 3,453	$ 3,331	$ 3,213	$ 3,097	$ 2,985	$ 2,876	$ 2,769	$ 2,666	$ 2,566	$ 2,451	$ 2,341	$ 2,237	$ 2,137

2 Reversible Lanes	Total
Total, $M	$ 0.16
Discounted at 3%	$ 0.10
Discounted at 7%	$ 0.06

Shoulder Running	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Truck																				
Northbound	$ 441	$ 457	$ 473	$ 489	$ 506	$ 523	$ 540	$ 558	$ 576	$ 594	$ 613	$ 632	$ 652	$ 671	$ 692	$ 712	$ 728	$ 744	$ 761	$ 777
Southbound	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Auto																				
Northbound	$ 3,104	$ 3,214	$ 3,327	$ 3,442	$ 3,559	$ 3,679	$ 3,801	$ 3,925	$ 4,052	$ 4,181	$ 4,313	$ 4,447	$ 4,584	$ 4,724	$ 4,866	$ 5,011	$ 5,122	$ 5,236	$ 5,351	$ 5,470
Southbound	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ 3,545	$ 3,671	$ 3,800	$ 3,931	$ 4,065	$ 4,202	$ 4,341	$ 4,483	$ 4,628	$ 4,776	$ 4,926	$ 5,080	$ 5,236	$ 5,395	$ 5,558	$ 5,724	$ 5,850	$ 5,980	$ 6,112	$ 6,247
Discounted at 3%	$ 3,149	$ 3,167	$ 3,182	$ 3,196	$ 3,209	$ 3,220	$ 3,230	$ 3,239	$ 3,246	$ 3,252	$ 3,257	$ 3,260	$ 3,263	$ 3,264	$ 3,265	$ 3,264	$ 3,239	$ 3,214	$ 3,190	$ 3,165
Discounted at 7%	$ 2,704	$ 2,617	$ 2,532	$ 2,448	$ 2,366	$ 2,285	$ 2,207	$ 2,130	$ 2,055	$ 1,982	$ 1,910	$ 1,841	$ 1,774	$ 1,708	$ 1,644	$ 1,583	$ 1,512	$ 1,444	$ 1,380	$ 1,318

Shoulder Running	Total
Total, $M	$ 0.10
Discounted at 3%	$ 0.06
Discounted at 7%	$ 0.04

Travel Time Savings due to Avoided Incidents

Users save time from more efficient incident management

I-17 Location 1: Black Canyon Hill

	Climbing Lane	2 Reversible Lanes	Shoulder Running
Total Hours Avoided per Year, 2035	54,000	286,000	53,000
% Truck	13.0%	13.0%	13.0%
% Auto	87.0%	87.0%	87.0%

*Holds share constant across build and no build, and is equal for northbound and southbound. See BlackCanyonHill tab.

Hourly Rates	$2013 Value of Time	$2015 Value of Time	
Truck	$ 25.80	$ 26.55	National Average
Auto	$ 17.50	$ 18.01	Personal Intercity Travel

Source: TIGER BENEFIT-COST ANALYSIS (BCA) RESOURCE GUIDE, 2015

http://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf

Value of Time 1.20% Annual Increase

	2015	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Truck	$ 26.55	$ 28.18	$ 28.52	$ 28.86	$ 29.20	$ 29.55	$ 29.91	$ 30.27	$ 30.63	$ 31.00	$ 31.37	$ 31.75	$ 32.13	$ 32.51	$ 32.90	$ 33.30	$ 33.70	$ 34.10	$ 34.51	$ 34.93	$ 35.35
Auto	$ 18.01	$ 19.11	$ 19.34	$ 19.57	$ 19.81	$ 20.05	$ 20.29	$ 20.53	$ 20.78	$ 21.03	$ 21.28	$ 21.53	$ 21.79	$ 22.05	$ 22.32	$ 22.59	$ 22.86	$ 23.13	$ 23.41	$ 23.69	$ 23.97

Discount Rate	3%
	7%
Annualization Factor	270
Discount Year	2016
Auto Occ Rate	1.55
Annual growth factor for incidents (thus a reduction in incidents avoided)	1.0%

I-17 Location 1: Black Canyon Hill

Hours Avoided per Year: Location 1	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Climbing Lane	39,996	40,929	41,863	42,797	43,730	44,664	45,597	46,531	47,465	48,398	49,332	50,266	51,199	52,133	53,066	54,000	54,540	55,085	55,636	56,193
2RLs	211,829	216,774	221,719	226,663	231,608	236,553	241,497	246,442	251,387	256,332	261,276	266,221	271,166	276,111	281,055	286,000	288,860	291,749	294,666	297,613
Shoulder Running	39,255	40,171	41,088	42,004	42,920	43,837	44,753	45,669	46,586	47,502	48,418	49,335	50,251	51,167	52,084	53,000	53,530	54,065	54,606	55,152

Climbing Lane

Value of Time	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Truck	$ 146,509	$ 151,728	$ 157,052	$ 162,481	$ 168,018	$ 173,664	$ 179,422	$ 185,293	$ 191,279	$ 197,381	$ 203,603	$ 209,946	$ 216,412	$ 223,002	$ 229,720	$ 236,567	$ 241,799	$ 247,148	$ 252,615	$ 258,203
Auto	$ 1,030,840	$ 1,067,561	$ 1,105,016	$ 1,143,216	$ 1,182,173	$ 1,221,901	$ 1,262,412	$ 1,303,720	$ 1,345,837	$ 1,388,777	$ 1,432,553	$ 1,477,181	$ 1,522,673	$ 1,569,044	$ 1,616,309	$ 1,664,483	$ 1,701,301	$ 1,738,934	$ 1,777,399	$ 1,816,715
Total	$ 1,177,349	$ 1,067,561	$ 1,105,016	$ 1,143,216	$ 1,182,173	$ 1,221,901	$ 1,262,412	$ 1,303,720	$ 1,345,837	$ 1,388,777	$ 1,432,553	$ 1,477,181	$ 1,522,673	$ 1,569,044	$ 1,616,309	$ 1,664,483	$ 1,701,301	$ 1,738,934	$ 1,777,399	$ 1,816,715
Discounted at 3%	$ 1,046,059	$ 920,888	$ 925,434	$ 929,539	$ 933,219	$ 936,485	$ 939,353	$ 941,835	$ 943,943	$ 945,689	$ 947,087	$ 948,146	$ 948,879	$ 949,298	$ 949,411	$ 949,231	$ 941,969	$ 934,763	$ 927,611	$ 920,515
Discounted at 7%	$ 898,194	$ 761,157	$ 736,319	$ 711,937	$ 688,036	$ 664,633	$ 641,746	$ 619,388	$ 597,568	$ 576,293	$ 555,569	$ 535,398	$ 515,782	$ 496,719	$ 478,208	$ 460,243	$ 439,649	$ 419,975	$ 401,182	$ 383,230

Climbing Lane	Total
Total, $M	$ 28.51
Discounted at 3%	$ 18.88
Discounted at 7%	$ 11.58

2 Reversibsle Lanes

Value of Time	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Truck	$ 775,957	$ 803,599	$ 831,792	$ 860,547	$ 889,872	$ 919,777	$ 950,271	$ 981,365	$ 1,013,068	$ 1,045,391	$ 1,078,344	$ 1,111,937	$ 1,146,180	$ 1,181,086	$ 1,216,664	$ 1,252,927	$ 1,280,641	$ 1,308,969	$ 1,337,923	$ 1,367,518
Auto	$ 5,459,633	$ 5,654,122	$ 5,852,493	$ 6,054,810	$ 6,261,140	$ 6,471,551	$ 6,686,109	$ 6,904,885	$ 7,127,949	$ 7,355,372	$ 7,587,227	$ 7,823,587	$ 8,064,528	$ 8,310,124	$ 8,560,453	$ 8,815,594	$ 9,010,594	$ 9,209,909	$ 9,413,632	$ 9,621,862
Total	$ 6,235,589	$ 6,457,721	$ 6,684,285	$ 6,915,357	$ 7,151,012	$ 7,391,327	$ 7,636,380	$ 7,886,250	$ 8,141,017	$ 8,400,763	$ 8,665,571	$ 8,935,524	$ 9,210,708	$ 9,491,210	$ 9,777,117	$ 10,068,520	$ 10,291,236	$ 10,518,878	$ 10,751,555	$ 10,989,380
Discounted at 3%	$ 5,540,240	$ 5,570,486	$ 5,597,983	$ 5,622,818	$ 5,645,075	$ 5,664,837	$ 5,682,184	$ 5,697,195	$ 5,709,946	$ 5,720,511	$ 5,728,963	$ 5,735,373	$ 5,739,809	$ 5,742,338	$ 5,743,026	$ 5,741,936	$ 5,698,008	$ 5,654,415	$ 5,611,156	$ 5,568,228
Discounted at 7%	$ 4,757,101	$ 4,604,266	$ 4,454,021	$ 4,306,537	$ 4,161,954	$ 4,020,392	$ 3,881,948	$ 3,746,701	$ 3,614,709	$ 3,486,018	$ 3,360,658	$ 3,238,645	$ 3,119,985	$ 3,004,674	$ 2,892,696	$ 2,784,030	$ 2,659,451	$ 2,540,447	$ 2,426,768	$ 2,318,175

2 Reversible Lanes	Total
Total, $M	$ 171.60
Discounted at 3%	$ 113.41
Discounted at 7%	$ 69.38

Shoulder Running

Value of Time	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Truck	$ 143,796	$ 148,919	$ 154,143	$ 159,472	$ 164,906	$ 170,448	$ 176,099	$ 181,861	$ 187,736	$ 193,726	$ 199,833	$ 206,058	$ 212,404	$ 218,873	$ 225,466	$ 232,186	$ 237,322	$ 242,571	$ 247,937	$ 253,421
Auto	$ 1,011,750	$ 1,047,792	$ 1,084,553	$ 1,122,045	$ 1,160,281	$ 1,199,273	$ 1,239,034	$ 1,279,577	$ 1,320,914	$ 1,363,058	$ 1,406,025	$ 1,449,826	$ 1,494,475	$ 1,539,988	$ 1,586,378	$ 1,633,659	$ 1,669,795	$ 1,706,731	$ 1,744,484	$ 1,783,072
Total	$ 1,011,750	$ 1,047,792	$ 1,084,553	$ 1,122,045	$ 1,160,281	$ 1,199,273	$ 1,239,034	$ 1,279,577	$ 1,320,914	$ 1,363,058	$ 1,406,025	$ 1,449,826	$ 1,494,475	$ 1,539,988	$ 1,586,378	$ 1,633,659	$ 1,669,795	$ 1,706,731	$ 1,744,484	$ 1,783,072
Discounted at 3%	$ 898,927	$ 903,834	$ 908,296	$ 912,325	$ 915,937	$ 919,143	$ 921,958	$ 924,393	$ 926,462	$ 928,177	$ 929,548	$ 930,588	$ 931,308	$ 931,718	$ 931,830	$ 931,653	$ 924,525	$ 917,452	$ 910,433	$ 903,468
Discounted at 7%	$ 771,859	$ 747,061	$ 722,683	$ 698,753	$ 675,294	$ 652,325	$ 629,862	$ 607,918	$ 586,501	$ 565,621	$ 545,281	$ 525,484	$ 506,231	$ 487,521	$ 469,352	$ 451,720	$ 431,507	$ 412,198	$ 393,753	$ 376,134

Shoulder Running	Total
Total, $M	$ 27.84
Discounted at 3%	$ 18.40
Discounted at 7%	$ 11.26

Emissions

Reduction in idling for incidents reduces emissions

Emissions Factors (g/hr) for Automobiles

	CO	NOX	PM2.5	PM10	SO2	VOC	CO2	THC
LDGV	71.225	3.515				2.683	8887	3.163

Source: EPA 2008, Table 1 — * grams of CO2 per gallon; 1 hour = 1 gallon

Accessed at: http://www.epa.gov/otaq/consumer/420f08025.pc — http://www.epa.gov/fueleconomy/fetrends/1975-2014/420r14023a.pdf

Emissions Factors (g/hr) for Trucks

	CO	NOX	PM2.5	PM10	SO2	VOC	CO2	THC
Heavy Duty Diesel, VIIIb	34.473	42.345	1.114	1.211		4.218	10180	4.27

Source: EPA 2008, Table 2 — * grams of CO2 per gallon; 1 hour = 1 gallon idling

Accessed at: http://www.epa.gov/otaq/consumer/420f08025.pc — http://www.epa.gov/fueleconomy/fetrends/1975-2014/420r14023a.pdf

http://www.epa.gov/region1/eco/diesel/pdfs/Diesel_Factsheet_Truck_Idling.pdf

I-17 Location 1 Inputs

Annual Peak Hours of Idling Reduced for Incidents	**Hours, 2035**				
Climbing Lane	54,000		Hours distributed by Vehicle Type		
2 Reversible Lanes	286,000		% Truck	13.0%	Annualization Factor 270
			% Auto	87.0%	
Shoulder Running	53,000		Note: Held constant throughout analysis period		
Note: Held constant throughout analysis period					

Annual Peak Hours of Idling Reduced	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Climbing Lane	39,996	40,929	41,863	42,797	43,730	44,664	45,597	46,531	47,465	48,398	49,332	50,266	51,199	52,133	53,066	54,000	54,540	55,085	55,636	56,193
2 Reversible Lanes	211,829	216,774	221,719	226,663	231,608	236,553	241,497	246,442	251,387	256,332	261,276	266,221	271,166	276,111	281,055	286,000	288,860	291,749	294,666	297,613
Shoulder Running	39,255	40,171	41,088	42,004	42,920	43,837	44,753	45,669	46,586	47,502	48,418	49,335	50,251	51,167	52,084	53,000	53,530	54,065	54,606	55,152

Annual Truck Hours of Idling Reduced	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Climbing Lane	5,199	5,321	5,442	5,564	5,685	5,806	5,928	6,049	6,170	6,292	6,413	6,535	6,656	6,777	6,899	7,020	7,090	7,161	7,233	7,305
2 Reversible Lanes	27,538	28,181	28,823	29,466	30,109	30,752	31,395	32,037	32,680	33,323	33,966	34,609	35,252	35,894	36,537	37,180	37,552	37,927	38,307	38,690
Shoulder Running	5,103	5,222	5,341	5,461	5,580	5,699	5,818	5,937	6,056	6,175	6,294	6,414	6,533	6,652	6,771	6,890	6,959	7,028	7,099	7,170

Annual Auto Hours of Idling Reduced	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Climbing Lane	34,796	35,609	36,421	37,233	38,045	38,858	39,670	40,482	41,294	42,107	42,919	43,731	44,543	45,356	46,168	46,980	47,450	47,924	48,404	48,888
2 Reversible Lanes	184,291	188,593	192,895	197,197	201,499	205,801	210,103	214,405	218,707	223,009	227,310	231,612	235,914	240,216	244,518	248,820	251,308	253,821	256,359	258,923
Shoulder Running	34,152	34,949	35,746	36,544	37,341	38,138	38,935	39,732	40,530	41,327	42,124	42,921	43,718	44,516	45,313	46,110	46,571	47,037	47,507	47,982

Only looking at vehicles, don't need to factor in occ rate

Annual Emission Avoided (tons)

907185 grams per short ton

1000000 grams per metric ton — 2,767,626

Climbing Lane	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
CO	2.93	3.00	3.07	3.13	3.20	3.27	3.34	3.41	3.48	3.54	3.61	3.68	3.75	3.82	3.89	3.96	3.99	4.03	4.08	4.12
NOX	0.38	0.39	0.40	0.40	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.47	0.48	0.49	0.50	0.51	0.51	0.52	0.53	0.53
PM2.5	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PM10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
SO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VOC	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.18	0.18	0.18
CO2	362.16	370.62	379.07	387.53	395.98	404.43	412.89	421.34	429.80	438.25	446.70	455.16	463.61	472.07	480.52	488.97	493.86	498.80	503.79	508.83
THC	0.15	0.15	0.15	0.16	0.16	0.16	0.17	0.17	0.17	0.18	0.18	0.18	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.20

All emissions are shown in short tons except for CO2, which is in metric tons

2 Reversible Lanes	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
CO	15.52	15.88	16.24	16.60	16.96	17.33	17.69	18.05	18.41	18.78	19.14	19.50	19.86	20.22	20.59	20.95	21.16	21.37	21.58	21.80
NOX	2.00	2.05	2.09	2.14	2.19	2.23	2.28	2.33	2.37	2.42	2.47	2.51	2.56	2.61	2.65	2.70	2.73	2.75	2.78	2.81
PM2.5	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05
PM10	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VOC	0.67	0.69	0.70	0.72	0.74	0.75	0.77	0.78	0.80	0.81	0.83	0.85	0.86	0.88	0.89	0.91	0.92	0.93	0.94	0.95
CO2	1,918.13	1,962.91	2,007.68	2,052.46	2,097.23	2,142.01	2,186.78	2,231.56	2,276.33	2,321.11	2,365.88	2,410.66	2,455.43	2,500.21	2,544.98	2,589.76	2,615.65	2,641.81	2,668.23	2,694.91
THC	0.77	0.79	0.81	0.83	0.84	0.86	0.88	0.90	0.92	0.93	0.95	0.97	0.99	1.01	1.02	1.04	1.05	1.06	1.07	1.08

All emissions are shown in short tons except for CO2, which is in metric tons

Shoulder Running	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
CO	2.88	2.94	3.01	3.08	3.14	3.21	3.28	3.35	3.41	3.48	3.55	3.61	3.68	3.75	3.81	3.88	3.92	3.96	4.00	4.04
NOX	0.37	0.38	0.39	0.40	0.41	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.47	0.48	0.49	0.50	0.51	0.51	0.52	0.52
PM2.5	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PM10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
SO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VOC	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.18
CO2	355.46	363.76	372.05	380.35	388.65	396.95	405.24	413.54	421.84	430.14	438.43	446.73	455.03	463.32	471.62	479.92	484.72	489.57	494.46	499.41
THC	0.14	0.15	0.15	0.15	0.16	0.16	0.16	0.17	0.17	0.17	0.18	0.18	0.18	0.19	0.19	0.19	0.20	0.20	0.20	0.20

All emissions are shown in short tons except for CO2, which is in metric tons

I-17 Location 1 Outputs

Climbing Lane

Annual Emissions Benefit (2015$ M)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
CO	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NOX	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
PM	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01
SO2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
VOC	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
THC	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
Total	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**
Discounted at 3%	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01
Discounted at 7%	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
CO2	**$ 0.02**	**$ 0.02**	**$ 0.02**	**$ 0.02**	**$ 0.02**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.04**	**$ 0.04**	**$ 0.04**	**$ 0.04**	**$ 0.04**
Discounted @ 3%	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02
Note:	Only discounted at 3% per Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, February 2010																			

Emissions 20-year Total	**20-year Total**
Millions of 2015$	$0.19
Discounted at 3%	$0.13
Discounted at 7%	$0.08

CO2	**20-year Total**
Millions of 2015$	$0.60
Discounted at 3%	$0.39

2 Reversible Lanes

Annual Emissions Benefit (2015$ M)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
CO	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NOX	$ 0.01	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02
PM	$ 0.02	$ 0.02	$ 0.02	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03
SO2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
VOC	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
THC	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
Total	**$ 0.04**	**$ 0.04**	**$ 0.04**	**$ 0.04**	**$ 0.05**	**$ 0.05**	**$ 0.05**	**$ 0.05**	**$ 0.05**	**$ 0.05**	**$ 0.05**	**$ 0.05**	**$ 0.05**	**$ 0.05**	**$ 0.05**	**$ 0.06**	**$ 0.06**	**$ 0.06**	**$ 0.06**	**$ 0.06**
Discounted at 3%	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03
Discounted at 7%	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.01	$ 0.01	$ 0.01	$ 0.01
CO2	**$ 0.11**	**$ 0.11**	**$ 0.12**	**$ 0.12**	**$ 0.13**	**$ 0.13**	**$ 0.14**	**$ 0.15**	**$ 0.15**	**$ 0.16**	**$ 0.16**	**$ 0.16**	**$ 0.17**	**$ 0.18**	**$ 0.18**	**$ 0.19**	**$ 0.20**	**$ 0.20**	**$ 0.21**	**$ 0.21**
Discounted @ 3%	$ 0.10	$ 0.10	$ 0.10	$ 0.10	$ 0.10	$ 0.10	$ 0.10	$ 0.10	$ 0.11	$ 0.11	$ 0.11	$ 0.11	$ 0.11	$ 0.11	$ 0.11	$ 0.11	$ 0.11	$ 0.11	$ 0.11	$ 0.11
Note:	Only discounted at 3% per Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, February 2010																			

Emissions 20-year Total	**20-year Total**
Millions of 2015$	$1.00
Discounted at 3%	$0.67
Discounted at 7%	$0.42

CO2	**20-year Total**
Millions of 2015$	$3.18
Discounted at 3%	$2.09

Shoulder Running																					
Annual Emissions Benefit (2015$ M)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
CO	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NOX	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
PM	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01
SO2	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
VOC	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
THC	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
Total	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**	**$ 0.01**
Discounted at 3%	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01	$ 0.01
Discounted at 7%	$ 0.01	$ 0.01	$ 0.01	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00	$ 0.00
CO2	**$ 0.02**	**$ 0.02**	**$ 0.02**	**$ 0.02**	**$ 0.02**	**$ 0.02**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.03**	**$ 0.04**	**$ 0.04**	**$ 0.04**	**$ 0.04**	**$ 0.04**
Discounted @ 3%	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02	$ 0.02
Note:	Only discounted at 3% per Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, February 2010																			

Emissions 20-year Total	**20-year Total**
Millions of 2015$	$0.19
Discounted at 3%	$0.13
Discounted at 7%	$0.08

CO2	**20-year Total**
Millions of 2015$	$0.59
Discounted at 3%	$0.38

Appendix F: Crash Modification Factors and Factored Unit Construction Costs

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
REHABILITATION							
Rehabilitate Pavement (AC)	$276,500	Mile	2.20	$610,000	Mill and replace 1"-3" AC pvmt; accounts for 38' width; for one direction of travel on two lane roadway; includes pavement, striping, delineators, RPMs, rumble strips	0.70	Combination of rehabilitate pavement (0.92), striping, delineators, RPMs (0.77 for combination), and rumble strips (0.89) = 0.70
Rehabilitate Bridge	$65	SF	2.20	$140	Based on deck area; bridge only - no other costs included	0.95	Assumed - should have a minor effect on crashes at the bridge
GEOMETRIC IMPROVEMENT							
Re-profile Roadway	$974,500	Mile	2.20	$2,140,000	Includes excavation of approximately 3", pavement replacement (AC), striping, delineators, RPMs, rumble strips, for one direction of travel of 2-lane roadway (38' width)	0.70	Assumed - this is similar to rehab pavement. This solution is intended to address vertical clearance at bridge, not profile issue; factor the cost as a ratio of needed depth to 3".
Realign Roadway	$2,960,000	Mile	2.20	$6,510,000	All costs per direction except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.50	Based on CalTrans and NC DOT
Improve Skid Resistance	$675,000	Mile	2.20	$1,490,000	Average cost of pvmt replacement and variable depth paving to increase super-elevation; for one direction of travel on two lane roadway; includes pavement, striping, delineators, RPMs, rumble strips	0.66	Combination of avg of 5 values from clearinghouse (0.77) and calculated value from HSM (0.87) for skid resistance; striping, delineators, RPMs (0.77 for combination), and rumble strips (0.89) = 0.66
INFRASTRUCTURE IMPROVEMENT							
Reconstruct to Urban Section	$1,000,000	Mile	2.20	$2,200,000	Includes widening by 16' total (AC = 12'+2'+2') to provide median, curb & gutter along both side of roadway, single curb for median, striping (doesn't include widening for additional travel lane).	0.88	From HSM
Construct Auxiliary Lanes (AC)	$914,000	Mile	2.20	$2,011,000	For addition of aux lane (AC) in one direction of travel; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.78	Average of 4 values from clearinghouse
Construct Climbing Lane (High)	$3,000,000	Mile	2.20	$6,600,000	In one direction; all costs except bridges; applicable to areas with large fills and cuts, retaining walls, rock blasting, steep slopes on both sides of road	0.75	From HSM
Construct Climbing Lane (Medium)	$2,250,000	Mile	2.20	$4,950,000	In one direction; all costs except bridges; applicable to areas with medium or large fills and cuts, retaining walls, rock blasting, steep slopes on one side of road	0.75	From HSM
Construct Climbing Lane (Low)	$1,500,000	Mile	2.20	$3,300,000	In one direction; all costs except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.75	From HSM

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Construct Reversible Lane (Low)	$2,400,000	Lane-Mile	2.20	$5,280,000	All costs except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.73 for uphill and 0.88 for downhill	Based on proposed conditions on I-17 with 2 reversible lanes and a conc barrier
Construct Reversible Lane (High)	$4,800,000	Lane-Mile	2.20	$10,560,000	All costs except bridges; applicable to areas with large fills and cuts, retaining walls, rock blasting, mountainous terrain	0.73 for uphill and 0.88 for downhill	Based on proposed conditions on I-17 with 2 reversible lanes and a conc barrier
Construct Passing Lane	$1,500,000	Mile	2.20	$3,300,000	In one direction; all costs except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.63	Average of 3 values from clearinghouse
Construct Entry/Exit Ramp	$730,000	Each	2.20	$1,610,000	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, typical earthwork & drainage; does not include any major structures or improvements on crossroad	1.09	Average of 16 values on clearinghouse; for adding a ramp not reconstructing. CMF applied to crashes 0.25 miles upstream/downstream from the gore.
Relocate Entry/Exit Ramp	$765,000	Each	2.20	$1,680,000	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, typical earthwork , drainage and demolition of existing ramp; does not include any major structures or improvements on crossroad	1.00	Assumed to not add any crashes since the ramp is simply moving and not being added. CMF applied to crashes 0.25 miles upstream/downstream from the gore.
Construct Turn Lanes	$42,500	Each	2.20	$93,500	Includes 14' roadway widening (AC) for one additional turn lane (250' long) on one leg of an intersection; includes AC pavement, curb & gutter, sidewalk, ramps, striping, and minor signal modifications	0.81	Avg of 7 values from HSM; CMF applied to intersection related crashes; this solution also applies when installing a deceleration lane
Modify Entry/Exit Ramp	$445,000	Each	2.20	$979,000	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, minor earthwork, & drainage; For converting existing ramp to parallel-type configuration	0.21	Average of 4 values from clearinghouse (for exit ramps) and equation from HSM (for entrance ramp). CMF applied to crashes within 1/8 mile upstream/downstream from the gore.
Widen & Modify Entry/Exit Ramp	$619,000	Each	2.20	$1,361,800	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, minor earthwork, & drainage; For converting 1-lane ramp to 2-lane ramp and converting to parallel-type ramp	0.21	Will be same as "Modify Ramp"
Replace Pavement (AC) (with overexcavation)	$1,446,500	Mile	2.20	$3,180,000	Accounts for 38' width; for one direction of travel on two lane roadway; includes pavement, overexcavation, striping, delineators, RPMs, rumble strips	0.70	Same as rehab
Replace Pavement (PCCP) (with overexcavation)	$1,736,500	Mile	2.20	$3,820,000	Accounts for 38' width; for one direction of travel on two lane roadway; includes pavement, overexcavation, striping, delineators, RPMs, rumble strips	0.70	Same as rehab

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Replace Bridge (Short)	$125	SF	2.20	$280	Based on deck area; bridge only - no other costs included; cost developed generally applies to bridges crossing small washes	0.95	Assumed - should have a minor effect on crashes at the bridge
Replace Bridge (Medium)	$160	SF	2.20	$350	Based on deck area; bridge only - no other costs included; cost developed generally applies to bridges crossing over the mainline freeway, crossroads, or large washes	0.95	Assumed - should have a minor effect on crashes at the bridge
Replace Bridge (Long)	$180	SF	2.20	$400	Based on deck area; bridge only - no other costs included; cost developed generally applies to bridges crossing large rivers or canyons	0.95	Assumed - should have a minor effect on crashes at the bridge
Widen Bridge	$175	SF	2.20	$390	Based on deck area; bridge only - no other costs included	0.90	Assumed - should have a minor effect on crashes at the bridge
Install Pedestrian Bridge	$135	SF	2.20	$300	Includes cost to construct bridge based on linear feet of the bridge. This costs includes and assumes ramps and sidewalks leading to the structure.	0.1 (ped only)	Assumed direct access on both sides of structure
Implement Automated Bridge De-icing	$115	SF	2.20	$250	Includes cost to replace bridge deck and install system	0.72 (snow/ice)	Average of 3 values on clearinghouse for snow/ice
Install Wildlife Crossing Under Roadway	$650,000	Each	2.20	$1,430,000	Includes cost of structure for wildlife crossing under roadway and 1 mile of fencing in each direction that is centered on the wildlife crossing	0.25 (wildlife)	Assumed; CMF applies to wildlife-related crashes within 0.5 miles both upstream and downstream of the wildlife crossing in both directions
Install Wildlife Crossing Over Roadway	$1,140,000	Each	2.20	$2,508,000	Includes cost of structure for wildlife crossing over roadway and 1 mile of fencing in each direction that is centered on the wildlife crossing	0.25 (wildlife)	Assumed; CMF applies to wildlife-related crashes within 0.5 miles both upstream and downstream of the wildlife crossing in both directions
Construct Drainage Structure - Minor	$280,000	Each	2.20	$616,000	Includes 3-36" pipes and roadway reconstruction (approx. 1,000 ft) to install pipes	0.70	Same as rehab; CMF applied to crashes 1/8 mile upstream/downstream of the structure
Construct Drainage Structure - Intermediate	$540,000	Each	2.20	$1,188,000	Includes 5 barrel 8'x6' RCBC and roadway reconstruction (approx. 1,000 ft) to install RCBC	0.70	Same as rehab; CMF applied to crashes 1/8 mile upstream/downstream of the structure
Construct Drainage Structure - Major	$8,000	LF	2.20	$17,600	Includes bridge that is 40' wide and reconstruction of approx. 500' on each approach	0.70	Same as rehab; CMF applied to crashes 1/8 mile upstream/downstream of the structure
Install Acceleration Lane	$127,500	Each	2.20	$280,500	For addition of an acceleration lane (AC) on one leg of an intersection that is 1,000' long plus a taper; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.85	Average of 6 values from the FHWA Desktop Reference for Crash Reduction Factors
OPERATIONAL IMPROVEMENT							
Implement Variable Speed Limits (Wireless, Overhead)	$718,900	Mile	2.20	$1,580,000	In one direction; includes 1 sign assembly per mile (foundation and structure), wireless communication, detectors	0.92	From 1 value from clearinghouse

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Implement Variable Speed Limits (Wireless, Ground-mount)	$169,700	Mile	2.20	$373,300	In one direction; includes 2 signs per mile (foundations and posts), wireless communication, detectors	0.92	From 1 value from clearinghouse
Implement Variable Speed Limits (Wireless, Solar, Overhead)	$502,300	Mile	2.20	$1,110,000	In one direction; includes 1 sign assembly per mile (foundation and structure), wireless communication, detectors, solar power	0.92	From 1 value from clearinghouse
Implement Variable Speed Limits (Wireless, Solar, Ground-mount)	$88,400	Mile	2.20	$194,500	In one direction; includes 2 signs per mile (foundations and posts), wireless communication, detectors, solar power	0.92	From 1 value from clearinghouse
Implement Ramp Metering (Low)	$25,000	Each	2.20	$55,000	For each entry ramp location; urban area with existing ITS backbone infrastructure; includes signals, poles, cabinet, detectors, pull boxes, etc	0.64	From 1 value from clearinghouse; CMF applied to crashes 0.25 miles after gore
Implement Ramp Metering (High)	$150,000	Mile	2.20	$330,000	Area without existing ITS backbone infrastructure; in addition to ramp meters, also includes conduit, fiber optic lines, and power	0.64	From 1 value from clearinghouse
Implement Signal Coordination	$140,000	Mile	2.20	$308,000	Includes conduit, conductors, and controllers for 4 intersections that span a total of approximately 2 miles	0.90	Assumed
Implement Left-Turn Phasing	$7,500	Each	2.20	$16,500	Includes four new signal heads (two in each direction) and associated conductors for one intersection	0.88 (protected) 0.98 (perm/prot or prot/perm)	From HSM; CMF = 0.94 for each protected approach and 0.99 for each perm/prot or prot/perm approach. CMFs of different approaches should be multiplied together. CMF applied to crashes within intersection
ROADSIDE DESIGN							
Install Guardrail	$130,000	Mile	2.20	$286,000	One side of road	0.62 (ROR)	0.62 is avg of 2 values from clearinghouse
Install Cable Barrier	$80,000	Mile	2.20	$176,000	In median	0.81	0.81 is average of 5 values from clearinghouse
Widen Shoulder (AC)	$256,000	Mile	2.20	$563,000	Assumes 10' of existing shoulder (combined left and right), includes widening shoulder by a total of 4'; new pavement for 4' width and mill and replace existing 10' width; includes pavement, minor earthwork, striping edge lines, RPMs, high-visibility delineators, safety edge, and rumble strips	0.68 (1-4') 0.64 (>= 4')	0.86 is avg of 5 values from clearing house for widening shoulder 1-4'. 0.76 is calculated from HSM for widening shoulder >= 4'. (Cost needs to be updated if dimension of existing and widened shoulder differ from Description.)
Rehabilitate Shoulder (AC)	$113,000	Mile	2.20	$249,000	One direction of travel (14' total shldr width-4' left and 10' right); includes paving (mill and replace), striping, high-visibility delineators, RPMs, safety edge, and rumble strips for both shoulders	0.72	0.98 is average of 34 values on clearinghouse for shldr rehab/replace; include striping, delineators, RPMs (0.77 combined CMF), and rumble strips (0.89). (Cost needs to be updated if dimension of existing shoulder differs from Description.)

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Replace Shoulder (AC)	$364,000	Mile	2.20	$801,000	One direction of travel (14' total shldr width-4' left and 10' right); includes paving (full reconstruction), striping, high-visibility delineators, RPMs, safety edge, and rumble strips for both shoulders	0.72	0.98 is average of 34 values on clearinghouse for shldr rehab/replace; include striping, delineators, RPMs (0.77 combined CMF), and rumble strips (0.89). (Cost needs to be updated if dimension of existing shoulder differs from Description.)
Install Rumble Strip	$5,500	Mile	2.20	$12,000	Both edges - one direction of travel; includes only rumble strip; no shoulder rehab or paving or striping	0.89	Average of 75 values on clearinghouse and consistent with HSM
Install Centerline Rumble Strip	$2,800	Mile	2.20	$6,000	Includes rumble strip only; no pavement rehab or striping	0.85	From HSM
Install Wildlife Fencing	$340,000	Mile	2.20	$748,000	Fencing only plus jump outs for 1 mile (both directions)	0.50 (wildlife)	Assumed
Remove Tree/Vegetation	$200,000	Mile	2.20	$440,000	Intended for removing trees that shade the roadway to allow sunlight to help melt snow and ice (see Increase Clear Zone CMF for general tree/vegetation removal in clear zone)	0.72 (snow/ice)	Average of 3 values on clearinghouse for snow/ice
Increase Clear Zone	$59,000	Mile	2.20	$130,000	In one direction; includes widening the clear zone by 10' to a depth of 3'	0.71	Median of 14 values from FHWA Desktop Reference for Crash Reduction Values
Install Access Barrier Fence	$15	LF	2.20	$33	8' fencing along residential section of roadway	0.10 (ped only)	Equal to ped overpass
Install Rock-Fall Mitigation - Wire Mesh	$1,320,000	Mile	2.20	$2,904,000	Includes wire mesh and rock stabilization (one direction)	0.75 (debris)	Assumed
Install Rock-Fall Mitigation - Containment Fence & Barrier	$2,112,000	Mile	2.20	$4,646,000	Includes containment fencing, concrete barrier, and rock stabilization (one direction)	0.75 (debris)	Assumed
Install Raised Concrete Barrier in Median	$650,000	Mile	2.20	$1,430,000	Includes concrete barrier with associated striping and reflective markings; excludes lighting in barrier (one direction)	0.90 (Cross-median and head on crashes eliminated completely)	All cross median and head-on fatal or incapacitating injury crashes are eliminated completely; all remaining crashes have 0.90 applied
Formalize Pullout (Small)	$7,500	Each	2.20	$17,000	Includes paving and signage (signs, posts, and foundations) - approximately 4,200 sf	0.97	Assumed - similar to Install Other General Warning Signs; CMF applied to crashes within 0.25 miles after sign
Formalize Pullout (Medium)	$27,500	Each	2.20	$61,000	Includes paving and signage (signs, posts, and foundations) - approximately 22,500 sf	0.97	Assumed - similar to Install Other General Warning Signs; CMF applied to crashes within 0.25 miles after sign
Formalize Pullout (Large)	$80,500	Each	2.20	$177,100	Includes paving and signage (signs, posts, and foundations) - approximately 70,000 sf	0.97	Assumed - similar to Install Other General Warning Signs; CMF applied to crashes within 0.25 miles after sign

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
INTERSECTION IMPROVEMENTS							
Construct Traffic Signal	$150,000	Each	2.20	$330,000	4-legged intersection; includes poles, foundations, conduit, controller, heads, luminaires, mast arms, etc.	0.95	From HSM; CMF applied to crashes within intersection only
Improve Signal Visibility	$35,000	Each	2.20	$77,000	4-legged intersection; signal head size upgrade, installation of new back-plates, and installation of additional signal heads on new poles.	0.85	Avg of 7 values from clearinghouse; CMF applied to crashes within intersection only
Install Raised Median	$360,000	Mile	2.20	$792,000	Includes removal of 14' wide pavement and construction of curb & gutter; does not include cost to widen roadway to accommodate the median; if the roadway needs to be widened, include cost from New General Purpose Lane	0.83	Avg from HSM
Install Transverse Rumble Strip/Pavement Markings	$3,000	Each	2.20	$7,000	Includes ped markings and rumble strips only across a 30' wide travelway; no pavement rehab or other striping	0.95	Avg of 17 values from clearinghouse; CMF applied to crashes within 0.5 miles after the rumble strips and markings
Construct Single-Lane Roundabout	$1,500,000	Each	2.20	$3,300,000	Removal of signal at 4-legged intersection; realignment of each leg for approx. 800 feet including paving, curbs, sidewalk, striping, lighting, signing	0.22	From HSM; CMF applied to crashes within intersection only
Construct Double-Lane Roundabout	$1,800,000	Each	2.20	$3,960,000	Removal of signal at 4-legged intersection; realignment of each leg for approx. 800 feet including paving, curbs, sidewalk, striping, lighting, signing	0.40	From HSM; CMF applied to crashes within intersection only
ROADWAY DELINEATION							
Install High-Visibility Edge Line Striping	$10,800	Mile	2.20	$23,800	2 edge lines and lane line - one direction of travel	0.77	Avg of 3 values from clearinghouse. Assumes package of striping, delineators, and RPMs. (If implemented separately, CMF will be higher.)
Install High-Visibility Delineators	$6,500	Mile	2.20	$14,300	Both edges - one direction of travel		Avg of 3 values from clearinghouse. Assumes package of striping, delineators, and RPMs. (If implemented separately, CMF will be higher.)
Install Raised Pavement Markers	$2,000	Mile	2.20	$4,400	Both edges - one direction of travel		Avg of 3 values from clearinghouse. Assumes package of striping, delineators, and RPMs. (If implemented separately, CMF will be higher.)
Install In-Lane Route Markings	$6,000	Each	2.20	$13,200	Installation of a series of three in-lane route markings in one lane	0.95	Assumed; CMF applied to crashes within 1.0 mile before the gore
IMPROVED VISIBILITY							

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Cut Side Slopes	$80	LF	2.20	$200	For small grading to correct sight distance issues; not major grading	0.85	Intent of this solution is to improve sight distance. Most CMF's are associated with vehicles traveling on slope. Recommended CMF is based on FDOT and NCDOT but is more conservative.
Install Lighting (connect to existing power)	$270,000	Mile	2.20	$594,000	One side of road only; offset lighting, not high-mast; does not include power supply; includes poles, luminaire, pull boxes, conduit, conductor	0.75 (night)	Average of 3 values on clearinghouse & consistent with HSM
Install Lighting (solar powered LED)	$10,000	Pole	2.20	$22,000	Offset lighting, not high-mast; solar power LED; includes poles, luminaire, solar panel	0.75 (night)	Average of 3 values on clearinghouse & consistent with HSM
DRIVER INFORMATION/WARNING							
Install Dynamic Message Sign (DMS)	$250,000	Each	2.20	$550,000	Includes sign, overhead structure, and foundations; wireless communication; does not include power supply	1.00	Not expected to reduce crashes
Install Dynamic Weather Warning Beacons	$40,000	Each	2.20	$88,000	Assumes solar operation and wireless communication or connection to existing power and communication; ground mounted; includes posts, foundations, solar panel, and dynamic sign	0.80 (weather related)	Avg of 3 values from FHWA Desktop Reference for Crash Reduction Factors; CMF applies to crashes within 0.25 miles after a sign
Install Dynamic Speed Feedback Signs	$25,000	Each	2.20	$55,000	Assumes solar operation and no communication; ground mounted; includes regulatory sign, posts, foundations, solar panel, and dynamic sign	0.94	Average of 2 clearinghouse values; CMF applies to crashes within 0.50 miles after a sign
Install Chevrons	$18,400	Mile	2.20	$40,500	On one side of road - includes signs, posts, and foundations	0.79	Average of 11 clearinghouse values
Install Curve Warning Signs	$2,500	Each	2.20	$5,500	Includes 2 signs, posts, and foundations	0.83	Average of 4 clearinghouse values; CMF applies to crashes within 0.25 miles after a sign
Install Traffic Control Device Warning Signs (e.g., stop sign ahead, signal ahead, etc.)	$2,500	Each	2.20	$5,500	Includes 2 signs, posts, and foundations	0.85	FHWA Desktop Reference for Crash Reduction Factors; CMF applies to crashes within 0.25 miles after a sign
Install Other General Warning Signs (e.g., intersection ahead, wildlife in area, slow vehicles, etc.)	$2,500	Each	2.20	$5,500	Includes 2 signs, posts, and foundations	0.97	Assumed; CMF applies to crashes within 0.25 miles after a sign
Install Wildlife Warning System	$162,000	Each	2.20	$356,400	Includes wildlife detection system at a designated wildlife crossing, flashing warning signs (assumes solar power), advance signing, CCTV (solar and wireless), game fencing for approximately 0.25 miles in each direction - centered on the wildlife crossing, and regular fencing for 1.0 mile in each direction - centered on the wildlife crossing.	0.50 (wildlife)	Assumed; CMF applies to wildlife-related crashes within 0.5 miles both upstream and downstream of the wildlife crossing in both directions

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Install Warning Sign with Beacons	$15,000	Each	2.20	$33,000	In both directions; includes warning sign, post, and foundation, and flashing beacons (assumes solar power) at one location	0.75	FHWA Desktop Reference for Crash Reduction Factors for Installing Flashing Beacons as Advance Warning; CMF applies to crashes within 0.25 miles after a sign
Install Larger Stop Sign with Beacons	$10,000	Each	2.20	$22,000	In one direction; includes large stop sign, post, and foundation, and flashing beacons (assumes solar power) at one location	0.85/0.81	Use 0.85 for adding beacons to an existing sign; 0.81 for installing a larger sign with flashing beacons; CMF applies to intersection related crashes
DATA COLLECTION							
Install Roadside Weather Information System (RWIS)	$60,000	Each	2.20	$132,000	Assumes wireless communication and solar power, or connection to existing power and communications	1.00	Not expected to reduce crashes
Install Closed Circuit Television (CCTV) Camera	$25,000	Each	2.20	$55,000	Assumes connection to existing ITS backbone or wireless communication; does not include fiber-optic backbone infrastructure; includes pole, camera, etc	1.00	Not expected to reduce crashes
Install Vehicle Detection Stations	$15,000	Each	2.20	$33,000	Assumes wireless communication and solar power, or connection to existing power and communications	1.00	Not expected to reduce crashes
Install Flood Sensors (Activation)	$15,000	Each	2.20	$33,000	Sensors with activation cabinet to alert through texting (agency)	1.00	Not expected to reduce crashes
Install Flood Sensors (Gates)	$100,000	Each	2.20	$220,000	Sensors with activation cabinet to alert through texting (agency) and beacons (public) plus gates	1.00	Not expected to reduce crashes
WIDEN CORRIDOR							
Construct New General Purpose Lane (PCCP)	$1,740,000	Mile	2.20	$3,830,000	For addition of 1 GP lane (PCCP) in one direction; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.90	North Carolina DOT uses 0.90 and Florida DOT uses 0.87
Construct New General Purpose Lane (AC)	$1,200,000	Mile	2.20	$2,640,000	For addition of 1 GP lane (AC) in one direction; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.90	North Carolina DOT uses 0.90 and Florida DOT uses 0.88
Convert a 2-Lane undivided highway to a 5-Lane highway	$1,576,000	Mile	2.20	$3,467,200	For expanding a 2-lane undivided highway to a 5-lane highway (4 through lanes with TWLTL), includes standard shoulder widths but no curb, gutter, or sidewalks	0.60	Assumed to be slightly lower than converting from a 4-lane to a 5-lane highway
Install Center Turn Lane	$1,053,000	Mile	2.20	$2,316,600	For adding a center turn lane (i.e., TWLTL); assumes symmetrical widening on both sides of the road; includes standard shoulder widths but no curb, gutter, or sidewalk	0.75	From FHWA Desktop Reference for Crash Reduction Factors, CMF Clearinghouse, and SR 87 CPS comparison

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
Construct 4-Lane Divided Highway (Using Existing 2-Lane Road for one direction)	$3,000,000	Mile	2.20	$6,600,000	In both directions; one direction uses existing 2-lane road; other direction assumes addition of 2 new lanes (AC) with standard shoulders; includes all costs except bridges	0.67	Assumed
Construct 4-Lane Divided Highway (No Use of Existing Roads)	$6,000,000	Mile	2.20	$13,200,000	In both directions; assumes addition of 2 new lanes (AC) with standard shoulders in each direction; includes all costs except bridges	0.67	Assumed
Construct Bridge over At-Grade Railroad Crossing	$10,000,000	Each	2.20	$22,000,000	Assumes bridge width of 4 lanes (AC) with standard shoulders; includes abutments and bridge approaches; assumes vertical clearance of 23'4" + 6'8" superstructure	0.72 (All train-related crashes eliminated)	Removes all train-related crashes at at-grade crossing; all other crashes CMF = 0.72
Construct Underpass at At-Grade Railroad Crossing	$15,000,000	Each	2.20	$33,000,000	Assumes underpass width of 4 lanes (AC) with standard shoulders; includes railroad bridge with abutments and underpass approaches; assumes vertical clearance of 16'6" + 6'6" superstructure	0.72 (All train-related crashes eliminated)	Removes all train-related crashes at at-grade crossing; all other crashes CMF = 0.72
Construct High-Occupancy Vehicle (HOV) Lane	$900,000	Mile	2.20	$1,980,000	For addition of 1 HOV lane (AC) in one direction with associated signage and markings; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.95	Similar to general purpose lane
ALTERNATE ROUTE							
Construct Frontage Roads	$2,400,000	Mile	2.20	$5,280,000	For 2-lane AC frontage road; includes all costs except bridges; for generally at-grade facility with minimal walls	0.90	Assumed - similar to new general purpose lane
Construct 2-Lane Undivided Highway	$3,000,000	Mile	2.20	$6,600,000	In both directions; assumes addition of 2 new lanes (AC) with standard shoulders in each direction; includes all costs except bridges	0.90	Assuming new alignment for a bypass

^ Factor accounts for traffic control, erosion control, construction surveying and quality control, mobilization, construction engineering, contingencies, indirect cost allocation, and miscellaneous work

Appendix G: Performance Area Risk Factors

Pavement Performance Area

- Elevation
- Mainline Daily Traffic Volume
- Mainline Daily Truck Volume

Elevation

Variance above 4000' divided by 1000; (Elev-4000)/1000

Score	Condition
0	< 4000’
0-5	4000’- 9000’
5	> 9000’

Mainline Daily Traffic Volume

Exponential equation; score = $5-(5*e^{(ADT*-0.000039)})$

Score	Condition
0	< 6,000
0-5	6,000 – 160,000
5	>160,000

Mainline Daily Truck Volume

Exponential equation; score = $5-(5*e^{(ADT*-0.00025)})$

Score	Condition
0	<900
0-5	900-25,000
5	>25,000

Bridge Performance Area

- Mainline Daily Traffic Volume
- Elevation
- Carries Mainline Traffic
- Detour Length
- Scour Critical Rating
- Vertical Clearance

Mainline Daily Traffic Volume

Exponential equation; score = $5-(5*e^{(ADT*-0.000039)})$

Score	Condition
0	<6,0000
0-5	6,000-160,000
5	>160,000

Elevation

Variance above 4000' divided by 1000; (Elev-4000)/1000

Score	Condition
0	< 4000’
0-5	4000’- 9000’
5	> 9000’

Carries Mainline Traffic

Score	Condition
0	Does not carry mainline traffic
5	Carries mainline traffic

Detour Length

Divides detour length by 10 and multiplies by 2.5

Score	Condition
0	0 miles
0-5	0-20 miles
5	> 20 miles

Scour Critical Rating

Variance below 8

Score	Condition
0	Rating > 8
0-5	Rating 8 - 3
5	Rating < 3

Vertical Clearance

Variance below 16’ x 2.5; (16 –Clearance) x 2.5

Score	Condition
0	>16’
0-5	16’-14’
5	<14’

Mobility Performance Area

- Mainline VMT
- Buffer Index (PTI-TTI)
- Detour Length
- Outside Shoulder width

Mainline VMT

Exponential equation; score = 5-(5*e$^{(ADT*-0.0000139)}$)

Score	Condition
0	<16,000
0-5	16,000-400,000
5	>400,000

Buffer Index

Buffer Index x 10

Score	Condition
0	Buffer Index = 0.00
0-5	Buffer Index 0.00-0.50
5	Buffer Index > 0.50

Detour Length

Score	Condition
0	Detour < 10 miles
5	Detour > 10 miles

Outside Shoulder Width

Variance below 10', if only 1 lane in each direction

Score	Condition
0	10' or above or >1 lane in each direction
0-5	10'-5' and 1 lane in each direction
5	5' or less and 1 lane in each direction

Safety Performance Area

- Mainline Daily Traffic Volume
- Interrupted Flow
- Elevation
- Outside Shoulder Width
- Vertical Grade

Mainline Daily Traffic Volume

Exponential equation; score = 5-(5*e$^{(ADT*-0.000039)}$)

Score	Condition
0	<6,000
0-5	6,000-160,000
5	>160,000

Interrupted Flow

Score	Condition
0	Not interrupted flow
5	Interrupted Flow

Elevation

Variance above 4000' divided by 1000; (Elev-4000)/1000

Score	Condition
0	< 4000'
0-5	4000'- 9000'
5	> 9000'

Outside Shoulder Width

Variance below 10'

Score	Condition
0	10' or above
0-5	10' - 5'
5	5' or less

Grade

Variance above 3% x 1.5

Score	Condition
0	< 3%
0-5	3% - 6.33%
5	>6.33%

Freight Performance Area

- Mainline Daily Truck Volume
- Detour Length
- Truck Buffer Index (TPTI-TTTI)
- Outside Shoulder Width

Mainline Daily Truck Volume

Exponential equation; score = 5-(5*e$^{(ADT*-0.00025)}$)

Score	Condition
0	<900
0-5	900-25,000
5	>25,000

Detour Length

Score	Condition
0	Detour < 10 miles
5	Detour > 10 miles

Truck Buffer Index

Truck Buffer Index x 10

Score	Condition
0	Buffer Index = 0.00
0-5	Buffer Index 0.00-0.50
5	Buffer Index > 0.50

Outside Shoulder Width

Variance below 10', if only 1 lane in each direction

Score	Condition
0	10' or above or >1 lane in each direction
0-5	10'-5' and 1 lane in each direction
5	5' or less and 1 lane in each direction

Solution Number	Mainline Traffic Vol (vpd) (2-way)	Solution Length (miles)	Bridge Detour Length (miles) (N19)	Elevation (ft)	Scour Critical Rating (0-9)	Carries Mainline Traffic (Y/N)	Bridge Vert. Clear (ft)	Mainline Truck Vol (vpd) (2-way)	Detour Length > 10 miles (Y/N)	Truck Buffer Index	Non-Truck Buffer Index	Grade (%)	Interrupted Flow (Y/N)	Outside/ Right Shoulder Width (ft)	1-lane each direction
17-1	33,072	1		2,260				4,200	y	0.05	0.09	3	n	10	n
17-2A	29,683	6	1	3,350	8	y	16.00	3,770	y	0.47	0.4	6	n	9.73	n
17-2B	29,683	6	1	3,350	8	n	16.29	3,770	y	0.47	0.4	6	n	9.73	n
17-3	29,683	6		3,350				3,770	y	0.09	0.07	6	n	9.73	n
17-4	29,683	0.5		3,400				3,770	y	0.47	0.4	4.4	n	9.73	n
17-5	27,138	4		3,700				3,447	y	0.11	0.14	5	n	9.97	n
17-6	20,208	5		4,250				3,080	y	0.34	0.31	5.2	n	10	n
17-7	22,377	0.2	12	3,300	8	n	15.18	3,153	y	0.08	0.13	4	n	9.93	n
17-8	22,377	3		3,400				3,153	y	0.08	0.13	2.4	n	9.96	n
17-9	22,377	2	1	3,425	8	y	16.00	3,153	y	0.06	0.11	4	n	9.93	n
17-10	22,377	4		3,800				3,153	y	0.08	0.13	5.9	n	9.96	n
17-11	22,377	4		3,800				3,153	y	0.06	0.11	5.6	n	9.93	n
17-12	18,951	0.25		3,850				2,740	y	0.26	0.31	4.2	n	10	n
17-13	18,951	6		5,325				2,740	y	0.26	0.31	6	n	10	n
17-14	18,951	2		4,625				2,740	y	0.07	0.1	6	n	10	n
17-15	18,951	2		5,425				2,740	y	0.26	0.31	4	n	10	n
17-16	16,031	4		6,400				2,318	y	0.07	0.12	6	n	10	n
17-17	16,244	1		6,475				2,606	y	0.04	0.08	4	n	10.35	n
17-18	16,244	1	1	6,330	8	y	16.00	2,606	y	0.04	0.08	3.7	n	10.16	n

Solution Number	Bridge	Pavement	Mobility	Safety	Freight	Risk Score (0 to 10)				
						Bridge	Pavement	Mobility	Safety	Freight
17-1	n	y	y	y	y	0.00	4.58	3.87	1.44	4.38
17-2A	y	n	y	y	y	2.97	0.00	6.79	3.27	6.38
17-2B	y	n	y	y	y	1.30	0.00	6.79	3.27	6.38
17-3	n	n	y	y	y	0.00	0.00	5.14	3.27	4.48
17-4	n	n	y	y	y	0.00	0.00	4.97	2.31	6.38
17-5	n	n	y	y	y	0.00	0.00	5.15	2.51	4.50
17-6	n	y	y	y	y	0.00	3.77	5.94	2.50	5.55
17-7	y	n	y	y	y	3.31	0.00	3.30	1.79	4.27
17-8	n	y	y	y	y	0.00	3.75	4.67	1.17	4.27
17-9	y	n	y	y	y	2.80	0.00	4.21	1.79	4.17
17-10	n	n	y	y	y	0.00	0.00	4.93	2.91	4.27
17-11	n	y	y	y	y	0.00	3.75	4.83	2.75	4.17
17-12	n	n	y	y	y	0.00	0.00	4.21	1.76	5.04
17-13	n	n	y	y	y	0.00	0.00	6.03	3.37	5.04
17-14	n	y	y	y	y	0.00	3.81	4.02	3.09	4.09
17-15	n	y	y	y	y	0.00	4.34	5.07	2.21	5.04
17-16	n	y	y	y	y	0.00	4.61	4.57	3.68	3.95
17-17	n	n	y	y	y	0.00	0.00	3.40	2.52	3.90
17-18	y	y	y	y	y	3.39	4.71	3.40	2.28	3.90

Appendix H: Candidate Solution Cost Estimate

	SOLUTION	QUANTITY	UNIT	UNIT COST	TOTAL CONSTRUCTION COST	NOTES
CS17.01	Table Mesa Rd TI Vertical Clearance Mitigation (Southbound MP 235.5 - 236.5)					
	Re-profile roadway (1 direction)	1	Mile	$2,140,000	$2,140,000	
				CONSTRUCTION SUBTOTAL	$2,140,000	
			3%	Preliminary Eng	$60,000	
			10%	Design	$210,000	
				TOTAL	$2,410,000	
CS17.02	Black Canyon Hill Mobility & Freight Improvements (MP 245-251)					
	Option A - climbing lane (northbound)					
	Northbound climbing lane	6	Mile	$6,600,000	$39,600,000	
	Replace Bumble Bee NB bridge	7150	SF	$350	$2,502,500	
				CONSTRUCTION SUBTOTAL	$42,100,000	
			3%	Preliminary Eng	$1,260,000	
			10%	Design	$4,210,000	
				TOTAL	$47,570,000	
	Option B - reversible lanes (2)					
	Construct Reversible lanes (2 lanes for 6 miles)	12	Lane-Mile	$10,560,000	$126,700,000	
	Replace Bumble Bee SB bridge	7700	SF	$350	$2,695,000	
				CONSTRUCTION SUBTOTAL	$129,400,000	
			3%	Preliminary Eng	$3,880,000	
			10%	Design	$12,940,000	
				TOTAL	$146,220,000	
	Option C - shoulder running (northbound)					
	Northbound shoulder running	6	Mile	$6,864,000	$41,200,000	Eliminated in BCA
				CONSTRUCTION SUBTOTAL	$41,200,000	
			3%	Preliminary Eng	$1,240,000	
			10%	Design	$4,120,000	
				TOTAL	$46,560,000	
CS17.03	Black Canyon Hill Southbound Safety (Southbound MP 245-251)					
	Replace guardrail	4	Mile	$286,000	$1,144,000	
	Install edge line striping	6	Mile	$23,800	$143,000	
	Install delineators	6	Mile	$14,300	$86,000	
	Install RPM's	6	Mile	$4,400	$26,000	

	SOLUTION	QUANTITY	UNIT	UNIT COST	TOTAL CONSTRUCTION COST	NOTES
	Install rumble strip	6	Mile	$12,000	$72,000	
	Install chevrons	2.5	Mile	$40,500	$101,000	
	Cut side slopes - southbound (length assumed)	5000	LF	$200	$1,000,000	
	Install speed feedback system	4	Each	$55,000	$220,000	
				CONSTRUCTION SUBTOTAL	$2,790,000	
			3%	Preliminary Eng	$80,000	
			10%	Design	$280,000	
				TOTAL	$3,150,000	
CS17.04	Sunset Point Safety Improvements (MP 252-253)					
	Modify ramp	2	Each	$979,000	$1,958,000	
	Install RWIS	1	Each	$132,000	$132,000	
	Install dynamic weather warning beacons	1	Each	$88,000	$88,000	
				CONSTRUCTION SUBTOTAL	$2,180,000	
			3%	Preliminary Eng	$70,000	
			10%	Design	$220,000	
				TOTAL	$2,470,000	
CS17.05	Badger Springs Northbound Climbing Lane (Northbound MP 256-260)					
	Northbound climbing lane	4	Mile	$3,300,000	$13,200,000	
				CONSTRUCTION SUBTOTAL	$13,200,000	
			3%	Preliminary Eng	$400,000	
			10%	Design	$1,300,000	
				TOTAL	$14,900,000	
CS17.06	Orme Road Safety Improvements (Southbound MP 269-274)					
	Total 5 miles; 5 curves; 2.5 miles of curves; 2.5 miles of tangent					
	Improve skid resistance	2.5	Mile	$1,490,000	$3,725,000	
	Install edge line striping	2.5	Mile	$23,800	$60,000	
	Install delineators	2.5	Mile	$14,300	$36,000	
	Install RPM's	2.5	Mile	$4,400	$11,000	
	Install rumble strip	2.5	Mile	$12,000	$30,000	
	Install chevrons	2.5	Mile	$40,500	$101,000	
	Install speed feedback system	4	Each	$55,000	$220,000	
				CONSTRUCTION SUBTOTAL	$4,180,000	
			3%	Preliminary Eng	$125,000	
			10%	Design	$418,000	

	SOLUTION	QUANTITY	UNIT	UNIT COST	TOTAL CONSTRUCTION COST	NOTES
				TOTAL	$4,723,000	
CS17.07	McGuireville TI Bridge					
	Option A - rehab bridge and construct new ramp					
	Construct new exit ramp	1	Each	$1,610,000	$1,610,000	
	New bridge over Dry Beaver Creek	7000	SF	$350	$2,450,000	
	Additional earthwork	1	Each	$1,000,000	$1,000,000	assumed
	Rehabilitate McGuireville bridge	9000	SF	$140	$1,260,000	
				CONSTRUCTION SUBTOTAL	$6,320,000	
			3%	Preliminary Eng	$190,000	
			10%	Design	$632,000	
	R/W	2.5	Acre	$260,000	$650,000	
				TOTAL	$7,792,000	
	Option B - replace bridge					
	Cost to replace TI from previous DCR	1	Lump Sum	$16,000,000	$16,000,000	
				CONSTRUCTION SUBTOTAL	$16,000,000	
			3%	Preliminary Eng	$480,000	
			10%	Design	$1,600,000	
	R/W	3.0	Acre	$260,000	$780,000	
				TOTAL	$18,860,000	
CS17.08	Middle Verde Road Northbound Safety Improvements (Northbound MP 290-293)					
	Total 3 miles; multiple curves; 2 miles of curves; 1 miles of tangent					
	Improve skid resistance	2	Mile	$1,490,000	$2,980,000	
	Install edge line striping	1	Mile	$23,800	$24,000	
	Install delineators	1	Mile	$14,300	$14,000	
	Install RPM's	1	Mile	$4,400	$4,000	
	Install rumble strip	1	Mile	$12,000	$12,000	
	Install chevrons	2	Mile	$40,500	$81,000	
	Install speed feedback system	4	Each	$55,000	$220,000	
	Install CCTV	1	Each	$55,000	$55,000	
				CONSTRUCTION SUBTOTAL	$3,390,000	
			3%	Preliminary Eng	$100,000	
			10%	Design	$340,000	
				TOTAL	$3,830,000	
CS17.09	Dry Beaver Creek Southbound Climbing Lane (Southbound MP 292-294)					

	SOLUTION	QUANTITY	UNIT	UNIT COST	TOTAL CONSTRUCTION COST	NOTES
	Southbound climbing lane	2	Mile	$3,300,000	$6,600,000	
	Widen Dry Beaver Creek SB	4280	SF	$390	$1,669,200	
				CONSTRUCTION SUBTOTAL	$8,270,000	
			3%	Preliminary Eng	$250,000	
			10%	Design	$830,000	
				TOTAL	$9,350,000	
CS17.10	Dry Beaver Creek Northbound Climbing Lane (Northbound MP 294-298)					
	Northbound climbing lane	4	Mile	$3,300,000	$13,200,000	
				CONSTRUCTION SUBTOTAL	$13,200,000	
			3%	Preliminary Eng	$400,000	
			10%	Design	$1,300,000	
				TOTAL	$14,900,000	
CS17.11	McGuireville Rest Area Safety Improvements (Southbound MP 295-299)					
	Total 4 miles; multiple curves; 2.5 miles of curves; 1.5 miles of tangent					
	Improve skid resistance	2.5	Mile	$1,490,000	$3,725,000	
	Install edge line striping	1.5	Mile	$23,800	$36,000	
	Install delineators	1.5	Mile	$14,300	$21,000	
	Install RPM's	1.5	Mile	$4,400	$7,000	
	Install rumble strip	1.5	Mile	$12,000	$18,000	
	Install chevrons	2.5	Mile	$40,500	$101,000	
	Install speed feedback system	4	Each	$55,000	$220,000	
	Install CCTV	1	Each	$55,000	$55,000	
				CONSTRUCTION SUBTOTAL	$4,180,000	
			3%	Preliminary Eng	$130,000	
			10%	Design	$420,000	
				TOTAL	$4,730,000	
CS17.12	SR 179 TI (MP 298.5 -299.0)					
	Modify ramp (NB exit and SB entrance)	2	Each	$979,000	$1,958,000	
				CONSTRUCTION SUBTOTAL	$1,960,000	
			3%	Preliminary Eng	$60,000	
			10%	Design	$200,000	
				TOTAL	$2,220,000	
CS17.13	Hog Tank Canyon Northbound Climbing Lane (Northbound MP 299-305)					

	SOLUTION	QUANTITY	UNIT	UNIT COST	TOTAL CONSTRUCTION COST	NOTES
	Northbound climbing lane	6	Mile	$3,300,000	$19,800,000	
	New DMS	1	Each	$550,000	$550,000	
	New CCTV	1	Each	$55,000	$55,000	
				CONSTRUCTION SUBTOTAL	$20,410,000	
			3%	Preliminary Eng	$610,000	
			10%	Design	$2,040,000	
				TOTAL	$23,060,000	
CS17.14	Hog Tank Canyon Southbound Safety Improvements (Southbound MP 300-302)					
	Improve skid resistance	2	Mile	$1,490,000	$2,980,000	
	Install chevrons	2	Mile	$40,500	$81,000	
	Install speed feedback system	2	Each	$55,000	$110,000	
	Excavate/grade cut slopes	2000	LF	$200	$400,000	
				CONSTRUCTION SUBTOTAL	$3,570,000	
			3%	Preliminary Eng	$107,000	
			10%	Design	$357,000	
				TOTAL	$4,034,000	
CS17.15	Rattlesnake Canyon Northbound Safety Improvements (Northbound MP 305-307)					
	Total 2 miles; 1 curve; 0.5 miles of curves; 1.5 miles of tangent					
	Improve skid resistance	0.5	Mile	$1,490,000	$745,000	
	Install edge line striping	1.5	Mile	$23,800	$36,000	
	Install delineators	1.5	Mile	$14,300	$21,000	
	Install RPM's	1.5	Mile	$4,400	$7,000	
	Install rumble strip	1.5	Mile	$12,000	$18,000	
	Install chevrons	0.5	Mile	$40,500	$20,000	
	Install speed feedback system	2	Each	$55,000	$110,000	
	Extend ramp	1	Each	$979,000	$979,000	
	Install CCTV	1	Each	$55,000	$55,000	
				CONSTRUCTION SUBTOTAL	$1,990,000	
			3%	Preliminary Eng	$60,000	
			10%	Design	$199,000	
				TOTAL	$2,249,000	
CS17.16	Red Hill Scenic Overlook Southbound Safety Improvements (Southbound MP 309-313)					
	Improve skid resistance	4	Mile	$1,490,000	$5,960,000	
	Install chevrons	4	Mile	$40,500	$162,000	
	Install speed feedback system	4	Each	$55,000	$220,000	

	SOLUTION	QUANTITY	UNIT	UNIT COST	TOTAL CONSTRUCTION COST	NOTES
	Install CCTV	1	Each	$55,000	$55,000	
				CONSTRUCTION SUBTOTAL	$6,400,000	
			3%	Preliminary Eng	$190,000	
			10%	Design	$640,000	
				TOTAL	$7,230,000	
CS17.17	Woods Canyon Southbound Climbing Lane (Southbound MP 316-317)					
	Southbound climbing lane	1	Mile	$4,950,000	$4,950,000	
				CONSTRUCTION SUBTOTAL	$4,950,000	
			3%	Preliminary Eng	$150,000	
			10%	Design	$500,000	
				TOTAL	$5,600,000	
CS17.18	Woods Canyon Safety (MP 316.5 - 317.5)					
	Realign NB roadway	1	Mile	$6,510,000	$6,510,000	
	Realign SB roadway	1	Mile	$6,510,000	$6,510,000	
	Additional earthwork (based on previous DCR)	1	Each	$10,000,000	$10,000,000	assumed (based on previous DCR)
	Install RWIS	1	Each	$132,000	$132,000	
	New Bridges (w/ de-icing)	22400	SF	$400	$8,960,000	$350/SF for bridge + $50/SF for de-icing
				CONSTRUCTION SUBTOTAL	$32,110,000	
			3%	Preliminary Eng	$960,000	
			10%	Design	$3,211,000	
				TOTAL	$36,281,000	
CS17.19	Kachina Village Pavement					
	Replace pavement (AC) - one direction	8	Mile	$3,170,000	$25,360,000	
	Replace pavement (PCCP) - both directions	2	Mile	$3,810,000	$7,620,000	
				CONSTRUCTION SUBTOTAL	$32,980,000	
			3%	Preliminary Eng	$990,000	
			10%	Design	$3,300,000	
				TOTAL	$37,270,000	Eliminated in LCCA
CS17.20	Airport Rd TI Bridge					
	Option A - rehab bridge					
	Rehabilitate Airport Rd bridge	7280	SF	$140	$1,020,000	
				CONSTRUCTION SUBTOTAL	$1,000,000	
			3%	Preliminary Eng	$30,000	
			10%	Design	$100,000	

SOLUTION		QUANTITY	UNIT	UNIT COST	TOTAL CONSTRUCTION COST	NOTES
				TOTAL	$1,130,000	Eliminated in LCCA
	Option B - replace bridge					
	Cost to replace TI from previous DCR	1	Lump Sum	$16,900,000	$16,900,000	
				CONSTRUCTION SUBTOTAL	$17,000,000	
			3%	Preliminary Eng	$510,000	
			10%	Design	$1,700,000	
				TOTAL	$19,210,000	Eliminated in LCCA

Appendix I: Performance Effectiveness Scores

Post-Project Performance Scores

LEGEND:
- user entered value
- calculated value for reference only
- calculated value for entry/use in other spreadsheet
- for input into Performance Effectiveness Score spreadsheet
- assumed values (do not modify)

			Solution #	17.01	17.02-A	17.02 - B	17.03	17.04	17.05	17.06	17.07-A	17.07-B	17.08	17.09	17.10	17.11	17.12
			Description	Table Mesa Vert Clr	NB Climbing Lane	Reversible Lanes	SB Safety	Sunset Point TI	NB Climbing Lane	SB Safety	New Ramp	Replace Bridge	NB Safety	SB Climbing Lane	NB Climbing Lane	SB Safety	SR 179 TI
			Project Beg MP	235.5	245	245	245	252	256	269	292.5	292.5	290	292	294	295	
			Project End MP	236.5	251	251	251	253	260	274	293.5	293.5	293	294	298	299	
			Project Length (miles)	1	6	6	6	1	4	5	1	1	3	2	4	4	0
			Segment Beg MP	232	245	245	245	245	253	263	288	288	288	288	288	288	288
			Segment End MP	245	253	253	253	253	263	279	299	299	299	299	299	299	299
			Segment Length (miles)	13	8	8	8	8	10	16	11	11	11	11	11	11	11
			Segment #	3	4	4	4	4	5	6	8	8	8	8	8	8	8
			Current # of Lanes (both directions)	4	4	4	4	4	4	4	4	4	4	4	4	4	4
			Project Type (one-way or two-way)	one-way	one-way	two-way	one-way	two-way	one-way	one-way	one-way	one-way	one-way	one-way	one-way	one-way	two-way
			Additional Lanes (one-way)	0	1	1	0	0	1	0	0	0	0	1	1	0	0
			Pro-Rated # of Lanes	4.00	4.75	5.50	4.00	4.00	4.40	4.00	4.00	4.00	4.00	4.18	4.36	4.00	4.00
		Notes and Directions	Description														
SAFETY	DIRECTIONAL SAFETY	Input current value from performance system (direction 1)	Orig Segment Directional Safety Index (direction 1)	0.667	0.488	0.488	1.639	0.488	1.363	1.553	2.999	2.999	2.999	2.084	2.999	2.084	2.999
		Input current value from performance system (direction 1)	Orig Segment Directional Fatal Crashes (direction 1)	3	1	1	5	1	5	4	6	6	6	4	6	4	6
		Input current value from performance system (direction 1)	Orig Segment Directional Incap Crashes (direction 1)	11	8	8	3	8	5	8	4	4	4	5	4	5	4
		Input current value from performance system (direction 1)	Original Fatal Crashes in project limits (direction 1)	0	1	1	4	0	2	Off-Line	0	0	Off-Line	0	2	Off-Line	1
		Input current value from performance system (direction 1)	Original Incap Crashes in project limits (direction 1)	1	5	5	1	3	3	Off-Line	0	0	Off-Line	0	1	Off-Line	0
		Input CMF value (direction 1) - If no CMF enter 1.0	CMF 1 (direction 1)(lowest CMF)	0.7	0.75	0.73	0.77	0.21	0.75	Off-Line	1	1	Off-Line	0.75	0.75	Off-Line	0.21
		Input CMF value (direction 1) - If no CMF enter 1.0	CMF 2 (direction 1)	1	1	1	1	1	1	Off-Line	1	1	Off-Line	1	1	Off-Line	1
		Input CMF value (direction 1) - If no CMF enter 1.1	CMF 3 (direction 1)	1	1	1	1	1	1	Off-Line	1	1	Off-Line	1	1	Off-Line	1
		Input CMF value (direction 1) - If no CMF enter 1.2	CMF 4 (direction 1)	1	1	1	1	1	1	Off-Line	1	1	Off-Line	1	1	Off-Line	1
		Input CMF value (direction 1) - If no CMF enter 1.0	CMF 5 (direction 1)	1	1	1	1	1	1	Off-Line	1	1	Off-Line	1	1	Off-Line	1
		Calculated Value (direction 1)	Total CMF (direction 1)	0.700	0.750	0.730	0.770	0.210	0.750	Off-Line	1.000	1.000	Off-Line	0.750	0.750	Off-Line	0.210
		Calculated Value (direction 1)	Fatal Crash reduction (direction 1)	0.000	0.250	0.270	0.920	0.000	0.500	0.682	0.000	0.000	1.228	0.000	0.500	0.954	0.790
		Calculated Value (direction 1)	Incap Crash reduction (direction 1)	0.300	1.250	1.350	0.230	2.370	0.750	1.773	0.000	0.000	0.682	0.000	0.250	1.363	0.000
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 1)	Post-Project Segment Directional Fatal Crashes (direction 1)	3.000	0.750	0.730	4.080	1.000	4.500	3.318	6.000	6.000	4.772	4.000	5.500	3.046	5.210
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 1)	Post-Project Segment Directional Incap Crashes (direction 1)	10.700	6.750	6.650	2.770	5.630	4.250	6.227	4.000	4.000	3.318	5.000	3.750	3.637	4.000
		Input value from updated Safety Index spreadsheet (direction 1)	Post-Project Segment Directional Safety Index (direction 1)	0.664	0.383	0.374	1.345	0.437	1.222	1.279	2.999	2.999	2.389	2.084	2.751	1.581	2.621
		Enter in Safety Needs spreadsheet to calculate new segment level Safety Need (direction 1)	Post-Project Segment Directional Safety Index (direction 1)	0.664	0.383	0.374	1.345	0.437	1.222	1.279	2.999	2.999	2.389	2.084	2.751	1.581	2.621
		Input current value from performance system (direction 2)	Orig Segment Directional Safety Index (direction 2)	0.838	1.639	1.639	0.488	1.639	0.654	1.092	2.084	2.084	2.084	2.999	2.084	2.999	2.084
		Input current value from performance system (direction 2)	Orig Segment Directional Fatal Crashes (direction 2)	4	5	5	1	5	2	3	4	4	4	6	4	6	4
		Input current value from performance system (direction 2)	Orig Segment Directional Incap Crashes (direction 2)	11	3	3	8	3	8	3	5	5	5	4	5	4	5
		Input current value from performance system (direction 2)	Original Fatal Crashes in project limits (direction 2)	0	0	4	0	1	0	0	0	0	0	0	0	0	0

			Solution #	17.01	17.02-A	17.02 - B	17.03	17.04	17.05	17.06	17.07-A	17.07-B	17.08	17.09	17.10	17.11	17.12
		Input current value from performance system (direction 2)	Original Incap Crashes in project limits (direction 2)	0	0	1	0	0	0	0	0	0	0	0	0	0	2
		Input CMF value (direction 2) - If no CMF enter 1.0	CMF 1 (direction 2)(lowest CMF)	1	1	0.88	1	0.21	1	1	1	1	1	1	1	1	0.21
		Input CMF value (direction 2) - If no CMF enter 1.0	CMF 2 (direction 2)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Input CMF value (direction 2) - If no CMF enter 1.1	CMF 3 (direction 2)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Input CMF value (direction 2) - If no CMF enter 1.2	CMF 4 (direction 2)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Input CMF value (direction 2) - If no CMF enter 1.0	CMF 5 (direction 2)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Calculated Value (direction 2)	Total CMF (direction 2)	1.000	1.000	0.880	1.000	0.210	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.210
		Calculated Value (direction 2)	Fatal Crash reduction (direction 2)	0.000	0.000	0.480	0.000	0.790	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Calculated Value (direction 2)	Incap Crash reduction (direction 2)	0.000	0.000	0.120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.580
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 2)	Post-Project Segment Directional Fatal Crashes (direction 2)	4.000	5.000	4.520	1.000	4.210	2.000	3.000	4.000	4.000	4.000	6.000	4.000	6.000	4.000
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 2)	Post-Project Segment Directional Incap Crashes (direction 2)	11.000	3.000	2.880	8.000	3.000	8.000	3.000	5.000	5.000	5.000	4.000	5.000	4.000	3.420
		Input value from updated Safety Index spreadsheet (direction 2)	Post-Project Segment Directional Safety Index (direction 2)	0.838	1.639	1.485	0.488	1.390	0.654	1.092	2.084	2.084	2.084	2.999	2.084	2.999	2.032
		Enter in Safety Needs spreadsheet to calculate new segment level Safety Need (direction 2)	Post-Project Segment Directional Safety Index (direction 2)	0.838	1.639	1.485	0.488	1.390	0.654	1.092	2.084	2.084	2.084	2.999	2.084	2.999	2.032
	SAFETY INDEX	Calculated Value - verify that it matches current performance system	Current Safety Index	0.753	1.064	1.064	1.064	1.064	1.009	1.323	2.542	2.542	2.542	2.542	2.542	2.542	2.542
		Enter in Safety Needs spreadsheet to calculate new segment level Safety Need	Post-Project Safety Index	0.751	1.011	0.930	0.917	0.914	0.938	1.186	2.542	2.542	2.237	2.542	2.418	2.290	2.327
	Needs	User entered value from Safety Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Safety Need	1.408	2.422	2.422	2.422	2.422	1.718	3.571	7.96	7.96	7.96	7.96	7.96	7.96	7.96
		User entered value from Safety Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Safety Need	1.406	2.183	1.751	1.663	1.656	1.343	3.119	7.96	7.96	6.802	7.96	7.493	7.006	7.147
MOBILITY	MOBILITY INDEX	Input current value from performance system	Original Segment Mobility Index	0.580	0.640	0.640	0.640	0.640	0.590	0.370	0.390	0.390	0.390	0.390	0.390	0.390	0.390
		Enter in Mobility Index Spreadsheet to determine new segment level Mobility Index	Post-Project # of Lanes (both directions)	4.00	4.75	5.50	4.00	4.00	4.40	4.00	4.00	4.00	4.00	4.18	4.36	4.00	4.00
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Mobility Index	0.58	0.54	0.47	0.64	0.64	0.54	0.37	0.39	0.39	0.39	0.38	0.36	0.39	0.39
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Mobility Index	0.580	0.540	0.470	0.640	0.640	0.540	0.370	0.390	0.390	0.390	0.380	0.360	0.390	0.390
	FUT V/C	Input current value from performance system	Original Segment Future V/C	No Change	0.780	0.780	No Change	No Change	0.720	No Change	No Change	No Change	No Change	0.470	0.470	No Change	No Change
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Future V/C	No Change	0.660	0.570	No Change	No Change	0.660	No Change	No Change	No Change	No Change	0.450	0.430	No Change	No Change
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Future V/C	No Change	0.660	0.570	No Change	No Change	0.660	No Change	No Change	No Change	No Change	0.450	0.430	No Change	No Change
	PEAK HOUR V/C	Input current value from performance system (direction 1)	Original Segment Peak Hour V/C (direction 1)	No Change	0.380	0.380	No Change	No Change	0.380	No Change	No Change	No Change	No Change	0.350	0.350	No Change	No Change
		Input current value from performance system (direction 2)	Original Segment Peak Hour V/C (direction 2)	No Change	0.380	0.380	No Change	No Change	0.400	No Change	No Change	No Change	No Change	0.350	0.350	No Change	No Change

			Solution #	17.01	17.02-A	17.02 - B	17.03	17.04	17.05	17.06	17.07-A	17.07-B	17.08	17.09	17.10	17.11	17.12
		*If One-Way project, enter in Mobility Index Spreadsheet to determine new segment level Peak Hour V/C. If Two-Way project, disregard	Adjusted total # of Lanes for use in directional peak hr	4.00	5.50	N/A	4.00	N/A	4.80	4.00	4.00	4.00	4.00	4.36	4.73	4.00	N/A
		Input value from updated Mobility Index spreadsheet (direction 1)	Post-Project Segement Peak Hr V/C (direction 1)	No Change	0.28	0.28	No Change	No Change	0.32	No Change	No Change	No Change	No Change	0.32	0.30	No Change	No Change
		Input value from updated Mobility Index spreadsheet (direction 2)	Post-Project Segement Peak Hr V/C (direction 2)	No Change	0.38	0.28	No Change	No Change	0.40	No Change	No Change	No Change	No Change	0.35	0.35	No Change	No Change
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Peak Hr V/C (direction 1)	No Change	0.280	0.280	No Change	No Change	0.320	No Change	No Change	No Change	No Change	0.320	0.300	No Change	No Change
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Peak Hr V/C (direction 2)	No Change	0.380	0.280	No Change	No Change	0.400	No Change	No Change	No Change	No Change	0.350	0.350	No Change	No Change
	TTI AND PTI	Calculated Value (both directions)	Safety Reduction Factor	0.998	0.951	0.874	0.862	0.859	0.930	0.896	1.000	1.000	0.880	1.000	0.951	0.901	0.915
		Calculated Value (both directions)	Safety Reduction	0.002	0.049	0.126	0.138	0.141	0.070	0.104	0.000	0.000	0.120	0.000	0.049	0.099	0.085
		Calculated Value (both directions)	Mobility Reduction Factor	1.000	0.844	0.734	1.000	1.000	0.915	1.000	1.000	1.000	1.000	0.974	0.923	1.000	1.000
		Calculated Value (both directions)	Mobility Reduction	0.000	0.156	0.266	0.000	0.000	0.085	0.000	0.000	0.000	0.000	0.026	0.077	0.000	0.000
		Input current value from performance system (direction 1)	Original Directional Segment TTI (direction 1)	1.110	1.210	1.210	1.000	1.210	1.200	1.380	1.140	1.140	1.140	1.130	1.140	1.130	1.140
		Input current value from performance system (direction 1)	Original Directional Segment PTI (direction 1)	1.200	1.610	1.610	1.070	1.610	1.340	1.690	1.270	1.270	1.270	1.240	1.270	1.240	1.270
		Input current value from performance system (direction 2)	Original Directional Segment TTI (direction 2)	1.090	1.000	1.000	1.210	1.000	1.140	1.130	1.130	1.130	1.130	1.140	1.130	1.140	1.130
		Input current value from performance system (direction 2)	Original Directional Segment PTI (direction 2)	1.170	1.070	1.070	1.610	1.070	1.210	1.230	1.240	1.240	1.240	1.270	1.240	1.270	1.240
		Calculated Value (both directions)	Reduction Factor for Segment TTI	0.000	0.047	0.080	0.000	0.000	0.025	0.000	0.000	0.000	0.000	0.008	0.023	0.000	0.000
		Calculated Value (both directions)	Reduction Factor for Segment PTI	0.001	0.046	0.091	0.041	0.042	0.038	0.031	0.000	0.000	0.036	0.005	0.030	0.030	0.025
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Directional Segment TTI (direction 1)	1.110	1.153	1.114	1.000	1.210	1.169	1.380	1.140	1.140	1.140	1.121	1.114	1.130	1.140
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Directional Segment PTI (direction 1)	1.199	1.536	1.464	1.026	1.542	1.289	1.637	1.270	1.270	1.224	1.234	1.232	1.203	1.238
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Directional Segment TTTI (direction 2)	1.090	1.000	1.000	1.210	1.000	1.140	1.130	1.130	1.130	1.130	1.140	1.130	1.140	1.130
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Directional Segment TPTI (direction 2)	1.170	1.070	1.035	1.610	1.025	1.210	1.230	1.240	1.240	1.240	1.270	1.240	1.270	1.209
	CLOSURE EXTENT	Input current value from performance system (direction 1)	Orig Segment Directional Closure Extent (direction 1)	0.110	0.750	0.750	0.610	0.750	0.420	0.150	0.150	0.150	0.150	0.220	0.150	0.220	0.150
		Input current value from performance system (direction 2)	Orig Segment Directional Closure Extent (direction 2)	0.780	0.610	0.610	0.750	0.610	0.280	0.050	0.220	0.220	0.220	0.150	0.220	0.150	0.220
		Input value from HCRS	Segment Closures with fatalities/injuries	18	15	15	15	15	10	7	13	13	13	13	13	13	13
		Input value from HCRS	Total Segment Closures	37	29	29	29	29	25	16	19	19	19	19	19	19	19
		Calculated Value (both directions)	% Closures with Fatality/Injury	0.49	0.52	0.52	0.52	0.52	0.40	0.44	0.68	0.68	0.68	0.68	0.68	0.68	0.68
		Calculated Value (both directions)	Closure Reduction	0.001	0.026	0.065	0.071	0.073	0.028	0.045	0.000	0.000	0.082	0.000	0.033	0.068	0.058
		Calculated Value (both directions)	Closure Reduction Factor	0.999	0.974	0.935	0.929	0.927	0.972	0.955	1.000	1.000	0.918	1.000	0.967	0.932	0.942
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Segment Directional Closure Extent (direction 1)	0.110	0.731	0.701	0.566	0.695	0.408	0.143	0.150	0.150	0.138	0.220	0.145	0.205	0.141
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Segment Directional Closure Extent (direction 2)	0.780	0.610	0.570	0.750	0.565	0.280	0.050	0.220	0.220	0.220	0.150	0.220	0.150	0.207
	BICYCLE ACCOM	Input current value from performance system	Orig Segment Bicycle Accomodation %	100.0%	97.0%	97.0%	97.0%	97.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		Input current value from performance system	Orig Segment Outside Shoulder width														

				Solution #	17.01	17.02-A	17.02 - B	17.03	17.04	17.05	17.06	17.07-A	17.07-B	17.08	17.09	17.10	17.11	17.12
FREIGHT		Input value from updated Mobility Index spreadsheet	Post-Project Segment Outside Shoulder width															
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Bicycle Accomodation (%)	100.0%	97.0%	97.0%	97.0%	97.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		Enter in Mobiity Needs spreadsheet to calculate new segment level Mobility Need	Post-Project Segment Bicycle Accomodation (%)	100.0%	97.0%	97.0%	97.0%	97.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	Needs	User entered value from Mobility Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Mobility Need	1.305	2.064	2.064	2.064	2.064	1.203	1.124	0.680	0.680	0.680	0.680	0.680	0.680	0.680
		User entered value from Mobility Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Mobility Need	1.305	1.491	1.235	2.045	1.973	1.006	1.083	0.680	0.680	0.677	0.666	0.643	0.677	0.675
	TTTI AND TPTI	Input current value from performance system (direction 1)	Original Directional Segment TTTI (direction 1)	1.030	1.340	1.340	1.070	1.340	1.090	1.270	1.050	1.050	1.080	1.050	1.080	1.050	1.080
		Input current value from performance system (direction 1)	Original Directional Segment TPTI (direction 1)	1.090	1.820	1.820	1.160	1.820	1.200	1.610	1.110	1.110	1.150	1.110	1.150	1.110	1.150
		Input current value from performance system (direction 2)	Original Directional Segment TTTI (direction 2)	1.010	1.070	1.070	1.340	1.070	1.020	1.030	1.080	1.080	1.050	1.080	1.050	1.080	1.050
		Input current value from performance system (direction 2)	Original Directional Segment TPTI (direction 2)	1.040	1.160	1.160	1.820	1.160	1.070	1.080	1.150	1.150	1.110	1.150	1.110	1.150	1.110
		Calculated Value (both directions)	Reduction Factor for Segment TTTI (both directions)	0.000	0.023	0.040	0.000	0.000	0.013	0.000	0.000	0.000	0.000	0.004	0.012	0.000	0.000
		Calculated Value (both directions)	Reduction Factor for Segment TPTI (both directions)	0.000	0.023	0.045	0.021	0.021	0.019	0.016	0.000	0.000	0.018	0.003	0.015	0.015	0.013
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Directional Segment TTTI (direction 1)	1.030	1.309	1.287	1.070	1.340	1.076	1.270	1.050	1.050	1.080	1.046	1.068	1.050	1.080
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Directional Segment TPTI (direction 1)	1.090	1.778	1.737	1.136	1.781	1.177	1.585	1.110	1.110	1.129	1.107	1.133	1.094	1.135
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Directional Segment TTTI (direction 2)	1.010	1.070	1.027	1.340	1.070	1.020	1.030	1.080	1.080	1.050	1.080	1.050	1.080	1.050
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Directional Segment TPTI (direction 2)	1.040	1.160	1.107	1.820	1.135	1.070	1.080	1.150	1.150	1.110	1.150	1.110	1.150	1.096
	FREIGHT INDEX	Value from above	Original Segment TPTI (direction 1)	1.090	1.820	1.820	1.160	1.820	1.200	1.610	1.110	1.110	1.150	1.110	1.150	1.110	1.150
		Value from above	Original Segment TPTI (direction 2)	1.040	1.160	1.160	1.820	1.160	1.070	1.080	1.150	1.150	1.110	1.150	1.110	1.150	1.110
		Calculated Value	Original Segment Freight Index	0.939	0.671	0.671	0.671	0.671	0.881	0.743	0.885	0.885	0.885	0.885	0.885	0.885	0.885
		Calculated Value	Post-Project Segment TPTI (direction 1)	1.090	1.778	1.737	1.136	1.781	1.177	1.585	1.110	1.110	1.129	1.107	1.133	1.094	1.135
		Calculated Value	Post-Project Segment TPTI (direction 2)	1.040	1.160	1.107	1.820	1.135	1.070	1.080	1.150	1.150	1.110	1.150	1.110	1.150	1.096
		Enter in Freight Needs spreadsheet to update segment level Freight Need	Post-Project Segment Freight Index	0.939	0.681	0.703	0.677	0.686	0.890	0.750	0.885	0.885	0.893	0.886	0.892	0.891	0.896
	CLOSURE DURATION	Input current value from performance system (direction 1)	Orig Segment Directional Closure Duration (dir 1)	19.720	194.020	194.020	175.250	194.020	119.960	24.860	44.200	44.200	32.690	44.200	32.690	44.200	32.690
		Input current value from performance system (direction 2)	Orig Segment Directional Closure Duration (dir 2)	209.830	175.250	175.250	194.020	175.250	49.380	13.570	32.690	32.690	44.200	32.690	44.200	32.690	44.200
		Calculated Value	Segment Closures with fatalities	18	15	15	15	15	10	7	13	13	13	13	13	13	13
		Calculated Value	Total Segment Closures	37	29	29	29	29	25	16	19	19	19	19	19	19	19
		Calculated Value	% Closures with Fatality	0.49	0.52	0.52	0.52	0.52	0.40	0.44	0.68	0.68	0.68	0.68	0.68	0.68	0.68
		Calculated Value	Closure Reduction	0.001	0.026	0.065	0.071	0.073	0.028	0.045	0.000	0.000	0.082	0.000	0.033	0.068	0.058
		Calculated Value	Closure Reduction Factor	0.999	0.974	0.250	0.929	0.927	0.972	0.955	1.000	1.000	0.918	1.000	0.967	0.932	0.942
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Segment Directional Closure Duration (direction 1)	19.701	189.066	48.505	162.721	179.866	116.606	23.733	44.200	44.200	30.006	44.200	31.599	41.207	30.798
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Segment Directional Closure Duration (direction 2)	209.830	175.250	43.813	194.020	162.465	49.380	13.570	32.690	32.690	44.200	32.690	44.200	32.690	41.642
	VERT CLR	Input current value from performance system	Original Segment Vertical Clearance		No Change	16.29	No Change	No Change	No Change	No Change	15.18	15.18	No Change	No Change	No Change	No Change	No Change

				Solution #	17.01	17.02-A	17.02 - B	17.03	17.04	17.05	17.06	17.07-A	17.07-B	17.08	17.09	17.10	17.11	17.12
BRIDGE		Input current value from performance system	Original vertical clearance for specific bridge			No Change	16.29	No Change	No Change	No Change	No Change	15.18	15.18	No Change	No Change	No Change	No Change	No Change
		Input post-project value (depends on solution)	Post-Project vertical clearance for specific bridge			No Change	16.50	No Change	No Change	No Change	No Change	16.50	16.50	No Change	No Change	No Change	No Change	No Change
		Input post-project value (depends on solution)(force segment clearance to equal this specific bridge)	Post-Project Segment Vertical Clearance			No Change	16.50	No Change	No Change	No Change	No Change	16.50	16.50	No Change	No Change	No Change	No Change	No Change
		Enter in Freight Needs spreadsheet to update segment level Freight Need	Post-Project Segment Vertical Clearance		0.00	No Change	16.50	No Change	No Change	No Change	No Change	16.50	16.50	No Change	No Change	No Change	No Change	No Change
	Needs	User entered value from Freight Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Freight Need		0.928	3.473	3.473	3.473	3.473	0.395	0.982	0.733	0.733	0.733	0.733	0.733	0.733	0.733
		User entered value from Freight Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Freight Need		0.584	3.278	2.245	3.377	3.189	0.388	0.922	0.275	0.275	0.730	0.733	0.731	0.730	0.729
	BRIDGE INDEX	Input current value from performance system	Original Segment Bridge Index		No Change	5.71	5.71	No Change	No Change	No Change	No Change	6.04	6.04	No Change	6.04	No Change	No Change	No Change
		Input current value from performance system	Original lowest rating for specific bridge		No Change	5	6	No Change	No Change	No Change	No Change	4	4	No Change	6	No Change	No Change	No Change
		Input post-project value (For repair +1, rehab +2, replace=8)	Post-Project lowest rating for specific bridge		No Change	8	8	No Change	No Change	No Change	No Change	6	8	No Change	6	No Change	No Change	No Change
		Enter in Bridge Index spreadsheet to calculate new Bridge Index	Post-Project lowest rating for specific bridge		No Change	8	8	No Change	No Change	No Change	No Change	6	8	No Change	6	No Change	No Change	No Change
		Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Bridge Index		No Change	6.58	6.34	No Change	No Change	No Change	No Change	6.30	6.57	No Change	6.04	No Change	No Change	No Change
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment Bridge Index		No Change	6.58	6.34	No Change	No Change	No Change	No Change	6.30	6.57	No Change	6.04	No Change	No Change	No Change
	SUFF RATING	Input current value from performance system	Original Segment Sufficiency Rating		No Change	93.97	93.97	No Change	No Change	No Change	No Change	42.64	42.64	No Change	89.20	No Change	No Change	No Change
		Input current value from performance system	Original Sufficiency Rating for specific bridge		No Change	90.40	95.98	No Change	No Change	No Change	No Change	42.64	42.64	No Change	97.25	No Change	No Change	No Change
		Input post-project value (For repair +10, rehab +20, replace=98)	Post-Project Sufficiency Rating for specific bridge		No Change	98.00	98.00	No Change	No Change	No Change	No Change	62.64	98.00	No Change	97.25	No Change	No Change	No Change
		Enter in Bridge Index spreadsheet to calculate new Bridge Index	Post-Project Sufficiency Rating for specific bridge		No Change	98.00	98.00	No Change	No Change	No Change	No Change	62.64	98.00	No Change	97.25	No Change	No Change	No Change
		Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Sufficiency Rating		No Change	96.19	94.61	No Change	No Change	No Change	No Change	62.64	98.00	No Change	89.68	No Change	No Change	No Change
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment Sufficiency Rating		No Change	96.19	94.61	No Change	No Change	No Change	No Change	62.64	98.00	No Change	89.68	No Change	No Change	No Change
	BR RTNG	Input current value from performance system	Original Segment Bridge Rating		No Change	5	5	No Change	No Change	No Change	No Change	4	4	No Change	4	No Change	No Change	No Change
		Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Bridge Rating		No Change	6	5	No Change	No Change	No Change	No Change	6	8	No Change	4	No Change	No Change	No Change
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment Bridge Rating		No Change	6	5	No Change	No Change	No Change	No Change	6	8	No Change	4	No Change	No Change	No Change
	% FUN OB	Input current value from performance system	Original Segment % Functionally Obsolete		No Change	60.88%	60.88%	No Change	No Change	No Change	No Change	0.00%	0.00%	No Change	13.60%	No Change	No Change	No Change
		Input updated value from updated Bridge Index spreadsheet (only remove bridge from FO if replace or rehab)	Post-Project Segment % Functionally Obsolete		No Change	31.67%	29.21%	No Change	No Change	No Change	No Change	0.00%	0.00%	No Change	13.60%	No Change	No Change	No Change
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment % Functionally Obsolete		No Change	31.67%	29.21%	No Change	No Change	No Change	No Change	0.00%	0.00%	No Change	13.60%	No Change	No Change	No Change
	Needs	User entered value from Bridge Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Bridge Need		No Change	1.496	1.496	No Change	No Change	No Change	No Change	1.234	1.234	No Change	0.792	No Change	No Change	No Change

				Solution #	17.01	17.02-A	17.02 - B	17.03	17.04	17.05	17.06	17.07-A	17.07-B	17.08	17.09	17.10	17.11	17.12
		User entered value from Bridge Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Bridge Need		No Change	0.154	0.392	No Change	No Change	No Change	No Change	0.447	0.00	No Change	0.792	No Change	No Change	No Change
PAVEMENT	PAVEMENT INDEX	Input current value from performance system	Original Segment Pavement Index		3.85	No Change	No Change	No Change	No Change	No Change	4.26	No Change	No Change	4.32	No Change	No Change	4.32	No Change
		Input current value from performance system	Original Segment IRI in project limits		78	No Change	No Change	No Change	No Change	No Change	55-65	No Change	No Change	50-90	No Change	No Change	30-55	No Change
		Input current value from performance system	Original Segment Cracking in project limits		5	No Change	No Change	No Change	No Change	No Change	0-3	No Change	No Change	0	No Change	No Change	0	No Change
		Input post-project value (For rehab, increase to 45; for replace increase to 30)	Post-Project IRI in project limits		30	No Change	No Change	No Change	No Change	No Change	30	No Change	No Change	30	No Change	No Change	30	No Change
		Enter in Pavement Index spreadsheet to calculate new Pavement Index	Post-Project IRI in project limits		30	No Change	No Change	No Change	No Change	No Change	30	No Change	No Change	30	No Change	No Change	30	No Change
		Input post-project value (Lower to 0 for rehab or replace)	Post-Project Cracking in project limits		0	No Change	No Change	No Change	No Change	No Change	0	No Change	No Change	0	No Change	No Change	0	No Change
		Enter in Pavement Index spreadsheet to calculate new Pavement Index	Post-Project Cracking in project limits		0	No Change	No Change	No Change	No Change	No Change	0	No Change	No Change	0	No Change	No Change	0	No Change
		Input updated segment value from updated Pavement Index spreadsheet	Post-Project Segment Pavement Index		3.88	No Change	No Change	No Change	No Change	No Change	4.33	No Change	No Change	4.37	No Change	No Change	4.35	No Change
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Pavement Index		3.88	No Change	No Change	No Change	No Change	No Change	4.33	No Change	No Change	4.37	No Change	No Change	4.35	No Change
	DIRECTION PSR	Input current value from performance system (direction 1)	Original Segment Directional PSR (direction 1)		3.86	No Change	No Change	No Change	No Change	No Change	4.02	No Change	No Change	4.01	No Change	No Change	4.17	No Change
		Input current value from performance system (direction 2)	Original Segment Directional PSR (direction 2)		3.92	No Change	No Change	No Change	No Change	No Change	4.08	No Change	No Change	4.17	No Change	No Change	4.01	No Change
		Value from above	Original Segment IRI in project limits		78	No Change	No Change	No Change	No Change	No Change	55-65	No Change	No Change	50-90	No Change	No Change	30-55	No Change
		Value from above	Post-Project directional IRI in project limits		30	No Change	No Change	No Change	No Change	No Change	30	No Change	No Change	30	No Change	No Change	30	No Change
		Input updated segment value from updated Pavement Index spreadsheet (direction 1)	Post-Project Segment Directional PSR (direction 1)		3.92	No Change	No Change	No Change	No Change	No Change	4.16	No Change	No Change	4.16	No Change	No Change	4.25	No Change
		Input updated segment value from updated Pavement Index spreadsheet (direction 2)	Post-Project Segment Directional PSR (direction 2)		3.92	No Change	No Change	No Change	No Change	No Change	4.08	No Change	No Change	4.17	No Change	No Change	4.01	No Change
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Directional PSR (direction 1)		3.92	No Change	No Change	No Change	No Change	No Change	4.16	No Change	No Change	4.16	No Change	No Change	4.25	No Change
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Directional PSR (direction 2)		3.92	No Change	No Change	No Change	No Change	No Change	4.08	No Change	No Change	4.17	No Change	No Change	4.01	No Change
	% FAIL	Input current value from performance system	Original Segment % Failure		3.8%	No Change	No Change	No Change	No Change	No Change	0.0%	No Change	No Change	4.5%	No Change	No Change	4.5%	No Change
		Input value from updated Pavement Index spreadsheet	Post-Project Segment % Failure		3.8%	No Change	No Change	No Change	No Change	No Change	0.0%	No Change	No Change	4.5%	No Change	No Change	4.5%	No Change
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment % Failure		3.8%	No Change	No Change	No Change	No Change	No Change	0.0%	No Change	No Change	4.5%	No Change	No Change	4.5%	No Change
	Needs	User entered value from Pavement Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Pavement Need		0.038	No Change	No Change	No Change	No Change	No Change	0.000	No Change	No Change	0.045	No Change	No Change	0.045	No Change
		User entered value from Pavement Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Pavement Need		0.038	No Change	No Change	No Change	No Change	No Change	0.000	No Change	No Change	0.045	No Change	No Change	0.045	No Change

LEGEND:

- user entered value
- calculated value for reference only
- calculated value for entry/use in other spreadsheet
- for input into Performance Effectiveness Score spreadsheet
- assumed values (do not modify)

			Solution #	17.13	17.14	17.15	17.16	17.17	17.18
			Description	NB Climbing Lane	SB Safety	NB Safety	SB Safety	SB Climbing Lane	Woods Canyon
			Project Beg MP	299	300	305	309	316	316.5
			Project End MP	305	302	307	313	317	317.5
			Project Length (miles)	6	2	2	4	1	1
			Segment Beg MP	299	299	299	307	316	316
			Segment End MP	307	307	307	316	323	323
			Segment Length (miles)	8	8	8	9	7	7
			Segment #	9	9	9	10	11	11
			Current # of Lanes (both directions)	4	4	4	4	4	4
			Project Type (one-way or two-way)	one-way	one-way	one-way	one-way	one-way	two-way
			Additional Lanes (one-way)	1	0	0	0	1	0
			Pro-Rated # of Lanes	4.75	4.00	4.00	4.00	4.14	4.00
		Notes and Directions	Description						
SAFETY	DIRECTIONAL SAFETY	Input current value from performance system (direction 1)	Orig Segment Directional Safety Index (direction 1)	2.390	1.972	2.390	0.909	0.238	2.189
		Input current value from performance system (direction 1)	Orig Segment Directional Fatal Crashes (direction 1)	3	2	3	1	0	2
		Input current value from performance system (direction 1)	Orig Segment Directional Incap Crashes (direction 1)	5	11	5	5	4	8
		Input current value from performance system (direction 1)	Original Fatal Crashes in project limits (direction 1)	0	Off-Line	Off-Line	1	0	1
		Input current value from performance system (direction 1)	Original Incap Crashes in project limits (direction 1)	4	Off-Line	Off-Line	4	0	2
		Input CMF value (direction 1) - If no CMF enter 1.0	CMF 1 (direction 1)(lowest CMF)	0.75	Off-Line	Off-Line	0.66	0.75	0.5
		Input CMF value (direction 1) - If no CMF enter 1.0	CMF 2 (direction 1)	1	Off-Line	Off-Line	0.79	1	1
		Input CMF value (direction 1) - If no CMF enter 1.1	CMF 3 (direction 1)	1	Off-Line	Off-Line	1	1	1
		Input CMF value (direction 1) - If no CMF enter 1.2	CMF 4 (direction 1)	1	Off-Line	Off-Line	1	1	1
		Input CMF value (direction 1) - If no CMF enter 1.0	CMF 5 (direction 1)	1	Off-Line	Off-Line	1	1	1
		Calculated Value (direction 1)	Total CMF (direction 1)	0.750	Off-Line	Off-Line	0.591	0.750	0.500
		Calculated Value (direction 1)	Fatal Crash reduction (direction 1)	0.000	0.863	1.335	0.409	0.000	0.500
		Calculated Value (direction 1)	Incap Crash reduction (direction 1)	1.000	2.091	0.272	1.637	0.000	1.000
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 1)	Post-Project Segment Directional Fatal Crashes (direction 1)	3.000	1.137	1.665	0.591	0.000	1.500
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 1)	Post-Project Segment Directional Incap Crashes (direction 1)	4.000	8.909	4.728	3.363	4.000	7.000
		Input value from updated Safety Index spreadsheet (direction 1)	Post-Project Segment Directional Safety Index (direction 1)	2.341	1.252	1.423	0.556	0.238	1.701
		Enter in Safety Needs spreadsheet to calculate new segment level Safety Need (direction 1)	Post-Project Segment Directional Safety Index (direction 1)	2.341	1.252	1.423	0.556	0.238	1.701
		Input current value from performance system (direction 2)	Orig Segment Directional Safety Index (direction 2)	1.972	2.390	1.972	0.805	2.189	0.238
		Input current value from performance system (direction 2)	Orig Segment Directional Fatal Crashes (direction 2)	2	3	2	1	2	0
		Input current value from performance system (direction 2)	Orig Segment Directional Incap Crashes (direction 2)	11	5	11	3	8	4
		Input current value from performance system (direction 2)	Original Fatal Crashes in project limits (direction 2)	0	0	0	0	0	0
		Input current value from performance system (direction 2)	Original Incap Crashes in project limits (direction 2)	0	0	0	0	0	1

				Solution #	17.13	17.14	17.15	17.16	17.17	17.18
		Input CMF value (direction 2) - If no CMF enter 1.0	CMF 1 (direction 2)(lowest CMF)		1	1	1	1	1	0.5
		Input CMF value (direction 2) - If no CMF enter 1.0	CMF 2 (direction 2)		1	1	1	1	1	1
		Input CMF value (direction 2) - If no CMF enter 1.1	CMF 3 (direction 2)		1	1	1	1	1	1
		Input CMF value (direction 2) - If no CMF enter 1.2	CMF 4 (direction 2)		1	1	1	1	1	1
		Input CMF value (direction 2) - If no CMF enter 1.0	CMF 5 (direction 2)		1	1	1	1	1	1
		Calculated Value (direction 2)	Total CMF (direction 2)		1.000	1.000	1.000	1.000	1.000	0.500
		Calculated Value (direction 2)	Fatal Crash reduction (direction 2)		0.000	0.000	0.000	0.000	0.000	0.000
		Calculated Value (direction 2)	Incap Crash reduction (direction 2)		0.000	0.000	0.000	0.000	0.000	0.500
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 2)	Post-Project Segment Directional Fatal Crashes (direction 2)		2.000	3.000	2.000	1.000	2.000	0.000
		Enter in Safety Index spreadsheet to calculate new Safety Index (direction 2)	Post-Project Segment Directional Incap Crashes (direction 2)		11.000	5.000	11.000	3.000	8.000	3.500
		Input value from updated Safety Index spreadsheet (direction 2)	Post-Project Segment Directional Safety Index (direction 2)		1.972	2.390	1.972	0.805	2.189	0.208
		Enter in Safety Needs spreadsheet to calculate new segment level Safety Need (direction 2)	Post-Project Segment Directional Safety Index (direction 2)		1.972	2.390	1.972	0.805	2.189	0.208
	SAFETY INDEX	Calculated Value - verify that it matches current performance system	Current Safety Index		2.181	2.181	2.181	0.857	1.214	1.214
		Enter in Safety Needs spreadsheet to calculate new segment level Safety Need	Post-Project Safety Index		2.157	1.821	1.698	0.681	1.214	0.955
	Needs	User entered value from Safety Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Safety Need		5.886	5.886	5.886	0.867	2.432	2.432
		User entered value from Safety Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Safety Need		5.797	4.524	4.047	0.749	2.432	1.191
MOBILITY	MOBILITY INDEX	Input current value from performance system	Original Segment Mobility Index		0.410	0.410	0.410	0.350	0.290	0.290
		Enter in Mobility Index Spreadsheet to determine new segment level Mobility Index	Post-Project # of Lanes (both directions)		4.75	4.00	4.00	4.00	4.14	4.00
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Mobility Index		0.34	0.41	0.41	0.35	0.28	0.29
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Mobility Index		0.340	0.410	0.410	0.350	0.280	0.290
	FUT V/C	Input current value from performance system	Original Segment Future V/C		0.490	No Change	No Change	No Change	0.340	No Change
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Future V/C		0.410	No Change	No Change	No Change	0.330	No Change
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Future V/C		0.410	No Change	No Change	No Change	0.330	No Change
	PEAK HOUR V/C	Input current value from performance system (direction 1)	Original Segment Peak Hour V/C (direction 1)		0.320	No Change	No Change	No Change	0.210	No Change
		Input current value from performance system (direction 2)	Original Segment Peak Hour V/C (direction 2)		0.320	No Change	No Change	No Change	0.230	No Change
		*If One-Way project, enter in Mobility Index Spreadsheet to determine new segment level Peak Hour V/C. If Two-Way project, disregard	Adjusted total # of Lanes for use in directional peak hr		5.50	4.00	4.00	4.00	4.29	N/A
		Input value from updated Mobility Index spreadsheet (direction 1)	Post-Project Segement Peak Hr V/C (direction 1)		0.23	No Change	No Change	No Change	0.190	No Change

				Solution #	17.13	17.14	17.15	17.16	17.17	17.18
		Input value from updated Mobility Index spreadsheet (direction 2)	Post-Project Segement Peak Hr V/C (direction 2)		0.32	No Change	No Change	No Change	0.230	No Change
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Peak Hr V/C (direction 1)		0.230	No Change	No Change	No Change	0.190	No Change
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Peak Hr V/C (direction 2)		0.320	No Change	No Change	No Change	0.230	No Change
	TTI AND PTI	Calculated Value (both directions)	Safety Reduction Factor		0.989	0.835	0.778	0.794	1.000	0.787
		Calculated Value (both directions)	Safety Reduction		0.011	0.165	0.222	0.206	0.000	0.213
		Calculated Value (both directions)	Mobility Reduction Factor		0.829	1.000	1.000	1.000	0.966	1.000
		Calculated Value (both directions)	Mobility Reduction		0.171	0.000	0.000	0.000	0.034	0.000
		Input current value from performance system (direction 1)	Original Directional Segment TTI (direction 1)		1.300	1.120	1.300	1.130	1.080	1.100
		Input current value from performance system (direction 1)	Original Directional Segment PTI (direction 1)		1.610	1.220	1.610	1.250	1.160	1.180
		Input current value from performance system (direction 2)	Original Directional Segment TTI (direction 2)		1.120	1.300	1.120	1.290	1.100	1.080
		Input current value from performance system (direction 2)	Original Directional Segment PTI (direction 2)		1.220	1.610	1.220	1.600	1.180	1.160
		Calculated Value (both directions)	Reduction Factor for Segment TTI		0.051	0.000	0.000	0.000	0.010	0.000
		Calculated Value (both directions)	Reduction Factor for Segment PTI		0.038	0.050	0.067	0.062	0.007	0.064
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Directional Segment TTI (direction 1)		1.233	1.120	1.300	1.130	1.069	1.100
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Directional Segment PTI (direction 1)		1.550	1.160	1.503	1.173	1.152	1.104
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Directional Segment TTTI (direction 2)		1.120	1.300	1.120	1.290	1.100	1.080
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Directional Segment TPTI (direction 2)		1.220	1.610	1.220	1.600	1.180	1.086
	CLOSURE EXTENT	Input current value from performance system (direction 1)	Orig Segment Directional Closure Extent (direction 1)		0.350	0.200	0.350	0.290	0.290	0.000
		Input current value from performance system (direction 2)	Orig Segment Directional Closure Extent (direction 2)		0.200	0.350	0.200	0.200	0.000	0.290
		Input value from HCRS	Segment Closures with fatalities/injuries		4	4	4	5	1	1
		Input value from HCRS	Total Segment Closures		15	15	15	12	4	4
		Calculated Value (both directions)	% Closures with Fatality/Injury		0.27	0.27	0.27	0.42	0.25	0.25
		Calculated Value (both directions)	Closure Reduction		0.003	0.044	0.059	0.086	0.000	0.053
		Calculated Value (both directions)	Closure Reduction Factor		0.997	0.956	0.941	0.914	1.000	0.947
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Segment Directional Closure Extent (direction 1)		0.349	0.191	0.329	0.265	0.290	0.000
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Segment Directional Closure Extent (direction 2)		0.200	0.350	0.200	0.200	0.000	0.275
	BICYCLE ACCOM	Input current value from performance system	Orig Segment Bicycle Accomodation %		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		Input current value from performance system	Orig Segment Outside Shoulder width							
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Outside Shoulder width							
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Bicycle Accomodation (%)		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		Enter in Mobiity Needs spreadsheet to calculate new segment level Mobility Need	Post-Project Segment Bicycle Accomodation (%)		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

				Solution #	17.13	17.14	17.15	17.16	17.17	17.18
FREIGHT	Needs	User entered value from Mobility Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Mobility Need		0.998	0.998	0.998	0.991	0.537	0.537
		User entered value from Mobility Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Mobility Need		0.804	0.994	0.914	0.985	0.526	0.530
	TTTI AND TPTI	Input current value from performance system (direction 1)	Original Directional Segment TTTI (direction 1)		1.290	1.060	1.290	1.070	1.020	1.030
		Input current value from performance system (direction 1)	Original Directional Segment TPTI (direction 1)		1.550	1.130	1.550	1.150	1.060	1.070
		Input current value from performance system (direction 2)	Original Directional Segment TTTI (direction 2)		1.060	1.290	1.060	1.250	1.030	1.020
		Input current value from performance system (direction 2)	Original Directional Segment TPTI (direction 2)		1.130	1.550	1.130	1.570	1.070	1.060
		Calculated Value (both directions)	Reduction Factor for Segment TTTI (both directions)		0.026	0.000	0.000	0.000	0.005	0.000
		Calculated Value (both directions)	Reduction Factor for Segment TPTI (both directions)		0.019	0.025	0.033	0.031	0.003	0.032
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Directional Segment TTTI (direction 1)		1.257	1.060	1.290	1.070	1.015	1.030
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Directional Segment TPTI (direction 1)		1.521	1.102	1.498	1.114	1.056	1.036
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Directional Segment TTTI (direction 2)		1.060	1.290	1.060	1.250	1.030	1.020
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Directional Segment TPTI (direction 2)		1.130	1.550	1.130	1.570	1.070	1.026
	FREIGHT INDEX	Value from above	Original Segment TPTI (direction 1)		1.550	1.130	1.550	1.150	1.060	1.070
		Value from above	Original Segment TPTI (direction 2)		1.130	1.550	1.130	1.570	1.070	1.060
		Calculated Value	Original Segment Freight Index		0.746	0.746	0.746	0.735	0.939	0.939
		Calculated Value	Post-Project Segment TPTI (direction 1)		1.521	1.102	1.498	1.114	1.056	1.036
		Calculated Value	Post-Project Segment TPTI (direction 2)		1.130	1.550	1.130	1.570	1.070	1.026
		Enter in Freight Needs spreadsheet to update segment level Freight Need	Post-Project Segment Freight Index		0.754	0.754	0.761	0.745	0.941	0.970
	CLOSURE DURATION	Input current value from performance system (direction 1)	Orig Segment Directional Closure Duration (dir 1)		122.530	107.000	122.530	121.240	124.430	0.000
		Input current value from performance system (direction 2)	Orig Segment Directional Closure Duration (dir 2)		107.000	122.530	107.000	41.700	0.000	124.430
		Calculated Value	Segment Closures with fatalities		4	4	4	5	1	1
		Calculated Value	Total Segment Closures		15	15	15	12	4	4
		Calculated Value	% Closures with Fatality		0.27	0.27	0.27	0.42	0.25	0.25
		Calculated Value	Closure Reduction		0.003	0.044	0.059	0.086	0.000	0.053
		Calculated Value	Closure Reduction Factor		0.997	0.956	0.941	0.914	1.000	0.947
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Segment Directional Closure Duration (direction 1)		122.163	102.290	115.286	110.836	124.430	0.000
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Segment Directional Closure Duration (direction 2)		107.000	122.530	107.000	41.700	0.000	117.791
	VERT CLR	Input current value from performance system	Original Segment Vertical Clearance		No Change	No Change	No Change	No Change	No Change	No Change
		Input current value from performance system	Original vertical clearance for specific bridge		No Change	No Change	No Change	No Change	No Change	No Change
		Input post-project value (depends on solution)	Post-Project vertical clearance for specific bridge		No Change	No Change	No Change	No Change	No Change	No Change
		Input post-project value (depends on solution)(force segment clearance to equal this specific bridge)	Post-Project Segment Vertical Clearance		No Change	No Change	No Change	No Change	No Change	No Change

				Solution #	17.13	17.14	17.15	17.16	17.17	17.18
BRIDGE		Enter in Freight Needs spreadsheet to update segment level Freight Need	Post-Project Segment Vertical Clearance		No Change	No Change	No Change	No Change	No Change	No Change
	Needs	User entered value from Freight Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Freight Need		1.277	1.277	1.277	1.232	0.362	0.362
		User entered value from Freight Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Freight Need		1.161	1.210	1.115	1.103	0.361	0.347
	BRIDGE INDEX	Input current value from performance system	Original Segment Bridge Index		No Change	No Change	No Change	No Change	No Change	6.91
		Input current value from performance system	Original lowest rating for specific bridge		No Change	No Change	No Change	No Change	No Change	7
		Input post-project value (For repair +1, rehab +2, replace=8)	Post-Project lowest rating for specific bridge		No Change	No Change	No Change	No Change	No Change	8
		Enter in Bridge Index spreadsheet to calculate new Bridge Index	Post-Project lowest rating for specific bridge		No Change	No Change	No Change	No Change	No Change	8
		Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Bridge Index		No Change	No Change	No Change	No Change	No Change	7.15
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment Bridge Index		No Change	No Change	No Change	No Change	No Change	7.15
	SUFF RATING	Input current value from performance system	Original Segment Sufficiency Rating		No Change	No Change	No Change	No Change	No Change	96.48
		Input current value from performance system	Original Sufficiency Rating for specific bridge		No Change	No Change	No Change	No Change	No Change	97.36
		Input post-project value (For repair +10, rehab +20, replace=98)	Post-Project Sufficiency Rating for specific bridge		No Change	No Change	No Change	No Change	No Change	98.00
		Enter in Bridge Index spreadsheet to calculate new Bridge Index	Post-Project Sufficiency Rating for specific bridge		No Change	No Change	No Change	No Change	No Change	98.00
		Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Sufficiency Rating		No Change	No Change	No Change	No Change	No Change	96.63
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment Sufficiency Rating		No Change	No Change	No Change	No Change	No Change	96.63
	BR RTNG	Input current value from performance system	Original Segment Bridge Rating		No Change	No Change	No Change	No Change	No Change	5
		Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Bridge Rating		No Change	No Change	No Change	No Change	No Change	5
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment Bridge Rating		No Change	No Change	No Change	No Change	No Change	5
	% FUN OB	Input current value from performance system	Original Segment % Functionally Obsolete		No Change	No Change	No Change	No Change	No Change	3.40%
		Input updated value from updated Bridge Index spreadsheet (only remove bridge from FO if replace or rehab)	Post-Project Segment % Functionally Obsolete		No Change	No Change	No Change	No Change	No Change	3.40%
		Enter in Bridge Needs spreadsheet to update segment level Bridge Need	Post-Project Segment % Functionally Obsolete		No Change	No Change	No Change	No Change	No Change	3.40%
	Needs	User entered value from Bridge Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Bridge Need		No Change	No Change	No Change	No Change	No Change	0.108
		User entered value from Bridge Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Bridge Need		No Change	No Change	No Change	No Change	No Change	0.108
PAVEMENT	PAVEMENT INDEX	Input current value from performance system	Original Segment Pavement Index		No Change	4.21	4.21	4.19	No Change	3.73
		Input current value from performance system	Original Segment IRI in project limits		No Change	40-60	33-34	50-55	No Change	70-106
		Input current value from performance system	Original Segment Cracking in project limits		No Change	0	0	0-4	No Change	3-4
		Input post-project value (For rehab, increase to 45; for replace increase to 30)	Post-Project IRI in project limits		No Change	30	30	30	No Change	30

				Solution #	17.13	17.14	17.15	17.16	17.17	17.18
		Enter in Pavement Index spreadsheet to calculate new Pavement Index	Post-Project IRI in project limits		No Change	30	30	30	No Change	30
		Input post-project value (Lower to 0 for rehab or replace)	Post-Project Cracking in project limits		No Change	0	0	0	No Change	0
		Enter in Pavement Index spreadsheet to calculate new Pavement Index	Post-Project Cracking in project limits		No Change	0	0	0	No Change	0
		Input updated segment value from updated Pavement Index spreadsheet	Post-Project Segment Pavement Index		No Change	4.23	4.21	4.23	No Change	3.85
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Pavement Index		No Change	4.23	4.21	4.23	No Change	3.85
	DIRECTION PSR	Input current value from performance system (direction 1)	Original Segment Directional PSR (direction 1)		No Change	4.18	3.77	4.06	No Change	3.50
		Input current value from performance system (direction 2)	Original Segment Directional PSR (direction 2)		No Change	3.77	4.18	4.01	No Change	3.82
		Value from above	Original Segment IRI in project limits		No Change	40-60	33-34	50-55	No Change	70-106
		Value from above	Post-Project directional IRI in project limits		No Change	30	30	30	No Change	30
		Input updated segment value from updated Pavement Index spreadsheet (direction 1)	Post-Project Segment Directional PSR (direction 1)		No Change	4.25	3.78	4.14	No Change	3.66
		Input updated segment value from updated Pavement Index spreadsheet (direction 2)	Post-Project Segment Directional PSR (direction 2)		No Change	3.77	4.18	4.01	No Change	3.92
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Directional PSR (direction 1)		No Change	4.25	3.78	4.14	No Change	3.66
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Directional PSR (direction 2)		No Change	3.77	4.18	4.01	No Change	3.92
	% FAIL	Input current value from performance system	Original Segment % Failure		No Change	18.8%	18.8%	0.0%	No Change	21.4%
		Input value from updated Pavement Index spreadsheet	Post-Project Segment % Failure		No Change	18.8%	18.8%	0.0%	No Change	14.3%
		Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment % Failure		No Change	18.8%	18.8%	0.0%	No Change	14.3%
	Needs	User entered value from Pavement Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Pavement Need		No Change	0.376	0.376	0.00	No Change	0.594
		User entered value from Pavement Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Pavement Need		No Change	0.376	0.376	0.00	No Change	0.298

Performance Effectiveness Scores – Application of Multiple Crash Modification Factors

I-17 Corridor Profile Study
CMF Application

CS17.06 (MP 269-274 Southbound)

							Effective	Current		Post-Project		Reduction				
BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	CMF	Fatal	Incap	Fatal	Incap	Fatal	Incap		Length	Notes
269	270	0.77	0.89	1	1	SB	0.728	1	1	0.728	0.728	0.272	0.272	Segment 6 SB tangent	1	
270	271.5	0.66	0.79	1	1	SB	0.591	0	2	0.000	1.181	0.000	0.819	Segment 6 SB curve	1.5	
271.5	273	0.77	0.89	1	1	SB	0.728	0	1	0.000	0.728	0.000	0.272	Segment 6 SB tangent	1.5	
273	274	0.66	0.79	1	1	SB	0.591	1	1	0.591	0.591	0.409	0.409	Segment 6 SB curve	1	
								2	5			0.682	1.773	Segment 6 SB		Doesn't include speed feedback

CS17.08 (MP 290-293 Northbound)

							Effective	Current		Post-Project		Reduction				
BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	CMF	Fatal	Incap	Fatal	Incap	Fatal	Incap		Length	Notes
290	290.5	0.77	0.89	1	1	NB	0.728	0	1	0.000	0.728	0.000	0.272	Segment 8 NB tangent	0.5	
290.5	291	0.66	0.79	1	1	NB	0.591	0	0	0.000	0.000	0.000	0.000	Segment 8 NB curve	0.5	
291	291.5	0.77	0.89	1	1	NB	0.728	0	0	0.000	0.000	0.000	0.000	Segment 8 NB tangent	0.5	
291.5	293	0.66	0.79	1	1	NB	0.591	3	1	1.772	0.591	1.228	0.409	Segment 8 NB curve	1.5	
								3	2			1.228	0.682	Segment 8 NB		Doesn't include speed feedback

CS17.11 (MP 295-299 Southbound)

							Effective	Current		Post-Project		Reduction				
BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	CMF	Fatal	Incap	Fatal	Incap	Fatal	Incap		Length	Notes
295	295.5	0.66	0.79	1	1	SB	0.591	0	0	0.000	0.000	0.000	0.000	Segment 8 SB curve	0.5	
295.5	296.5	0.77	0.89	1	1	SB	0.728	1	2	0.728	1.455	0.272	0.545	Segment 8 SB tangent	1	
296.5	297	0.66	0.79	1	1	SB	0.591	0	0	0.000	0.000	0.000	0.000	Segment 8 SB curve	0.5	
297	297.5	0.77	0.89	1	1	SB	0.728	1	0	0.728	0.000	0.272	0.000	Segment 8 SB tangent	0.5	
297.5	299	0.66	0.79	1	1	SB	0.591	1	2	0.591	1.181	0.409	0.819	Segment 8 SB curve	1.5	
								3	4			0.954	1.363	Segment 8 SB		Doesn't include speed feedback

CS17.14 (MP 300-302 Southbound)

							Effective	Current		Post-Project		Reduction				
BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	CMF	Fatal	Incap	Fatal	Incap	Fatal	Incap		Length	Notes
300	300.5	0.66	0.79	0.85	1	SB	0.546	1	1	0.546	0.546	0.454	0.454	Segment 9 SB curve	0.5	Includes side slope excavation
300.5	302	0.66	0.79	1	1	SB	0.591	1	4	0.591	2.363	0.409	1.637	Segment 9 SB curve	1.5	
								2	5			0.863	2.091	Segment 9 SB		Doesn't include speed feedback

CS17.15 (MP 305-307 Northbound)

							Effective	Current		Post-Project		Reduction				
BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	CMF	Fatal	Incap	Fatal	Incap	Fatal	Incap		Length	Notes
305	306.5	0.77	0.89	1	1	NB	0.728	2	1	1.455	0.728	0.545	0.272	Segment 9 NB tangent	1.5	
306.5	307	0.21	1	1	1	NB	0.210	1	0	0.210	0.000	0.790	0.000	Segment 9 NB Modify ramp	0.5	Accounts for Modify Ramp rather than Improve Skid Resistance
								3	1			1.335	0.272	Segment 9 NB		Doesn't include speed feedback

Performance Effectiveness Scores – Five Performance Areas

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Pavement					Bridge					Safety					Mobility					Freight				
				Existing Need	Post-Solution Need	Raw Score	Risk Factor	Factored Score	Existing Need	Post-Solution Need	Raw Score	Risk Factor	Factored Score	Existing Need	Post-Solution Need	Raw Score	Risk Factor	Factored Score	Existing Need	Post-Solution Need	Raw Score	Risk Factor	Factored Score	Existing Need	Post-Solution Need	Raw Score	Risk Factor	Factored Score
17.01	Table Mesa Rd TI Vertical Clearance Mitigation	SB 235.5-236.5	2.41	0.038	0.038	0.000	4.58	0.000	0.000	0.000	0.000	0.00	0.000	1.408	1.406	0.002	1.44	0.003	1.305	1.305	0.000	3.87	0.000	0.928	0.584	0.344	4.38	1.507
17.02-A	Black Canyon Hill NB Climbing Lane	NB 245 -251	47.57	0.000	0.000	0.000	0.00	0.000	1.496	0.154	1.342	2.97	3.986	2.422	2.183	0.239	3.27	0.782	2.064	1.491	0.573	6.79	3.891	3.473	3.278	0.195	6.38	1.244
17.02-B	Black Canyon Hill Reversible Lanes	245 - 251	146.22	0.000	0.000	0.000	0.00	0.000	1.496	0.392	1.104	1.30	1.435	2.422	1.751	0.671	3.27	2.194	2.064	1.235	0.829	6.79	5.629	3.473	2.245	1.228	6.38	7.835
17.03	Black Canyon SB Safety	SB 245 -251	3.15	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.00	0.000	2.422	1.663	0.759	3.27	2.482	2.064	2.045	0.019	5.14	0.098	3.473	3.377	0.096	4.48	0.430
17.04	Sunset Point Safety	252-253	2.31	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.00	0.000	2.422	1.656	0.766	2.31	1.769	2.064	1.973	0.091	4.97	0.452	3.473	3.189	0.284	6.38	1.812
17.05	Badger Springs NB Climbing Lane	NB 256 - 260	14.9	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.00	0.000	1.718	1.343	0.375	2.51	0.941	1.203	1.006	0.197	5.15	1.015	0.395	0.388	0.007	4.50	0.032
17.06	Orme Rd SB Safety	SB 269 - 274	4.72	0.000	0.000	0.000	3.77	0.000	0.000	0.000	0.000	0.00	0.000	3.571	3.119	0.452	2.50	1.130	1.124	1.083	0.041	5.94	0.244	0.982	0.922	0.060	5.55	0.333
17.07-A	McGuireville TI Ramp & Bridge Rehab	293	7.79	0.000	0.000	0.000	0.00	0.000	1.234	0.447	0.787	3.31	2.605	7.960	7.960	0.000	1.79	0.000	0.680	0.680	0.000	3.30	0.000	0.733	0.275	0.458	4.27	1.956
17.07-B	McGuireville Bridge Replace	293	18.86	0.000	0.000	0.000	0.00	0.000	1.234	0.000	1.234	3.31	4.085	7.960	7.960	0.000	1.79	0.000	0.680	0.680	0.000	3.30	0.000	0.733	0.275	0.458	4.27	1.956
17.08	Middle Verde NB Safety	NB 290 -293	3.77	0.045	0.045	0.000	3.75	0.000	0.000	0.000	0.000	0.00	0.000	7.960	6.802	1.158	1.17	1.355	0.680	0.677	0.003	4.67	0.014	0.733	0.730	0.003	4.27	0.013
17.09	Dry Beaver Creek SB Climbing Lane	SB 292 -294	9.35	0.000	0.000	0.000	0.00	0.000	0.790	0.790	0.000	2.80	0.000	7.960	7.960	0.000	1.79	0.000	0.680	0.666	0.014	4.21	0.059	0.733	0.733	0.000	4.17	0.000
17.10	Dry Beaver Creek NB Climbing Lane	NB 294 - 298	14.90	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.00	0.000	7.960	7.493	0.467	2.91	1.359	0.680	0.643	0.037	4.93	0.182	0.733	0.731	0.002	4.27	0.009
17.11	McGuireville SB Rest Area Safety	SB 295 -299	4.66	0.045	0.045	0.000	3.75	0.000	0.000	0.000	0.000	0.00	0.000	7.960	7.006	0.954	2.75	2.624	0.680	0.677	0.003	4.83	0.014	0.733	0.730	0.003	4.17	0.013
17.12	SR 179 TI Safety	298.5 - 299	2.22	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.00	0.000	7.960	7.147	0.813	1.76	1.431	0.680	0.675	0.005	4.21	0.021	0.733	0.729	0.004	5.04	0.020
17.13	Hog Tank Canyon NB Climbing Lane	NB 299 - 305	22.37	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.00	0.000	5.886	5.797	0.089	3.37	0.300	0.998	0.804	0.194	6.03	1.170	1.277	1.161	0.116	5.04	0.585
17.14	Hog Tank Canyon SB	SB 300 -302	4.03	0.376	0.376	0.000	3.81	0.000	0.000	0.000	0.000	0.00	0.000	5.886	4.524	1.362	3.09	4.209	0.998	0.994	0.004	4.02	0.016	1.277	1.210	0.067	4.09	0.274

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Pavement					Bridge					Safety					Mobility					Freight				
				Existing Need	Post-Solution Need	Raw Score	Risk Factor	Factored Score	Existing Need	Post-Solution Need	Raw Score	Risk Factor	Factored Score	Existing Need	Post-Solution Need	Raw Score	Risk Factor	Factored Score	Existing Need	Post-Solution Need	Raw Score	Risk Factor	Factored Score	Existing Need	Post-Solution Need	Raw Score	Risk Factor	Factored Score
	Safety																											
17.15	Rattlesnake NB Canyon Safety	NB 305 - 307	2.19	0.376	0.376	0.000	4.34	0.000	0.000	0.000	0.000	0.00	0.000	5.886	4.047	1.839	2.21	4.064	0.998	0.914	0.084	5.07	0.426	1.277	1.115	0.162	5.04	0.816
17.16	Red Hill SB Scenic Overlook Safety	SB 309 - 313	7.17	0.000	0.000	0.000	4.61	0.000	0.000	0.000	0.000	0.00	0.000	0.867	0.749	0.118	3.68	0.434	0.991	0.985	0.006	4.57	0.027	1.232	1.103	0.129	3.95	0.510
17.17	Woods Canyon SB Climbing Lane	SB 316 - 317	5.60	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.00	0.000	2.432	2.432	0.000	2.52	0.000	0.537	0.526	0.011	3.40	0.037	0.362	0.361	0.001	3.90	0.004
17.18	Woods Canyon Bridges	316.5 - 317.5	36.14	0.594	0.298	0.296	4.71	1.394	0.108	0.108	0.000	3.39	0.000	2.432	1.191	1.241	2.28	2.829	0.537	0.530	0.007	3.40	0.024	0.362	0.347	0.015	3.90	0.059

Performance Effectiveness Scores – Emphasis Areas

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Safety Emphasis Area						Mobility Emphasis Area						Total Factored Score
				Existing Corridor Need	Post-Solution Corridor Need	Raw Score	Risk Factor	Emphasis Factor	Factored Score	Existing Corridor Need	Post-Solution Corridor Need	Raw Score	Risk Factor	Emphasis Factor	Factored Score	
17.01	Table Mesa Rd TI Vertical Clearance Mitigation	SB 235.5-236.5	2.41	2.502	2.501	0.001	1.44	2.25	0.003	0.441	0.441	0.000	3.87	2.25	0.000	1.513
17.02-A	Black Canyon Hill NB Climbing Lane	NB 245 -251	47.57	2.502	2.493	0.009	3.27	2.25	0.066	0.441	0.435	0.006	6.79	2.25	0.092	10.060
17.02-B	Black Canyon Hill Reversible Lanes	245 - 251	146.22	2.502	2.479	0.023	3.27	2.25	0.169	0.441	0.431	0.010	6.79	2.25	0.153	17.415
17.03	Black Canyon SB Safety	SB 245 -251	3.15	2.502	2.477	0.025	3.27	2.25	0.184	0.441	0.441	0.000	5.14	2.25	0.000	3.194
17.04	Sunset Point Safety	252-253	2.31	2.502	2.476	0.026	2.31	2.25	0.135	0.441	0.441	0.000	4.97	2.25	0.000	4.169
17.05	Badger Springs NB Climbing Lane	NB 256 - 260	14.9	2.502	2.486	0.016	2.51	2.25	0.090	0.441	0.437	0.004	5.15	2.25	0.046	2.124
17.06	Orme Rd SB Safety	SB 269 - 274	4.72	2.502	2.456	0.046	2.50	2.25	0.259	0.441	0.441	0.000	5.94	2.25	0.000	1.965
17.07-A	McGuireville TI Ramp & Bridge Rehab	293	7.79	2.502	2.502	0.000	1.79	2.25	0.000	0.441	0.441	0.000	3.30	2.25	0.000	4.561
17.07-B	McGuireville Bridge Replace	293	18.86	2.502	2.502	0.000	1.79	2.25	0.000	0.441	0.441	0.000	3.30	2.25	0.000	6.040
17.08	Middle Verde NB Safety	NB 290 -293	3.77	2.502	2.431	0.071	1.17	2.25	0.187	0.441	0.441	0.000	4.67	2.25	0.000	1.569
17.09	Dry Beaver Creek SB Climbing Lane	SB 292 -294	9.35	2.502	2.501	0.001	1.79	2.25	0.004	0.441	0.440	0.001	4.21	2.25	0.009	0.072
17.10	Dry Beaver Creek NB Climbing Lane	NB 294 - 298	14.90	2.502	2.473	0.029	2.91	2.25	0.190	0.441	0.439	0.002	4.93	2.25	0.022	1.762
17.11	McGuireville SB Rest Area Safety	SB 295 -299	4.66	2.502	2.443	0.059	2.75	2.25	0.365	0.441	0.441	0.000	4.83	2.25	0.000	3.016

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Safety Emphasis Area						Mobility Emphasis Area						Total Factored Score
				Existing Corridor Need	Post-Solution Corridor Need	Raw Score	Risk Factor	Emphasis Factor	Factored Score	Existing Corridor Need	Post-Solution Corridor Need	Raw Score	Risk Factor	Emphasis Factor	Factored Score	
17.12	SR 179 TI Safety	298.5 - 299	2.22	2.502	2.451	0.051	1.76	2.25	0.202	0.441	0.441	0.000	4.21	2.25	0.000	1.674
17.13	Hog Tank Canyon NB Climbing Lane	NB 299 - 305	22.37	2.502	2.497	0.005	3.37	2.25	0.038	0.441	0.437	0.004	6.03	2.25	0.054	2.147
17.14	Hog Tank Canyon SB Safety	SB 300 -302	4.03	2.502	2.440	0.062	3.09	2.25	0.431	0.441	0.441	0.000	4.02	2.25	0.000	4.930
17.15	Rattlesnake NB Canyon Safety	NB 305 - 307	2.19	2.502	2.420	0.082	2.21	2.25	0.408	0.441	0.441	0.000	5.07	2.25	0.000	5.714
17.16	Red Hill SB Scenic Overlook Safety	SB 309 - 313	7.17	2.502	2.467	0.035	3.68	2.25	0.290	0.441	0.441	0.000	4.57	2.25	0.000	1.261
17.17	Woods Canyon SB Climbing Lane	SB 316 - 317	5.60	2.502	2.501	0.001	2.52	2.25	0.006	0.441	0.441	0.000	3.40	2.25	0.000	0.047
17.18	Woods Canyon Bridges	316.5 - 317.5	36.14	2.502	2.464	0.038	2.28	2.25	0.195	0.441	0.441	0.000	3.40	2.25	0.000	4.501

Performance Effectiveness Scores – Results

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Risk Factored Benefit Score					Risk Factored Emphasis Area Score		Total Factored Benefit Score	F_{VMT}	F_{NPV}	Performance Effectiveness Score	Notes
				Pavement	Bridge	Mobility	Safety	Freight	Safety	Mobility					
17.01	Table Mesa Rd TI Vertical Clearance Mitigation	SB 235.5-236.5	2.41	0.000	0.000	0.000	0.003	1.507	0.003	0.000	1.513	1.03	20.2	13.0	
17.02-A	Black Canyon Hill NB Climbing Lane	NB 245 -251	47.57	0.000	3.986	3.891	0.782	1.244	0.066	0.092	10.060	3.55	20.2	15.2	
17.02-B	Black Canyon Hill Reversible Lanes	245 - 251	146.22	0.000	1.435	5.629	2.194	7.835	0.169	0.153	17.415	4.58	20.2	11.0	
17.03	Black Canyon SB Safety	SB 245 -251	3.15	0.000	0.000	0.098	2.482	0.430	0.184	0.000	3.194	3.55	15.3	55.1	
17.04	Sunset Point Safety	252-253	2.31	0.000	0.000	0.452	1.769	1.812	0.135	0.000	4.169	0.93	20.2	34.0	
17.05	Badger Springs NB Climbing Lane	NB 256 - 260	14.9	0.000	0.000	1.015	0.941	0.032	0.090	0.046	2.124	2.65	20.2	7.6	
17.06	Orme Rd SB Safety	SB 269 - 274	4.72	0.000	0.000	0.244	1.130	0.333	0.259	0.000	1.965	2.52	20.2	21.2	
17.07-A	McGuireville TI Ramp & Bridge Rehab	293	7.79	0.000	2.605	0.000	0.000	1.956	0.000	0.000	4.561	0.30	20.2	3.6	
17.07-B	McGuireville Bridge Replace	293	18.86	0.000	4.085	0.000	0.000	1.956	0.000	0.000	6.040	0.30	30.6	3.0	
17.08	Middle Verde NB Safety	NB 290 -293	3.77	0.000	0.000	0.014	1.355	0.013	0.187	0.000	1.569	1.86	20.2	15.7	
17.09	Dry Beaver Creek SB Climbing Lane	SB 292 -294	9.35	0.000	0.000	0.059	0.000	0.000	0.004	0.009	0.072	1.34	20.2	0.2	
17.10	Dry Beaver Creek NB Climbing Lane	NB 294 - 298	14.90	0.000	0.000	0.182	1.359	0.009	0.190	0.022	1.762	2.32	20.2	5.5	
17.11	McGuireville SB Rest Area Safety	SB 295 -299	4.66	0.000	0.000	0.014	2.624	0.013	0.365	0.000	3.016	2.32	20.2	30.3	

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Risk Factored Benefit Score					Risk Factored Emphasis Area Score		Total Factored Benefit Score	F_{VMT}	F_{NPV}	Performance Effectiveness Score	Notes
				Pavement	Bridge	Mobility	Safety	Freight	Safety	Mobility					
17.12	SR 179 TI Safety	298.5 - 299	2.22	0.000	0.000	0.021	1.431	0.020	0.202	0.000	1.674	0.37	20.2	5.7	
17.13	Hog Tank Canyon NB Climbing Lane	NB 299 - 305	22.37	0.000	0.000	1.170	0.300	0.585	0.038	0.054	2.147	2.73	20.2	5.3	
17.14	Hog Tank Canyon SB Safety	SB 300 -302	4.03	0.000	0.000	0.016	4.209	0.274	0.431	0.000	4.930	1.16	20.2	28.6	
17.15	Rattlesnake NB Canyon Safety	NB 305 - 307	2.19	0.000	0.000	0.426	4.064	0.816	0.408	0.000	5.714	1.16	20.2	61.0	
17.16	Red Hill SB Scenic Overlook Safety	SB 309 - 313	7.17	0.000	0.000	0.027	0.434	0.510	0.290	0.000	1.261	1.80	20.2	6.4	
17.17	Woods Canyon SB Climbing Lane	SB 316 - 317	5.60	0.000	0.000	0.037	0.000	0.004	0.006	0.000	0.047	0.53	20.2	0.1	
17.18	Woods Canyon Bridges	316.5 - 317.5	36.14	1.394	0.000	0.024	2.829	0.059	0.195	0.000	4.501	1.01	20.2	2.5	

Appendix J: Solution Prioritization Scores

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Pavement		Bridge		Safety		Mobility		Freight		Total Factored Score	Risk Factors					Weighted Risk Factor	Performance Effectiveness Score	Segment Need	Prioritization Score
				Score	%	Score	%	Score	%	Score	%	Score	%		Pavement	Bridge	Safety	Mobility	Freight				
17.01	Table Mesa Rd TI Vertical Clearance Mitigation	SB 235.5-236.5	$2.41	0.000	0.0%	0.000	0.0%	0.006	0.4%	0.000	0.0%	1.507	99.6%	1.513	1.14	1.51	1.78	1.36	1.36	1.362	13.0	1.00	18
17.02-A	Black Canyon Hill NB Climbing Lane	NB 245 -251	$47.57	0.000	0.0%	3.986	39.6%	0.848	8.4%	3.982	39.6%	1.244	12.4%	10.060	1.14	1.51	1.78	1.36	1.36	1.455	11.0	1.87	41
17.02-B	Black Canyon Hill Reversible Lanes	245 - 251	$146.22	0.000	0.0%	1.435	8.2%	2.363	13.6%	5.782	33.2%	7.835	45.0%	17.415	1.14	1.51	1.78	1.36	1.36	1.429	55.1	1.87	29
17.03	Black Canyon SB Safety	SB 245 -251	$3.15	0.000	0.0%	0.000	0.0%	2.666	83.5%	0.098	3.1%	0.430	13.5%	3.194	1.14	1.51	1.78	1.36	1.36	1.711	15.2	1.87	176
17.04	Sunset Point Safety	252-253	$2.47	0.000	0.0%	0.000	0.0%	1.905	45.7%	0.452	10.8%	1.812	43.5%	4.169	1.14	1.51	1.78	1.36	1.36	1.552	34.0	1.87	99
17.05	Badger Springs NB Climbing Lane	NB 256 - 260	$14.90	0.000	0.0%	0.000	0.0%	1.032	48.6%	1.061	49.9%	0.032	1.5%	2.124	1.14	1.51	1.78	1.36	1.36	1.564	7.6	1.03	12
17.06	Orme Rd SB Safety	SB 269 - 274	$4.72	0.000	0.0%	0.000	0.0%	1.389	70.7%	0.244	12.4%	0.333	16.9%	1.965	1.14	1.51	1.78	1.36	1.36	1.657	21.2	1.47	52
17.07-A	McGuireville TI Ramp & Bridge Rehab	293	$7.79	0.000	0.0%	2.605	57.1%	0.000	0.0%	0.000	0.0%	1.956	42.9%	4.561	1.14	1.51	1.78	1.36	1.36	1.446	3.6	1.17	6
17.07-B	McGuireville Bridge Replace	293	$18.86	0.000	0.0%	4.085	67.6%	0.000	0.0%	0.000	0.0%	1.956	32.4%	6.040	1.14	1.51	1.78	1.36	1.36	1.461	3.0	1.17	5
17.08	Middle Verde NB Safety	NB 290 -293	$3.83	0.000	0.0%	0.000	0.0%	1.542	98.3%	0.014	0.9%	0.013	0.8%	1.569	1.14	1.51	1.78	1.36	1.36	1.773	15.7	1.17	32
17.09	Dry Beaver Creek SB Climbing Lane	SB 292 -294	$9.35	0.000	0.0%	0.000	0.0%	0.004	5.6%	0.068	94.4%	0.000	0.0%	0.072	1.14	1.51	1.78	1.36	1.36	1.383	0.2	1.17	0.3
17.10	Dry Beaver Creek NB Climbing Lane	NB 294 - 298	$14.90	0.000	0.0%	0.000	0.0%	1.549	87.9%	0.205	11.6%	0.009	0.5%	1.762	1.14	1.51	1.78	1.36	1.36	1.729	5.5	1.17	11
17.11	McGuireville SB Rest Area Safety	SB 295 -299	$4.73	0.000	0.0%	0.000	0.0%	2.989	99.1%	0.014	0.5%	0.013	0.4%	3.016	1.14	1.51	1.78	1.36	1.36	1.776	30.3	1.17	63
17.12	SR 179 TI Safety	298.5 - 299	$2.22	0.000	0.0%	0.000	0.0%	1.633	97.5%	0.021	1.3%	0.020	1.2%	1.674	1.14	1.51	1.78	1.36	1.36	1.770	5.7	1.17	12
17.13	Hog Tank Canyon NB Climbing Lane	NB 299 - 305	$23.06	0.000	0.0%	0.000	0.0%	0.338	15.7%	1.224	57.0%	0.585	27.2%	2.147	1.14	1.51	1.78	1.36	1.36	1.426	5.3	1.47	11
17.14	Hog Tank Canyon SB Safety	SB 300 -302	$4.03	0.000	0.0%	0.000	0.0%	4.640	94.1%	0.016	0.3%	0.274	5.6%	4.930	1.14	1.51	1.78	1.36	1.36	1.755	28.6	1.47	74
17.15	Rattlesnake NB Canyon Safety	NB 305 - 307	$2.25	0.000	0.0%	0.000	0.0%	4.472	78.3%	0.426	7.5%	0.816	14.3%	5.714	1.14	1.51	1.78	1.36	1.36	1.689	61.0	1.47	151
17.16	Red Hill SB Scenic Overlook Safety	SB 309 - 313	$7.23	0.000	0.0%	0.000	0.0%	0.724	57.4%	0.027	2.2%	0.510	40.4%	1.261	1.14	1.51	1.78	1.36	1.36	1.601	6.4	0.87	9
17.17	Woods Canyon SB Climbing Lane	SB 316 - 317	$5.60	0.000	0.0%	0.000	0.0%	0.006	12.1%	0.037	79.6%	0.004	8.3%	0.047	1.14	1.51	1.78	1.36	1.36	1.411	0.1	1.30	0.2
17.18	Woods Canyon Bridges	316.5 - 317.5	$36.28	1.394	31.0%	0.000	0.0%	3.024	67.2%	0.024	0.5%	0.059	1.3%	4.501	1.14	1.51	1.78	1.36	1.36	1.574	2.5	1.30	5

Appendix K: Preliminary Scoping Reports for Prioritized Solutions

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION	
Date: March 1, 2017	**ADOT Project Manager:**
Project Name: Table Mesa Road TI Vertical Clearance Mitigation (Southbound MP 235.5 – 236.5)	
City/Town Name: North of New River	**County: Maricopa**
Primary Route/Street: I-17 (southbound)	
Beginning Limit: MP 235.5	
End Limit: MP 236.5	
Project Length: 1 miles	
Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)* ☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:	
Adjacent Land Ownership(s): *(Check all that apply)* ☐ City/Town; ☐ County; ☐ ADOT; ☐ Private; ☐ Federal; ☐ Tribal; ☒ Other: State Trust Land *http://gis.azland.gov/webapps/parcel/*	

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION *(If applicable)*	
LPA/Tribal Name:	
LPA/Tribal Contact:	
Email Address:	**Phone Number:**
Administration: ☐ ADOT Administered ☐ Self-Administered ☐ Certification Acceptance	

PROJECT NEED
The existing Table Mesa Road southbound structure does not meet the minimum vertical clearance requirement and the existing ramp configuration does not allow trucks to by-pass the restriction.

PROJECT PURPOSE			
What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐
Enhance freight mobility by removing vertical clearance restriction.			

PROJECT TYPE		
Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS	
Check any risks identified that may impact the project's scope, schedule, or budget:	
☒ Access / Traffic Control / Detour Issues	☒ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☐ Structures & Geotech	☐ Other:

Risk Description: *(If a box is checked above, briefly explain the risk)*

Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.

Potential R/W from ASLD (for new ramp option).

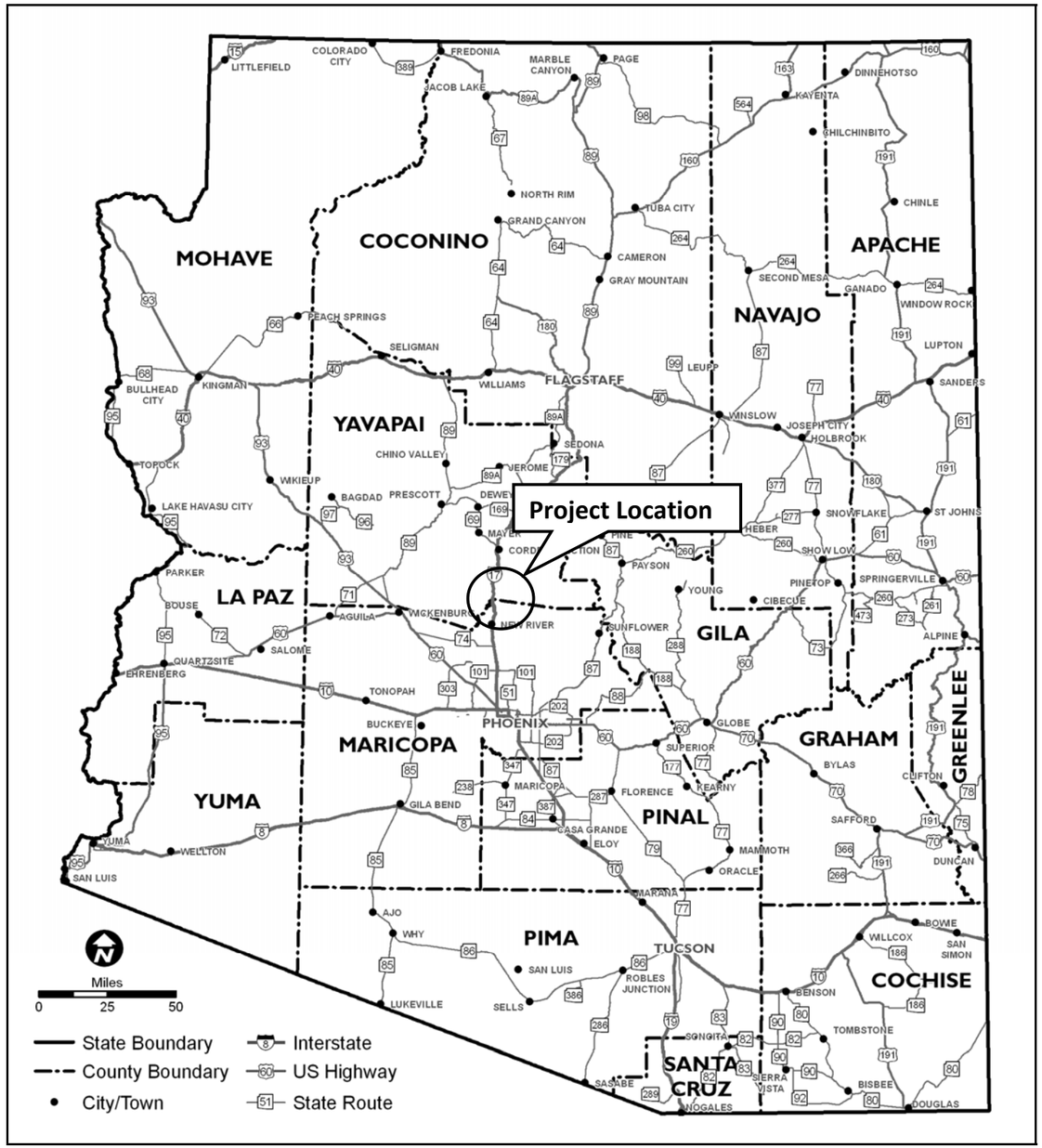
FUNDING SOURCE(S)				
Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE				
Preliminary Engineering	Design	Right-of-Way	Construction	Total
$60,000	$210,000	$0	$2,140,000	$2,410,000

PROJECT DELIVERY
Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:
Design Program Year: FY
Construction Program Year: FY

ATTACHMENTS
1) State Location Map
2) Project Vicinity Map
3) Project Scope of Work
4) Project Schedule
5) Itemized Cost Estimate
6) 15% Design Plan Sheets (as needed)

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Reconstruct southbound roadway and lower profile by approximately 3”

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: March 1, 2017	**ADOT Project Manager:**
Project Name: Black Canyon Hill Mobility & Freight Improvements	
City/Town Name: North of Black Canyon City	**County: Yavapai**
Primary Route/Street: I-17	
Beginning Limit: MP 245	
End Limit: MP 251	
Project Length: 6 miles	

Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)*

☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:

Adjacent Land Ownership(s): *(Check all that apply)*

☐ City/Town; ☐ County; ☐ ADOT; ☐ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land

http://gis.azland.gov/webapps/parcel/

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION

(If applicable)

LPA/Tribal Name:	
LPA/Tribal Contact:	
Email Address:	**Phone Number:**

Administration: ☐ ADOT Administered ☐ Self-Administered ☐ Certification Acceptance

PROJECT NEED

The existing geometric characteristics contribute to mobility and safety needs. Northbound uphill grades create speed differentials between vehicle and driver types. Existing 2-lane segment does not supply ample passing opportunities affecting safety and mobility. Projected travel demand is expected to exceed existing capacity.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☒

Enhance mobility and safety by providing additional capacity.

PROJECT TYPE

Pavement Preservation ☐	Roadway Widening ☒	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS

Check any risks identified that may impact the project's scope, schedule, or budget:

☒ Access / Traffic Control / Detour Issues	☐ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☒ Structures & Geotech	☐ Other:

Risk Description: *(If a box is checked above, briefly explain the risk)*

Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.

Large fills and cuts, and potential retaining walls may lead to geotechnical concerns.

FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$1,260,000 (Option A) $3,880,000 (Option B)	$4,210,000 (Option A) $12,940,000 (Option B)	$0 (Option A) $0 (Option B)	$42,100,000 (Option A) $129,400,000 (Option B)	$47,570,000 (Option A) $146,220,000 (Option B)

PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

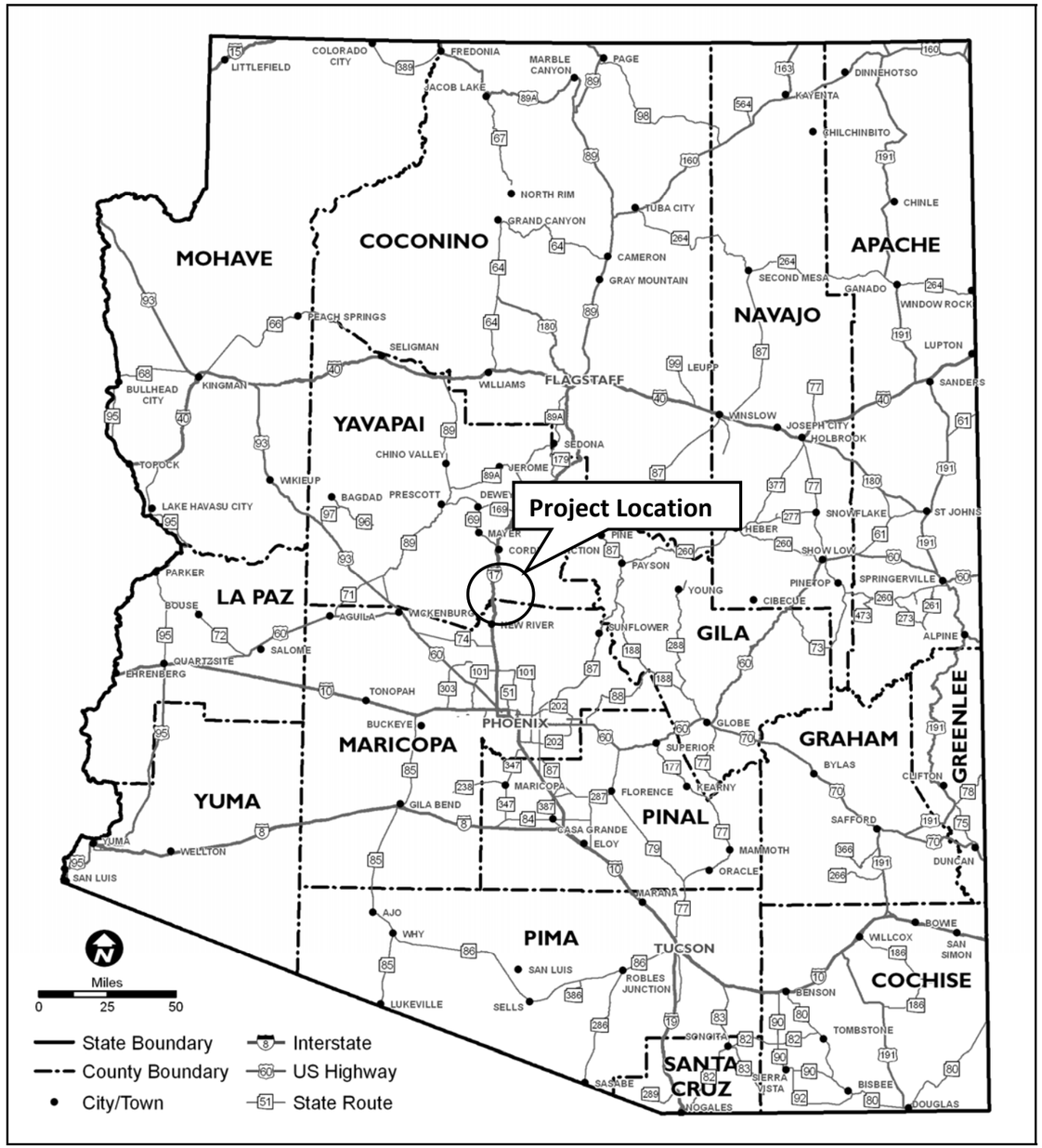
Design Program Year: FY

Construction Program Year: FY

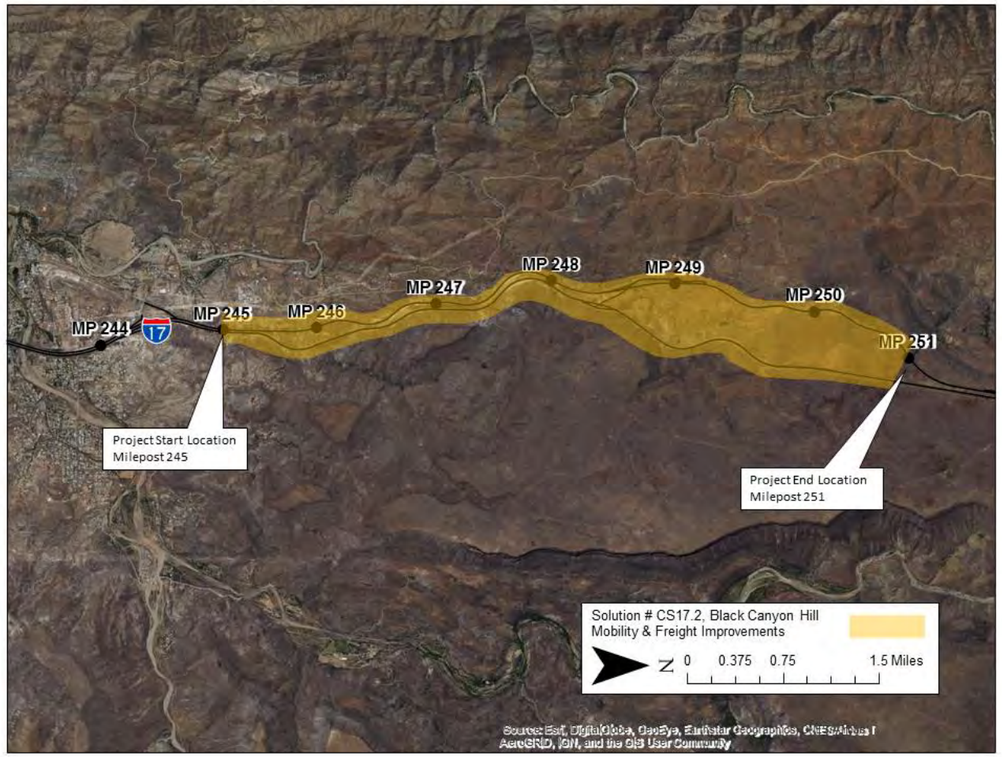
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**
4) **Project Schedule**
5) **Itemized Cost Estimate**
6) **15% Design Plan Sheets (as needed)**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• ***Option A:*** • Construct northbound climbing lane • Replace Bumble Bee Road northbound bridge • ***Option B:*** • Construct reversible lanes • Replace Bumble Bee Road southbound bridge

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: March 1, 2017	**ADOT Project Manager:**
Project Name: Black Canyon Hill Southbound Safety Improvements	
City/Town Name: North of Black Canyon City	**County: Yavapai**
Primary Route/Street: I-17	
Beginning Limit: MP 245	
End Limit: MP 251	
Project Length: 6 miles	

Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)*

☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:

Adjacent Land Ownership(s): *(Check all that apply)*

☐ City/Town; ☐ County; ☐ ADOT; ☐ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land

http://gis.azland.gov/webapps/parcel/

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION

(If applicable)

LPA/Tribal Name:	
LPA/Tribal Contact:	
Email Address:	**Phone Number:**

Administration: ☐ ADOT Administered ☐ Self-Administered ☐ Certification Acceptance

PROJECT NEED

The existing geometric characteristics contribute to mobility and safety needs. Curvature of existing southbound roadway and downhill grades contribute to crashes.

This segment of I-17 experiences crash rates and frequencies above the statewide average

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

Enhance safety with enhanced delineation, improving visibility (sight distance), and providing driver feedback for southbound traffic

PROJECT TYPE

Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS

Check any risks identified that may impact the project's scope, schedule, or budget:

☒ Access / Traffic Control / Detour Issues	☐ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☒ Structures & Geotech	☐ Other:

Risk Description: *(If a box is checked above, briefly explain the risk)*

Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.

Large fills and cuts, and potential retaining walls may lead to geotechnical concerns.

FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$ 80,000	$ 280,000	$0	$ 2,790,000	$ 3,150,000

PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

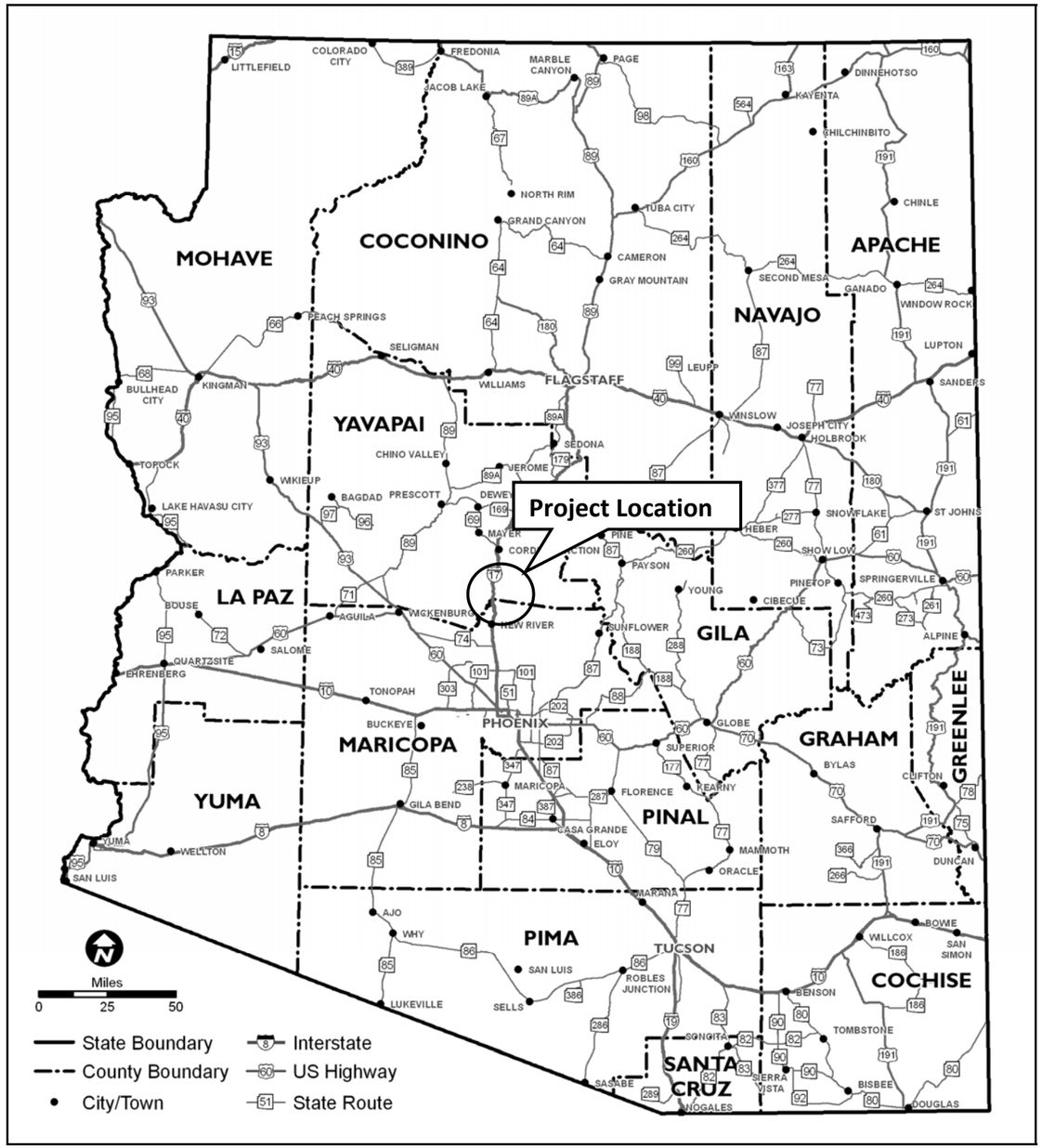
Design Program Year: FY

Construction Program Year: FY

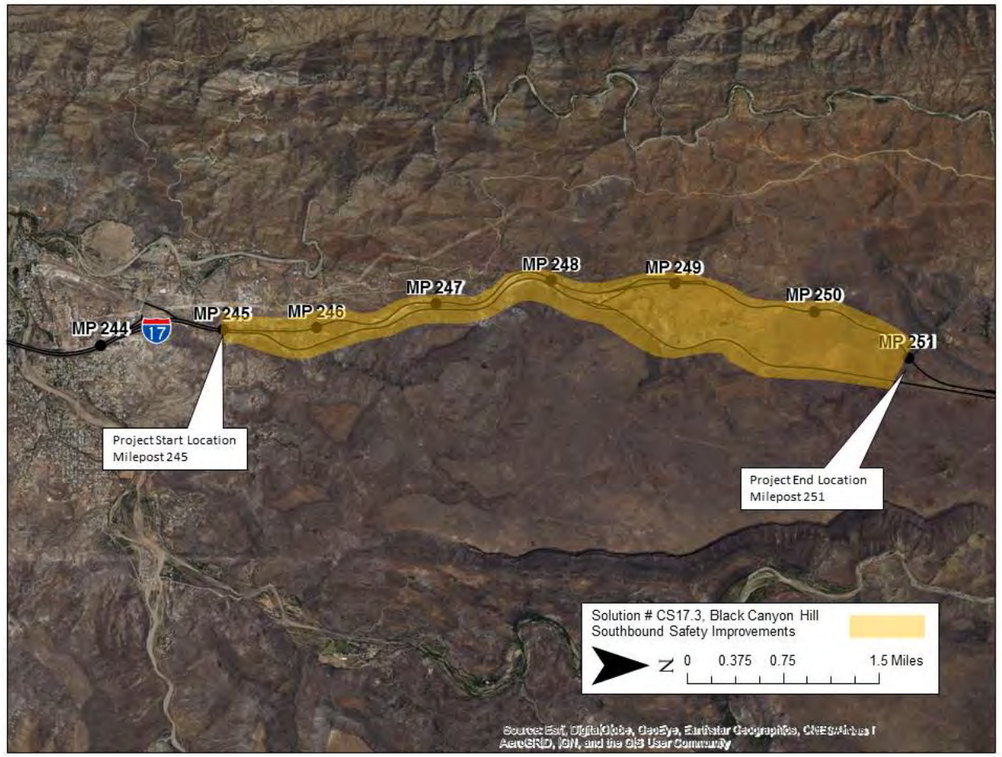
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**
4) **Project Schedule**
5) **Itemized Cost Estimate**
6) **15% Design Plan Sheets (as needed)**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Enhance roadway design (replace guardrail) • Install high visibility striping and delineators, raised pavement markers, and rumble strips • Install chevrons on curves • Excavate/grade cut slopes to improve sight distance • Install dynamic speed feedback system on southbound roadway (near MP 248 & MP 251)

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: March 1, 2017 | **ADOT Project Manager:**

Project Name: Sunset Point Safety Improvements (MP 252 – 253)

City/Town Name: at Sunset Point TI | **County: Yavapai**

Primary Route/Street: I-17

Beginning Limit: MP 252

End Limit: MP 253

Project Length: 1 miles

Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)*

☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:

Adjacent Land Ownership(s): *(Check all that apply)*

☐ City/Town; ☐ County; ☐ ADOT; ☒ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land

http://gis.azland.gov/webapps/parcel/

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION

(If applicable)

LPA/Tribal Name:

LPA/Tribal Contact:

Email Address: | **Phone Number:**

Administration: ☐ ADOT Administered ☐ Self-Administered ☐ Certification Acceptance

PROJECT NEED

Taper-type exit ramps restrict the ability of existing traffic to decelerate and separate from mainline traffic. This area experiences heavy cross-winds.

This segment of I-17 experiences crash rates and frequencies above the statewide average.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

Enhance safety by providing additional distance for exiting traffic to decelerate by extending ramps, and enhance weather data collection and driver information by providing a dynamic wind warning system.

PROJECT TYPE

Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS

Check any risks identified that may impact the project's scope, schedule, or budget:

☒ Access / Traffic Control / Detour Issues	☐ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☐ Structures & Geotech	☐ Other:

Risk Description:

Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.

FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$ 70,000	$ 220,000	$0	$ 2,180,000	$ 2,470,000

PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

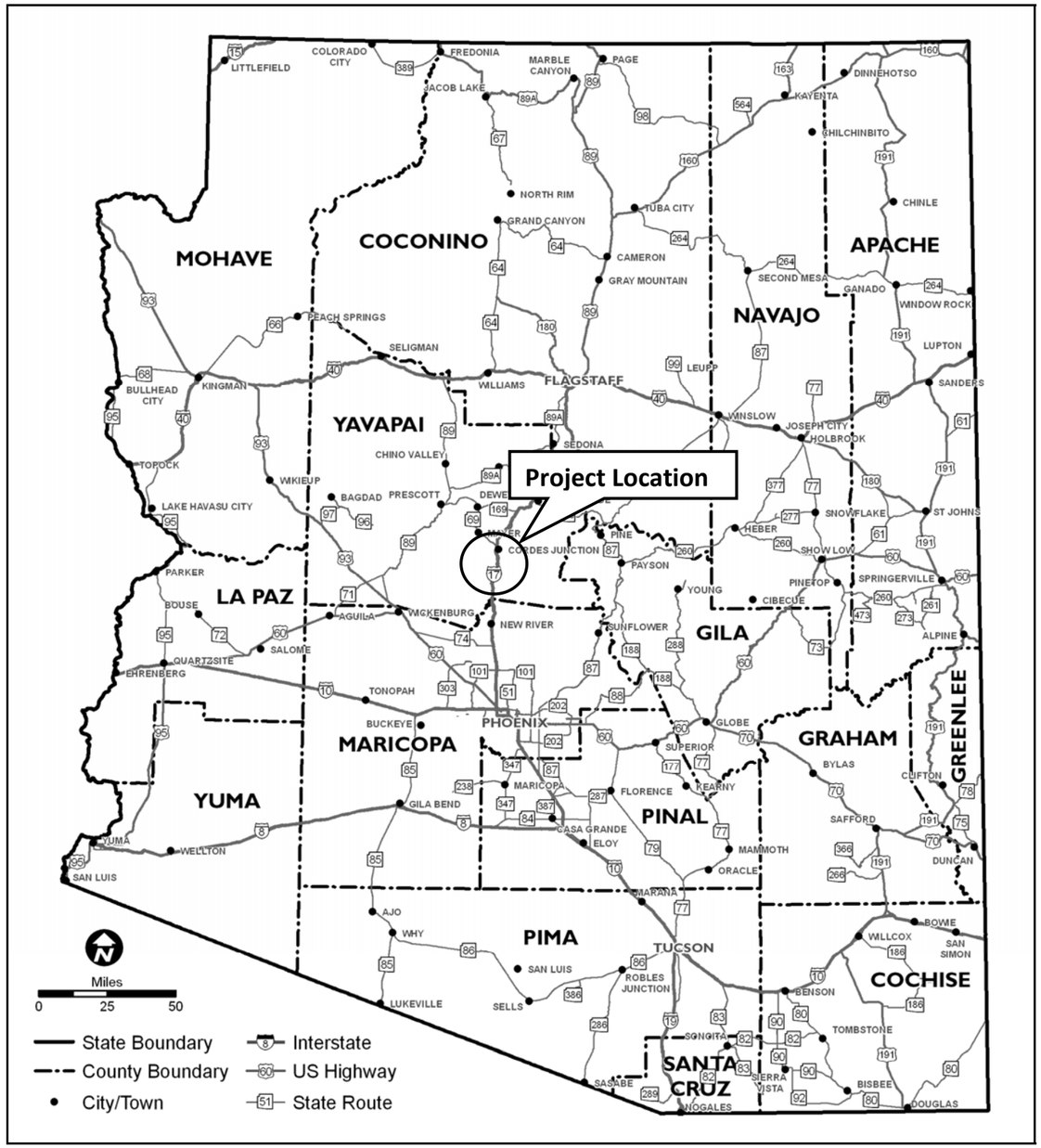
Design Program Year: FY

Construction Program Year: FY

ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**
4) **Project Schedule**
5) **Itemized Cost Estimate**
6) **15% Design Plan Sheets (as needed)**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Extend (northbound and southbound) exit ramps to create parallel-type exit ramps to Sunset Point TI • Install RWIS and dynamic wind warning system

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION	
Date: March 1, 2017	**ADOT Project Manager:**
Project Name: Badger Springs Northbound Climbing Lane	
City/Town Name: South of Cordes Junction	**County: Yavapai**
Primary Route/Street: I-17 (northbound)	
Beginning Limit: MP 256	
End Limit: MP 260	
Project Length: 4 miles	
Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)* ☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:	
Adjacent Land Ownership(s): *(Check all that apply)* ☐ City/Town; ☐ County; ☐ ADOT; ☐ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land *http://gis.azland.gov/webapps/parcel/*	

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION *(If applicable)*		
LPA/Tribal Name:		
LPA/Tribal Contact:		
Email Address:	**Phone Number:**	
Administration: ☐ ADOT Administered	☐ Self-Administered	☐ Certification Acceptance

PROJECT NEED
Uphill grades create speed differentials between vehicle and driver types. Existing 2-lane segment does not supply ample passing opportunities affecting mobility.

PROJECT PURPOSE			
What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐
Enhance mobility and safety by constructing a climbing lane for northbound traffic.			

PROJECT TYPE		
Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS	
Check any risks identified that may impact the project's scope, schedule, or budget:	
☒ Access / Traffic Control / Detour Issues	☐ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☐ Structures & Geotech	☐ Other:
Risk Description: *(If a box is checked above, briefly explain the risk)* *Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.*	

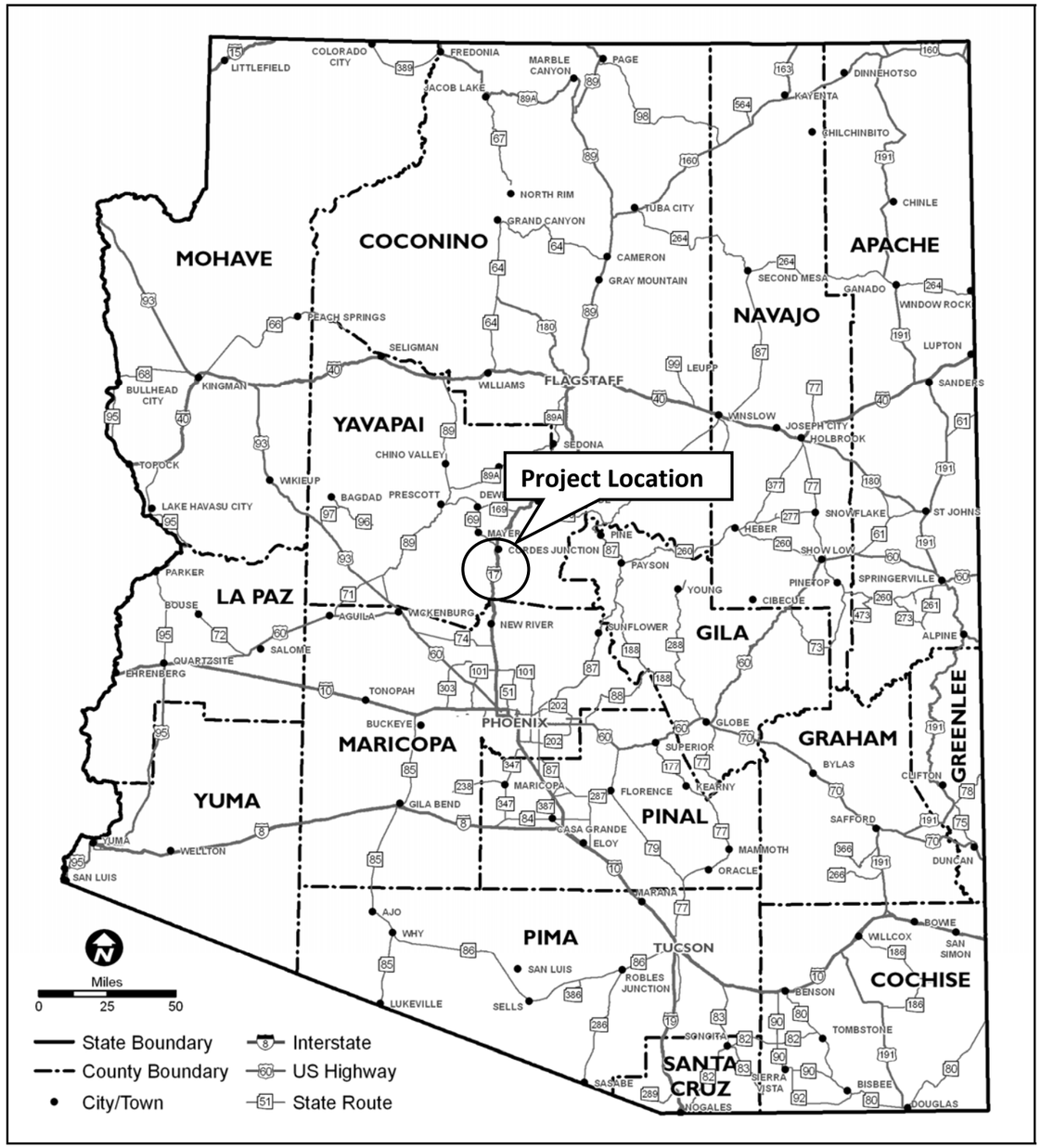
FUNDING SOURCE(S)				
Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE				
Preliminary Engineering	Design	Right-of-Way	Construction	Total
$ 400,000	$1,300,000	$0	$ 13,200,000	$ 14,900,000

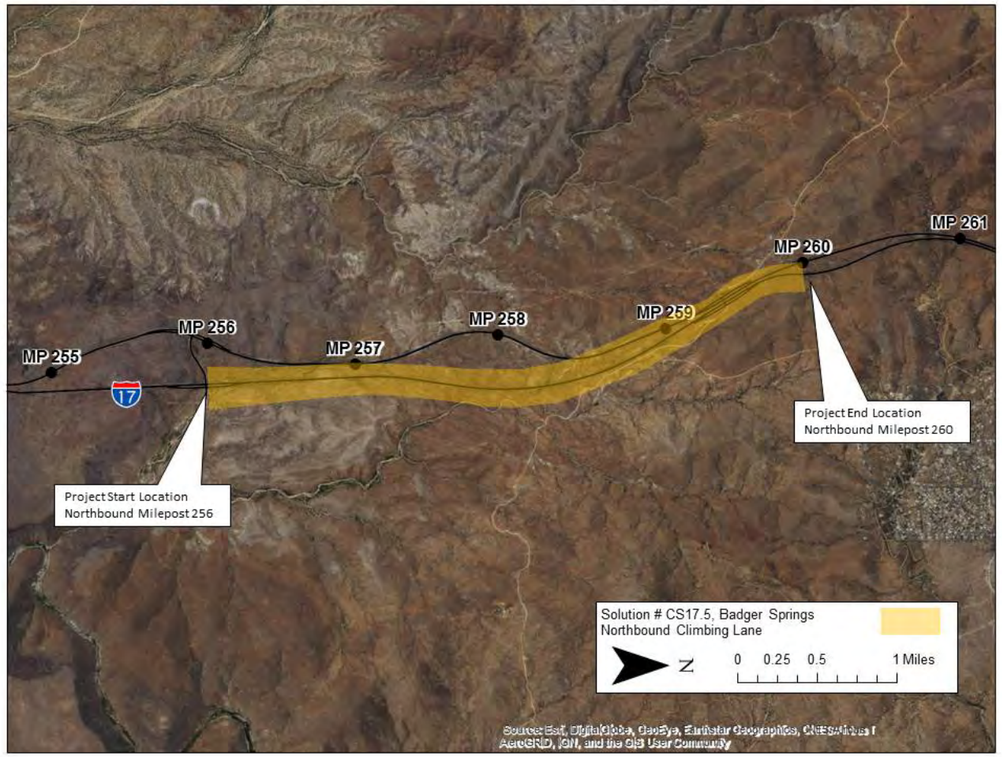
PROJECT DELIVERY
Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:
Design Program Year: FY
Construction Program Year: FY

ATTACHMENTS
1) State Location Map
2) Project Vicinity Map
3) Project Scope of Work
4) Project Schedule
5) Itemized Cost Estimate
6) 15% Design Plan Sheets (as needed)

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Widen northbound roadway to provide climbing lane

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: March 1, 2017	**ADOT Project Manager:**
Project Name: McGuireville TI Bridge	
City/Town Name: McGuireville	**County: Yavapai**
Primary Route/Street: I-17	
Beginning Limit: MP 292.2	
End Limit: MP 293.5	
Project Length: 1 miles	

Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)*

☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:

Adjacent Land Ownership(s): *(Check all that apply)*

☐ City/Town; ☐ County; ☐ ADOT; ☒ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land

http://gis.azland.gov/webapps/parcel/

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION

(If applicable)

LPA/Tribal Name:	
LPA/Tribal Contact:	
Email Address:	**Phone Number:**

Administration: ☐ ADOT Administered ☐ Self-Administered ☐ Certification Acceptance

PROJECT NEED

The existing McGuireville TI bridge does not meet the minimum vertical clearance requirement for southbound traffic and the existing ramp configuration does not allow trucks to by-pass the restriction. Due to the vertical clearance, the bridge has been impacted numerous times over the last 10 years. In addition, the existing structure has a superstructure rating of 4 which results in the bridge being classified as structurally deficient.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☒	Modernization ☒	Expansion ☐

Enhance freight mobility by removing vertical clearance restriction. Improve bridge superstructure condition and reduce life-cycle costs.

PROJECT TYPE

Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☒	Bridge Replacement ☒	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS

Check any risks identified that may impact the project's scope, schedule, or budget:

☒ Access / Traffic Control / Detour Issues	☒ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☒ Structures & Geotech	☐ Other:

Risk Description:

Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.

Potential R/W from private owners.

New bridges over Dry Beaver Creek may lead to structural or geotechnical concerns.

FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$190,000 (Option A) $480,000 (Option B)	$632,000 (Option A) $1,600,000 (Option B)	$650,000 (Option A) $780,000 (Option B)	$6,320,000 (Option A) $16,000,000 (Option B)	$7,792,000 (Option A) $18,860,000 (Option B)

PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

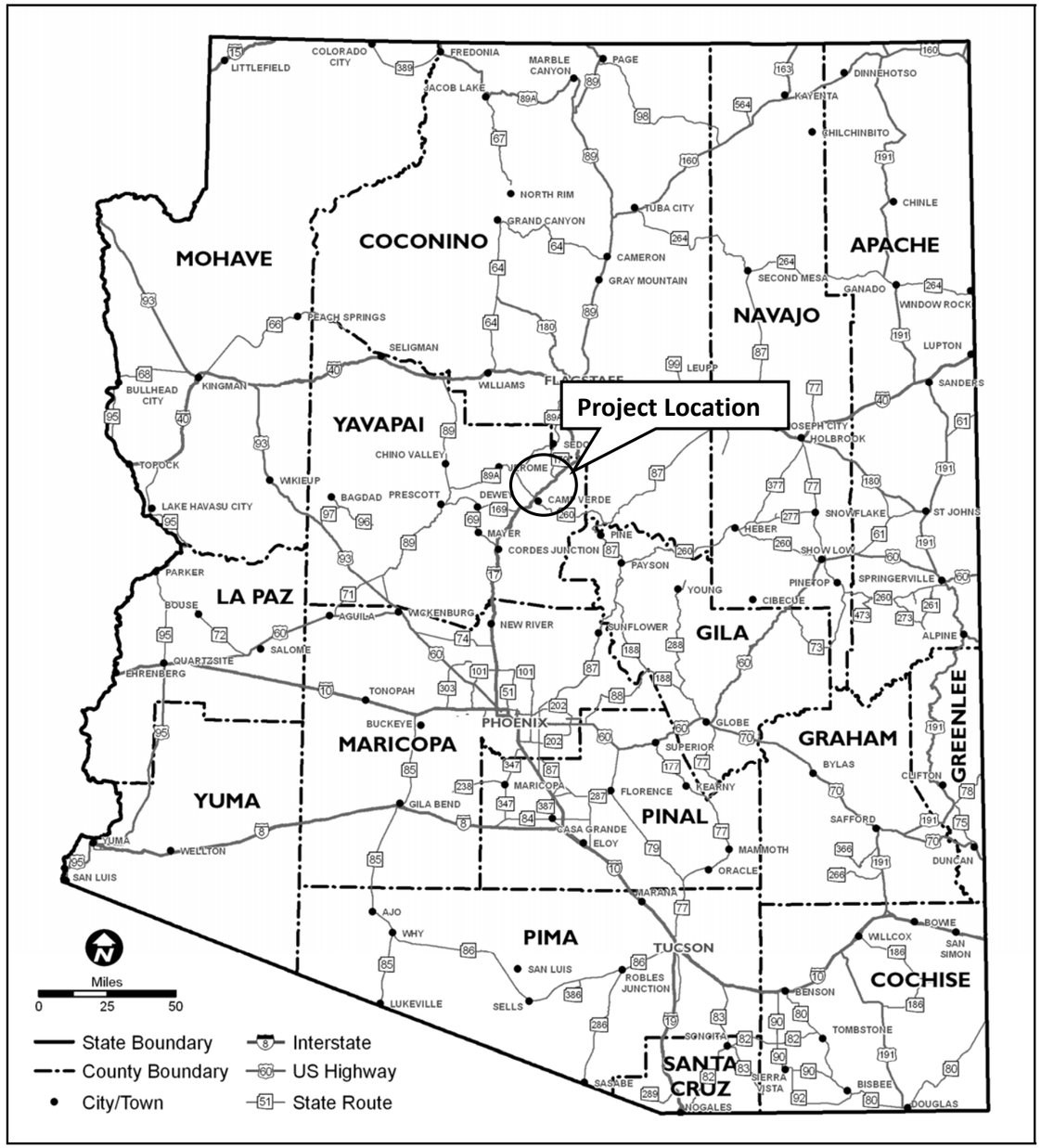
Design Program Year: FY

Construction Program Year: FY

ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**
4) **Project Schedule**
5) **Itemized Cost Estimate**
6) **15% Design Plan Sheets (as needed)**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• ***Option A:***
• Rehabilitate McGuireville TI bridge
• Construct new southbound exit ramp with new bridge over Dry Beaver Creek
• ***Option B:***
• Replace McGuireville TI bridge

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION	
Date: March 1, 2017	**ADOT Project Manager:**
Project Name: Middle Verde Road Northbound Safety Improvements	
City/Town Name: North of Camp Verde	**County: Yavapai**
Primary Route/Street: I-17 (northbound)	
Beginning Limit: MP 290	
End Limit: MP 293	
Project Length: 3 miles	
Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)* ☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:	
Adjacent Land Ownership(s): *(Check all that apply)* ☐ City/Town; ☐ County; ☐ ADOT; ☒ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land *http://gis.azland.gov/webapps/parcel/*	

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION *(If applicable)*		
LPA/Tribal Name:		
LPA/Tribal Contact:		
Email Address:	**Phone Number:**	
Administration: ☐ ADOT Administered	☐ Self-Administered	☐ Certification Acceptance

PROJECT NEED
Curvature of existing northbound roadway contributes to run-off-road crashes. *This segment of I-17 experiences crash rates and frequencies above the statewide average.*

PROJECT PURPOSE			
What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐
Enhance safety by improving skid resistance and delineation, and providing driver feedback for northbound traffic.			

PROJECT TYPE		
Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS	
Check any risks identified that may impact the project's scope, schedule, or budget:	
☒ Access / Traffic Control / Detour Issues	☐ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☐ Structures & Geotech	☐ Other:
Risk Description: *Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.*	

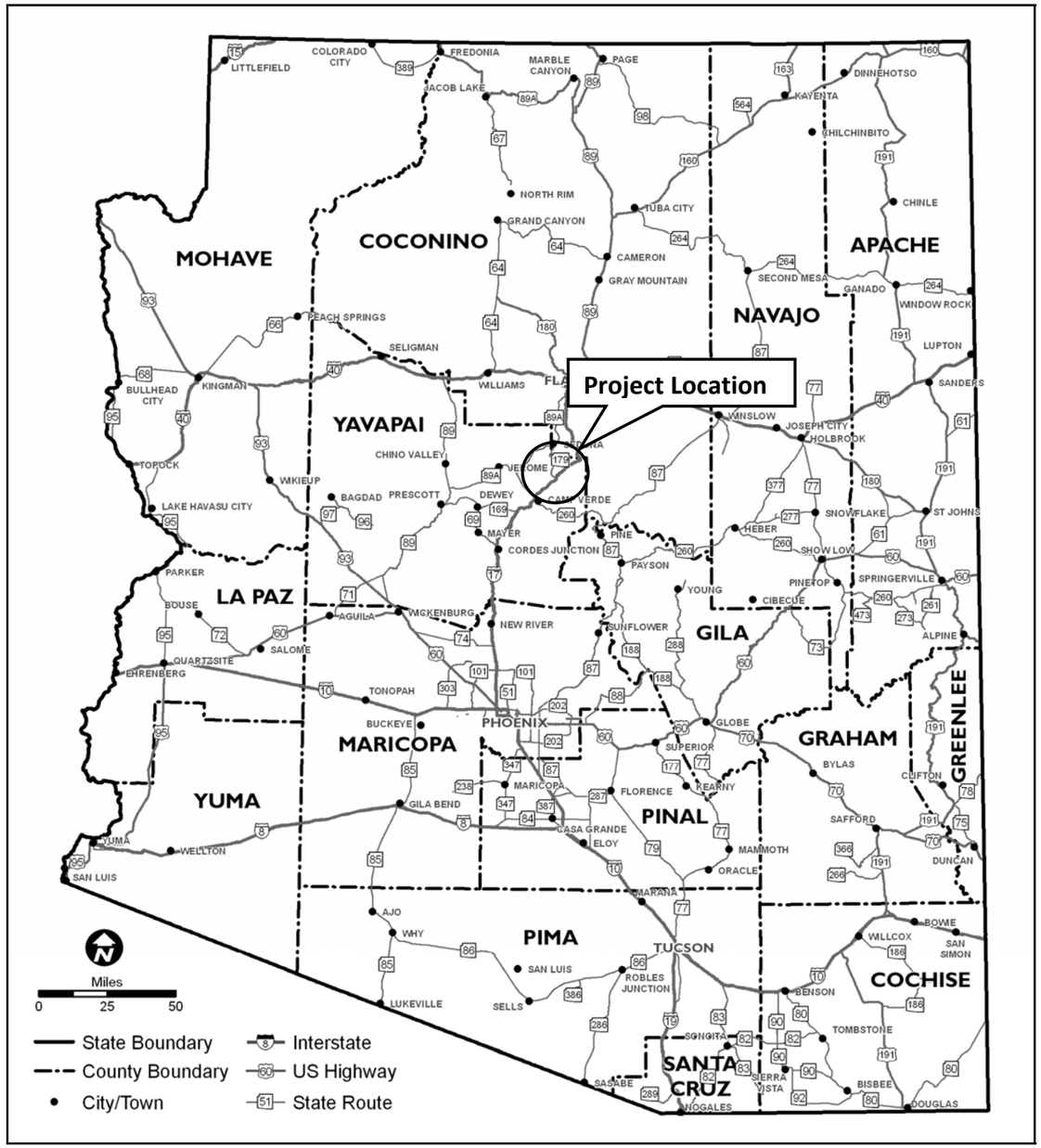
FUNDING SOURCE(S)				
Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE				
Preliminary Engineering	Design	Right-of-Way	Construction	Total
$ 100,000	$ 340,000	$0	$ 3,390,000	$ 3,830,000

PROJECT DELIVERY
Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:
Design Program Year: FY
Construction Program Year: FY

ATTACHMENTS
1) State Location Map
2) Project Vicinity Map
3) Project Scope of Work
4) Project Schedule
5) Itemized Cost Estimate
6) 15% Design Plan Sheets (as needed)

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Improve skid resistance on northbound curves by either reconstructing pavement (and increasing super-elevation), milling and replacing with variable depth AC to increase super-elevation, or milling and replacing pavement • Install high visibility striping and delineators, raised pavement markers, and rumble strips • Install chevrons on curves • Install dynamic speed feedback system for northbound traffic (near MP 291 & MP 293) • Install CCTV on existing DMS near MP 289

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: March 1, 2017	**ADOT Project Manager:**
Project Name: Dry Beaver Creek Southbound Climbing Lane	
City/Town Name: South of SR179 TI	**County: Yavapai**
Primary Route/Street: I-17 (southbound)	
Beginning Limit: MP 292	
End Limit: MP 294	
Project Length: 2 miles	

Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)*

☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:

Adjacent Land Ownership(s): *(Check all that apply)*

☐ City/Town; ☐ County; ☐ ADOT; ☒ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land

http://gis.azland.gov/webapps/parcel/

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION

(If applicable)

LPA/Tribal Name:	
LPA/Tribal Contact:	
Email Address:	**Phone Number:**

Administration: ☐ ADOT Administered ☐ Self-Administered ☐ Certification Acceptance

PROJECT NEED

Uphill grades create speed differentials between vehicle and driver types. Existing 2-lane segment does not supply ample passing opportunities affecting safety and mobility.

This segment of I-17 experiences crash rates and frequencies above the statewide average.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

Enhance safety and mobility by constructing a climbing lane for southbound traffic.

PROJECT TYPE

Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS

Check any risks identified that may impact the project's scope, schedule, or budget:

☒ Access / Traffic Control / Detour Issues	☐ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☐ Structures & Geotech	☐ Other:

Risk Description:

Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.

FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$ 250,000	$ 830,000	$0	$ 8,270,000	$ 9,350,000

PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

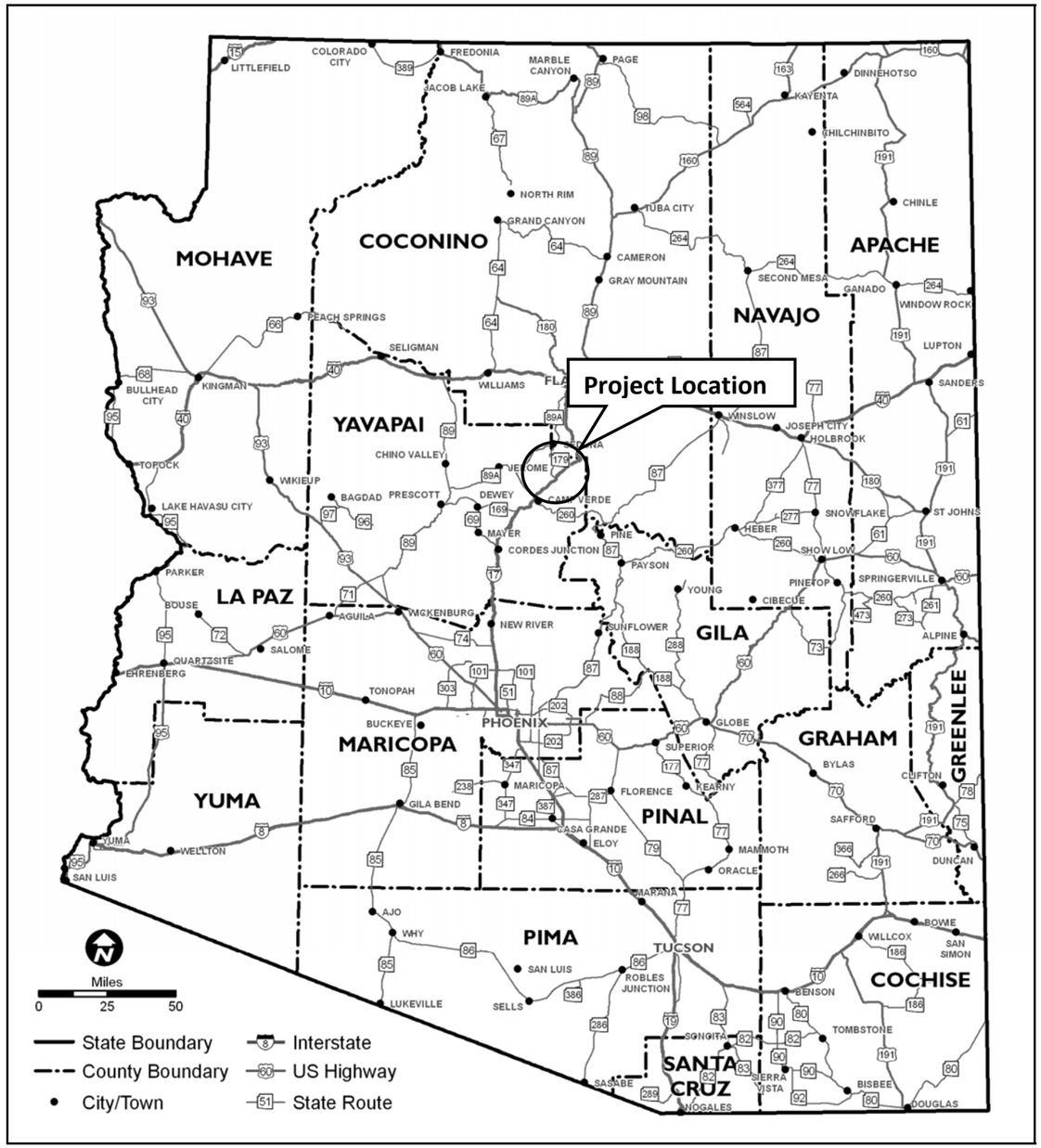
Design Program Year: FY

Construction Program Year: FY

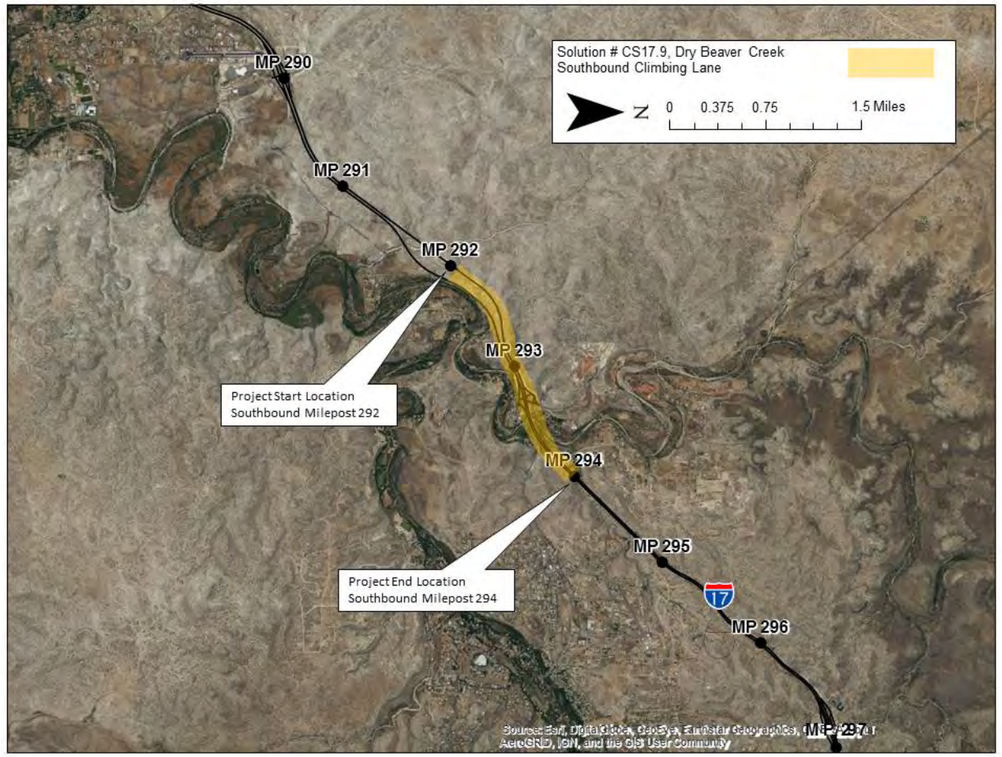
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**
4) **Project Schedule**
5) **Itemized Cost Estimate**
6) **15% Design Plan Sheets (as needed)**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Widen southbound roadway to provide climbing lane • Widen Dry Beaver Creek bridge

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: March 1, 2017	**ADOT Project Manager:**
Project Name: Dry Beaver Creek Northbound Climbing Lane	
City/Town Name: South of SR179 TI	**County: Yavapai**
Primary Route/Street: I-17 (northbound)	
Beginning Limit: MP 294	
End Limit: MP 298	
Project Length: 4 miles	

Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)*

☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:

Adjacent Land Ownership(s): *(Check all that apply)*

☐ City/Town; ☐ County; ☐ ADOT; ☒ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land

http://gis.azland.gov/webapps/parcel/

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION

(If applicable)

LPA/Tribal Name:	
LPA/Tribal Contact:	
Email Address:	**Phone Number:**

Administration: ☐ ADOT Administered ☐ Self-Administered ☐ Certification Acceptance

PROJECT NEED

Uphill grades create speed differentials between vehicle and driver types. Existing 2-lane segment does not supply ample passing opportunities affecting safety and mobility.

This segment of I-17 experiences crash rates and frequencies above the statewide average.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

Enhance safety and mobility by constructing a climbing lane for northbound traffic.

PROJECT TYPE

Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS

Check any risks identified that may impact the project's scope, schedule, or budget:

☒ Access / Traffic Control / Detour Issues	☐ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☐ Structures & Geotech	☐ Other:

Risk Description:

Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.

FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$ 400,000	$ 1,300,000	$0	$ 13,200,000	$ 14,900,000

PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

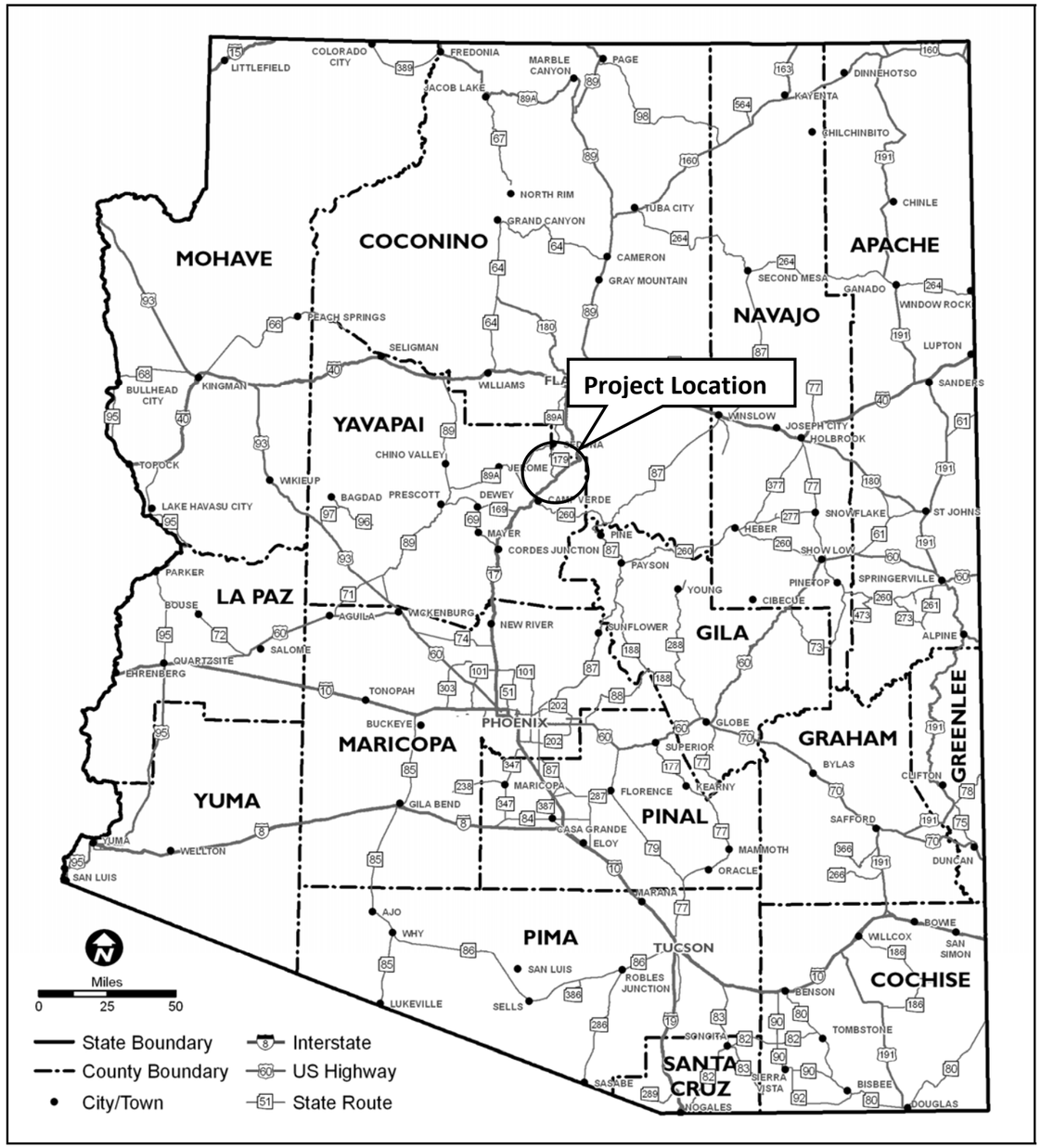
Design Program Year: FY

Construction Program Year: FY

ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**
4) **Project Schedule**
5) **Itemized Cost Estimate**
6) **15% Design Plan Sheets (as needed)**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Widen northbound roadway to provide climbing lane

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION	
Date: March 1, 2017	**ADOT Project Manager:**
Project Name: McGuireville Rest Area Southbound Safety Improvements	
City/Town Name: South of SR179 TI	**County: Yavapai**
Primary Route/Street: I-17 (southbound)	
Beginning Limit: MP 295	
End Limit: MP 299	
Project Length: 4 miles	
Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)* ☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:	
Adjacent Land Ownership(s): *(Check all that apply)* ☐ City/Town; ☐ County; ☐ ADOT; ☒ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land *http://gis.azland.gov/webapps/parcel/*	

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION *(If applicable)*		
LPA/Tribal Name:		
LPA/Tribal Contact:		
Email Address:	**Phone Number:**	
Administration: ☐ ADOT Administered	☐ Self-Administered	☐ Certification Acceptance

PROJECT NEED
Curvature of existing southbound roadway and downhill grade contribute to run-off-road crashes. *This segment of I-17 experiences crash rates and frequencies above the statewide average.*

PROJECT PURPOSE			
What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐
Enhance safety by improving skid resistance and delineation, and providing driver feedback for southbound traffic.			

PROJECT TYPE		
Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS	
Check any risks identified that may impact the project's scope, schedule, or budget:	
☒ Access / Traffic Control / Detour Issues	☐ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☐ Structures & Geotech	☐ Other:
Risk Description: *Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.*	

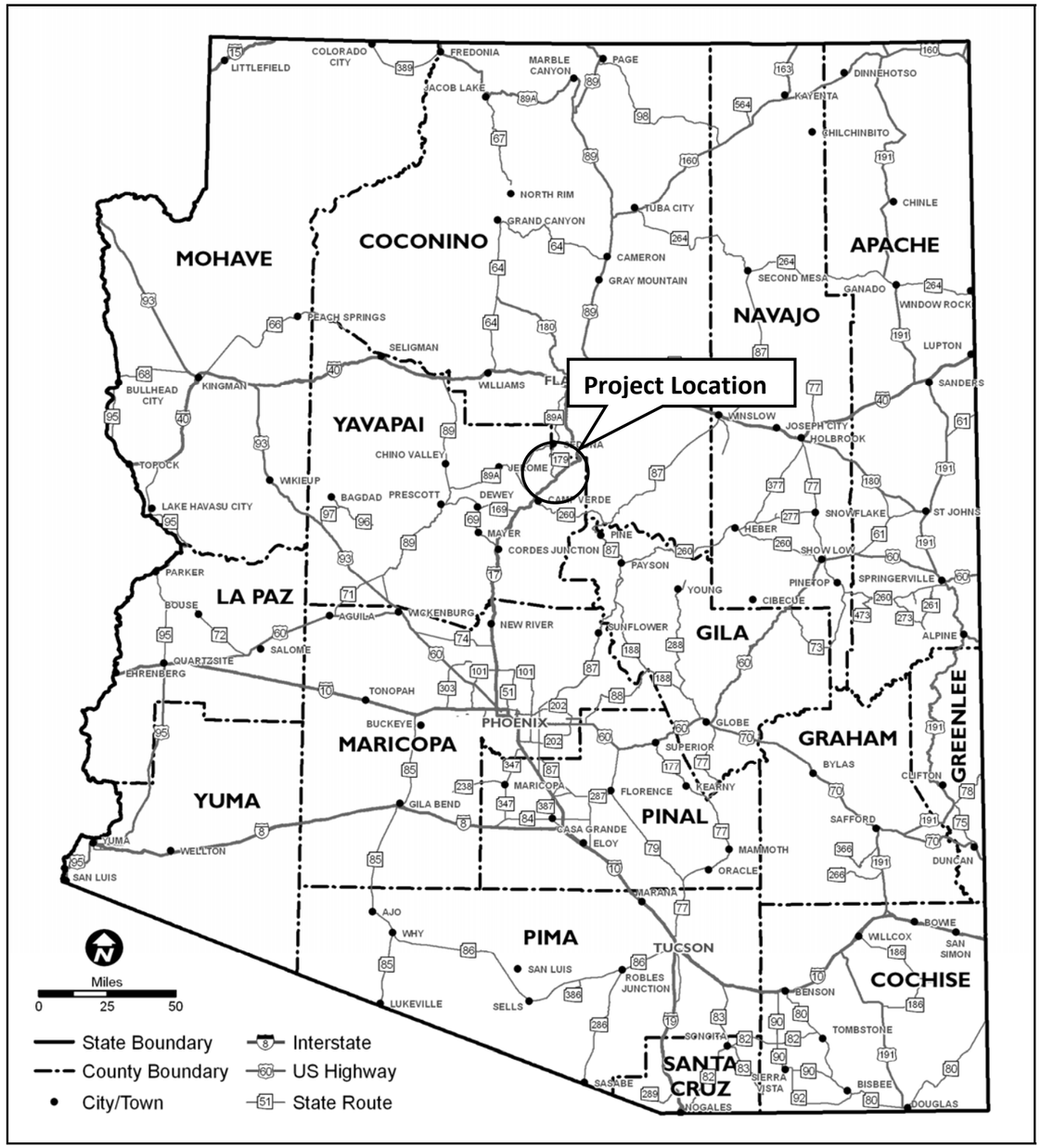
FUNDING SOURCE(S)				
Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE				
Preliminary Engineering	Design	Right-of-Way	Construction	Total
$ 130,000	$ 420,000	$0	$ 4,180,000	$ 4,730,000

PROJECT DELIVERY
Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:
Design Program Year: FY
Construction Program Year: FY

ATTACHMENTS
1) State Location Map
2) Project Vicinity Map
3) Project Scope of Work
4) Project Schedule
5) Itemized Cost Estimate
6) 15% Design Plan Sheets (as needed)

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Improve skid resistance on southbound curves by either reconstructing pavement (and increasing super-elevation), milling and replacing with variable depth AC to increase super-elevation, or milling and replacing pavement • Install high visibility striping and delineators, raised pavement markers, and rumble strips • Install chevrons on curves • Install dynamic speed feedback system for southbound traffic (near MP 297 & MP 299) • Install CCTV on existing DMS near MP 297.4

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION	
Date: March 1, 2017	**ADOT Project Manager:**
Project Name: SR 179 TI	
City/Town Name: at SR 179 TI	**County: Yavapai**
Primary Route/Street: I-17	
Beginning Limit: MP 298.5	
End Limit: MP 299.5	
Project Length: 1 miles	
Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)* ☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:	
Adjacent Land Ownership(s): *(Check all that apply)* ☐ City/Town; ☐ County; ☐ ADOT; ☐ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land *http://gis.azland.gov/webapps/parcel/*	

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION *(If applicable)*		
LPA/Tribal Name:		
LPA/Tribal Contact:		
Email Address:	**Phone Number:**	
Administration: ☐ ADOT Administered	☐ Self-Administered	☐ Certification Acceptance

PROJECT NEED
Taper-type entrance ramps restrict the ability of entering traffic to accelerate and merge with mainline traffic. Taper-type exit ramps restrict the ability of existing traffic to decelerate and separate from mainline traffic. *This segment of I-17 experiences crash rates and frequencies above the statewide average.*

PROJECT PURPOSE			
What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐
Enhance safety by providing additional distance for entering traffic to merge with mainline traffic and exiting traffic to decelerate by extending ramps.			

PROJECT TYPE		
Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS	
Check any risks identified that may impact the project's scope, schedule, or budget:	
☒ Access / Traffic Control / Detour Issues	☐ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☐ Structures & Geotech	☐ Other:
Risk Description: *Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.*	

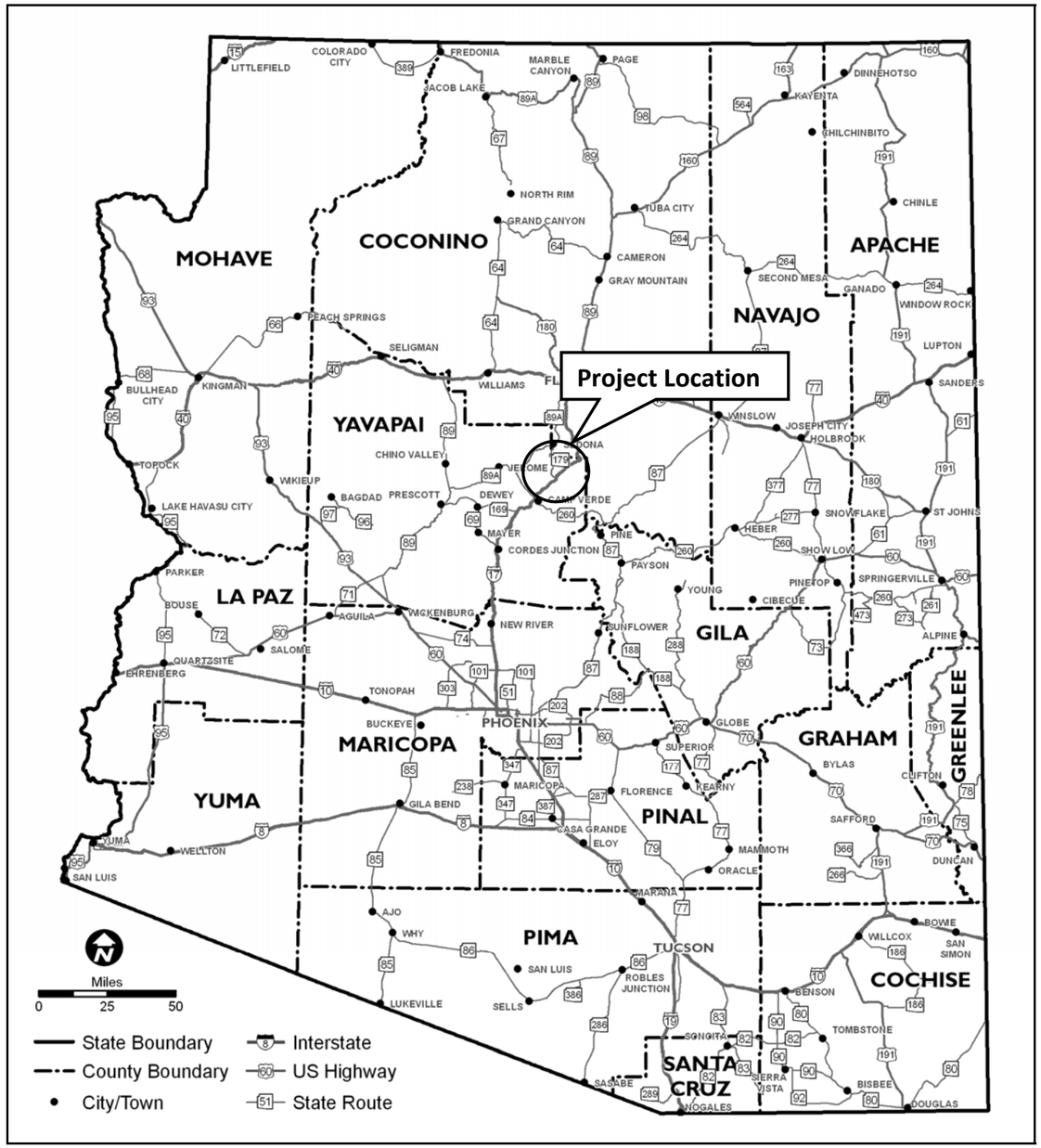
FUNDING SOURCE(S)				
Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE				
Preliminary Engineering	Design	Right-of-Way	Construction	Total
$ 60,000	$ 200,000	$0	$ 1,960,000	$ 2,220,000

PROJECT DELIVERY
Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:
Design Program Year: FY
Construction Program Year: FY

ATTACHMENTS
1) State Location Map
2) Project Vicinity Map
3) Project Scope of Work
4) Project Schedule
5) Itemized Cost Estimate
6) 15% Design Plan Sheets (as needed)

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Extend southbound entrance ramp to create parallel-type entrance ramp from SR 179 TI • Extend northbound exit ramp to create parallel-type exit ramp to SR 179 TI

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: March 1, 2017	**ADOT Project Manager:**
Project Name: Hog Tank Canyon Northbound Climbing Lane	
City/Town Name: North of SR179 TI	**County: Yavapai**
Primary Route/Street: I-17 (northbound)	
Beginning Limit: MP 299	
End Limit: MP 305	
Project Length: 6 miles	

Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)*

☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:

Adjacent Land Ownership(s): *(Check all that apply)*

☐ City/Town; ☐ County; ☐ ADOT; ☐ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land

http://gis.azland.gov/webapps/parcel/

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION

(If applicable)

LPA/Tribal Name:	
LPA/Tribal Contact:	
Email Address:	**Phone Number:**

Administration: ☐ ADOT Administered ☐ Self-Administered ☐ Certification Acceptance

PROJECT NEED

Uphill grades create speed differentials between vehicle and driver types. Existing 2-lane segment does not supply ample passing opportunities affecting safety and mobility.

This segment of I-17 experiences crash rates and frequencies above the statewide average.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

Enhance safety and mobility by constructing a climbing lane for northbound traffic.

PROJECT TYPE

Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS

Check any risks identified that may impact the project's scope, schedule, or budget:

☒ Access / Traffic Control / Detour Issues	☐ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☐ Structures & Geotech	☐ Other:

Risk Description:

Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.

FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$ 610,000	$ 2,040,000	$0	$ 20,410,000	$ 23,060,000

PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

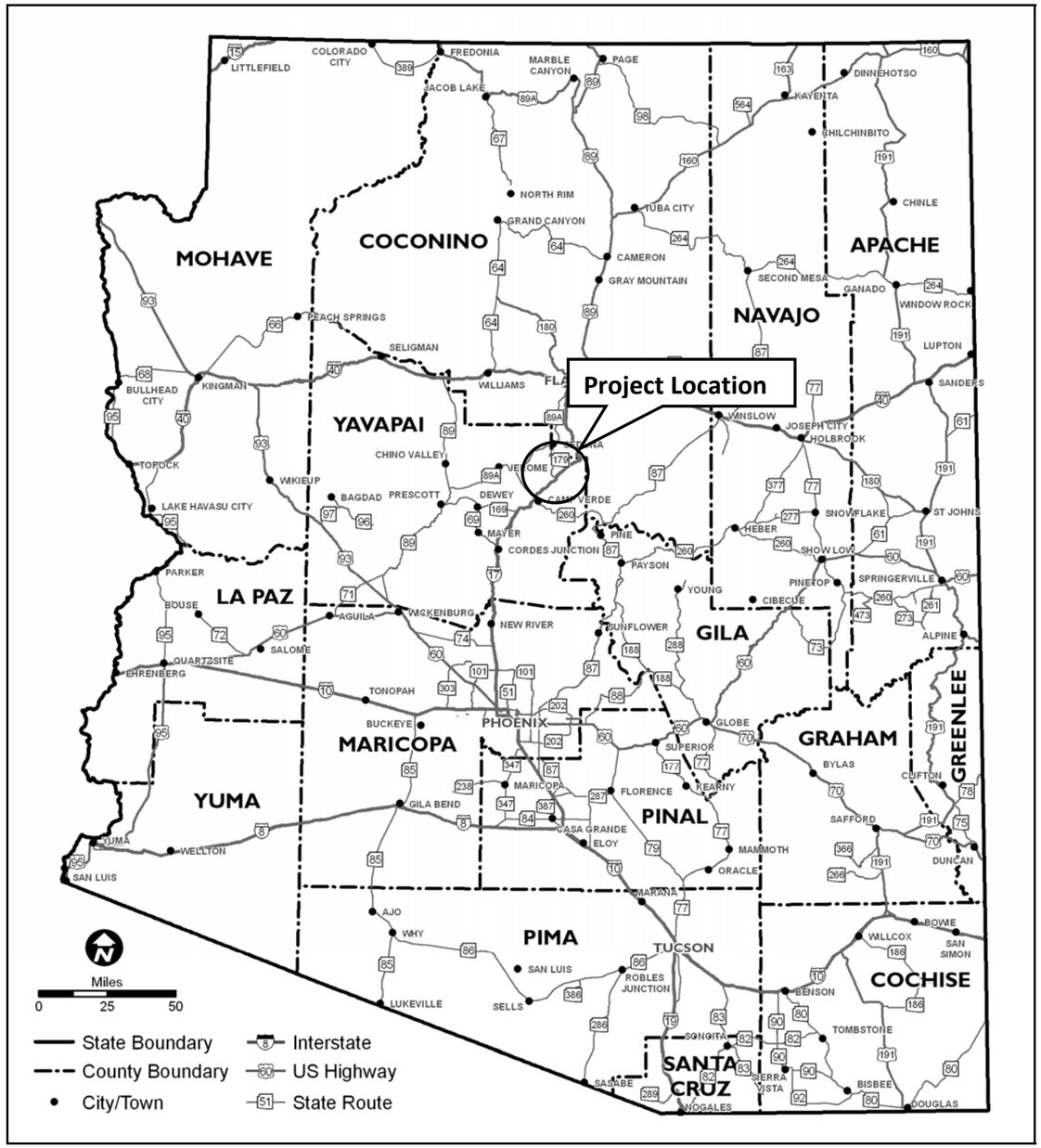
Design Program Year: FY

Construction Program Year: FY

ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**
4) **Project Schedule**
5) **Itemized Cost Estimate**
6) **15% Design Plan Sheets (as needed)**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Widen northbound roadway to provide climbing lane • Install new DMS at MP 303.4 with CCTV

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: March 1, 2017 | **ADOT Project Manager:**

Project Name: Rattlesnake Canyon Northbound Safety Improvements

City/Town Name: North of SR179 TI | **County: Yavapai**

Primary Route/Street: I-17 (northbound)

Beginning Limit: MP 305

End Limit: MP 307

Project Length: 2 miles

Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)*

☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:

Adjacent Land Ownership(s): *(Check all that apply)*

☐ City/Town; ☐ County; ☐ ADOT; ☐ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land

http://gis.azland.gov/webapps/parcel/

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION

(If applicable)

LPA/Tribal Name:

LPA/Tribal Contact:

Email Address: | **Phone Number:**

Administration: ☐ ADOT Administered ☐ Self-Administered ☐ Certification Acceptance

PROJECT NEED

Curvature of existing northbound roadway contributes to run-off-road crashes, and uphill grade restricts ability of traffic on northbound entrance ramp to merge with mainline traffic at Stoneman Lake TI.

This segment of I-17 experiences crash rates and frequencies above the statewide average.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

Enhance safety by improving skid resistance and delineation, and providing driver feedback for northbound traffic. Enhance safety by providing additional distance for entering traffic to merge with mainline traffic by extending northbound entrance ramp to create a parallel entrance ramp.

PROJECT TYPE

Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS

Check any risks identified that may impact the project's scope, schedule, or budget:

☒ Access / Traffic Control / Detour Issues	☐ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☐ Structures & Geotech	☐ Other:

Risk Description:

Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.

FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$ 60,000	$ 199,000	$0	$ 1,990,000	$ 2,249,000

PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

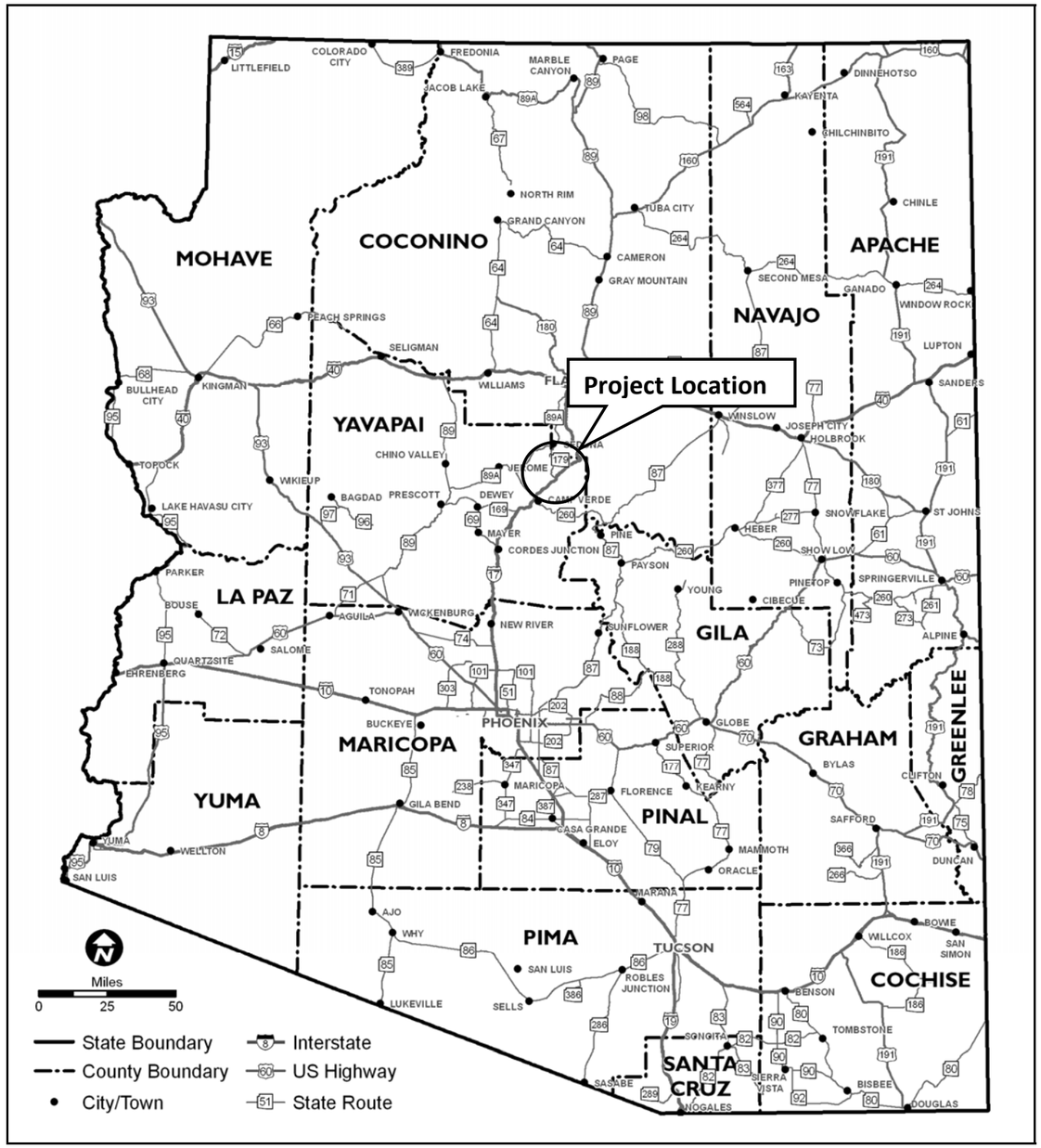
Design Program Year: FY

Construction Program Year: FY

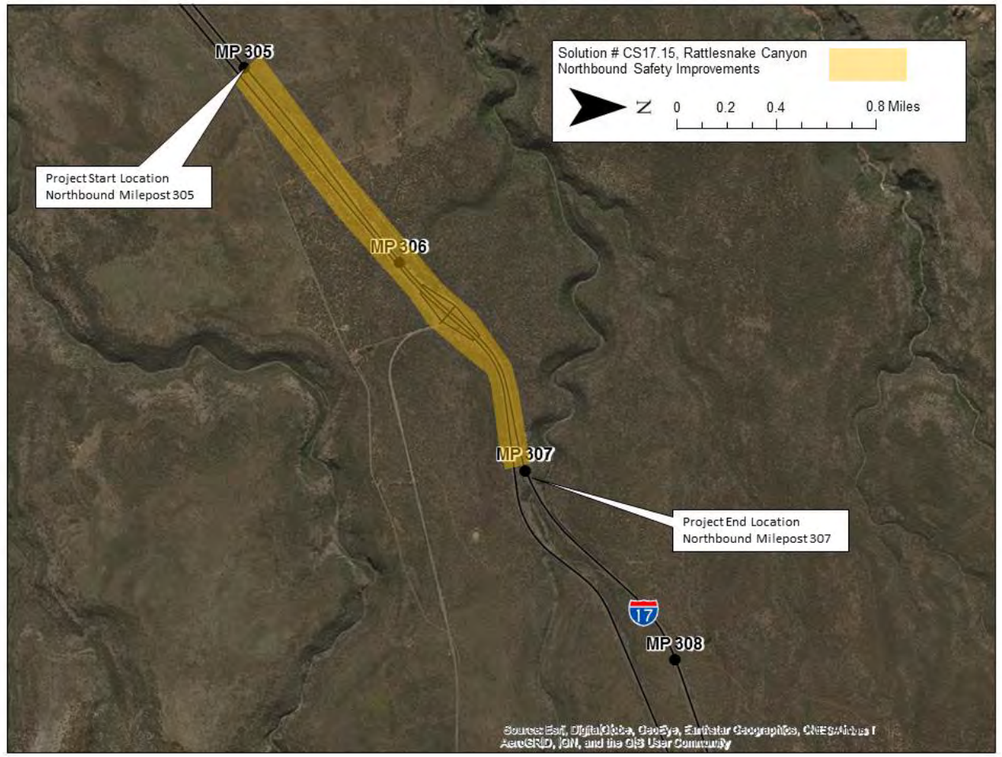
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**
4) **Project Schedule**
5) **Itemized Cost Estimate**
6) **15% Design Plan Sheets (as needed)**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Improve skid resistance on northbound curves by either reconstructing pavement (and increasing super-elevation), milling and replacing with variable depth AC to increase super-elevation, or milling and replacing pavement • Install high visibility striping and delineators, raised pavement markers, and rumble strips • Install chevrons on curves • Install dynamic speed feedback system for northbound traffic • Extend northbound entrance ramp to create parallel-type entrance ramp from Stoneman Lake TI • Install CCTV near MP 306.5

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: March 1, 2017 | **ADOT Project Manager:**

Project Name: Red Hill Scenic Overlook Southbound Safety Improvements

City/Town Name: Red Hill Scenic Overlook | **County: Yavapai and Coconino**

Primary Route/Street: I-17 (southbound)

Beginning Limit: MP 309

End Limit: MP 313

Project Length: 4 miles

Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)*

☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:

Adjacent Land Ownership(s): *(Check all that apply)*

☐ City/Town; ☐ County; ☐ ADOT; ☐ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land

http://gis.azland.gov/webapps/parcel/

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION

(If applicable)

LPA/Tribal Name:

LPA/Tribal Contact:

Email Address: | **Phone Number:**

Administration: ☐ ADOT Administered ☐ Self-Administered ☐ Certification Acceptance

PROJECT NEED

Curvature of existing southbound roadway near Red Hill Scenic Overlook contributes to run-off-road crashes.

This area of I-17 experiences crash rates and frequencies above the statewide average.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

Enhance safety by improving skid resistance and delineation, and providing driver feedback for southbound traffic.

PROJECT TYPE

Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS

Check any risks identified that may impact the project's scope, schedule, or budget:

☒ Access / Traffic Control / Detour Issues	☐ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☐ Structures & Geotech	☐ Other:

Risk Description:

Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.

FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$ 190,000	$ 640,000	$0	$ 6,400,000	$ 7,230,000

PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

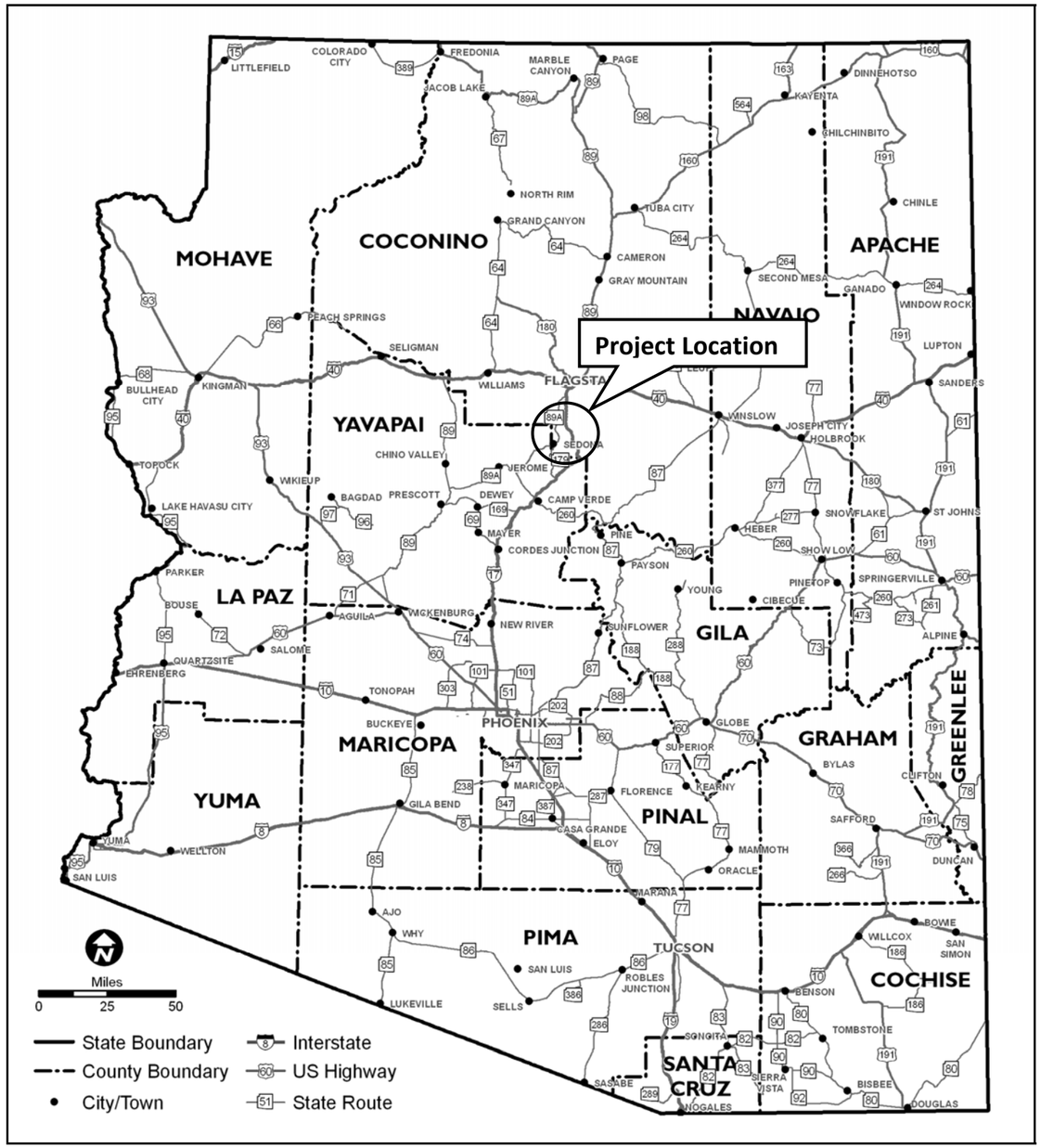
Design Program Year: FY

Construction Program Year: FY

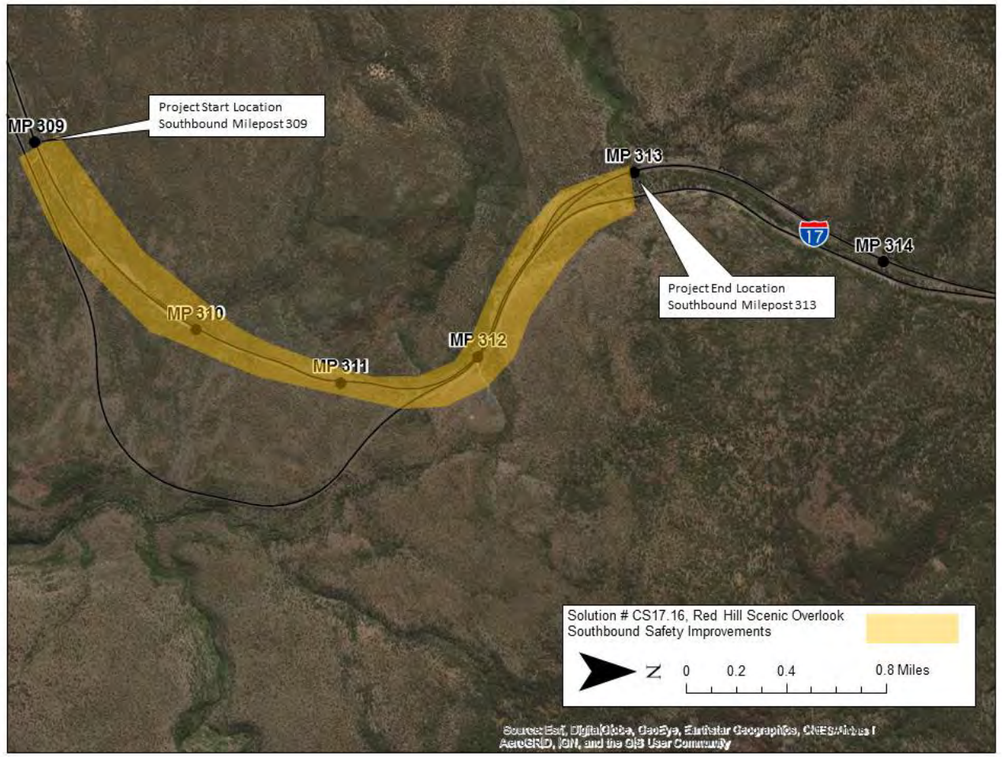
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**
4) **Project Schedule**
5) **Itemized Cost Estimate**
6) **15% Design Plan Sheets (as needed)**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Improve skid resistance on southbound curves by either reconstructing pavement (and increasing super-elevation), milling and replacing with variable depth AC to increase super-elevation, or milling and replacing pavement • Install high visibility striping and delineators, raised pavement markers, and rumble strips • Install chevrons on curves • Install dynamic speed feedback system (near MP 311 & MP 313) • Install CCTV near MP 312.3

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: March 1, 2017	**ADOT Project Manager:**
Project Name: Woods Canyon Safety Improvements	
City/Town Name: North of Rocky Park Road TI	**County: Coconino**
Primary Route/Street: I-17	
Beginning Limit: MP 316.5	
End Limit: MP 317.5	
Project Length: 1 miles	

Right-of-Way Ownership(s) (where proposed project construction would occur)**:** *(Check all that apply)*

☐ City/Town**;** ☐ County; ☒ ADOT ; ☐ Private ; ☐ Federal; ☐ Tribal; ☐ Other:

Adjacent Land Ownership(s): *(Check all that apply)*

☐ City/Town; ☐ County; ☐ ADOT; ☒ Private; ☒ Federal; ☐ Tribal; ☐ Other: State Trust Land

http://gis.azland.gov/webapps/parcel/

LOCAL PUBLIC AGENCY (LPA) or TRIBAL GOVERNMENT INFORMATION

(If applicable)

LPA/Tribal Name:	
LPA/Tribal Contact:	
Email Address:	**Phone Number:**

Administration: ☐ ADOT Administered ☐ Self-Administered ☐ Certification Acceptance

PROJECT NEED

The existing geometry does not meet design criteria. Freezing of the Woods Canyon bridge deck and shading of the roadway create icy conditions.

This segment of I-17 experiences crash rates and frequencies above the statewide average.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

Enhance safety by mitigating geometry, installing RWIS to collect weather information and installing bridge de-icing system.

PROJECT TYPE

Pavement Preservation ☐	Roadway Widening ☐	System Enhancement ☒
Bridge Scour/Rehab ☐	Bridge Replacement ☐	Sign Replacement ☐
Other ☐ :		

PRELIMINARY SCOPING REPORT

PROJECT RISKS

Check any risks identified that may impact the project's scope, schedule, or budget:

☒ Access / Traffic Control / Detour Issues	☒ Right-of-Way
☒ Constructability / Construction Window Issues	☐ Environmental
☐ Stakeholder Issues	☐ Utilities
☐ Structures & Geotech	☐ Other:

Risk Description: *(If a box is checked above, briefly explain the risk)*

Traffic control, detours, and constructability will be an issue along I-17 due to the traffic volumes and lack of alternate route.

Potential R/W from Coconino National Forest (for realignment option).

FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STP	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Other:	

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$ 960,000	$ 3,211,000	$0	$ 32,110,000	$ 36,281,000

PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

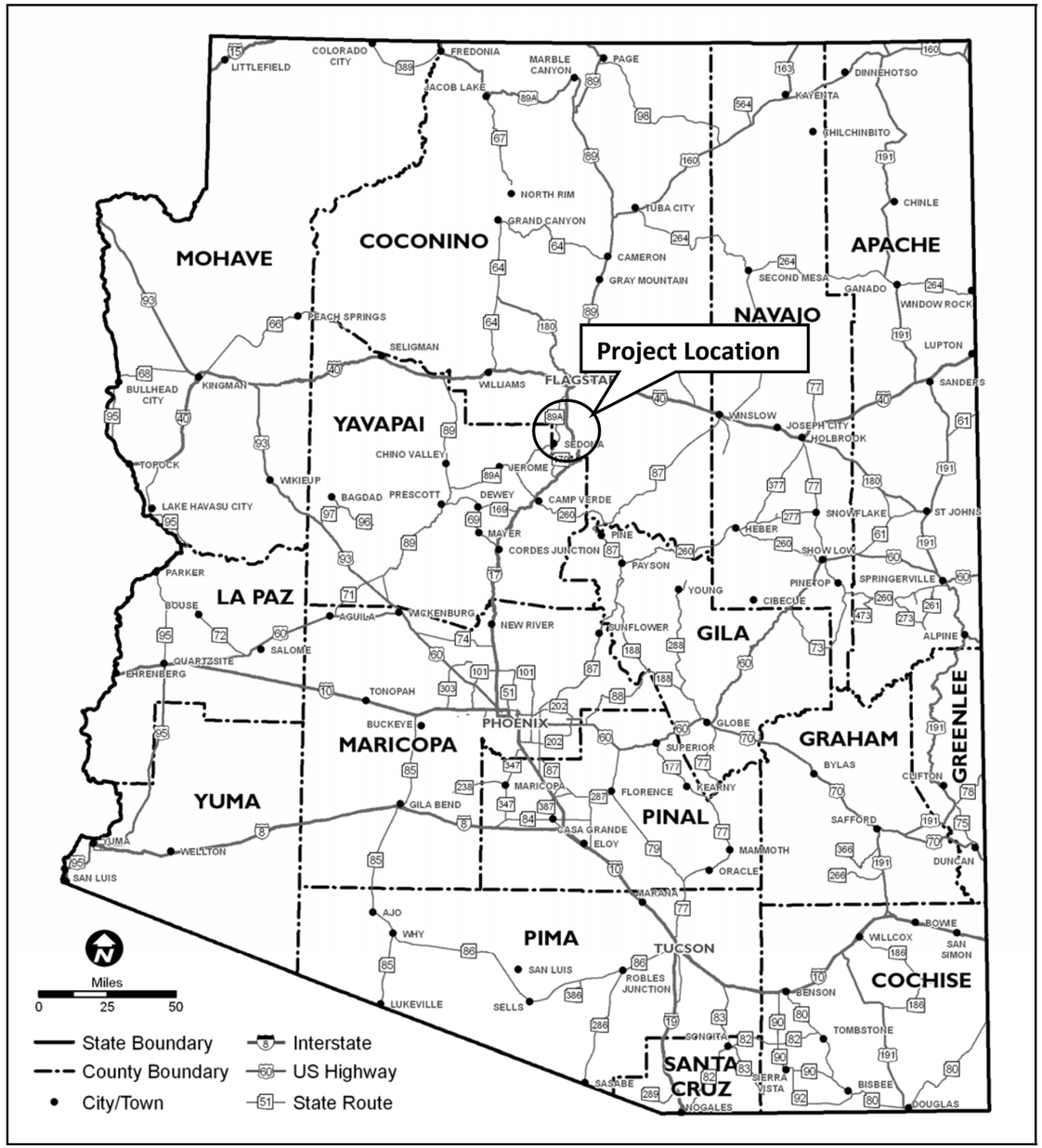
Design Program Year: FY

Construction Program Year: FY

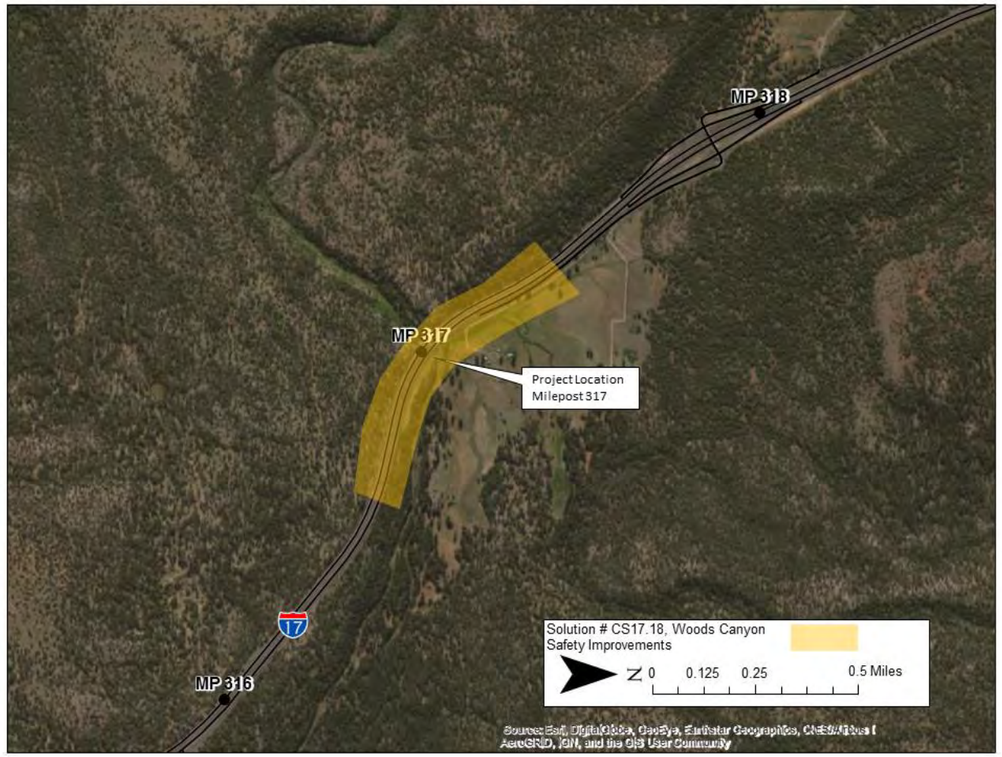
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**
4) **Project Schedule**
5) **Itemized Cost Estimate**
6) **15% Design Plan Sheets (as needed)**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
OPTION A (mitigate geometry) • Realign roadway • Install RWIS • Replace bridges including de-icing system