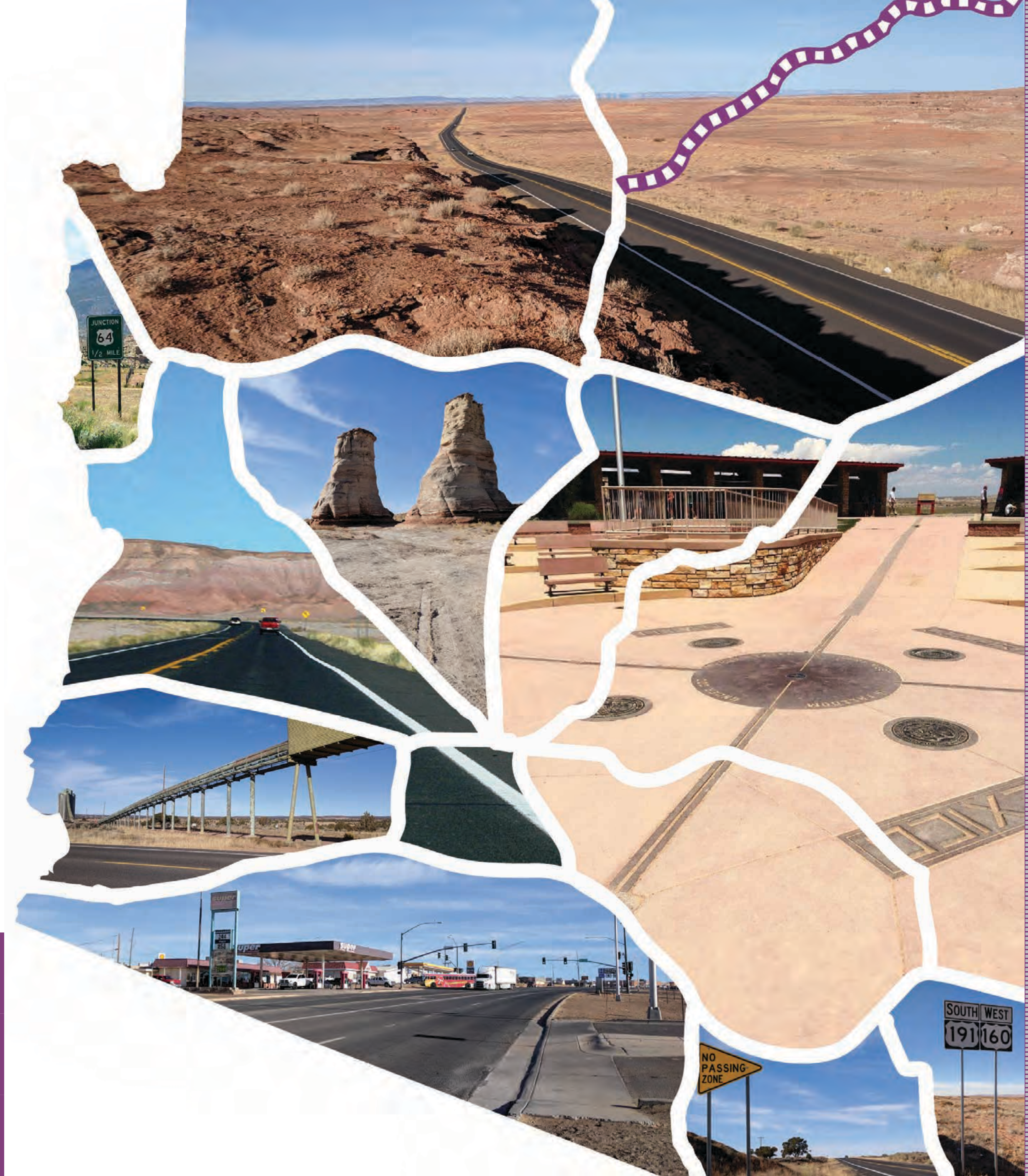
FINAL REPORT

US 160 Corridor Profile Study

US 89 Junction to New Mexico State Line

PREPARED FOR ADOT MARCH 2018



ADOT WORK TASK NO.
MPD 0042-17

ADOT CONTRACT NO.
17-000151766

Prepared by

US 160 CORRIDOR PROFILE STUDY

US 89 JUNCTION TO NEW MEXICO STATE LINE

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PREPARED FOR:

ARIZONA DEPARTMENT OF TRANSPORTATION

PREPARED BY:

AECOM

This report was funded in part through grants from the Federal Highway Administration, U.S. Department of Transportation. The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data, and for the use or adaptation of previously published material, presented herein. The contents do not necessarily reflect the official views or policies of the Arizona Department of Transportation or the Federal Highway Administration, U.S. Department of Transportation. This report does not constitute a standard, specification, or regulation. Trade or manufacturers' names that may appear herein are cited only because they are considered essential to the objectives of the report. The U.S. government and the State of Arizona do not endorse products or manufacturers.

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ACRONYMS & ABBREVIATIONS

AADT	Average Annual Daily Traffic
ABISS	Arizona Bridge Information and Storage System
ADOT	Arizona Department of Transportation
AGFD	Arizona Game and Fish Department
ASLD	Arizona State Land Department
AZTDM	Arizona Travel Demand Model
BCA	Benefit-Cost Analysis
BLM	Bureau of Land Management
BQAZ	Building a Quality Arizona
CCTV	Closed Circuit Television
CR	Cracking Rating
DCR	Design Concept Report
DMS	Dynamic Message Sign
FHWA	Federal Highway Administration
FY	Fiscal Year
HCRS	Highway Condition Reporting System
HERE	Real time traffic conditions database produced by American Digital Cartography Inc.
HPMS	Highway Performance Monitoring System
I	Interstate
IRI	International Roughness Index
ITS	Intelligent Transportation System
LCCA	Life-Cycle Cost Analysis
LOS	Level of Service
LRTP	Long Range Transportation Plan
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
NTS	Navajo Transit System
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
SOV	Single Occupancy Vehicle
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
US	United States Route
USDOT	United States Department of Transportation
V/C	Volume to Capacity Ratio
VMT	Vehicle-Miles Travelled
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 US Route 160 between the US Route 89 and New Mexico Stateline. This study examines key performance measures relative to the US 160 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 has completed 21 CPS within four separate groupings or rounds. The US 160 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:

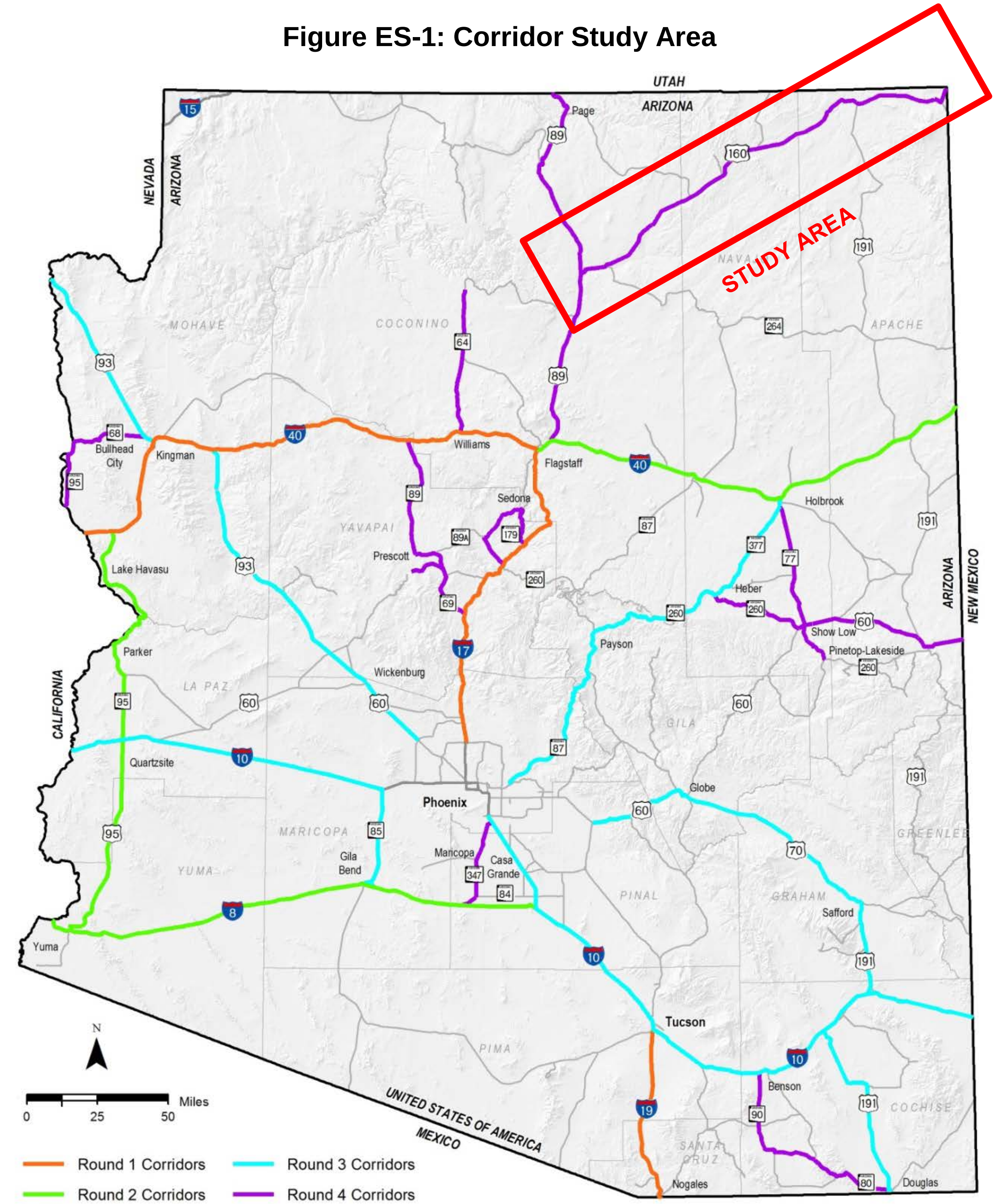
- Inventory past improvement recommendations
- Define corridor goals and objectives
- Assess existing performance based on quantifiable performance measures
- Propose various solutions to improve corridor performance
- Identify specific solutions that can provide quantifiable benefits relative to the 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 US 160 Corridor Profile Study 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.

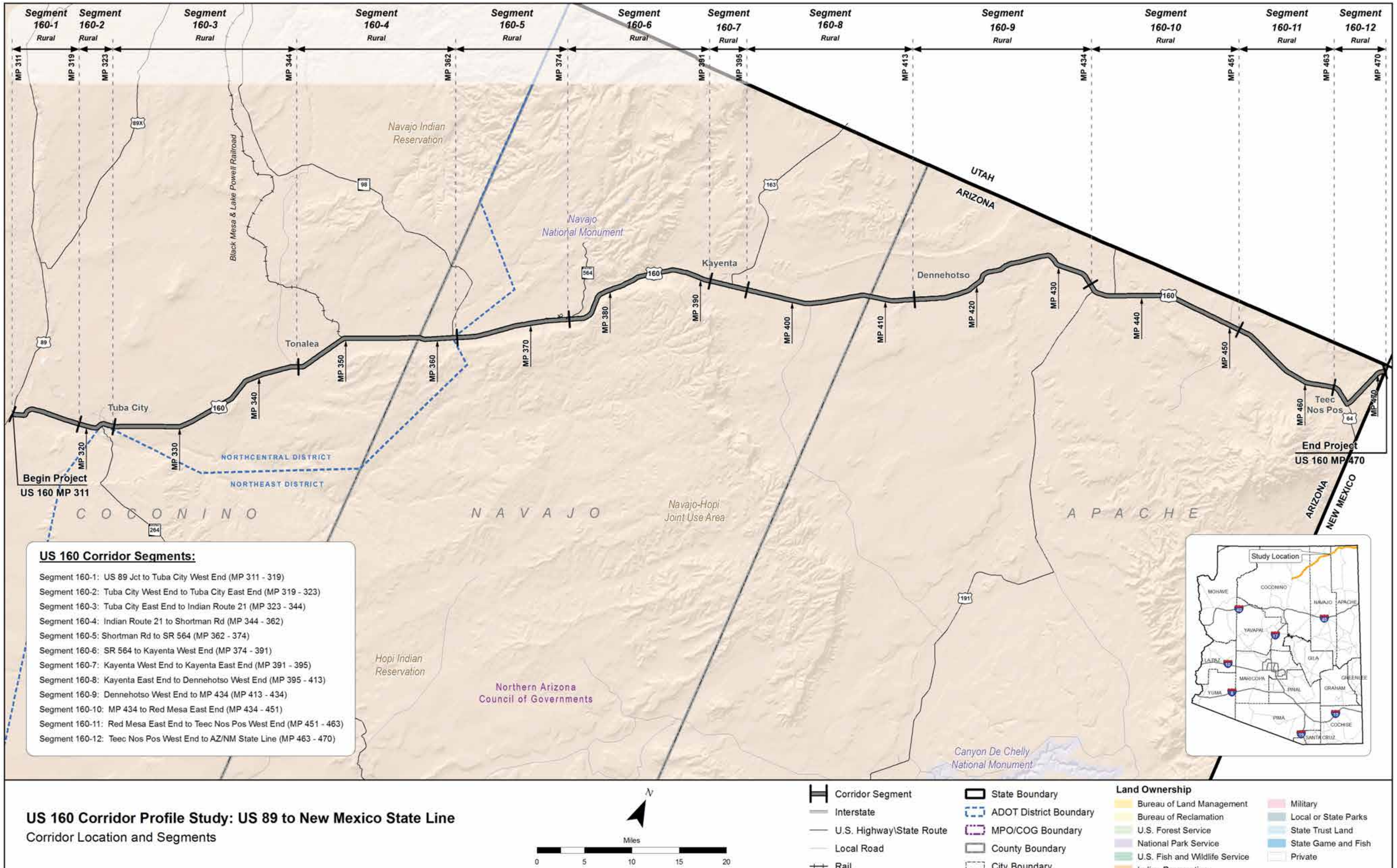
Figure ES-1: Corridor Study Area



Study Location and Corridor Segments

The US 160 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

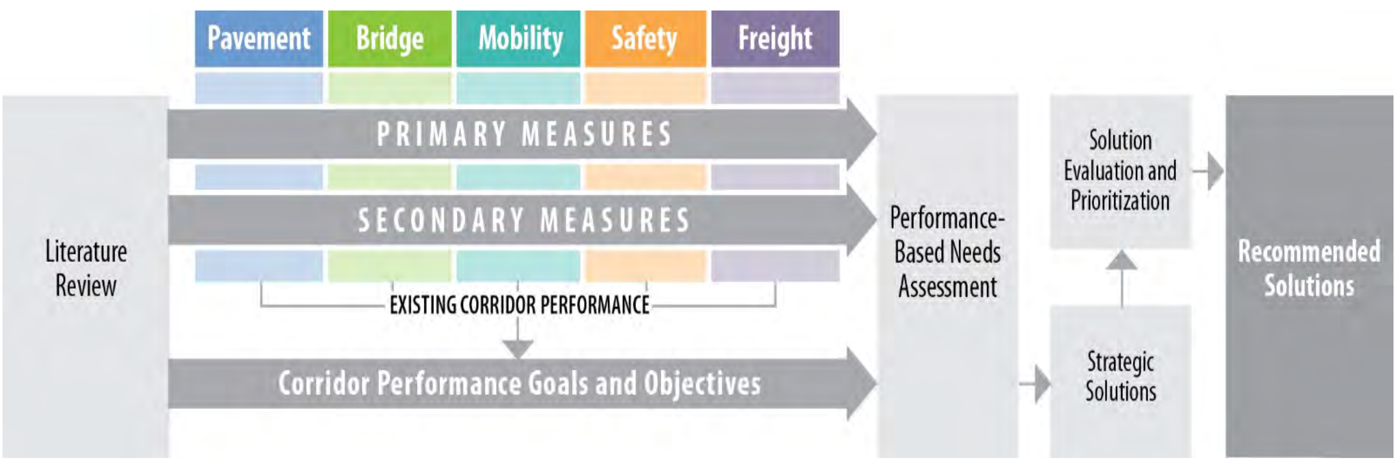
A series of performance measures were used to assess the US 160 Corridor. The results of the performance evaluation are used to define corridor needs relative to the long term goals and objectives for the corridor.

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 identified desirable/average range
Fair/Average Performance	– Rating is within identified desirable/average range
Poor/Below Average Performance	– Rating is below 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 US 160 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 76% of the corridor shows “good” performance in the Pavement Index. For the Bridge Index, 100% of the corridor shows “fair” performance. Approximately 97% of the corridor shows “good” performance in Mobility, while the remaining 3% shows “fair” performance. Almost half of the corridor (49%) for the Safety index shows “below average” performance, while 35% of the corridor shows “above average” performance. For the Freight Index, approximately 37% of the corridor shows “good” performance while 45% shows “fair” performance and 18% shows “poor” performance.

In general the lowest performance along the US 160 Corridor generally occurs in the Safety and Freight performance areas while the Pavement and Mobility have the highest performance.

- Overall Performance: The Pavement and Mobility performance areas show generally “good” or “fair” performance; the Bridge performance area shows “fair” performance throughout; the Safety performance area shows generally “below average” performance; and the Freight performance area shows a mix of “good”, “fair”, and “poor” performance
- The pavement performance is generally in “good” except at a few isolated locations. One out of twelve segments shows “poor” performance for % Area Failure.
- The bridge performance is generally “fair” overall with only three bridges (Hamblin Wash Bridge, Chinle Wash Bridge and Walker Creek Bridge) that have a single rating of 5 along the corridor. Also, three bridges (Begashibito Wash Bridge, Chinle Wash Bridge and Walker Creek Bridge) rate as functionally obsolete in segments 160-4, 160-9, and 160-10.
- The Mobility Index along the corridor has “good” performance with no recurring delays and few non-recurring delays (Planning Time Index) in segment 160-6, 160-10, and 160-11.
- The closures along the corridor are generally in line with the statewide average for both the closure frequency and duration. However, there is one outlier with “poor” closure frequency, i.e. segment 160-4 in the westbound direction, which is mainly due to weather related closures higher than the statewide average.
- Overall, based on the weighted average of the Safety Index, the corridor performs “below average”.
- The Freight Index weighted average indicates “fair” performance for the US 160 Corridor, however, segments 160-10 and 160-11 show “poor” performance level for Directional TPTI, as well as for Freight Index meaning the segments have “poor” travel time reliability due to non-recurring congestion.
- Lowest Performing Segment: Segment 160-10 shows “poor/below average” performance for many performance measures
- Highest Performing Segment: Segment 160-1 shows “good/above average” performance for many performance measures

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

Segment #	Length (miles)	Pavement Performance Area			Bridge Performance Area				Mobility Performance Area											
		Pavement Index	Directional PSR (EB / WB)	% Area Failure	Bridge Index	Sufficiency Rating	% Deck Area Functionally Obsolete	Lowest Bridge Rating	Mobility Index	Future Daily V/C	Existing Peak Hour V/C EB	Existing Peak Hour V/C WB	Closure Extent (instances/milepost/ year/mile) EB	Closure Extent (instances/milepost/ year/mile) WB	Directional TTI (all vehicles) EB	Directional TTI (all vehicles) WB	Directional PTI (all vehicles) EB	Directional PTI (all vehicles) WB	% Bicycle Accommo dation	% Non-Single Occupancy Vehicle (SOV) Trips
160-1*[e2]	8	4.04	3.76	0.0%	5.00	71.80	0.0%	5	0.32	0.39	0.24	0.25	0.08	0.00	1.07	1.02	1.48	1.88	0%	14.2%
160-2*[e2]	4	3.87	3.59	0.0%	No Bridges in Segment				0.72	0.87	0.51	0.67	0.10	0.00	1.12	1.17	3.75	3.25	84%	14.2%
160-3^[e2]	21	3.66	3.51	0.0%	No Bridges in Segment				0.18	0.21	0.15	0.15	0.24	0.05	1.01	1.01	1.30	1.35	19%	12.7%
160-4^[e2]	18	4.16	4.04	0.0%	6.00	64.30	100.0%	6	0.12	0.15	0.08	0.09	0.34	0.70	1.00	1.00	1.31	1.25	9%	14.7%
160-5^[e2]	12	4.39	4.17	0.0%	No Bridges in Segment				0.17	0.20	0.12	0.13	0.00	0.05	1.01	1.00	1.33	1.23	0%	17.5%
160-6^[e2]	17	3.60	3.40	11.8%	No Bridges in Segment				0.27	0.33	0.21	0.20	0.12	0.34	1.02	1.06	1.51	2.11	0%	15.9%
160-7*[e2]	4	4.13	4.04	0.0%	No Bridges in Segment				0.41	0.53	0.26	0.27	0.10	0.15	1.12	1.16	3.26	3.07	6%	6.9%
160-8^[e2]	18	4.03	3.88	0.0%	6.00	83.70	0.0%	6	0.12	0.14	0.08	0.08	0.03	0.01	1.00	1.00	1.15	1.20	0%	7.2%
160-9^[e2]	21	3.29	3.18	28.6%	6.42	76.40	52.5%	5	0.11	0.13	0.10	0.10	0.04	0.04	1.01	1.02	1.37	1.37	1%	12.1%
160-10^[e2]	17	3.45	3.76	11.8%	5.00	62.70	100.0%	5	0.19	0.22	0.12	0.12	0.14	0.01	1.05	1.04	1.89	1.85	1%	16.7%
160-11^[e2]	12	4.00	3.78	0.0%	No Bridges in Segment				0.18	0.21	0.11	0.11	0.00	0.07	1.02	1.01	2.27	1.83	0%	0.0%
160-12*[e2]	7	4.13	4.03	0.0%	No Bridges in Segment				0.17	0.20	0.12	0.12	0.09	0.06	1.08	1.12	2.95	3.40	4%	0.0%
Weighted Corridor Average		3.82	3.70	6.29%	5.81	72.55	34.33%	5.33	0.19	0.23	0.14	0.15	0.12	0.14	1.03	1.03	1.65	1.69	6.2%	11.8%

SCALES												
Performance Level	Non-Interstate		All				Urban (Rural)	All	Uninterrupted (Interrupted)		All	
Good/Above Average	> 3.50	< 5%	> 6.5	> 80	< 12%	> 6	< 0.71 (< 0.56)	< 0.22	< 1.15 (1.30)	<1.30 (3.00)	> 90%	> 17%
Fair/Average	2.90 - 3.50	5% - 20%	5.0 - 6.5	50 - 80	12% - 40%	5 – 6	0.71 - 0.89 (0.56 - 0.76)	0.22 – 0.62	1.15-1.33 (1.3-2)	1.30-1.50 (3-6)	60% - 90%	11% - 17%
Poor/Below Average	< 2.90	> 20%	< 5.0	< 50	> 40 %	< 5	> 0.89(> 0.76)	> 0.62	> 1.33 (2.00)	>1.50 (6.00)	< 60%	< 11%

^Uninterrupted Flow Facility
*Interrupted Flow Facility
[a]4 Lane Freeway with Daily Volume < 25,000
[b]4 Lane Freeway with Daily Volume > 25,000
[c]2 or 3 or 4 Lane Divided Highway
[d]4 or 4 Lane Undivided Highway
[e]2 or 3 Lane Undivided Highway
[1]Urban Operating Environment
[2]Rural Operating Environment

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

Segment #	Length (miles)	Safety Performance Area							Freight Performance Area							
		Safety Index	Directional Safety Index		% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	% of Fatal + Incapacitating Injury Crashes Involving Trucks	% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers	Freight Index	Directional TTI (trucks only)		Directional PTI (trucks only)		Closure Duration (minutes/milepost closed/year/mile)		Bridge Vertical Clearance (feet)
			EB	WB						EB	WB	EB	WB	EB	WB	
160-1*[e2]	8	0.70	1.40	0.00	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.47	1.20	1.15	1.84	2.39	10.33	0.00	No UP
160-2*[e2]	4	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.34	1.17	1.24	2.43	3.49	12.05	0.00	No UP
160-3^[e2]	21	3.59	3.61	3.57	47%	Insufficient Data	Insufficient Data	Insufficient Data	0.68	1.07	1.11	1.48	1.47	56.37	9.00	No UP
160-4^[e2]	18	1.99	3.83	0.15	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.76	1.07	1.08	1.24	1.40	74.91	93.23	No UP
160-5^[e2]	12	0.04	0.00	0.07	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.77	1.09	1.06	1.36	1.25	0.00	15.85	No UP
160-6^[e2]	17	0.39	0.69	0.10	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.69	1.10	1.13	1.41	1.48	22.76	59.93	No UP
160-7*[e2]	4	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.22	1.34	1.34	3.98	5.28	18.85	14.75	No UP
160-8^[e2]	18	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.82	1.05	1.08	1.18	1.26	9.33	5.26	No UP
160-9^[e2]	21	1.43	0.72	2.14	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.81	1.06	1.06	1.21	1.25	10.24	8.38	No UP
160-10^[e2]	17	2.28	1.90	2.66	44%	Insufficient Data	Insufficient Data	Insufficient Data	0.49	1.13	1.10	2.25	1.86	35.48	4.65	No UP
160-11^[e2]	12	0.65	1.30	0.00	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.48	1.15	1.11	1.74	2.39	0.00	9.30	No UP
160-12*[e2]	7	0.37	0.37	0.37	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.44	1.19	1.17	2.17	2.33	19.89	26.43	No UP
Weighted Corridor Averages		1.53	1.75	1.30	46%	Insufficient Data	Insufficient Data	Insufficient Data	0.65	1.10	1.11	1.60	1.74	26.73	23.78	No UP
SCALES																
Performance Level		2 or 3 Lane Undivided							Uninterrupted (Interrupted)							
Good/Above Average		< 0.94			< 51%	< 5.2%	< 18.5%	< 2.2%	> 0.77 (0.33)	<1.15 (1.30)		<1.30 (3.00)		< 44.18		> 16.5
Fair/Average		0.94 – 1.06			51% - 58%	5.2% - 7.1%	18.5% - 26.5%	2.2% - 4.2%	0.67-0.77 (.17-.33)	1.15-1.33 (1.3-2)		1.30-1.50 (3-6)		44.18 -124.86		16.0-16.5
Poor/Below Average		> 1.06			> 58%	> 7.1%	> 26.5%	> 4.2%	< 0.67 (.17)	>1.33 (2.00)		>1.50 (6.00)		> 124.86		< 16.0

^Uninterrupted Flow Facility
*Interrupted Flow Facility
[a]4 Lane Freeway with Daily Volume < 25,000
[b]4 Lane Freeway with Daily Volume > 25,000
[c]2 or 3 or 4 Lane Divided Highway
[d]4 or 4 Lane Undivided Highway
[e]2 or 3 Lane Undivided Highway
[1]Urban Operating Environment
[2]Rural Operating Environment

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

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

NEEDS ASSESSMENT

Corridor Description

The US 160 Corridor provides an important connection from Northwest New Mexico and Southwest Colorado to economic and recreational activities in Northcentral Arizona and other destinations to the north and south of US 160. Beginning at the intersection of US 89, west of Tuba City, the corridor extends to New Mexico state line, near Four Corners, providing a key economic and recreational link in the region and state. US 160 Corridor is generally a two-lane undivided rural arterial highway, except in Tuba City and Kayenta where it becomes four-lanes to accommodate local traffic and provide various business and residential accesses.

Corridor Objectives

Statewide goals and performance measures were established by the goals and objectives contained in the ADOT Long-Range Transportation Plan (LRTP), 2010-2035 which were updated in 2017. Statewide performance goals that are relevant to US 160 performance areas were identified and corridor goals were then formulated for each of the five performance areas that aligned with the overall statewide goals established by the LRTP. Based on stakeholder input, corridor goals, corridor objectives, and performance results, three "Emphasis Areas" were identified for the US 160 Corridor, Pavement, Safety and Mobility.

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.**

Figure ES-4: Needs Assessment Process

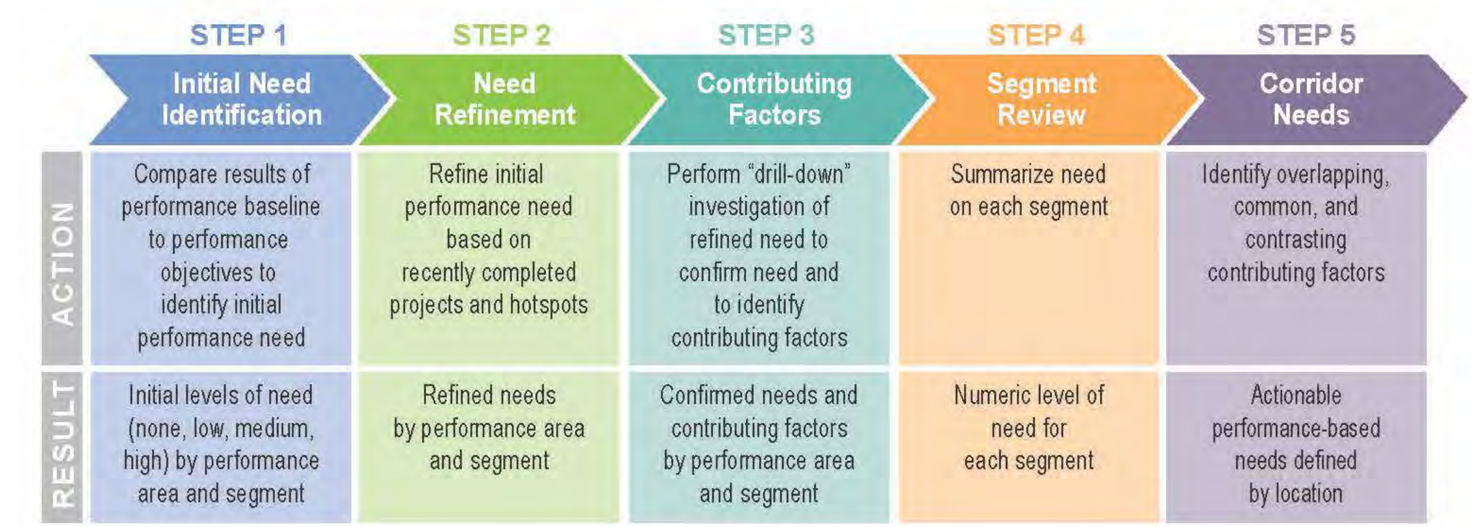


Figure ES-5: Initial Need Ratings in Relation to Baseline Performance (Bridge Example)

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

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

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

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 average need scores of the performance areas identified as emphasis areas (Pavement, Safety and Mobility for the US 160 Corridor). There are eight segments with a Low overall average need, three segments with a Medium overall average need, and one segment with a High overall average need. More information on the identified final needs in each performance area is provided below.

Pavement Needs

- Pavement hot spots were identified on 2 miles of segment 160-6, 6 miles of segment 160-9, and 2 miles of segment 160-10.
- There were no recently completed paving projects that addressed the needs of the three identified segments.
- Segment 160-9 appears to have a higher level of need in percentage of pavement failure, which may warrant consideration of alternative treatments on the concentrated area.

Bridge Needs

- Bridge needs occur due to under-performing bridges on four of the five segments with bridges.
- Bridge needs were identified at 4 (Hamblin Wash Bridge, Begashibito Wash Bridge, Chinle Wash Bridge and Walker Creek Bridge) of the total 6 bridges.
- There are no bridge Hot Spots within the US 160 Corridor.
- Two bridges have current deck ratings of 5 and three bridges indicate as Functionally Obsolete.
- Segments 160-4 and 9 were identified with Low needs, segment 160-1 with Medium needs, and 160-10 with High needs.

Mobility Needs

- Highest mobility need is identified on segment 160-2 primarily due to the Mobility Index score and Future Daily V/C (congestion).
- Low Mobility needs were identified on eleven of the twelve segments, mainly due to lesser percentage of Bicycle Accommodation and directional PTI issues.
- A higher than average number of closures, primarily due to accidents and or incidents, occurs on segments 160-1 and 160-7 to 160-12.
- The PTI in segments 160-6, 160-10 and 160-11 exhibits high levels of need due to lack of passing lanes.

Safety Needs

- Safety Needs were identified on six of the twelve segments, 97 miles (61%) of the corridor.
- The highest level of needs have been identified in segments 160-3, 160-4, 160-9, and 160-10.
- More than half of the crashes involve single vehicle, which may indicate events due to excessive speed, poor nighttime lighting or inadequate roadway geometry.
- Elevated numbers of pedestrian crashes in segment 160-3 due to lack of crossing opportunities outside Tuba City limits.
- There are no safety hot spots along the corridor.
- Segments 160-2, 160-7 and 160-8 had too small of a sample to present accurate data.

Freight Needs

- The highest level of need was identified on segments 160-10 and 160-11 due to elevated values for Freight Index and directional TPTI. Issues with TPTI and reliability are likely related to lack of passing lanes and location of Mexican Water gas station within the segment.
- Freight needs are Medium for segments 160-3, 160-6, and 160-7, and Low for segment 160-4.
- 100% of closures were related to incidents/accidents along the corridor.
- There are no underpasses along the corridor.

Segment Level Needs Summary

- Segment 160-1 has overlapping needs in Bridge, Mobility and Safety. Bridge needs are impacted by the evaluation rating of the Hamblin Wash Bridge at MP 312.20. Mobility needs are impacted by high level of need in Bicycle Accommodation due to shoulder widths. Safety needs are impacted by the EB Directional Safety Index.
- Segment 160-3 has overlapping needs in Mobility, Safety and Freight. Mobility needs are impacted by high level of need in Bicycle Accommodation due to shoulder widths. Safety needs are impacted by the Safety Index and the Directional Safety Index.
- Segment 160-4 has overlapping needs in Bridge, Mobility, Safety and Freight. Bridge needs are impacted by the Functionally Obsolete Deck Area of the Begashibito Wash Bridge at MP 349.90. Mobility needs are impacted by low level of closure frequency in the WB direction and high level of need in Bicycle Accommodation due to shoulder widths. Safety needs are impacted by the Safety Index and the EB Directional Safety Index. Freight needs are impacted by Freight Index, elevated PTI in the WB direction, and elevated Closure Duration. Roadway closures are mainly due to weather related conditions.
- Segment 160-6 has overlapping needs in Pavement, Mobility and Freight. Pavement needs are impacted by Directional PSR and Failure Hot Spots at MP 379-381. Mobility needs are impacted by elevated PTI and high level of need in Bicycle Accommodation due to shoulder

widths. Freight needs are impacted by Freight Index, elevated PTI, and elevated Closure Duration in WB direction. Roadway closures are mainly due to weather related conditions or Obstructions/Hazards.

- Segment 160-7 has overlapping needs in Mobility and Freight. Mobility needs are impacted by high level of need in Bicycle Accommodation due to shoulder widths. Freight needs are impacted by Freight Index and elevated PTI. Also, the segment is classified as “Poor” reliability due to highest buffer index.
- Segment 160-9 has overlapping needs in Pavement, Bridge, Mobility and Safety. Pavement needs are impacted by Directional PSR and Failure Hot Spots at MP 424-429, and MP 433-434. Bridge needs are impacted by the deck rating of the Chinle Wash Bridge at MP 429. Mobility needs are impacted by elevated PTI and high level of need in Bicycle Accommodation due to shoulder widths. Safety needs are impacted by the Safety Index and the WB Directional Safety Index.
- Segment 160-10 has overlapping needs in all five performance areas. Pavement needs are impacted by failure hot spots at MP 438-440. Bridge needs are impacted by the deck rating and Functionally Obsolete Deck Area of the Walker Creek Bridge at MP 435.33. Mobility needs are impacted by elevated PTI and high level of need in Bicycle Accommodation due to shoulder widths. Safety needs are impacted by the Safety Index and the Directional Safety Index. Freight needs are impacted by Freight Index and elevated PTI.
- Segment 160-11 has overlapping needs in Mobility, Safety and Freight. Mobility needs are impacted by elevated PTI and high level of need in Bicycle Accommodation due to shoulder widths. Safety needs are impacted by the EB Directional Safety Index. Freight needs are impacted by Freight Index and elevated PTI.
- Segment 160-2 shows Mobility needs only, primarily due to the Mobility Index score and Future Daily V/C (congestion).
- Segment 160-5, 8 and 12 shows Mobility needs only, primarily due to lesser percentage of Bicycle Accommodation and directional PTI issues.

Overlapping Needs

This section identifies overlapping performance needs on the US 160 Corridor, which provides guidance to develop strategic solutions that address more than one performance are 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:

- Segment 160-10 contains needs in all five performance areas
- Segments 160-3 and 160-9 have more than one elevated need
- Average needs of segments 160-3 and 160-4 exhibit Medium level, and exhibit High level for segment 160-10.

Table ES-3: Summary of Needs by Segment

Performance Area	Segment Number and Mileposts (MP)											
	160-1	160-2	160-3	160-4	160-5	160-6	160-7	160-8	160-9	160-10	160-11	160-12
	MP 311-319	MP 319-323	MP 323-344	MP 344-362	MP 362-374	MP 374-391	MP 391-395	MP 395-413	MP 413-434	MP 434-451	MP 451-463	MP 463-470
Pavement+	None*	None*	None*	None*	None*	Low	None*	None*	Medium	Low	None*	None*
Bridge	Medium	None*	None*	Low	None*	None*	None*	None*	Low	High	None*	None*
Mobility+	Low	High	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Safety+	Low	N/A#	High	High	None*	None*	N/A#	N/A#	High	High	Low	None*
Freight	None*	None*	Medium	Low	None*	Medium	Medium	None*	None*	High	High	None*
Average Need (0-3)	**0.77**	**0.90**	**1.23**	**1.23**	**0.23**	**0.77**	**0.70**	**0.30**	**1.54**	**2.08**	**0.92**	**0.23**

+ Identified as an emphasis area for the US 160 Corridor.

 # N/A indicates insufficient or no data available to determine level of need.

**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.*

Level of Need	Average Need Range
None*	< 0.1
Low	0.1 - 1.0
Medium	1.0 - 2.0
High	> 2.0

STRATEGIC SOLUTIONS

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

The US 160 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 US 160 Corridor will be considered along with other candidate projects in the ADOT statewide programming process.

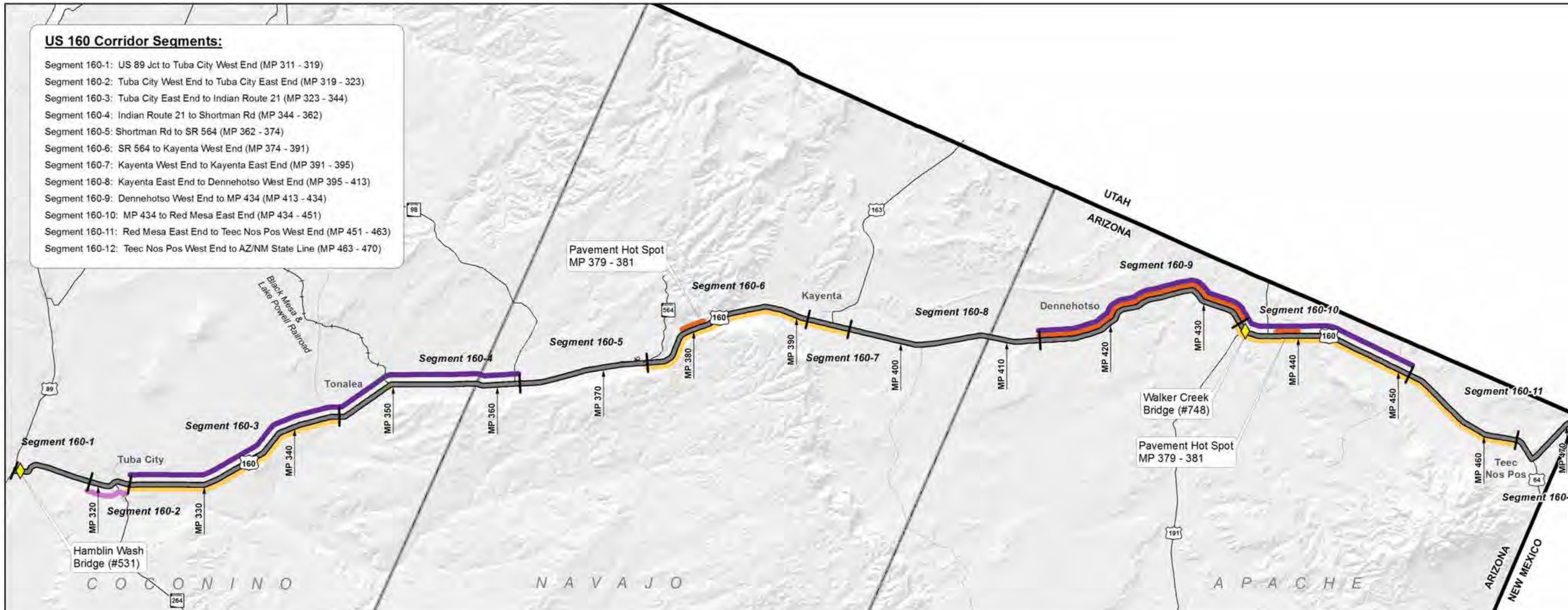
Candidate solutions include some or all of the following characteristics:

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

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

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

Figure ES-6: Strategic Investment Areas



Performance Area	160-1	160-2	160-3	160-4	160-5	160-6	160-7	160-8	160-9	160-10	160-11	160-12
	MP 311-319	MP 319-323	MP 323-344	MP 344-362	MP 362-374	MP 374-391	MP 391-395	MP 395-413	MP 413-434	MP 434-451	MP 451-463	MP 463-470
Pavement+	-	-	-	-	-	Hot Spot	-	-	Medium	Hot Spot	-	-
Bridge	Medium	-	-	-	-	-	-	-	-	High	-	-
Mobility+	-	High	-	-	-	-	-	-	-	-	-	-
Safety+	-	-	High	High	-	-	-	-	High	High	-	-
Freight	-	-	Medium	-	-	Medium	Medium	-	-	High	High	-

+ Identified as emphasis area for US 160 Corridor

Notes: Figure shows strategic investment areas, which are segments with Medium and High levels of need and locations of hot spots.

A "-" symbol indicates a segment level of need of Low, None or N/A, which is not considered strategic.

US 160 Corridor Profile Study: US 89 to New Mexico State Line

Strategic Investment Areas

N

Miles 0 5 10 15 20

Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary

PERFORMANCE AREA NEEDS
SAFETY
PAVEMENT
FREIGHT
MOBILITY
BRIDGE

Level of Need	Average Need Range
None*	< 0.1
Low	0.1 - 1.0
Medium	1.0 - 2.0
High	> 2.0

SOLUTION EVALUATION AND PRIORITIZATION

Candidate Solutions were evaluated in multiple steps including a 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 multiple options, rehabilitate the area of need, or fully reconstruct the issue area or structure. These options are evaluated through a LCCA to determine the best approach for each location where a pavement or bridge solution is recommended. The LCCA could eliminate options from further consideration and will 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 the LCCA process are complete, 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 Evaluation to help differentiate between similar solutions based on factors that are not directly addressed in the performance system.

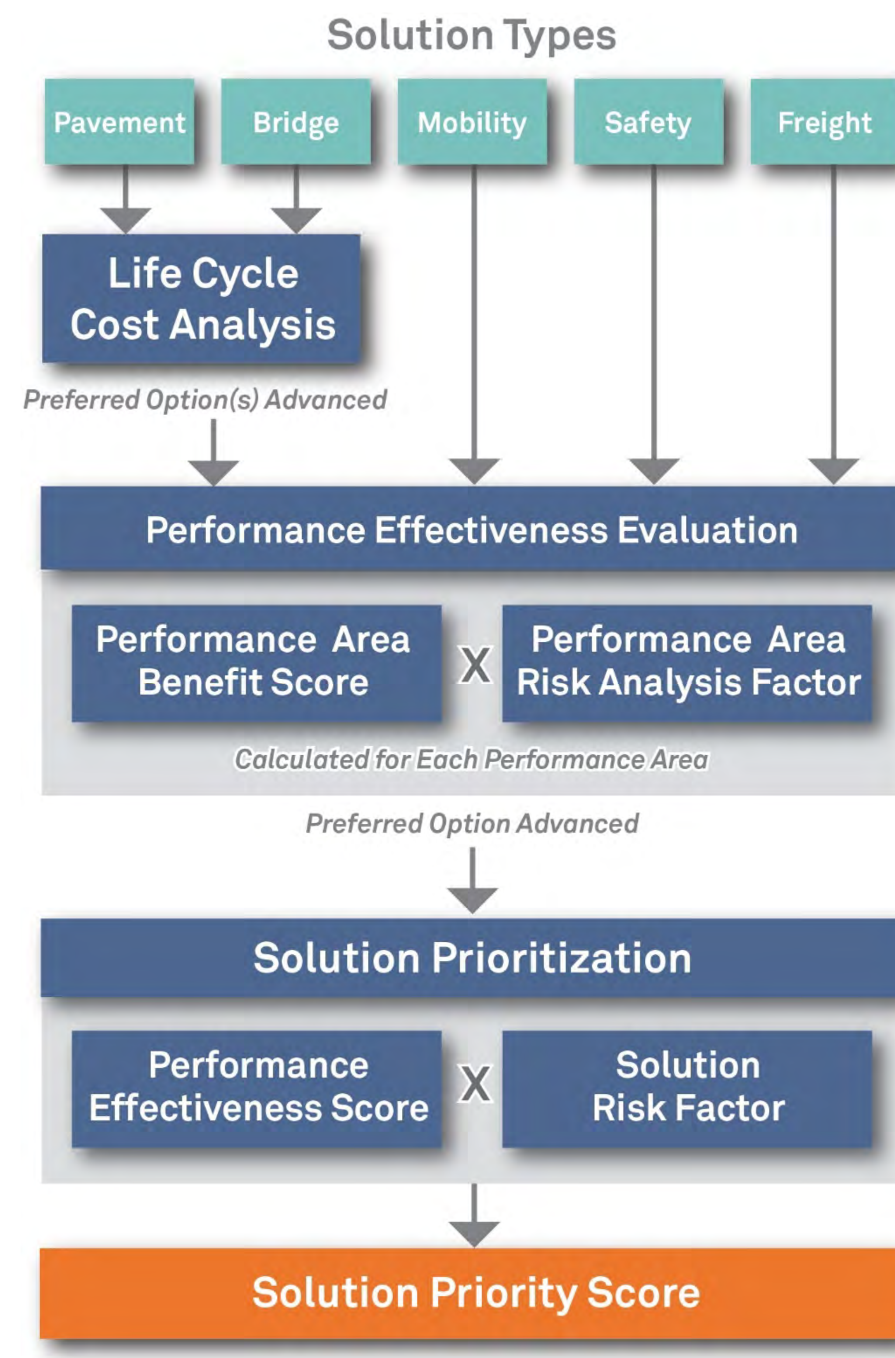
Solution Risk Analysis

All candidate solutions advanced through the Performance Effectiveness Evaluation are also evaluated through a Risk Analysis process. The risk analysis is conducted to develop a 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 and risk factor 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 US 160 Corridor. Implementation of these solutions is anticipated to improve performance of the US 160 Corridor, primarily in the Mobility, Safety, and Freight performance areas. The highest priority solution address needs in the Mexican Water area (MP 432-438).

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 US 160 Corridor:

- When recommending future projects along the US 160 Corridor, review historical ratings and levels of investment. According to data used for this study, the following pavement location has exhibited high historical investment issues:
  - Pavement MP 362-374
- As the area continues to grow, continue to provide support for a standard Diamond Interchange with a structure over US 89 at the US 89/US 160 intersection as recommended in Final Design Concept Report - US 89 Antelope Hills to Jct. US 160 MP 442 to MP 484.

Policy and Initiative Recommendations

In addition to location-specific needs, general corridor and system-wide needs have also been identified through the CPS process. While these needs are more overarching and cannot be individually evaluated through the CPS process, it is important to document them. A list of recommended policies and initiatives was developed for consideration when programming future projects not only on US 160, 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 four CPS rounds:

- 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
- At traffic interchanges with existing communication connectivity to the ADOT TOC, consideration should be given to adding thermal detection cameras for vehicle detection with the capability for wrong way vehicle detection.
- Improved vehicle detection systems, as recommended by ADOT Systems Technology group, should be deployed at traffic interchanges for improved traffic control.

Next Steps

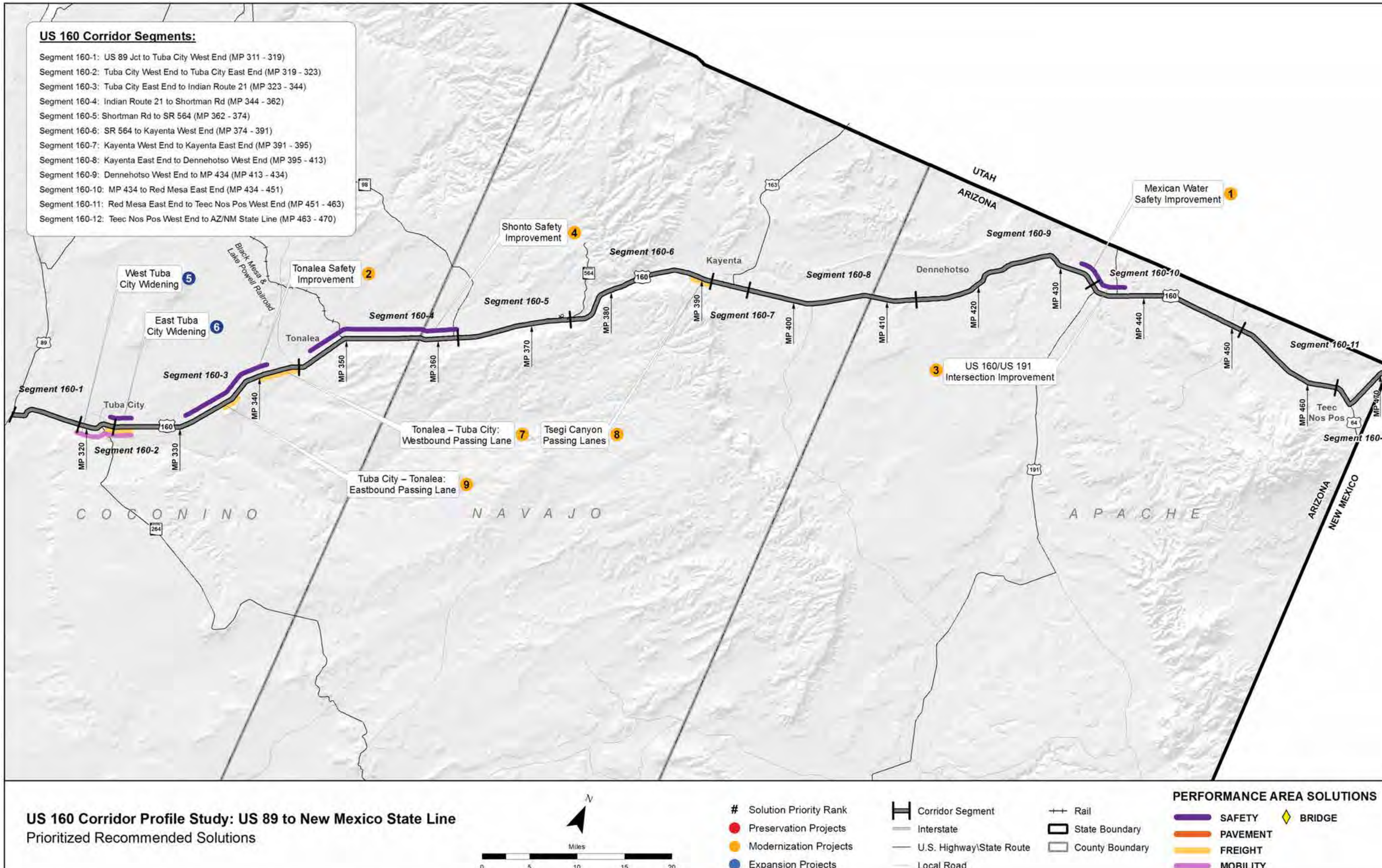
Candidate solutions developed for the US 160 Corridor will be considered along with other candidate projects in the ADOT statewide programming process. It is important to note that the candidate solutions are intended to represent strategic solutions to address existing performance needs related to the 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 four CPS rounds, the results will be incorporated into a summary document comparing all corridors that is expected to provide a performance-based review of statewide needs and candidate solutions.

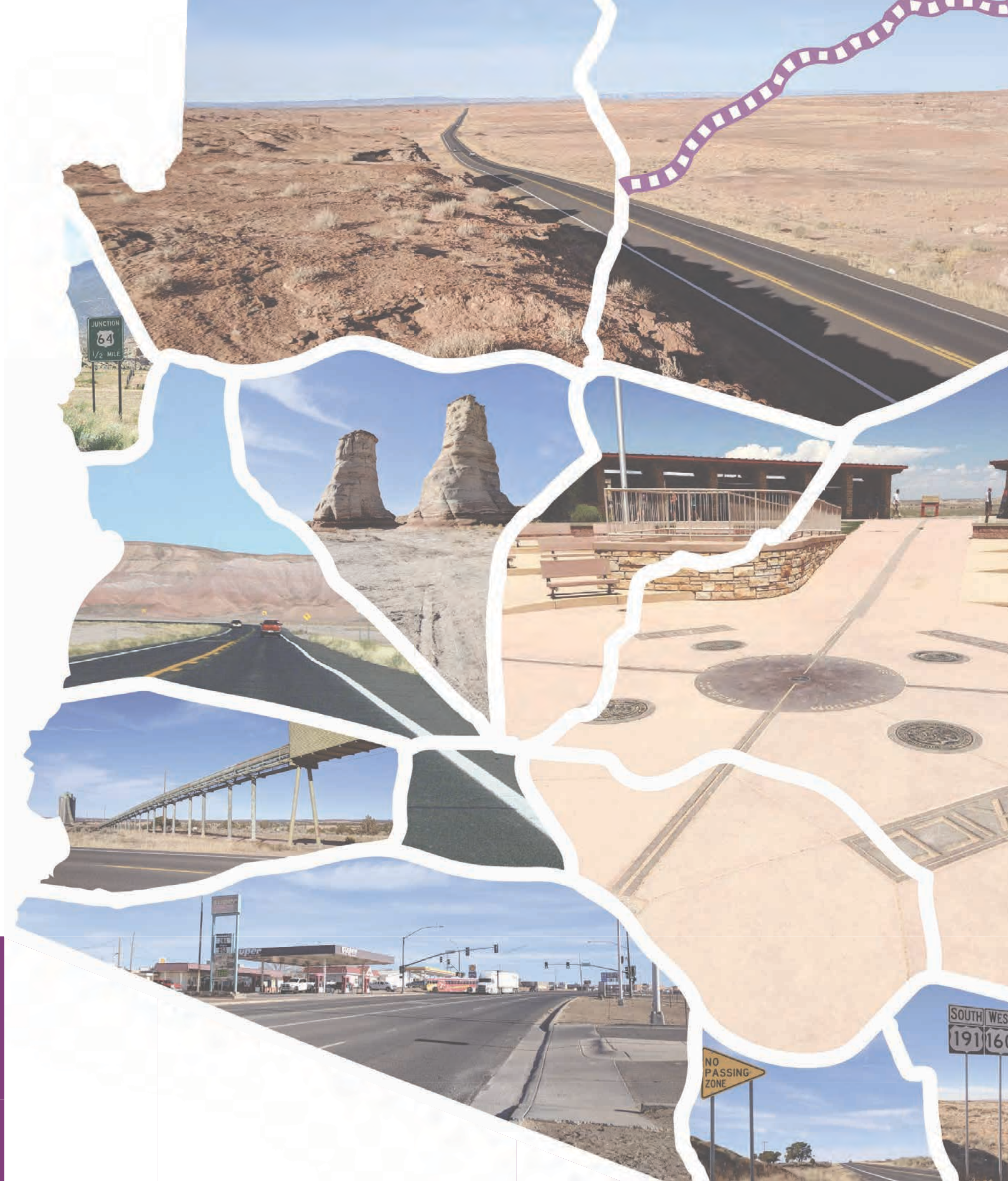
Table ES-4: Prioritized Recommended Solutions

Rank	Candidate Solution #	Option	Candidate Solution Name	Candidate Solution Scope	Estimated Cost (in millions)	Investment Category ([P] Preservation [M] Modernization [E] Expansion)	Prioritization Score
1	CS160.8	-	Mexican Water Safety Improvement (MP 432 - 438)	Widen shoulder in both directions (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips) Install curve warning signs in both directions Install chevrons on curves (MP 432.5 to MP 433.5 and MP 434.5 to MP 435.5)	$4.14	M	**174**
2	CS160.3	-	Tonalea Safety Improvement (MP 331 - 341)	Widen shoulder in both directions (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips) Install curve warning signs in both directions Install chevrons on curve (MP 336 to MP 336.5)	$7.87	M	**144**
3	CS160.9	-	US 160/US 191 Intersection Improvement (MP 435 - 437)	Install eastbound acceleration lane at US 191 intersection (MP 434.8) Install eastbound deceleration lane at US 191 intersection (MP 434.8) Install westbound acceleration lane at US 191 intersection (MP 437.2) Install lighting (solar powered LED) at US 191 intersections (MP 434.8 and MP 437.2)	$1.25	M	**129**
4	CS160.6	-	Shonto Safety Improvement (MP 346 - 362)	Widen shoulder in both directions (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips) Install lighting (solar powered LED) at SR 98 intersection (MP 361.6) Install curve warning signs in both directions Install chevrons on curve (MP 358 to MP 359)	$14.57	M	**101**
5	CS160.1	-	West Tuba City Widening (MP 319 - 321.6)	Convert 2-Lane undivided highway to a 5-Lane highway	$10.19	E	**55**
6	CS160.2	-	East Tuba City Widening (MP 322.4 - 325)	Convert 2-Lane undivided highway to a 5-Lane highway Install lighting (connecting to existing power) in both directions	$13.68	E	**52**
7	CS160.5	-	Tonalea-Tuba City: Westbound Passing Lane (MP 340 - 343)	Construct westbound passing lane from MP 340 – MP 341 Construct westbound passing lane from MP 342 – MP 343	$7.46	M	**14**
8	CS160.7	-	Tsegi Canyon Passing Lanes (MP 389 - 391)	Construct westbound passing lane from MP 389 – MP 390 Construct eastbound passing lane from MP 390 – MP 391	$7.46	M	**11**
9	CS160.4	-	Tuba City-Tonalea: Eastbound Passing Lane (MP 335 - 336.5)	Construct eastbound passing lane from MP 335 – MP 336.5	$5.59	M	**8**

Figure ES-8: Prioritized Recommended Solutions



Final Report



Final Report

1.0 INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study (CPS) of US Route 160 between US Route 89 and New Mexico Stateline. The study examines key performance measures relative to the US 160 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 has completed 21 CPS within four separate groupings.

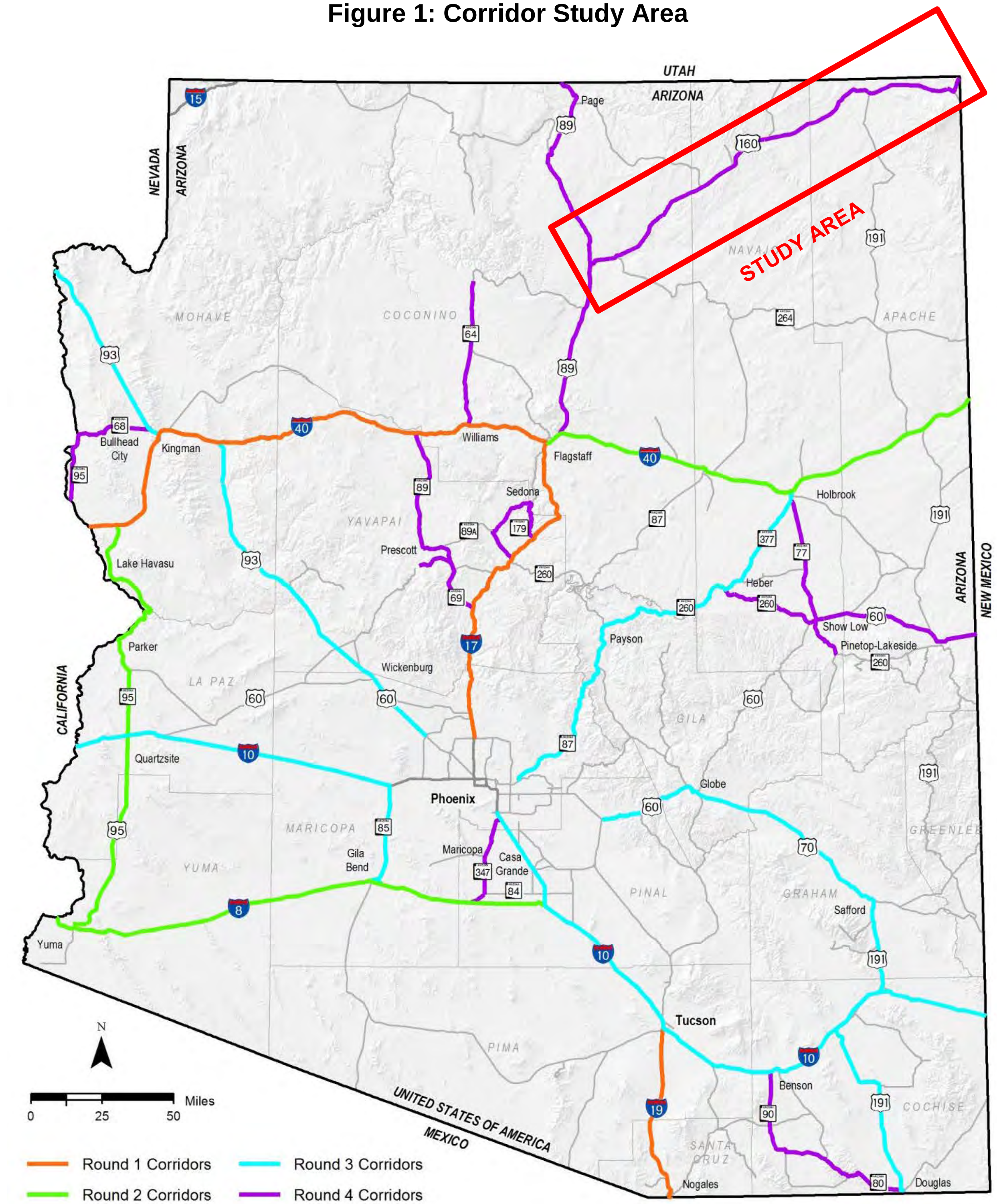
The fourth round (Round 4) of studies began in Spring 2017, and include:

- SR 64: I-40 to Grand Canyon National Park
- SR 68: SR 95 North to US 93 and SR 95 North: California State Line to Nevada State Line
- SR 69: I-17 to SR 89; Fain Rd: SR 69 to SR 89A; SR 89A: Fain Rd to SR 89; SR 89: SR 89A to I-40
- SR 77: US 60 to SR 377
- US 89: Flagstaff to Utah State Line
- SR 90: I-10 to SR 80 and SR 80: SR 90 to US 191
- US 160: US 89 to New Mexico State Line
- SR 179: I-17 to SR 89A; SR 89A: SR 179 to SR 260; and SR 260: SR 89A to I-17
- SR 260: SR 277 to SR 73 and US 60: SR 260 to New Mexico State Line
- SR 347: I-10 to SR 84 and SR 84: SR 347 to I-8

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 US 160 Corridor, depicted in **Figure 1** along with other previously completed CPS, is one of the strategic statewide corridors identified and the subject of this Round 4 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 US 160 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 US 160 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 US 160 Corridor provides an important connection from Northwest New Mexico and Southwest Colorado to economic and recreational activities in Northcentral Arizona and other destinations to the north and south of US 160. It begins at the intersection of US 89, west of Tuba City, and extends approximately 159 miles to New Mexico state line, north of Teec Nos Pos, near Four Corners. US 160 Corridor is generally a two-lane undivided rural arterial highway, except in Tuba City and Kayenta where it becomes four-lanes to accommodate local traffic and provide various business and residential accesses.

The corridor is located in two ADOT Districts (Northcentral and Northeast), one planning area (Northern Arizona Council of Governments [NACOG]), and three counties (Coconino, Navajo and Apache). It serves as a primary east-west commuter and commercial route between Tuba City, Kayenta, and surrounding communities of the Navajo Nation and Hopi Reservation.

The route has high peak travel on the weekends from people traveling between the commerce centers of Tuba City and Kayenta and to Flagstaff, Arizona; Farmington, New Mexico; and Cortez, Colorado. Traffic is expected to increase along the corridor with Tuba City and Kayenta having been designated as the “growth centers” of the Navajo Nation. With the expected growth, increased congestion and safety concerns will occur unless this future traffic is accommodated with necessary improvements.

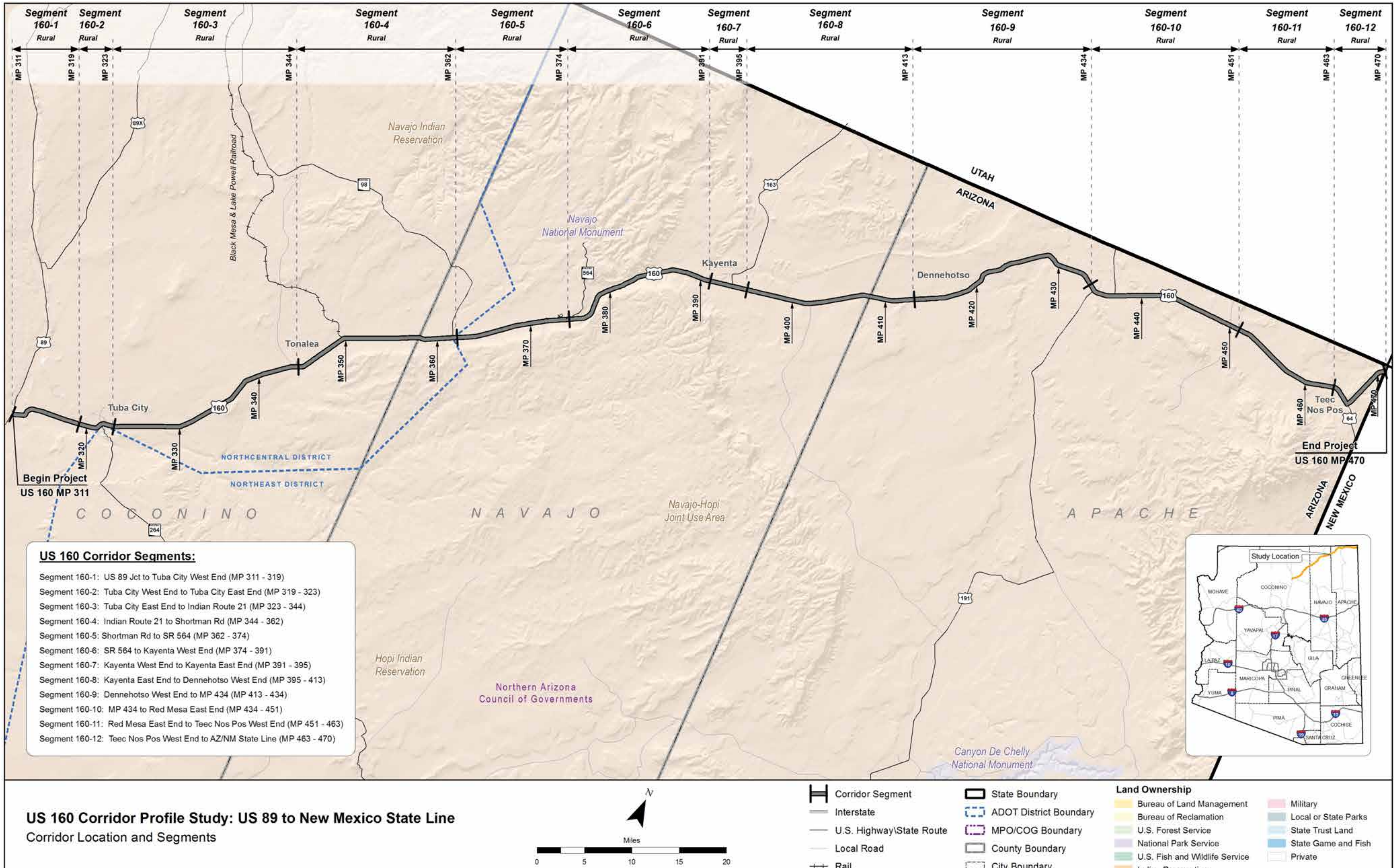
1.4 Corridor Segments

The US 160 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. Segmentation by similar characteristics (e.g., urban/rural surroundings, road width, traffic volumes) allowed the analysis to highlight anomalies or instances of poor performance within the context of each segment. The corridor is segmented at logical breaks where the context changes due to differences in characteristics such as terrain, daily traffic volumes, or roadway typical section. Additional segment breaks may occur at major intersections or junctions, where the corridor transitions from rural to urban environments, other similar operating environments, maintenance sections, and at jurisdictional changes. Corridor segments are described in **Table 1** and shown in **Figure 2**.

Table 1: US 160 Corridor Segments

Segment #	Begin	End	Approx. Begin Milepost	Approx. End Milepost	Approx. Length (miles)	Typical Through Lanes (EB/WB)	2015/2035 Average Annual Daily Traffic Volume (vpd)	Character Description
160-1	US 89 Junction	Tuba City West End	311	319	8	1,1	6,300/9,800	Segment 160-1 is rural in nature and is located within Coconino County. Segment 160-1 is an undivided facility and includes one unsignalized junction with US 89 and provides bi-directional turn lane access to the Tuba City Airport.
160-2	Tuba City West End	Tuba City East End	319	323	4	2,2	10,900/17,000	Segment 160-2 is rural in nature, extends through the length of the Tuba City and Moenkopi town limits, and is located within Coconino County. Sections of Segment 160-2 are undivided with a flush median. It has one signalized junction with SR 264 Southbound, five unsignalized intersections, and various business/residential accesses.
160-3	Tuba City East End	Indian Route 21	323	344	21	1,1	4,600/7,000	Segment 160-3 is rural in nature and located within Coconino County. Segment 160-3 is an undivided facility and has various accesses to unpaved roads/trails.
160-4	Indian Route 21	Shortman Road	344	362	18	1,1	3,300/5,000	Segment 160-4 is rural in nature and located within Coconino and Navajo Counties. Segment 160-4 is an undivided facility and has one unsignalized junction with SR 98 Northbound and various accesses to unpaved roads/trails.
160-5	Shortman Road	SR 564	362	374	12	1,1	4,400/6,500	Segment 160-5 is rural in nature and located within Navajo County. Segment 160-5 has one unsignalized junction with SR 564 and various accesses to unpaved roads/trails.
160-6	SR 564	Kayenta West End	374	391	17	1,1	5,600/8,300	Segment 160-6 is rural in nature and located within Navajo County. Segment 160-6 is an undivided facility and has various accesses to unpaved roads/trails.
160-7	Kayenta West End	Kayenta Town East End	391	395	4	2,2	5,100/9,700	Segment 160-7 is rural in nature, extends through the Town of Kayenta and is located within Navajo County. Sections of Segment 160-7 are undivided with a flush center median. It has one signalized junction with US 163 North, one unsignalized intersection, and various business/residential accesses.
160-8	Kayenta Town East End	Dennehotso West End	395	413	18	1,1	3,200/4,600	Segment 160-8 is rural in nature and located within Navajo and Apache Counties. Segment 160-8 is an undivided facility and has one unsignalized intersection.
160-9	Dennehotso West End	MP 434	413	434	21	1,1	3,100/4,400	Segment 160-9 is rural in nature, extends through the Town of Dennehotso, and is located within Apache County. Segment 160-9 is an undivided facility, has various accesses to unpaved roads/trails, and intersects access routes to Mexican Water.
160-10	MP 434	Red Mesa East End	434	451	17	1,1	3,100/4,300	Segment 160-10 is rural in nature, extends through the Town of Red Mesa, and is located within Apache County. Segment 160-10 is a undivided facility and has two unsignalized junctions with US 191 South and US 191 North, one unsignalized intersection, and various accesses to unpaved roads/trails.
160-11	Red Mesa East End	Teec Nos Pos West End	451	463	12	1,1	3,000/4,300	Segment 160-11 is rural in nature and located within Apache County. Segment 160-11 is an undivided facility and has various accesses to unpaved roads/trails.
160-12	Teec Nos Pos West End	AZ/NM State Line	463	470	7	1,1	2,300/3,300	Segment 160-12 is rural in nature, extends through the Town of Teec Nos Pos, is located within Apache County, and terminates at the Arizona-New Mexico State Line. Segment 160-12 is an undivided facility and has one unsignalized junction with US 64 and various accesses to unpaved roads/trails.

Figure 2: Corridor Location and Segments



1.5 Corridor Characteristics

The US 160 Corridor provides an important connection from Northwest New Mexico and Southwest Colorado to economic and recreational activities in Northcentral Arizona and other destinations to the north and south of US 160. Beginning at the intersection of US 89, west of Tuba City, the corridor extends to New Mexico state line, near Four Corners, providing a key economic and recreational link in the region and state.

National Context

US 160 is part of the National Highway System, and is classified by ADOT as Rural Principal Arterials, except within the Tuba City and Kayenta urban limits, where US 160 is classified as a Urban Principal Arterial. The corridor provides east-west connectivity from Arizona to New Mexico and Colorado, and further east eventually terminating in Missouri west of Mindenmines.

The corridor is located in the Navajo Nation, which is the largest federally recognized Indian Reservation in the United States encompassing over 27,000 square miles and extends into portions of Arizona, New Mexico, and Utah. The Navajo Nation is divided into five geographical districts generally referred to as agencies. US 160 Corridor plays an important part in the Navajo Nation economic road network providing the most direct and fastest link between Tuba City Agency in Arizona and Shiprock Agency in New Mexico.

Regional Connectivity

US 160 crosses mostly rural terrain of Northeastern Arizona and intersects other north-south running U.S. Highways, State Routes, and Indian Routes as it travels east-west. The corridor begins at US 89 near the western edge of Navajo Nation and provides a gateway access to Northcentral Arizona, mainly Flagstaff, Page and the Grand Canyon National Park, for the eastern regions. Near Tuba City, it intersects State Route 264 which connects to various Hopi Reservation communities in the south. It goes through Tonalea and Cow Springs before intersecting State Route 98 providing direct connection to Page in the north. As the corridor enters Kayenta, it intersects with U.S. Route 163 which travels north to Monument Valley Navajo Tribal Park near the Arizona-Utah border. It continues northeast through Dennehotso, then intersects and has a brief overlap with U.S. Route 191 in Mexican Water. It goes east until Teec Nos Pos, where it intersects U.S. Route 64, then turns northeast to go to Four Corners and enters New Mexico.

Commercial Truck Traffic

US 160 Corridor is a regional truck route connecting Northern Arizona to Utah, New Mexico and Colorado. The corridor has been identified by ADOT State Transportation Plan as a National Freight Truck Route for truck and hazardous material on the national highway system.

According to ADOT's 2015 Highway Performance Monitoring System (HPMS) data, the average daily commercial truck volumes along the corridor range from less than 100 to nearly 600 trucks per day. Segments with volumes over 300 daily commercial trucks include Segment 160-2 and 160-6. The high volume of trucks on these segments can be attributed to the Tuba City and Kayenta growth centers of the Navajo Nation. Commercial trucks account for the transport of all consumer goods to markets and stores of the communities along the corridor.

The area is also a destination of fuel transportation to numerous local gas stations on or near US 160 Corridor. Hazardous material transportation incidents involving the release of gasoline, diesel, and oil have been reported in the past. Thus, sharing of relatively heavy truck and tourist traffic on a rural 2-lane road has become a safety concern.

Teec Nos Pos Port of Entry along Segment 160-12 at MP 465.2 is located at the intersection of US 160 and US 64. This location has a weigh station and requires the trucks to stop for inspection, which can create delay with commercial truck traffic.

Commuter Traffic

Moderate commuter traffic is present on US 160, especially at the junctions around Segments 160-1, 160-2, 160-6 and 160-7. This is due to commuters traveling to Flagstaff, Monument Valley Navajo Tribal Park, and between the commerce centers of Tuba City and Kayenta. As per the 2035 forecasts, traffic is expected to increase along these segments, and increased congestion and safety concerns will occur unless this future traffic is accommodated with necessary improvements.

Other population centers along the corridor, including Tonalea/Red Lake, Black Mesa, Tsegi, Dennehotso, Tes Nez Iah, Mexican Water, and Teec Nos Pos, add to the inter-city commuter traffic on the US 160 to a much lesser degree.

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, 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 2015, 42.1 million people visited Arizona who collectively spent $21 billion in the state, which supports jobs and generates tax revenue.

Various scenic sites are located along the corridor, however, there are no designated national or state parks in the corridor area. US 160 Corridor is mainly used to access roads leading to recreational areas which include the Navajo National Monument, located off SR 564, Monument Valley, located off US 163, and Four Corners Monument. Other local scenic viewpoints along US 160 include Dinosaur Tracks (MP 316.5), Elephants's Feet (MP 345) and White Mesa Natural Bridge (MP 345).

US 160 intersects US 89 on the west, thereby providing a gateway access from New Mexico and Colorado to Northern Arizona, mainly Flagstaff, Page and the Grand Canyon National Park, one of the most visited sites in the country with over 6 million visitors last year.

Multi-Modal Uses

Freight Rail

The Black Mesa and Lake Powell Railroad is not a common carrier system and is owned by the Peabody Coal Company specifically to haul coal from the Kayenta Mine near Kayenta to the Salt River Project Navajo Generating Station power plant at Page. The railroad runs parallel to US 160 Corridor from the Kayenta mine (west of SR 564) to MP 350 (Cow Springs Lake).

Overall, the railroad is about 78-miles in length and has no stations or terminals located along its main line and do not cross the US 160 Corridor at any point. Present-day operations are believed to include 3 round trips per day from the mine to the generating station.

Passenger Rail

There are no existing and proposed passenger rails in Northeast Arizona.

Bicycles/Pedestrians

Shoulders generally average 5 feet in width to accommodate cyclists on US 160.

Bus/Transit

Navajo Transit System (NTS) administers and operates inter-city bus transportation services for the general public. It is a department under the Division of General Services within the Navajo Nation Government and is funded primarily through the New Mexico and Arizona Departments of Transportation.

NTS provides bus services on 15 fixed routes along state highways out of which 4 routes run along US 160 Corridor, namely, Route 01: Tuba City/Fort Defiance, Route 03: Kayenta/Fort Defiance, Route 11: Flagstaff/Tuba City, and Route 12: Kayenta/Tuba City. NTS has proposed two new routes in its long-term transportation plan – Kayenta to Utah border and Kayenta to Page.

NTS buses pick up riders at designated stops, but no NTS stops/stations have been constructed. The transit system connects with Hopi Transit System, Greyhound Busline, Amtrak Passenger Train, and Flagstaff Mountain Line. Other public transit services that provide transportation along US 160 include School district buses and Community Health Representatives. (*Source: http://www.navajotransit.com/*)

Aviation

There are two public use airports along the US 160 Corridor, the Tuba City Airport in segment 160-1 and Kayenta Airport in segment 160-7, and are owned by the Navajo Nation.

Land Ownership, Land Uses, and Jurisdictions

As shown previously in **Figure 2**, US 160 is located within Coconino, Apache, and Navajo counties and lies entirely within Navajo and Hopi Nation tribal lands. All Indian reservation lands are held in trust by the Federal government and obtaining any new right-of-way will need to be approved by the Secretary of the Department of Interior through the Bureau of Indian Affairs with simultaneous consent from the affected Tribal governments.

Existing land uses along the study corridor generally consist of residential and ceremonial, commercial, transportation/utilities (e.g., power line and railroad, etc.), agricultural, and recreational with a majority being undeveloped vacant land primarily used for sheep and cattle grazing.

Several small to medium-sized unincorporated towns are located along the study corridor. Residential and commercial development is concentrated around the towns of Tuba City, Moenkopi, Red Lake, Tsegi, Dennehotso, Tes Nez Iah, Mexican Water, Red Mesa, and Teec Nos Pos. Kayenta is the Navajo Nation's fifth largest growth center and is the only incorporated community on the Navajo Nation. Kayenta Township is implementing a comprehensive plan for the development of the town with revenues collected from its local sales tax.

Population Centers

The US 160 Corridor extends through three counties (Coconino, Navajo, and Apache) and is entirely rural. There are two minor population centers along the corridor in Tuba City and Kayenta. Modest population growth is projected in Tuba City, however population losses are projected for Kayenta and other communities located along the corridor. **Table 2** shows current (2015) population by county and towns/census designated places along with projected future (2040) population and growth.

Table 2: Current and Future Population

Community	2010 Population	2015 Population	2040 Population	% Change 2010-2040	Total Growth
Coconino County	**134,421**	**141,602**	**167,897**	**25%**	**33,476**
Tuba City	8,611	8,881	9,628	12%	1,017
Unincorporated	53,567	55,236	59,856	12%	6,289
Navajo County	**107,449**	**109,671**	**120,094**	**12%**	**12,645**
Kayenta	5,189	5,141	4,174	-20%	-1,015
Unincorporated	68,097	69,495	71,830	5%	3,733
Apache County	**71,518**	**72,215**	**66,427**	**-7%**	**-5,091**
Dennehotso	746	753	686	-8%	-60
Teec Nos Pos	730	737	671	-8%	-59
Unincorporated	61,192	61,811	54,099	-12%	-7,093

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

Major Traffic Generators

Much of the traffic on US 160 results from commercial, inter-city and long distance recreational travel. The route experiences high peak travel on the weekends from people traveling to Flagstaff, Arizona; Farmington, New Mexico; and Cortez, Colorado. Also, various recreational spots like

Navajo National Monument, Monument Valley, and Four Corners Monument located off the corridor generates tourist traffic.

Tuba City and Kayenta are significant employment centers and regional centers for health care and community services, schools, public safety as well as banking, shopping, dining and other services. The concentration of facilities at these two centers generates inter-city commuter traffic to and from other smaller communities located along the corridor. Freight traffic is observed as well due to transport of all consumer goods to markets and stores of the communities along the corridor.

The Kayenta mine, operated by Peabody Western Coal Company, is located south of the corridor near segment 160-6. It constitutes as an important employment generator in the region and attracts commuter traffic to and from the mine along US 160.

Tribes

The study corridor lies entirely within Navajo Nation and Hopi Tribe lands. The Navajo Nation controls a majority of the lands adjacent to US 160 with an exception of a two areas, which are controlled by the Hopi Tribe. The Hopi Tribe land includes Moenkopi Village near Tuba City and a small portion located south of US 160 near MP 340. The Navajo Nation is divided into Chapters, which have their own local planning authority. The US 160 intersects 10 Navajo Chapters which are listed in the table below. *(Source: http://www.navajo-nsn.gov/chapters.htm)*

Navajo Chapter	Approximate Mileposts
Bodaway	312.0-315.5
Coalmine Mesa	315.5-321.0
Tuba City	321.0-337.0
Red Lake	337.0-356.0
Shonto	356.0-375.0
Kayenta	375.0-407.0
Dennehotso	407.0-429.0
Mexican Water	429.0-439.5
Red Mesa	439.5-450.0
Teec Nos Pos	450.0-470.5

Many San Juan Paiute tribal members reside in several distinct communities located on the Navajo Nation, primarily in northern Arizona and southeastern Utah. The largest of these communities are located at Willow Springs, near Tuba City and at Navajo Mountain on the Arizona and Utah border.

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 US 160 Corridor:

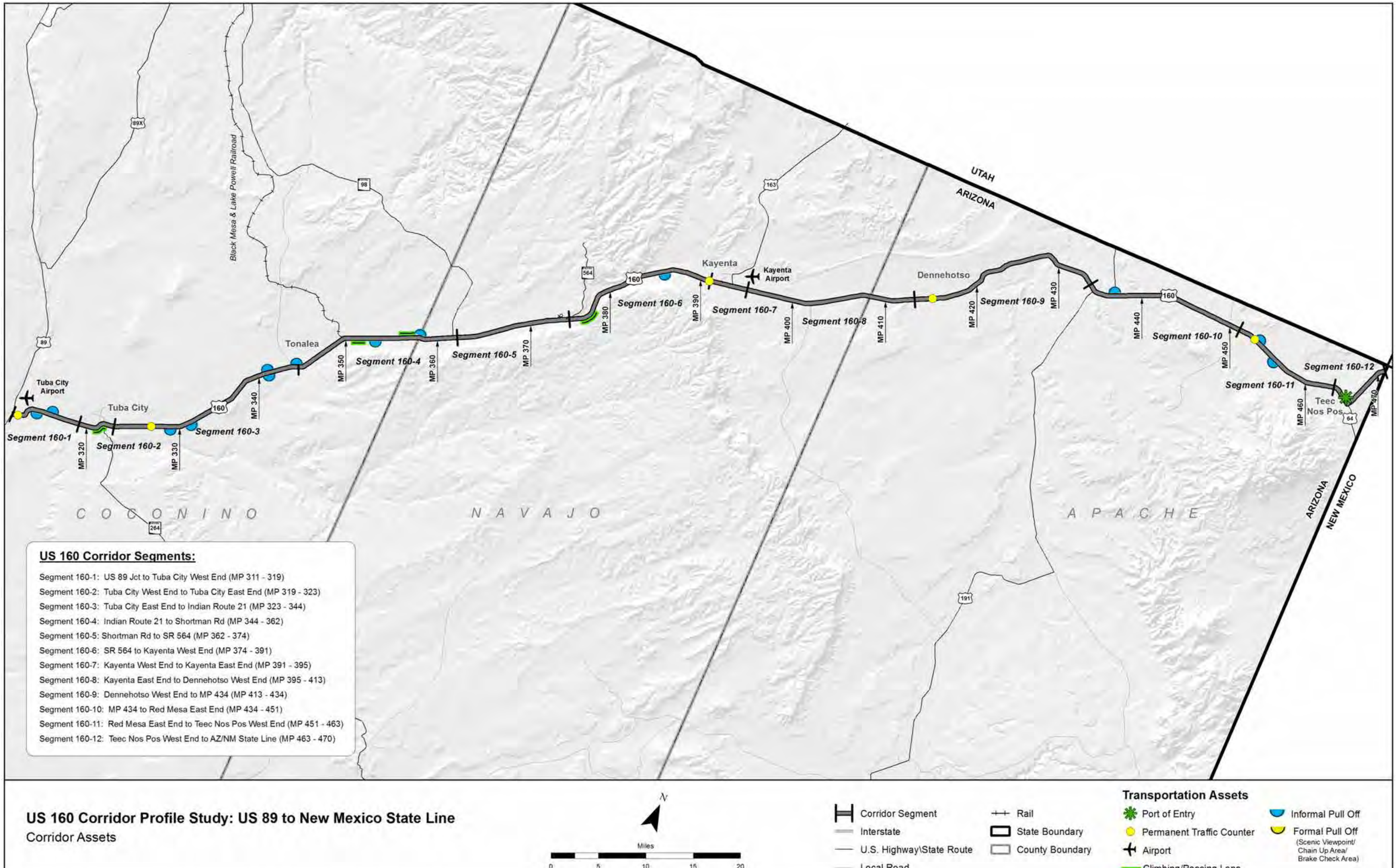
- US 160 travels through three distinct vegetation zones, namely, Plains and Great Basin Grassland, Great Basin Desertscrub, and Great Basin Conifer Woodland.
- Plains and Great Basin Grasslands are found northeast of Red Lake, south of Kayenta, and in the vicinity of Teec Nos Pos.
- The Great Basin Desertscrub occurs between Tuba City and Red Lake and between Kayenta and Red Mesa.
- The Woodland community occurs generally between Red Lake and Kayenta
- A Potential Wildlife Linkage Zone is identified along Segments 160-6 and 160-7, and it further extends along SR 564 and part of SR 163 in Kayenta. This portion of the Fracture Zone is designated as a Potential Linkage Zone to design and conserve functional linkage(s) critical for wildlife movement.
- No Wildlife Waters are located along and around US 160.
- Species of Greatest Conservation need are identified around Segment 160-2, in Tuba City and Moenkopi, with the conservation potential ranging from medium to low.
- Riparian areas in the Southwest are crucial habitats for wildlife sustainability and often serve as wildlife movement corridors within the landscape. Such areas exist around Segment 160-2, mostly in the southern west part of US 160 and SR 264 intersection (Moenkopi), and are indicated as areas of high conservation potential.
- Species of Economic and Recreational Importance are identified around Segment 160-2, in Tuba City and Moenkopi, with a low conservation potential.
- The Wildlife Stressors are various potential stressors to Arizona's wildlife species. The stressors affecting the study corridor most are Air Traffic, Contaminants/Waste Water, Deicing, Drilling for Fuels, Habitat Degradation, Illegal Dumping, Loss of Keystone Species, Mining, and Railroads.

Corridor Assets

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

A freight weigh station is located near the New Mexico border in Teec Nos Pos, Arizona. There are two public use airports, at Tuba City and Kayenta, owned by the Navajo Nation along US 160. The route being a two-lane undivided rural arterial highway has no traffic interchanges or grade separated road crossings, however, the corridor does have few signaled traffic intersections, passing lanes, and informal pull-offs. There are total five permanent traffic counters located along the US 160 Corridor.

Figure 3: Corridor Assets



1.6 Corridor Stakeholders and Input Process

A Technical Advisory Committee (TAC) was created that 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 key stakeholders between August 2017 and January 2018 to present the results and obtain feedback.

Key stakeholders identified for this study include:

- ADOT Northcentral District
- ADOT Northeast District
- ADOT Technical Groups
- Northern Arizona Council of Governments (NACOG)
- Navajo Nation Government
- Hopi Tribal Council
- Federal Highway Administration (FHWA)

Several chapter deliverables were developed during the course of the Corridor Profile Study. The chapters were provided to the TAC for review and comments.

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 US 160 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

- AASHTO U.S. Bicycle Route System, 2015 (ADOT)
- ADOT 2018-2022 State Transportation Improvement Program
- Statewide Bicycle and Pedestrian Plan Update, 2013 (ADOT)
- Climbing and Passing Lane Prioritization Study, 2015 (ADOT)
- Arizona Key Commerce Corridors, 2013 (ADOT)
- Arizona Multimodal Freight Analysis Study, 2008 (ADOT)
- Arizona Port of Entry Study, 2014 (ADOT)
- Arizona Roadway Departure Safety Implementation Plan, 2014 (ADOT)
- Arizona State Airport System Plan, 2008 (ADOT)
- Arizona State Rail Plan, 2011 (ADOT)
- Arizona Statewide Dynamic Message Sign Master Plan, 2011 (ADOT)
- Arizona Statewide Rail Framework Study, 2010 (ADOT)
- Arizona Statewide Rest Area Study, 2010 (ADOT)
- Arizona Statewide Travel Demand Model (ADOT)
- Arizona Wildlife Action Plan / Arizona Wildlife Linkages Assessment
- Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT)
- Travel Management Plan, 2012 (BLM)
- What Moves You Arizona; Long Range Transportation Plan 2010-2035, 2011 (ADOT)
- Arizona Strategic Highway Safety Plan, 2014 (ADOT)
- Arizona Transparency Report, 2012 (ADOT)
- Arizona Statewide Shoulders Study, 2015 (ADOT)
- Detection and Warning Systems for Wrong-Way Driving, 2015 (ADOT)
- Arizona State Freight Plan, 2016 (ADOT)
- Pedestrian Safety Action Plan, 2017 (ADOT)
- ITS Architecture Plan (ADOT)
- Low Volume Routes Study, 2017 (ADOT)
- Jason's Law Survey

Regional Planning Studies

- Regional Transportation Improvement Program FY17-23, NACOG
- Coconino County Comprehensive Plan Final Draft, 2015
- Coconino County Road Capital Improvement Plan FY 2015 – 24
- Navajo County Comprehensive Plan, 2011
- Apache County Comprehensive Plan, 2004

Planning Assistance for Rural Areas and Small Area Transportation Studies

- Kayenta Township Multimodal Transportation Study, 2012

Design Concept Reports and Project Assessments

- US 89 Antelope Hills to Jct. US 160 MP 442 to MP 484 DCR, 2007
- US 160, MP 460.5 to 462.6 Passing Lane, Final Project Assessment, 2004
- US 160, Jct. US 89 to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007
- US 160, Red Mesa to Teec Nos Pos Pavement Preservation, Final Project Assessment, 2009
- US 160, Tsegi to Kayenta Drainage Repairs, Final Project Assessment, 2006
- US 160, County Line to Black Mesa Pavement Preservation, Final Project Assessment, 2011
- US 160, Jct. US 89 to Van's Trading Post Pavement Preservation, Final Project Assessment, 2004
- US 160, Kayenta to Jct. N 59 Pavement Preservation, Final Project Assessment, 2004
- US 160, Dennehotso to Linz Pavement Preservation, Final Project Assessment, 2001

- US 160, Jct. SR 564 to Tsegi Roadway Widening and Passing Lanes, Final Project Assessment, 2000
- US 160, E Tuba City to Navajo Co. Line Pavement Preservation, Final Project Assessment, 2001
- US 160, US 160 Passing Lanes, Final Project Assessment, 2003
- US 160, Van's Trading Post to East of SR 264 Roadway Widening and Drainage Improvements, Final Project Assessment, 2001

Summary of Prior Recommendations

Various studies and plans, including several Design Concept Reports (DCRs), have recommended improvements to the US 160 Corridor as shown in **Table 3** and **Figure 4**. They include, but are not limited to:

- Widening of numerous sections of US 160, some of which will require right-of-way acquisition. Many other proposed improvements are associated with the recommended widening:
  - Widening from 2 lane undivided to 4 lane divided highway with median, flush median or curbed median from MP311.5 to MP401.4 and MP434.8 to MP465.8
  - Approximately 50 miles of shoulder widening and improvement at various locations
- Addition of Passing Lanes at the following locations:
  - EB: MP311 - MP320
  - EB: MP335 - MP341
  - WB: MP343 - MP337
  - EB: MP361 - MP367
  - WB: MP369 - MP375
  - EB: MP385 - MP391
  - EB/WB: MP401 – MP435
  - WB: MP458 - MP463
- Addition of Climbing Lanes at the following locations:
  - EB: MP312 - MP314
  - WB: MP345 - MP343
  - EB: MP381 - MP384
  - WB: MP462 - MP460
- Addition of various Roadway Departure Countermeasures such as centerline rumble stripes, shoulder rumble stripes, alignment delineation, and lighting
- Multimodal transportation upgrade at Kayenta
- Teec Nos Pos Port of Entry Improvements
- Development of Junction US 89/US 160 Diamond Interchange
- US 160/ SR 564 Traffic Intersection Improvement
- Scour Retrofit of Laguna Creek Bridge
- Bridge Replacement of Chinle Wash Bridge
- ITS improvements, such as dynamic message signs
  - EB DMS at MP386 (between Tsegi and Kayenta)
  - EB DMS at MP430 (before US 160 and US 191 Junction)
  - EB DMS at MP460

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	311	-	-	Jct. US 89 / US 160 Diamond Interchange		✓		-	N/A	Y (EA)	US 89 Antelope Hills to Jct. US 160 MP 442 to MP 484 DCR, 2007
2	311	470	159	US 160 widening to Four Corners area			✓	-	N/A	N	Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT)
3	311	470	159	Roadway Departure Countermeasures • Centerline Rumble Stripes (MP 360-400) • Edge Line Rumble Stripes or Shoulder Rumble Stripes (MP 313-313.5, 352-352.5, 361.5-362, 364-365.5, 368-368.5, 372-373, 383-383.5, 392-392.5, 394.5-395, 397.5-398, 417-417.5, 455-455.5,456-456.5, 460-460.5) • Alignment Delineation, Lighting (MP 392-392.5, 394.5-395)		✓		-	N/A	N	Arizona Roadway Departure Safety Implementation Plan, 2014 (ADOT)
4	311	320	9	• US 160 EB: MP311 - MP320 Passing Lane • US 160 EB: MP312 - MP314 Climbing Lane		✓		-	N/A	N	Climbing and Passing Lane Prioritization Study, 2015 (ADOT)
5	311	321.68	10.68	US 89-MP 321.68 Paved Shoulder Need		✓		-	N/A	N	Statewide Bicycle and Pedestrian Plan Update, 2013 (ADOT)

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?)	
6	311.5	401.4	89.9	• US 160 311.5 – MP 318.5 Expand to 4-lane Rural Divided with Median • US 160 318.5 – MP 324.4 Expand to 4-lane Fringe Urban with Flush Median • US 160 MP 324.4 – MP 343.8 Expand to 4-lane Rural Divided with Median • US 160 MP 343.8 – MP 361.6 Expand to 4-lane Rural Divided with Median • US 160 MP 361.6 – MP 374.3 Expand to 4-lane Rural Divided with Median • US 160 MP 374.3 – MP 392.6 Expand to 4-lane Rural Divided with Median • US 160 MP 392.6 – MP 395.7 Expand to 4-lane Fringe Urban with Curbed Median • US 160 MP 395.7 – MP 401.4 Expand to 4-lane Rural Divided with Median			✓	-	N/A	Y (EO)	US 160, Jct. US 89 to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007
7	318	325	7	IR 6731 – SR 98 Bus Pullout		✓		FY-19	F005901C	N	ADOT 2017-2021 State Transportation Improvement Program
8	323	324.5	1.5	US 160 323-324.5 Pedestrian Safety Improvements		✓		-	N/A	N	Pedestrian Safety Action Plan, 2017 (ADOT)
9	329.76	338	8.24	MP 329.76-BIA 021 Shoulder Paving		✓		-	N/A	N	Statewide Bicycle and Pedestrian Plan Update, 2013 (ADOT)
10	335	343	8	• US 160 EB: MP335 - MP341 Passing Lane • US 160 WB: MP343 - MP337 Passing Lane		✓		-	N/A	N	Climbing and Passing Lane Prioritization Study, 2015 (ADOT)
11	345	343	2	US 160 WB: MP345 - MP343 Climbing Lane		✓		-	N/A	N	Climbing and Passing Lane Prioritization Study, 2015 (ADOT)
12	361	367	6	US 160 EB: MP361 - MP367 Passing Lane		✓		-	N/A	N	Climbing and Passing Lane Prioritization Study, 2015 (ADOT)

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?)	
13	364	374	2	Widen Shoulders (EB/WB) US 160: MP 364 - MP 366, MP 366 - MP 368, MP 368 - MP 370, MP 370 - MP 372, MP 372 - MP 374		✓		-	N/A	N	Arizona Statewide Shoulders Study, 2015 (ADOT)
14	369	375	6	US 160 WB: MP369 - MP375 Passing Lane		✓		-	N/A	N	Climbing and Passing Lane Prioritization Study, 2015 (ADOT)
15	373	390	17	Long House Valley – Kayenta Pavement Preservation	✓			FY-20	N/A	N	ADOT 2017-2021 State Transportation Improvement Program
16	374	-	-	SR 564 Traffic Intersection Improvement		✓		-	N/A	N	Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT)
17	381	384	3	US 160 EB: MP381 - MP384 Climbing Lane		✓		-	N/A	N	Climbing and Passing Lane Prioritization Study, 2015 (ADOT)
18	385	391	6	US 160 EB: MP385 - MP391 Passing Lane		✓		-	N/A	N	Climbing and Passing Lane Prioritization Study, 2015 (ADOT)
19	386	-	-	US 160 MP 386 EB DMS Sign		✓		-	N/A	N	Arizona Statewide Dynamic Message Sign Master Plan, 2011 (ADOT)
20	390	395	5	• US 160 Advance Intersection Warning Devices • US 163 and US-160 Streetlight Study • US 163 and US-160 Access Consolidation • US 163 and US 160 Roadway Beautification and Landscaping • Business Signs on US 160 and US 163 • Right-Turn Deceleration Lanes on US 163 and US 160 (MP 393.5) • Improve Access and Circulation US 163 and US 160 intersection (MP 393.5)				-	N/A	N	Kayenta Township Multimodal Transportation Study, 2012
21	392	394	2	Widen Shoulder US 160: MP 392 - MP 394 EB/WB		✓		-	N/A	N	Arizona Statewide Shoulders Study, 2015 (ADOT)

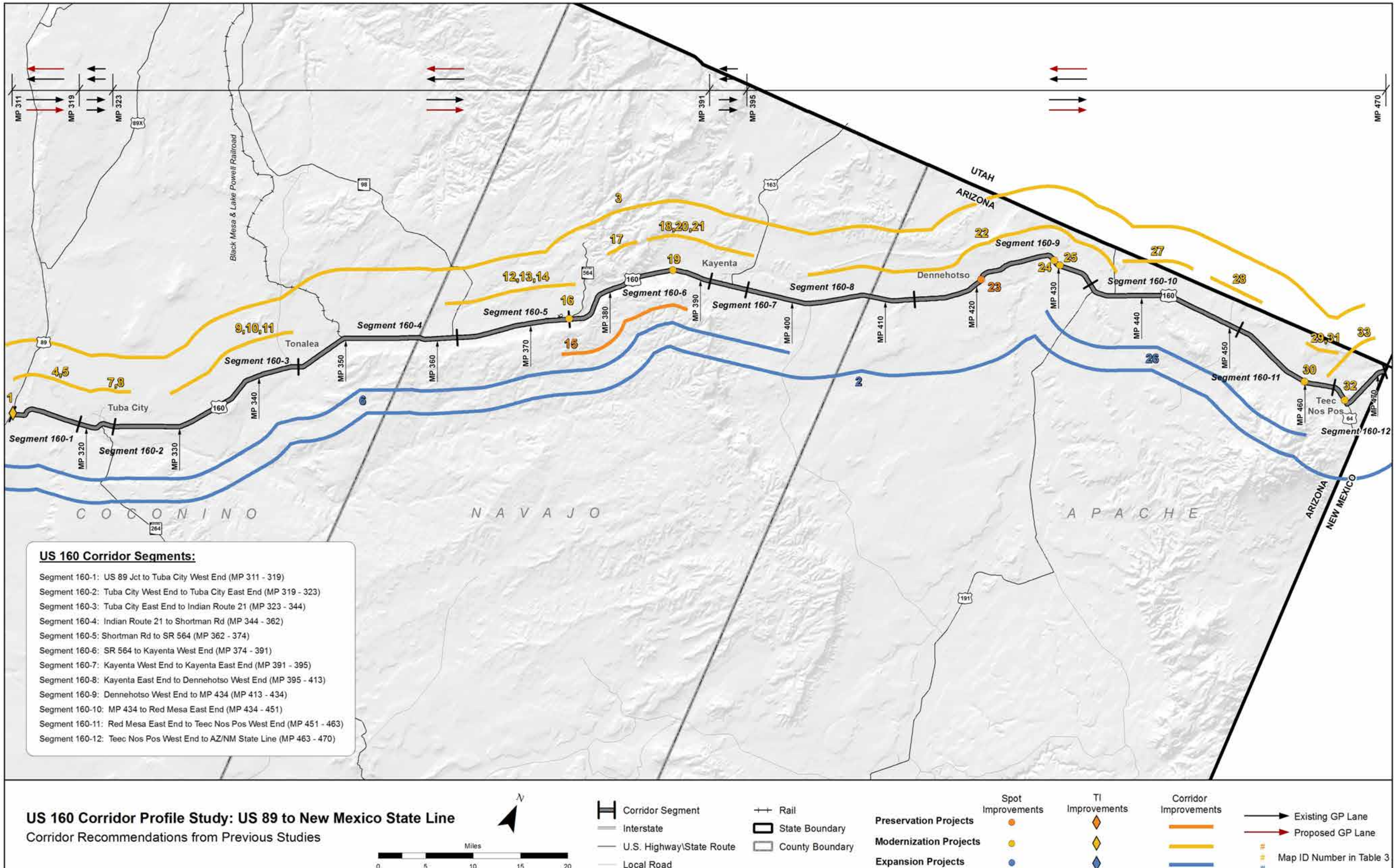
Table 3: Corridor Recommendations from Previous Studies (continued)

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?)	
22	401.4	434.8	33.4	Climbing lane, passing lane, and shoulder widening improvements		✓		-	N/A	Y (EO)	US 160, Jct. US 89 to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007
23	420	421	1	Laguna Creek Bridge STR #20001 – Scour Retrofit	✓			FY-17	H891301C	N	ADOT 2017-2021 State Transportation Improvement Program
24	429	430	1	Chinle Wash Bridge STR #746 Bridge Replacement		✓		FY-19	H849001C	N	ADOT 2017-2021 State Transportation Improvement Program
25	430	-	-	US 160 MP 430 EB DMS Sign		✓		-	N/A	N	Arizona Statewide Dynamic Message Sign Master Plan, 2011 (ADOT)
26	434.8	465.8	31	• US 160 MP 434.8 – MP 437.2 Expand to 4-lane Rural Divided with Median • US 160 MP 437.2 – MP 463.7 Expand to 4-lane Rural Divided with Median • US 160 MP 463.7 – MP 465.1 Expand to 4-lane Fringe Urban with Flush Median • US 160 MP 465.1 – MP 465.8 Expand to 4-lane Urban with Flush Median			✓	-	N/A	Y (EO)	US 160, Jct. US 89 to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007
27	438	444	2	Widen Shoulders (EB/WB) US 160:MP 438 - MP 440, MP 440 - MP 442, MP 442 - MP 444		✓		-	N/A	N	Arizona Statewide Shoulders Study, 2015 (ADOT)
28	446	452	2	Widen Shoulder (EB/WB) US 160: MP 446 - MP 448, MP 448 - MP 450, MP 450 - MP 452		✓		-	N/A	N	Arizona Statewide Shoulders Study, 2015 (ADOT)
29	458	463	5	• US 160 WB: MP458 - MP463 Passing Lane • US 160 WB: MP462 - MP460 Climbing Lane		✓		-	H603701C N/A	Y (EO)	US 160, MP 460.5 - 462.6, Final Project Assessment, 2007 Climbing and Passing Lane Prioritization Study, 2015 (ADOT)
30	460	-	-	US 160 MP 460 EB DMS Sign		✓		-	N/A	N	Arizona Statewide Dynamic Message Sign Master Plan, 2011 (ADOT)

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?)	
31	460	462	2	Widen Shoulder US 160: MP 460 - MP 462 EB/WB Widen		✓		-	N/A	N	Arizona Statewide Shoulders Study, 2015 (ADOT)
32	465.2	-	-	Teec Nos Pos Mainline Screening (weight and credential screening, cameras, signage and signals on the mainline)		✓		-	N/A	N	Arizona Port of Entry Study, 2014 (ADOT) Arizona Key Commerce Corridors, 2013 (ADOT)
33	465.8	470.8	5	Shoulder widening		✓		-	N/A	Y (EO)	US 160, Jct. US 89 to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007

Figure 4: Corridor Recommendations from Previous Studies



2.0 CORRIDOR PERFORMANCE

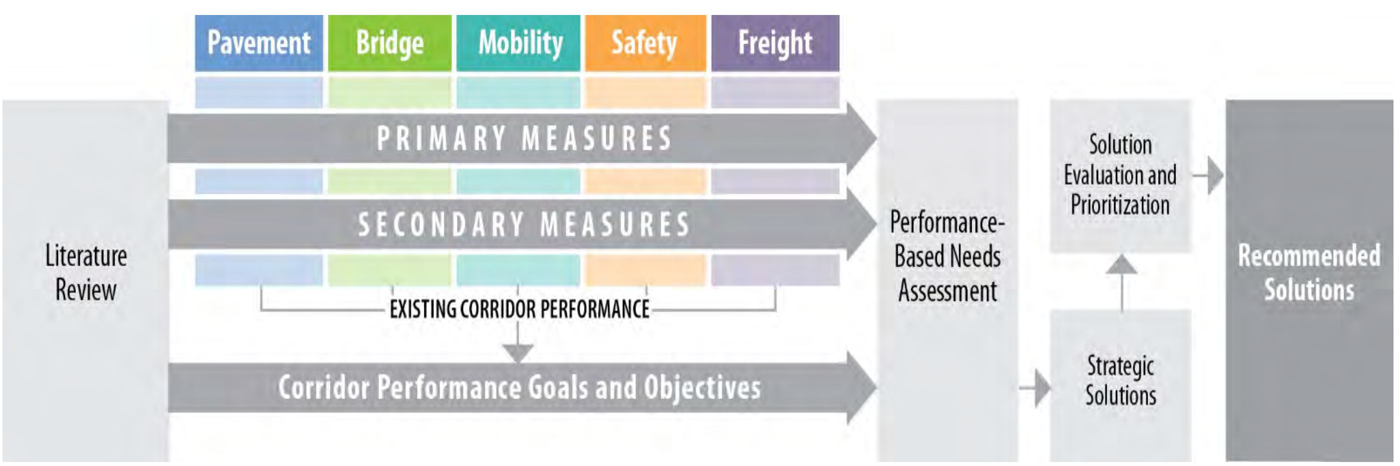
This chapter describes the evaluation of the existing performance of the US 160 Corridor. A series of performance measures is used to assess the corridor. The results of the performance evaluations are used to define corridor needs relative to the long term goals and objectives for the corridor.

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

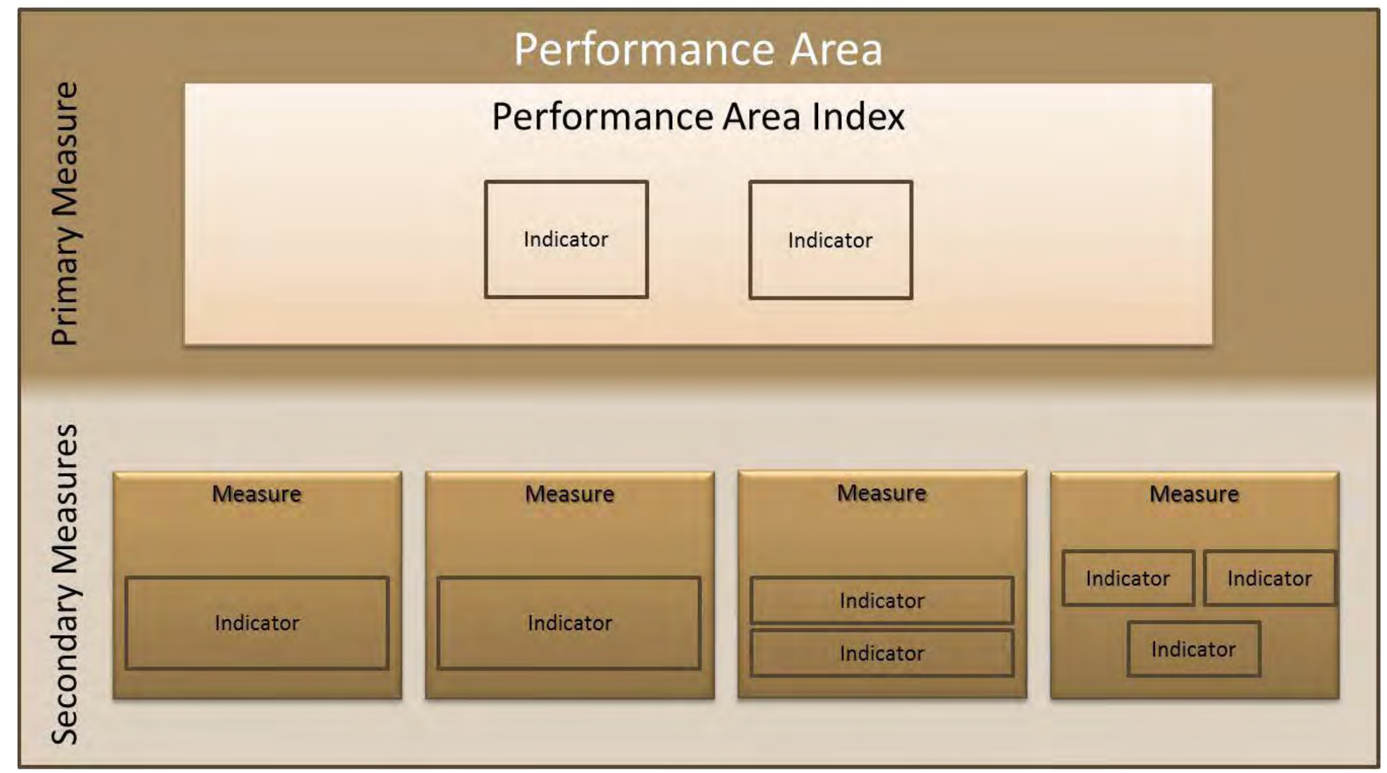
Performance Area	Primary Measure	Secondary Measures
Pavement	**Pavement Index** Based on a combination of International Roughness Index and cracking	• Directional Pavement Serviceability • Pavement Failure • Pavement Hot Spots
Bridge	**Bridge Index** Based on lowest of deck, substructure, superstructure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

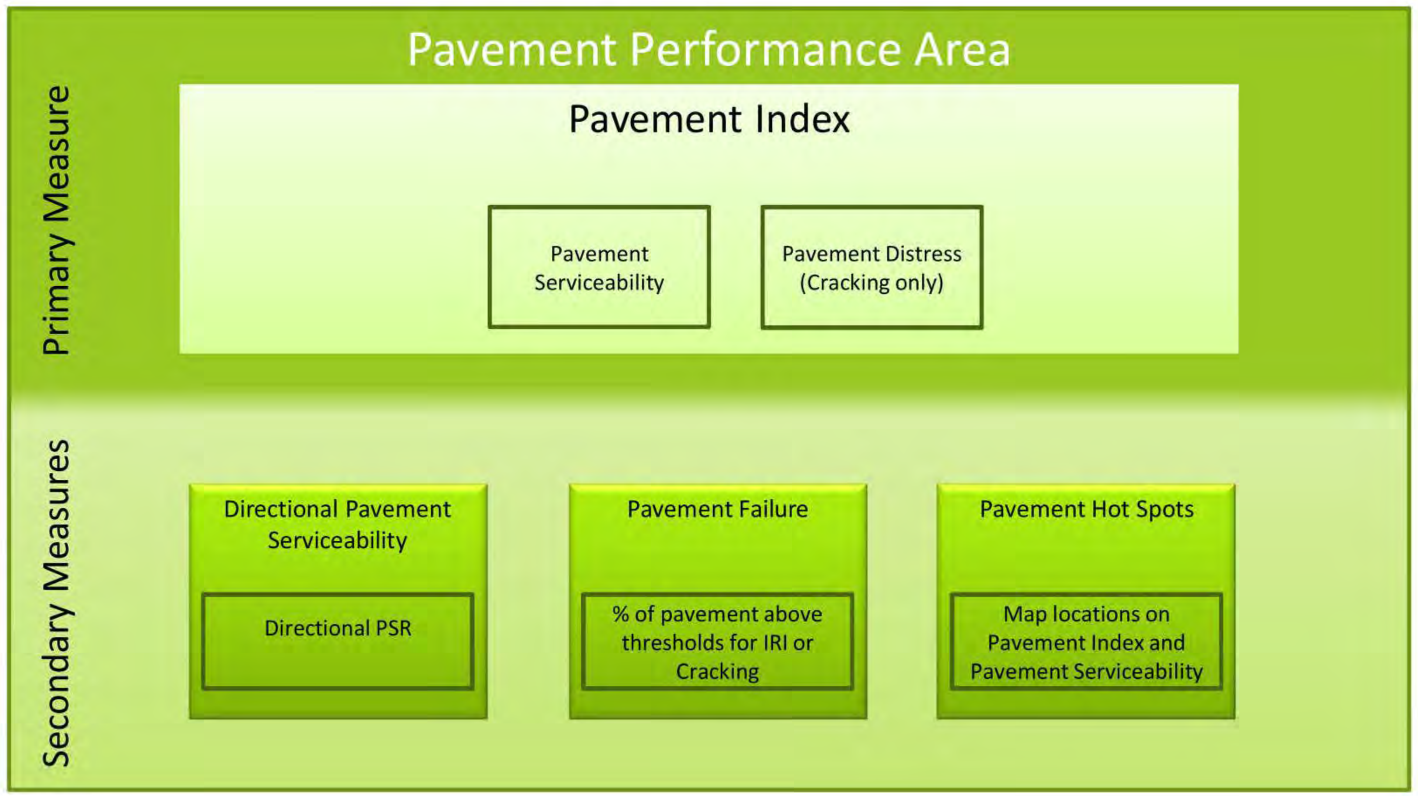
Figure 6: Performance Area Template



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 US 160 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 US 160 Corridor, the following operating environments were identified:

- Non-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:

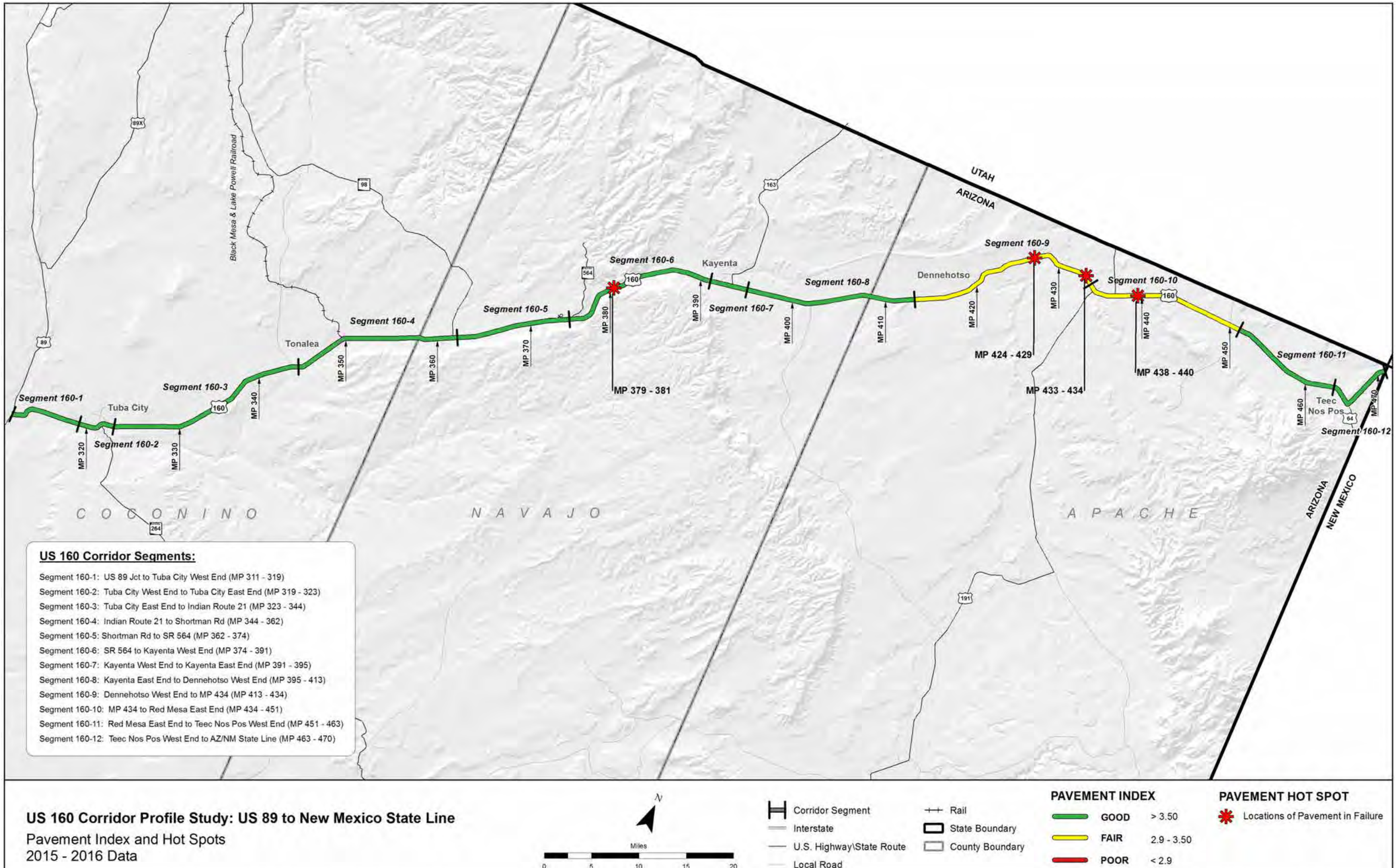
- Overall, based on the weighted average of the Pavement Index, the pavement is in “good” condition.
- According to the Pavement Index, the entire Pavement is in “good” condition except segments 160-9 and 160-10, which show “fair” performance.
- There are four failure hot spots along the corridor, one each located in segments 160-6 and 10, and two in segment 160-9
- 28.6% of the pavement area in segment 160-9 is considered to be in failure, i.e. above the failure thresholds for IRI or Cracking.
- The Pavement Serviceability in the eastbound (EB) and westbound (WB) directions is similar since the corridor is undivided. Directional PSR performance is “good”, with the exception of “fair” performance in segments 160-6 and 9.
- Segment 160-9 has the highest % Area Failure, and Directional PSR value is “fair”.

Table 5 summarizes the Pavement performance results for the US 160 Corridor. **Figure 8** illustrates the primary Pavement Index performance and locations of Pavement hot spots along the US 160 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
			EB	WB	
160-1	8	4.04	3.76		0.0%
160-2	4	3.87	3.59		0.0%
160-3	21	3.66	3.51		0.0%
160-4	18	4.16	4.04		0.0%
160-5	12	4.39	4.17		0.0%
160-6	17	3.60	3.40		11.8%
160-7	4	4.13	4.04		0.0%
160-8	18	4.03	3.88		0.0%
160-9	21	3.29	3.18		28.6%
160-10	17	3.45	3.76		11.8%
160-11	12	4.00	3.78		0.0%
160-12	7	4.13	4.03		0.0%
Weighted Corridor Average		3.82	3.70		6.29%
SCALES					
Performance Level		Non-Interstate			
Good		> 3.50	> 3.50		< 5%
Fair		2.90 - 3.50	2.90 - 3.50		5% - 20%
Poor		< 2.90	< 2.90		> 20%

Figure 8: Pavement Performance

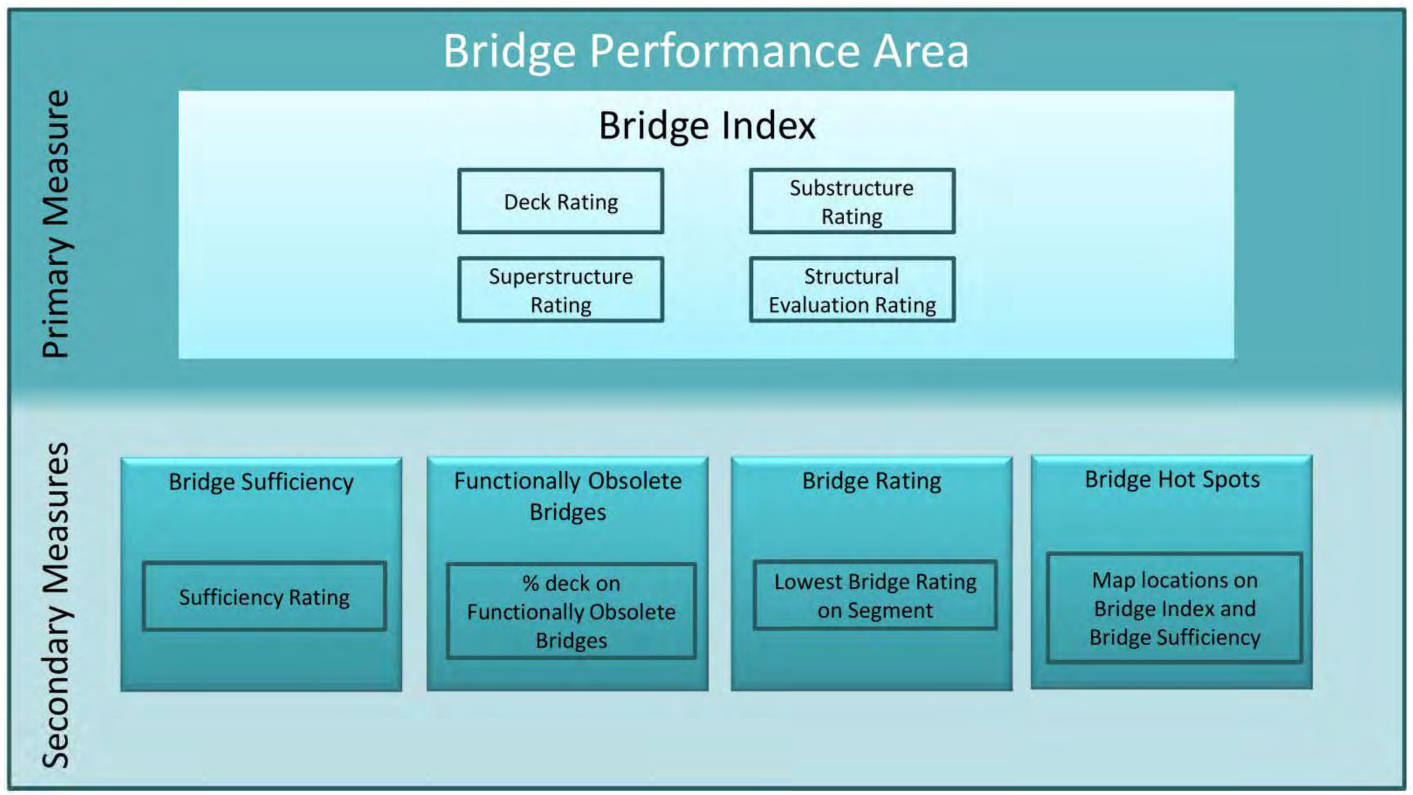


2.3 Bridge Performance Area

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 US 160 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



<u>Primary Bridge Index</u>

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.

<u>Secondary Bridge Measures</u>

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:

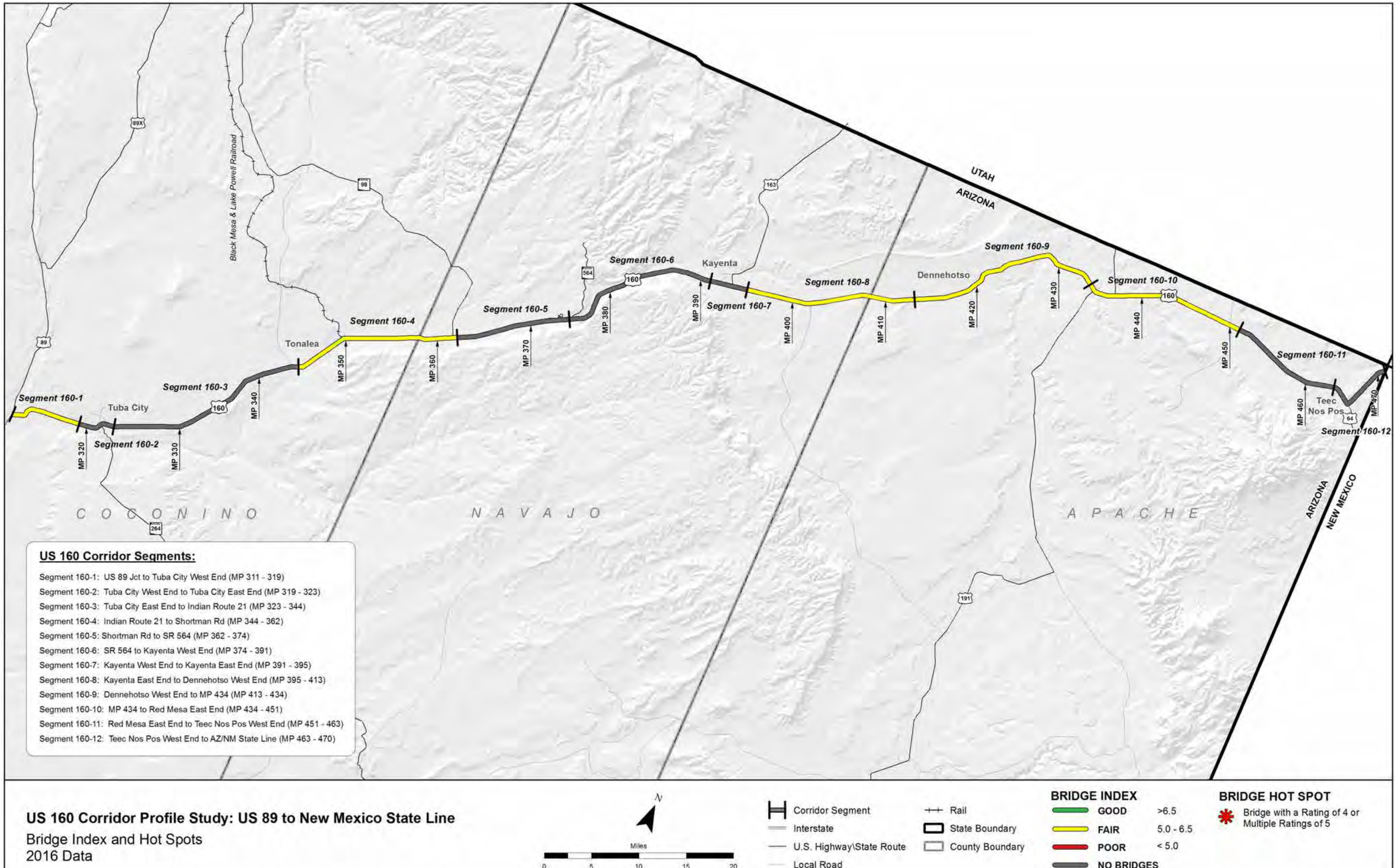
- Overall, based on the weighted average of the Bridge Index the corridor is performing in a "fair" manner. All the segments with bridges have "fair" performance level.
- There are no bridges located in seven out of the twelve segments, which are 160-2, 160-3, 160-5, 160-6, 160-7, 160-11, and 160-12.
- There are no bridges designated as structurally deficient along the corridor.
- There are no bridges with a sufficiency rating of "poor" in the corridor.
- There are three bridges (Hamblin Wash Bridge, Chinle Wash Bridge and Walker Creek Bridge) with a rating of 5 along the corridor, none of which have multiple 5 ratings.
- Three bridges (Begashibito Wash Bridge, Chinle Wash Bridge and Walker Creek Bridge) are rated as "Poor" due to higher percentage of deck area on functionally obsolete bridges.
- There are no bridge hot spots located throughout the entire corridor.

Table 6 summarizes the Bridge performance results for the US 160 Corridor. **Figure 10** illustrates the primary Bridge Index performance and locations of Bridge hot spots along the US 160 Corridor. Maps for each secondary measure can be found in **Appendix A.**

Table 6: Bridge Performance

Segment #	Segment Length (miles)	# of Bridges	Bridge Index	Sufficiency Rating	% of Deck Area on Functionally Obsolete Bridges	Lowest Bridge Rating
160-1	8	1	5.00	71.80	0.0%	5
160-2	4	0	No Bridges in Segment			
160-3	21	0	No Bridges in Segment			
160-4	18	1	6.00	64.30	100.0%	6
160-5	12	0	No Bridges in Segment			
160-6	17	0	No Bridges in Segment			
160-7	4	0	No Bridges in Segment			
160-8	18	1	6.00	83.70	0.0%	6
160-9	21	2	6.42	76.40	52.5%	5
160-10	17	1	5.00	62.70	100.0%	5
160-11	12	0	No Bridges in Segment			
160-12	7	0	No Bridges in Segment			
Weighted Corridor Average			5.81	72.55	34.33%	5.33
SCALES						
Performance Level			**ALL**			
Good			> 6.5	> 80	< 12%	> 6
Fair			5.0 – 6.5	50 - 80	12% - 40%	5 – 6
Poor			< 5.0	< 50	> 40 %	< 5

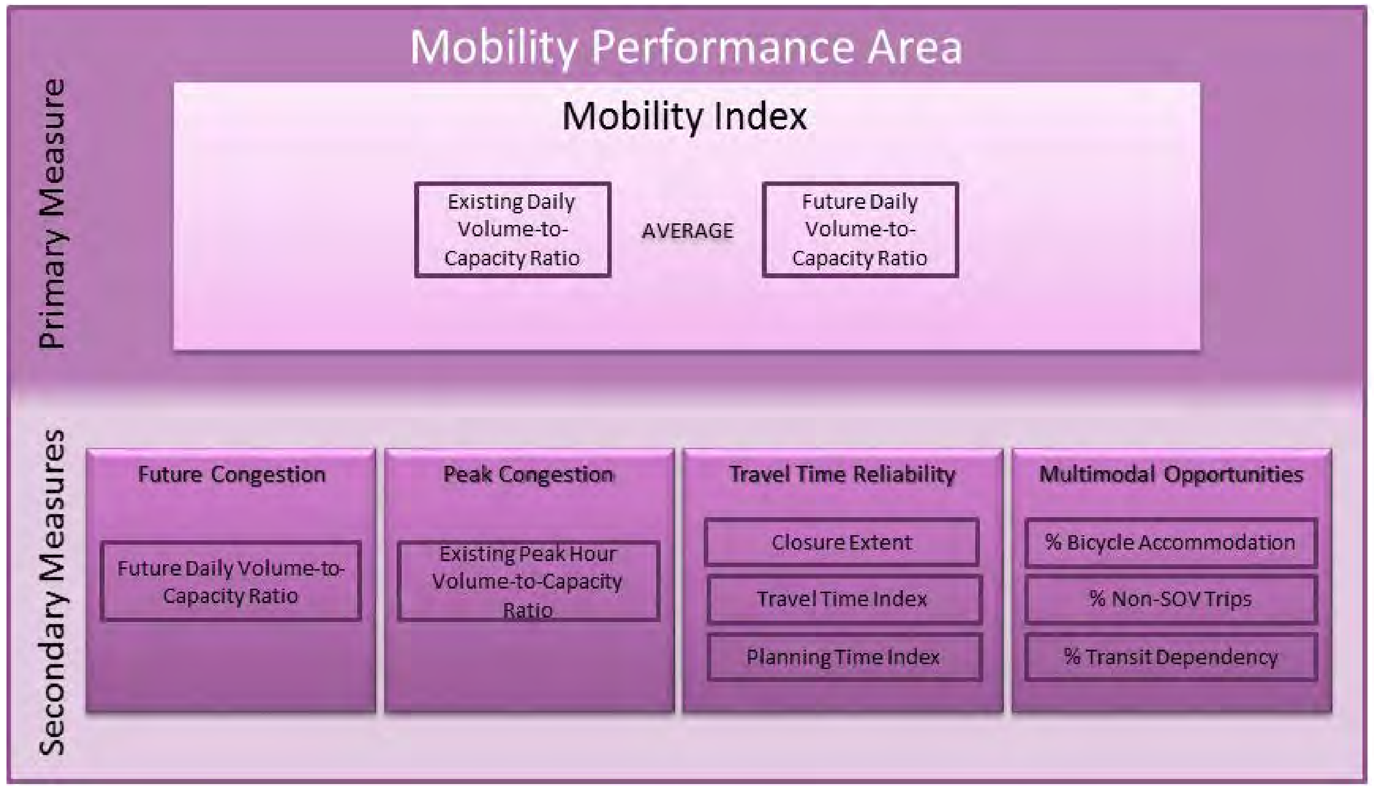
Figure 10: Bridge Performance



2.4 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 US 160 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 (2015) 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 US 160 Corridor, the following operating environments were identified:

- Rural Interrupted Flow: Segments 160-1, 160-2, 160-7 and 160-12
- Rural Uninterrupted Flow: Segments 160-3 through 160-6 and 160-8 through 160-11

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:
  - o 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
  - o 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 performance of traffic operations is “good”.
- The performance for existing peak hour traffic operations is “good” along the entire corridor.
- The performance of future traffic operations is anticipated to be “poor” in only one of the twelve segments, i.e. Segment 160-2. All other segments are anticipated to perform “good” with respect to their future traffic operations.
- Segment 160-2 has the highest Mobility Index and performs the worst in the Future V/C performance measure.
- A majority of the segments show “good” performance relative to the Closure Extent performance measure.
- Westbound segment 160-4 has the highest number of closures compared to all other segments.
- The Directional TTI measure shows “good” performance all along the corridor.
- The Directional PTI measure shows mixed performance along the corridor. Three segments, 160-6, 160-10, and 160-11, show “poor” performance in both the directions indicating that the segments are less reliable due to non-recurring congestion.
- All the segments show “poor” performance for accommodation of bicycles, except segment 160-2.
- Bicycles are not prohibited on any segment of the corridor; however, most of the segments have shoulder width less than 6 feet.
- A majority of the corridor shows “fair” or “poor” performance for non-SOV trips, meaning that many vehicles carry only a single occupant.
- Only segment 160-5 shows “good” performance for the percentage of Non-SOV Trips performance measure.

Table 7 summarizes the Mobility performance results for the US 160 Corridor. **Figure 12** illustrates the primary Mobility Index performance along the US 160 Corridor. Maps for each secondary measure can be found in **Appendix A**.

Table 7: Mobility Performance

Segment #	Segment Length (miles)	Mobility Index	Future Daily V/C	Existing Peak Hour V/C		Closure Extent (instances/milepost/year/mile)		Directional TTI (all vehicles)		Directional PTI (all vehicles)		% Bicycle Accommodation	% Non-Single Occupancy Vehicle (SOV)Trips
				EB	WB	EB	WB	EB	WB	EB	WB		
160-1*[2]	8	0.32	0.39	0.24	0.25	0.08	0.00	1.07	1.02	1.48	1.88	0%	14.2%
160-2*[2]	4	0.72	0.87	0.51	0.67	0.10	0.00	1.12	1.17	3.75	3.25	84%	14.2%
160-3^[2]	21	0.18	0.21	0.15	0.15	0.24	0.05	1.01	1.01	1.30	1.35	19%	12.7%
160-4^[2]	18	0.12	0.15	0.08	0.09	0.34	0.70	1.00	1.00	1.31	1.25	9%	14.7%
160-5^[2]	12	0.17	0.20	0.12	0.13	0.00	0.05	1.01	1.00	1.33	1.23	0%	17.5%
160-6^[2]	17	0.27	0.33	0.21	0.20	0.12	0.34	1.02	1.06	1.51	2.11	0%	15.9%
160-7*[2]	4	0.41	0.53	0.26	0.27	0.10	0.15	1.12	1.16	3.26	3.07	6%	6.9%
160-8^[2]	18	0.12	0.14	0.08	0.08	0.03	0.01	1.00	1.00	1.15	1.20	0%	7.2%
160-9^[2]	21	0.11	0.13	0.10	0.10	0.04	0.04	1.01	1.02	1.37	1.37	1%	12.1%
160-10^[2]	17	0.19	0.22	0.12	0.12	0.14	0.01	1.05	1.04	1.89	1.85	1%	16.7%
160-11^[2]	12	0.18	0.21	0.11	0.11	0.00	0.07	1.02	1.01	2.27	1.83	0%	0.0%
160-12*[2]	7	0.17	0.20	0.12	0.12	0.09	0.06	1.08	1.12	2.95	3.40	4%	0.0%
Weighted Corridor Average		0.19	0.23	0.14	0.15	0.12	0.14	1.03	1.03	1.65	1.69	6.2%	11.8%

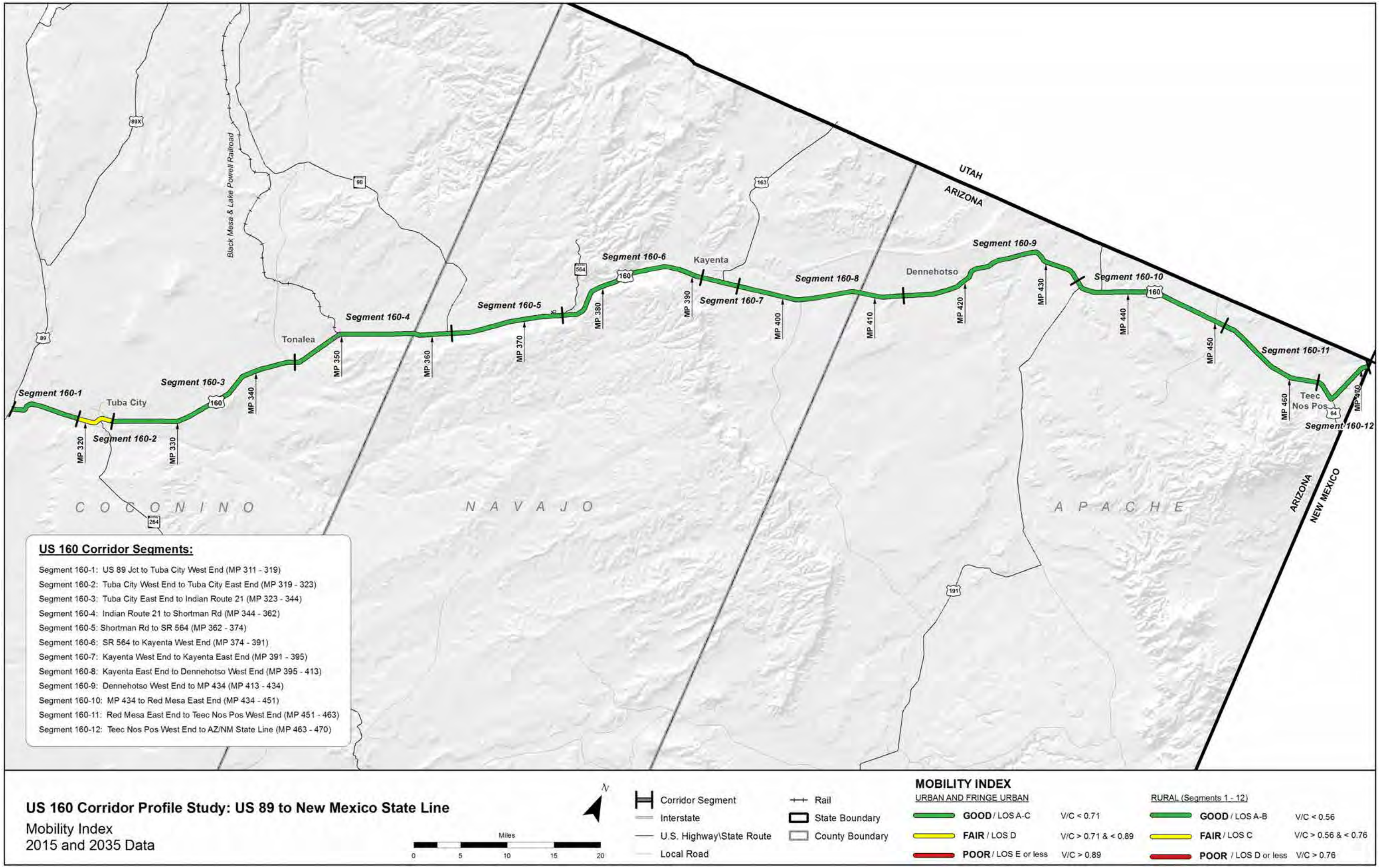
SCALES

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%

Interrupted Flow	
<1.30	<3.00
1.30-2.00	3.00-6.00
>2.00	>6.00

^Uninterrupted Flow Facility [1]Urban Operating Environment
*Interrupted Flow Facility [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 US 160 Corridor, the following operating environments were identified:

- 2 or 3 Lane Undivided Highway: all segments

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.

For the US 160 Corridor, it was determined that the crash unit type performance measures for crashes involving trucks, motorcycles and non-motorized travelers all have insufficient data (i.e., too small of a sample size) to generate reliable performance ratings. Therefore, these measures were not included in the performance evaluation for this corridor. Similarly, segments 160-2, 7, and 8 have insufficient data at the primary safety index to generate reliable performance ratings and were therefore not included in the performance evaluation.

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

- A total of 57 fatal and incapacitating injury crashes occurred along the US 160 Corridor from 2011-2015; of these crashes, 34 were fatal and 23 involved incapacitating injuries.
- Overall, based on the weighted average of the Safety Index, the corridor shows “below average” performance.
- For the Safety Index, the segments are about divided evenly among the two performance rating levels, with five segments showing “above average” performance, and four segments showing “below average” performance.
- Segments 160-3 and 160-10 perform “below average” in the Safety Index and both directions of travel for the Directional Safety Index, however, they perform “above average” in the Top 5 SHSP Emphasis Areas.
- All segments, except segment 160-3 and 160-10, have insufficient data to generate reliable performance ratings for the Top 5 SHSP Emphasis Areas performance measure
- Although the corridor has some “below average” performing segments, it does not have any Safety hot spots.

Table 8 summarizes the Safety performance results for the US 160 Corridor. **Figure 14** illustrates the primary Safety Index performance and locations of safety hot spots along the US 160 Corridor. Maps for each secondary measure can be found in **Appendix A**.

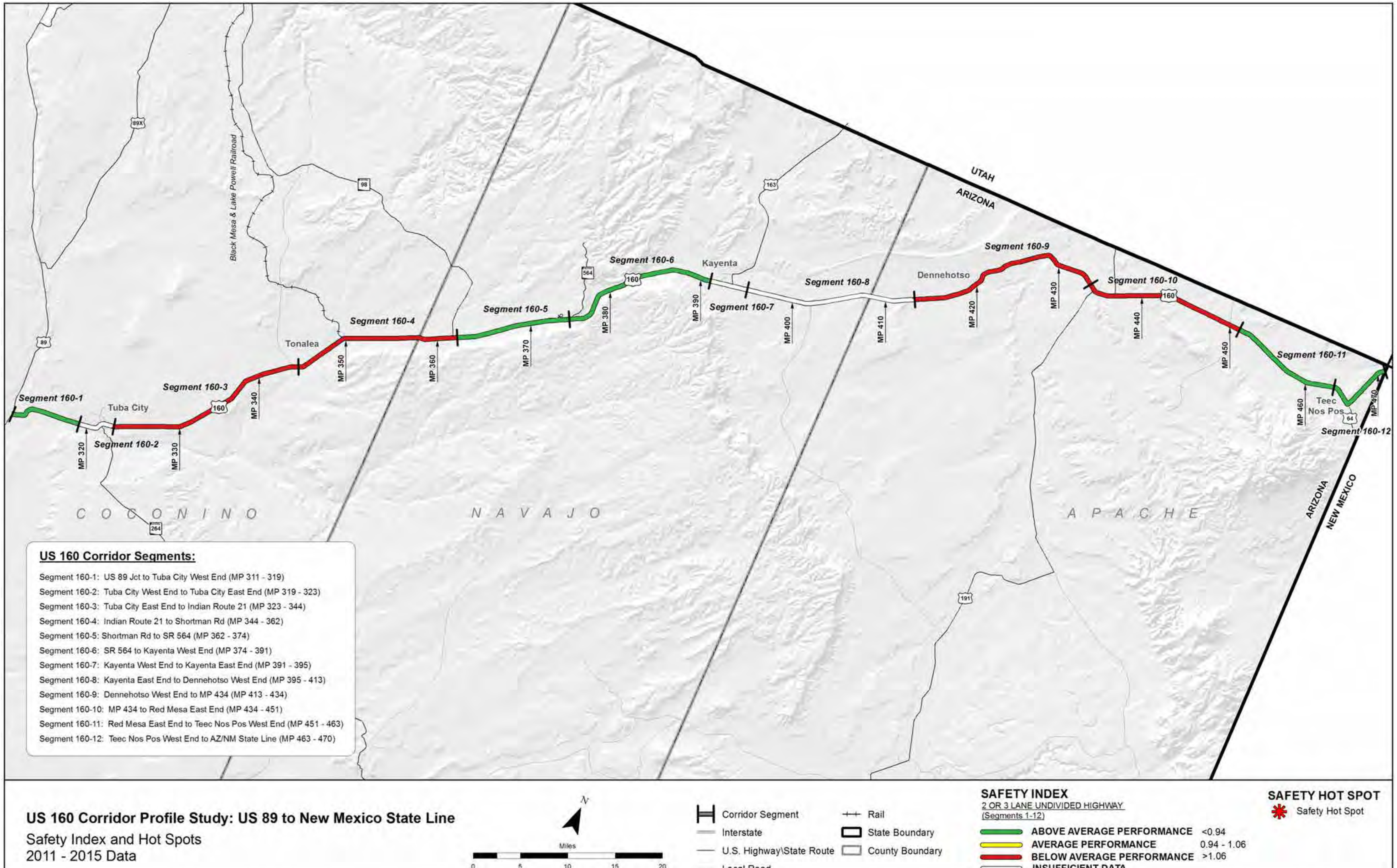
Table 8: Safety Performance

Segment #	Segment Length (miles)	Total Fatal & Incapacitating Injury Crashes (F/I)	Safety Index	Directional Safety Index		% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	% of Fatal + Incapacitating Injury Crashes Involving Trucks	% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers
				EB	WB				
160-1[e]	8	1/0	0.70	1.40	0.00	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
160-2[e]	4	1/0	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
160-3[e]	21	12/3	3.59	3.61	3.57	47%	Insufficient Data	Insufficient Data	Insufficient Data
160-4[e]	18	5/5	1.99	3.83	0.15	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
160-5[e]	12	0/1	0.04	0.00	0.07	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
160-6[e]	17	1/2	0.39	0.69	0.10	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
160-7[e]	4	1/2	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
160-8[e]	18	3/1	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
160-9[e]	21	4/0	1.43	0.72	2.14	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
160-10[e]	17	5/4	2.28	1.90	2.66	44%	Insufficient Data	Insufficient Data	Insufficient Data
160-11[e]	12	1/1	0.65	1.30	0.00	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
160-12[e]	7	0/4	0.37	0.37	0.37	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Weighted Corridor Average			1.53	1.75	1.30	46%	Insufficient Data	Insufficient Data	Insufficient Data
SCALES									
Performance Level			2 or 3 Lane Undivided Highway						
Above Average			< 0.94			< 51%	< 5.2%	< 18.5%	< 2.2%
Average			0.94 – 1.06			51% - 58%	5.2% - 7.1%	18.5% - 26.5%	2.2% - 4.2%
Below Average			> 1.06			> 58%	> 7.1%	> 26.5%	> 4.2%

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

[a]4 lane Freeway with Daily Volume < 25,000 [b]4 Lane Freeway with Daily Volume > 25,000 [c]2 or 3 or 4 Lane Divided Highway [d]4 or 5 Lane Undivided Highway [e]2 or 3 Lane Undivided Highway

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 relate 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 US 160 Corridor, the following operating environments were identified:

- Rural Interrupted Flow: Segments 160-1, 160-2, 160-7 and 160-12
- Rural Uninterrupted Flow: Segments 160-3 through 160-6 and 160-8 through 160-11

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 the freight mobility for the corridor and for each segment. The four secondary measures provide more detailed information to assess freight performance for each segment.

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

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

- Overall, based on the weighted average of the Freight Index, the freight mobility shows "fair" performance, with five segments performing "good", five segments performing "fair", and two segments performing "poor".
- All the segments show "good" performance for the Directional TTTI, except for segment 160-7 which shows a "fair" performance level.
- Majority of the segments along the corridor show "good" or "fair" performance for Directional TPTI, except segments 160-10 and 160-11.
- Segments 160-10 and 160-11 show "poor" performance level for Directional TPTI, as well as for Freight Index indicating that the segments are less reliable due to their non-recurring congestions.
- A majority of the segments show "good" performance in the Closure Duration performance measure.
- Segment 160-4 has the longest duration of closures compared to other segments of the corridor with a "fair" performance level in both the directions.
- There are no underpasses along the corridor.

Table 9 summarizes the Freight performance for the US 160 Corridor. **Figure 16** illustrates the primary freight index performance and locations of freight hot spots along US 160. Maps for each secondary measure can be found in **Appendix A.**

Table 9: Freight Performance

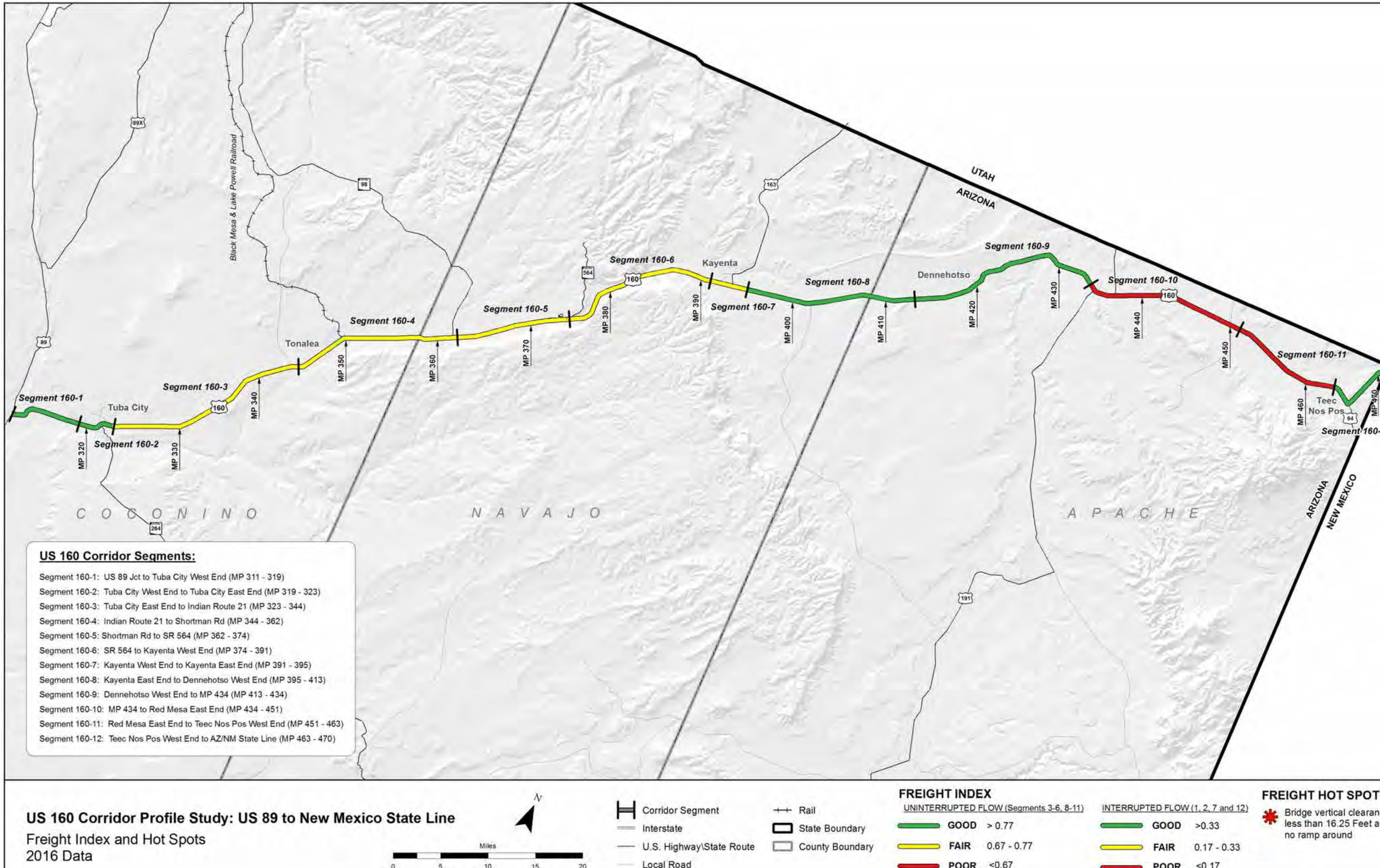
Segment #	Segment Length (miles)	Freight Index	Directional TTTI		Directional TPTI		Closure Duration (minutes/milepost closed/year/mile)		Bridge Vertical Clearance (feet)
			EB	WB	EB	WB	EB	WB	
160-1*[2]	8	0.47	1.20	1.15	1.84	2.39	10.33	0.00	No UP
160-2*[2]	4	0.34	1.17	1.24	2.43	3.49	12.05	0.00	No UP
160-3^[2]	21	0.68	1.07	1.11	1.48	1.47	56.37	9.00	No UP
160-4^[2]	18	0.76	1.07	1.08	1.24	1.40	74.91	93.23	No UP
160-5^[2]	12	0.77	1.09	1.06	1.36	1.25	0.00	15.85	No UP
160-6^[2]	17	0.69	1.10	1.13	1.41	1.48	22.76	59.93	No UP
160-7*[2]	4	0.22	1.34	1.34	3.98	5.28	18.85	14.75	No UP
160-8^[2]	18	0.82	1.05	1.08	1.18	1.26	9.33	5.26	No UP
160-9^[2]	21	0.81	1.06	1.06	1.21	1.25	10.24	8.38	No UP
160-10^[2]	17	0.49	1.13	1.10	2.25	1.86	35.48	4.65	No UP
160-11^[2]	12	0.48	1.15	1.11	1.74	2.39	0.00	9.30	No UP
160-12*[2]	7	0.44	1.19	1.17	2.17	2.33	19.89	26.43	No UP
Weighted Corridor Average		0.65	1.10	1.11	1.60	1.74	26.73	23.78	0.00

SCALES

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

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

Figure 16: Freight Performance



2.7 Corridor Performance Summary

Based on the results presented in the preceding sections, the following general observations were made related to the performance of the US 160 Corridor:

- Overall Performance: The Pavement and Mobility performance areas show generally "good" or "fair" performance; the Bridge performance area shows "fair" performance throughout; the Safety performance area shows generally "below average" performance; and the Freight performance area shows a mix of "good", "fair", and "poor" performance
- The pavement performance is generally in "good" except at a few isolated locations. One out of twelve segments shows "poor" performance for % Area Failure.
- The bridge performance is generally "fair" overall with only three bridges (Hamblin Wash Bridge, Chinle Wash Bridge and Walker Creek Bridge) that have a single rating of 5 along the corridor. Also, three bridges (Begashibito Wash Bridge, Chinle Wash Bridge and Walker Creek Bridge) rate as functionally obsolete in segments 160-4, 160-9, and 160-10.
- The Mobility Index along the corridor has "good" performance with no recurring delays and few non-recurring delays (Planning Time Index) in segment 160-6, 160-10, and 160-11.
- The closures along the corridor are generally in line with the statewide average for both the closure frequency and duration. However, there is one outlier with "poor" closure frequency, i.e. segment 160-4 in the westbound direction, which is mainly due to weather related closures higher than the statewide average.
- Overall, based on the weighted average of the Safety Index, the corridor performs "below average".
- The Freight Index weighted average indicates "fair" performance for the US 160 Corridor, however, segments 160-10 and 160-11 show "poor" performance level for Directional TPTI, as well as for Freight Index meaning the segments have "poor" travel time reliability due to non-recurring congestion.
- Lowest Performing Segments: Segments 160-10 shows "poor/below average" performance for many performance measures
- Highest Performing Segments: Segments 160-1 shows "good/above average" performance for many performance measures

Figure 17 shows the percentage of the US 160 Corridor that rates either "good/above average performance", "fair/average performance", or "poor/below average" performance for each primary measure. Approximately 76% of the corridor shows "good" performance in the Pavement Index. For the Bridge Index, 100% of the corridor shows "fair" performance. Approximately 97% of the corridor shows "good" performance in Mobility, while the remaining 3% shows "fair" performance. Almost half of the corridor (49%) for the Safety index shows "below average" performance, while 35% of the corridor shows "above average" performance. For the Freight Index, approximately 37% of the corridor shows "good" performance while 45% shows "fair" performance and 18% shows "poor" performance.

The lowest performance along the US 160 Corridor generally occurs in the Safety and Freight performance areas while the Pavement and Mobility have the highest performance.

Table 10 shows a summary of corridor performance for all primary measures and secondary measure indicators for the US 160 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

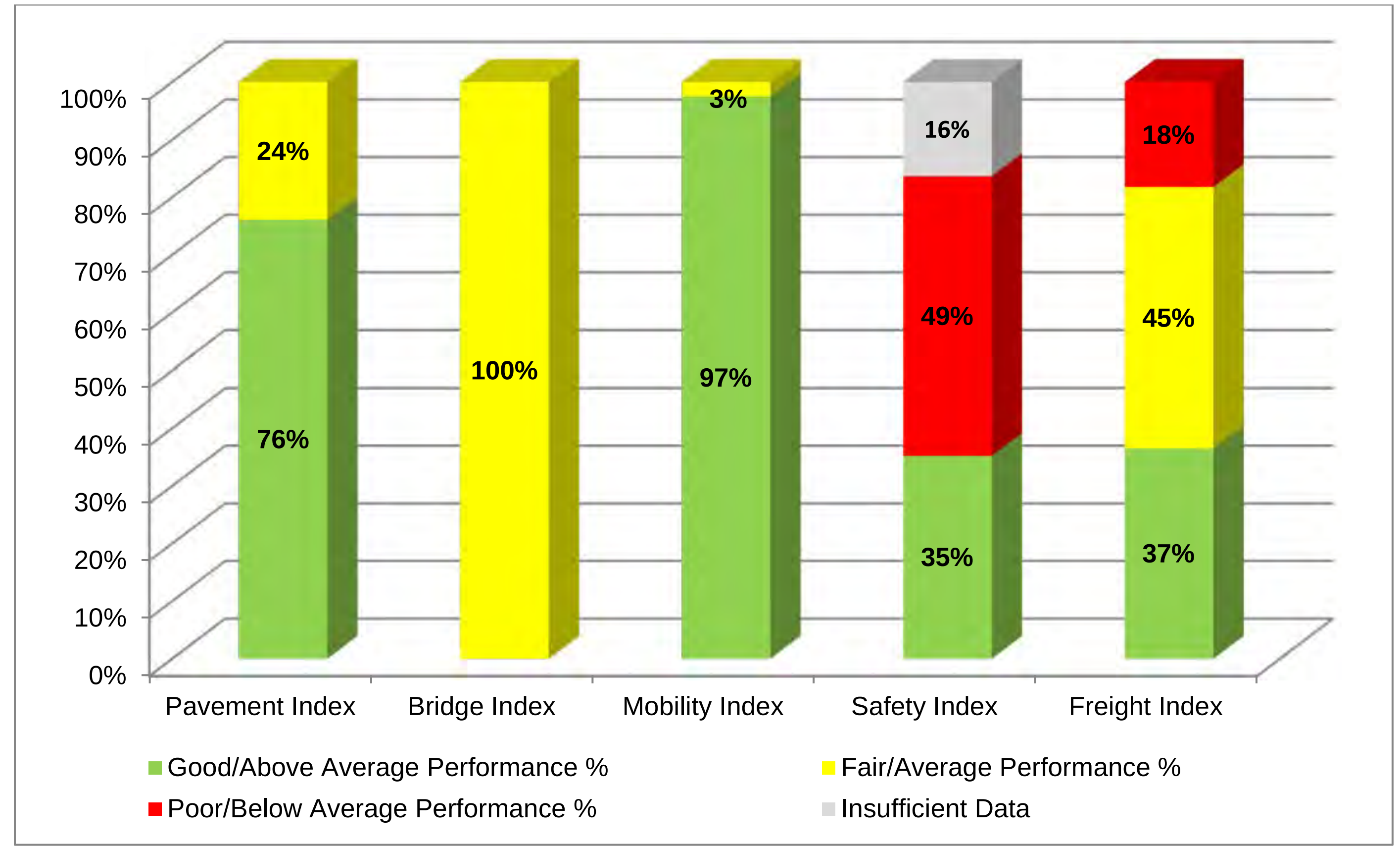
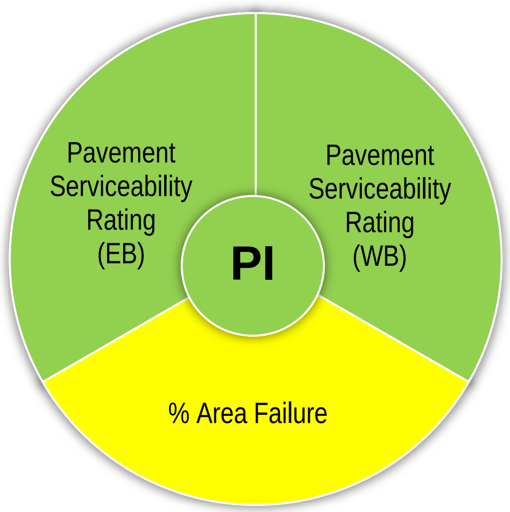


Figure 18: Corridor Performance Summary by Performance Measure

<table>
<tr><th>Pavement</th><th>Bridge</th><th>Mobility</th><th>Safety</th><th>Freight</th></tr>
<tr>
<td>
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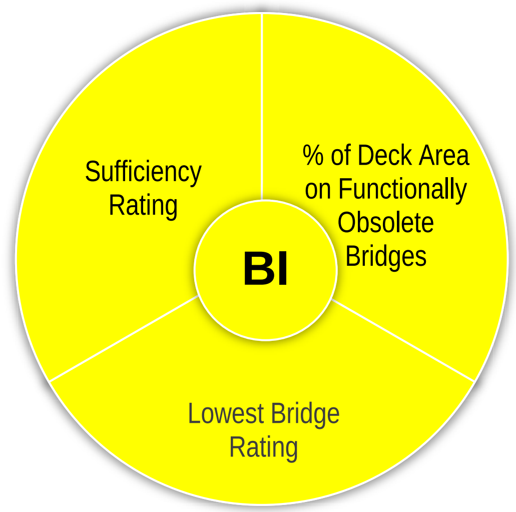
<td>
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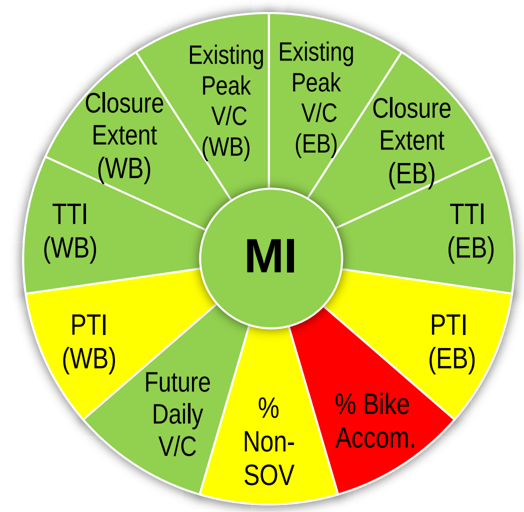
<td>
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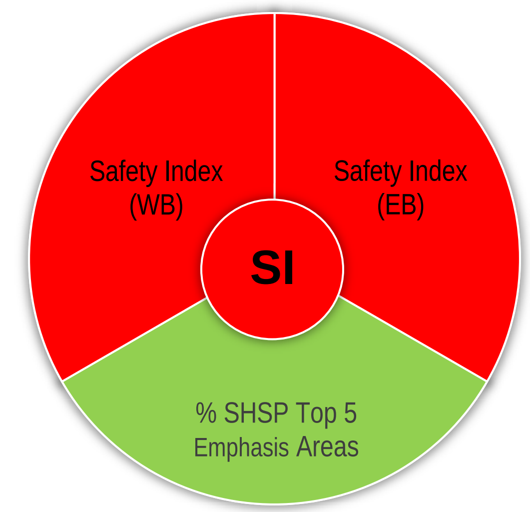
<td>
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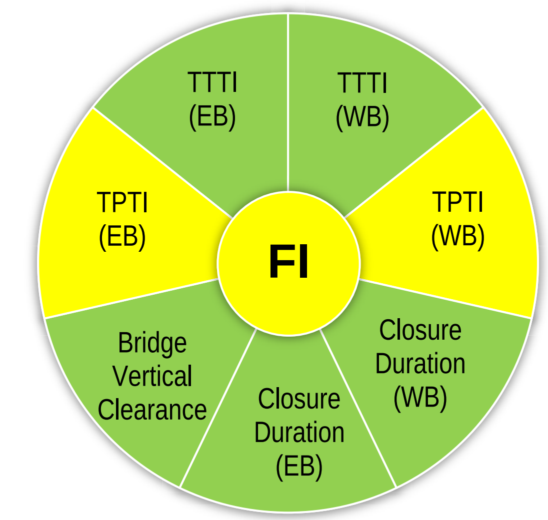
<td>
</td>
</tr>
<tr>
<td>Pavement Index (PI): based on two pavement condition ratings from the ADOT Pavement Database; the two ratings are the International Roughness Index (IRI) and the Cracking Rating.</td>
<td>Bridge Index (BI): based on four bridge condition ratings from the ADOT Bridge Database; the four ratings are the Deck Rating, Substructure Rating, Superstructure Rating, and Structural Evaluation Rating</td>
<td>Mobility Index (MI): an average of the existing daily volume-to-capacity (V/C) ratio and the projected 2035 daily V/C ratio</td>
<td>Safety Index (SI): combines the bi-directional frequency and rate of fatal and incapacitating injury crashes, compared to crash occurrences on similar roadways in Arizona</td>
<td>Freight Index (FI): a reliability performance measure based on the bi-directional planning time index for truck travel</td>
</tr>
<tr>
<td>➢ 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</td>
<td>➢ 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</td>
<td>➢ Future Daily V/C – the future 2035 V/C ratio provides a measure of future congestion if no capacity improvements are made to the corridor
➢ Existing Peak Hour V/C – the existing peak hour V/C ratio for each direction of travel provides a measure of existing peak hour congestion during typical weekdays
➢ Closure Extent – the average number of instances a particular milepost is closed per year per mile on a given segment of the corridor in a specific direction of travel
➢ Directional Travel Time Index (TTI) – the ratio of the average peak period travel time to the free-flow travel time; the TTI represents recurring delay along the corridor
➢ Directional Planning Time Index (PTI) – the ratio of the 95th percentile travel time to the free-flow travel time; the PTI represents non-recurring delay along the corridor
➢ % Bicycle Accommodation – the percentage of a segment that accommodates bicycle travel
➢ % Non-single Occupancy Vehicle (Non-SOV) Trips –the percentage of trips that are taken by vehicles carrying more than one occupant</td>
<td>➢ Directional Safety Index – the combination of the directional frequency and rate of fatal and incapacitating injury crashes, compared to crash occurrences on similar roadways in Arizona
➢ % of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors – the percentage of fatal and incapacitating crashes that involve at least one of the five Strategic Highway Safety Plan (SHSP) emphasis areas on a given segment compared to the statewide average percentage on roads with similar operating environments
➢ % of Fatal + Incapacitating Crashes Involving SHSP Crash Unit Types – the percentage of total fatal and incapacitating injury crashes that involves a given crash unit type (motorcycle, truck, non-motorized traveler) compared to the statewide average percentage on roads with similar operating environments</td>
<td>➢ Directional Truck Travel Time Index (TTTI) – the ratio of the average peak period truck travel time to the free-flow truck travel time; the TTTI represents recurring delay along the corridor
➢ Directional Truck Planning Time Index (TPTI) – the ratio the 95th percentile truck travel time to the free-flow truck travel time; the TPTI represents non-recurring delay along the corridor
➢ Closure Duration – the average time a particular milepost is closed per year per mile on a given segment of the corridor in a specific direction of travel
➢ Bridge Vertical Clearance – the minimum vertical clearance over the travel lanes for underpass structures on each segment</td>
</tr>
</table>

Table 10: Corridor Performance Summary by Segment and Performance Measure

Segment #	Length (miles)	Pavement Performance Area: Pavement Index	Directional PSR EB	Directional PSR WB	% Area Failure	Bridge Performance Area: Bridge Index	Sufficiency Rating	% Deck Area Functionally Obsolete	Lowest Bridge Rating	Mobility Performance Area: Mobility Index	Future Daily V/C	Existing Peak Hour V/C EB	Existing Peak Hour V/C WB	Closure Extent (instances/milepost/ year/mile) EB	Closure Extent (instances/milepost/ year/mile) WB	Directional TTI (all vehicles) EB	Directional TTI (all vehicles) WB	Directional PTI (all vehicles) EB	Directional PTI (all vehicles) WB	% Bicycle Accommo dation	% Non-Single Occupancy Vehicle (SOV) Trips
160-1*[e2]	8	4.04	3.76		0.0%	5.00	71.80	0.0%	5	0.32	0.39	0.24	0.25	0.08	0.00	1.07	1.02	1.48	1.88	0%	14.2%
160-2*[e2]	4	3.87	3.59		0.0%	No Bridges in Segment				0.72	0.87	0.51	0.67	0.10	0.00	1.12	1.17	3.75	3.25	84%	14.2%
160-3^[e2]	21	3.66	3.51		0.0%	No Bridges in Segment				0.18	0.21	0.15	0.15	0.24	0.05	1.01	1.01	1.30	1.35	19%	12.7%
160-4^[e2]	18	4.16	4.04		0.0%	6.00	64.30	100.0%	6	0.12	0.15	0.08	0.09	0.34	0.70	1.00	1.00	1.31	1.25	9%	14.7%
160-5^[e2]	12	4.39	4.17		0.0%	No Bridges in Segment				0.17	0.20	0.12	0.13	0.00	0.05	1.01	1.00	1.33	1.23	0%	17.5%
160-6^[e2]	17	3.60	3.40		11.8%	No Bridges in Segment				0.27	0.33	0.21	0.20	0.12	0.34	1.02	1.06	1.51	2.11	0%	15.9%
160-7*[e2]	4	4.13	4.04		0.0%	No Bridges in Segment				0.41	0.53	0.26	0.27	0.10	0.15	1.12	1.16	3.26	3.07	6%	6.9%
160-8^[e2]	18	4.03	3.88		0.0%	6.00	83.70	0.0%	6	0.12	0.14	0.08	0.08	0.03	0.01	1.00	1.00	1.15	1.20	0%	7.2%
160-9^[e2]	21	3.29	3.18		28.6%	6.42	76.40	52.5%	5	0.11	0.13	0.10	0.10	0.04	0.04	1.01	1.02	1.37	1.37	1%	12.1%
160-10^[e2]	17	3.45	3.76		11.8%	5.00	62.70	100.0%	5	0.19	0.22	0.12	0.12	0.14	0.01	1.05	1.04	1.89	1.85	1%	16.7%
160-11^[e2]	12	4.00	3.78		0.0%	No Bridges in Segment				0.18	0.21	0.11	0.11	0.00	0.07	1.02	1.01	2.27	1.83	0%	0.0%
160-12*[e2]	7	4.13	4.03		0.0%	No Bridges in Segment				0.17	0.20	0.12	0.12	0.09	0.06	1.08	1.12	2.95	3.40	4%	0.0%
Weighted Corridor Average		3.82	3.70		6.29%	5.81	72.55	34.33%	5.33	0.19	0.23	0.14	0.15	0.12	0.14	1.03	1.03	1.65	1.69	6.2%	11.8%
		SCALES																			
Performance Level		Non-Interstate				All				Urban (Rural)				All		Uninterrupted (Interrupted)				All	
Good/Above Average		> 3.50			< 5%	> 6.5	> 80	< 12%	> 6	< 0.71 (< 0.56)				< 0.22		< 1.15 (1.30)		<1.30 (3.00)		> 90%	> 17%
Fair/Average		2.90 - 3.50			5% - 20%	5.0 - 6.5	50 - 80	12% - 40%	5 – 6	0.71 - 0.89 (0.56 - 0.76)				0.22 – 0.62		1.15-1.33 (1.3-2)		1.30-1.50 (3-6)		60% - 90%	11% - 17%
Poor/Below Average		< 2.90			> 20%	< 5.0	< 50	> 40 %	< 5	> 0.89(> 0.76)				> 0.62		> 1.33 (2.00)		>1.50 (6.00)		< 60%	< 11%

^Uninterrupted Flow Facility
*Interrupted Flow Facility
[a]4 Lane Freeway with Daily Volume < 25,000
[b]4 Lane Freeway with Daily Volume > 25,000
[c]2 or 3 or 4 Lane Divided Highway
[d]4 or 4 Lane Undivided Highway
[e]2 or 3 Lane Undivided Highway
[1]Urban Operating Environment
[2]Rural Operating Environment

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

Segment #	Length (miles)	Safety Performance Area							Freight Performance Area							
		Safety Index	Directional Safety Index		% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	% of Fatal + Incapacitating Injury Crashes Involving Trucks	% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers	Freight Index	Directional TTI (trucks only)		Directional PTI (trucks only)		Closure Duration (minutes/milepost closed/year/mile)		Bridge Vertical Clearance (feet)
			EB	WB						EB	WB	EB	WB	EB	WB	
160-1*[e2]	8	0.70	1.40	0.00	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.47	1.20	1.15	1.84	2.39	10.33	0.00	No UP
160-2*[e2]	4	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.34	1.17	1.24	2.43	3.49	12.05	0.00	No UP
160-3^[e2]	21	3.59	3.61	3.57	47%	Insufficient Data	Insufficient Data	Insufficient Data	0.68	1.07	1.11	1.48	1.47	56.37	9.00	No UP
160-4^[e2]	18	1.99	3.83	0.15	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.76	1.07	1.08	1.24	1.40	74.91	93.23	No UP
160-5^[e2]	12	0.04	0.00	0.07	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.77	1.09	1.06	1.36	1.25	0.00	15.85	No UP
160-6^[e2]	17	0.39	0.69	0.10	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.69	1.10	1.13	1.41	1.48	22.76	59.93	No UP
160-7*[e2]	4	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.22	1.34	1.34	3.98	5.28	18.85	14.75	No UP
160-8^[e2]	18	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.82	1.05	1.08	1.18	1.26	9.33	5.26	No UP
160-9^[e2]	21	1.43	0.72	2.14	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.81	1.06	1.06	1.21	1.25	10.24	8.38	No UP
160-10^[e2]	17	2.28	1.90	2.66	44%	Insufficient Data	Insufficient Data	Insufficient Data	0.49	1.13	1.10	2.25	1.86	35.48	4.65	No UP
160-11^[e2]	12	0.65	1.30	0.00	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.48	1.15	1.11	1.74	2.39	0.00	9.30	No UP
160-12*[e2]	7	0.37	0.37	0.37	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.44	1.19	1.17	2.17	2.33	19.89	26.43	No UP
Weighted Corridor Averages		1.53	1.75	1.30	46%	Insufficient Data	Insufficient Data	Insufficient Data	0.65	1.10	1.11	1.60	1.74	26.73	23.78	No UP
SCALES																
Performance Level		2 or 3 Lane Undivided							Uninterrupted (Interrupted)							
Good/Above Average		< 0.94			< 51%	< 5.2%	< 18.5%	< 2.2%	> 0.77 (0.33)	<1.15 (1.30)		<1.30 (3.00)		< 44.18		> 16.5
Fair/Average		0.94 – 1.06			51% - 58%	5.2% - 7.1%	18.5% - 26.5%	2.2% - 4.2%	0.67-0.77 (.17-.33)	1.15-1.33 (1.3-2)		1.30-1.50 (3-6)		44.18 -124.86		16.0-16.5
Poor/Below Average		> 1.06			> 58%	> 7.1%	> 26.5%	> 4.2%	< 0.67 (.17)	>1.33 (2.00)		>1.50 (6.00)		> 124.86		< 16.0

^Uninterrupted Flow Facility

*Interrupted Flow Facility

[a]4 Lane Freeway with Daily Volume < 25,000

[b]4 Lane Freeway with Daily Volume > 25,000

[c]2 or 3 or 4 Lane Divided Highway

[d]4 or 4 Lane Undivided Highway

[e]2 or 3 Lane Undivided Highway

[1]Urban Operating Environment

[2]Rural Operating Environment

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

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

3.0 NEEDS ASSESSMENT

3.1 Corridor Objectives

Statewide goals and performance measures were established by the goals and objectives contained in the ADOT Long-Range Transportation Plan (LRTP), 2010-2035 which were updated in 2017. Statewide performance goals that are relevant to US 160 performance areas were identified and corridor goals were then formulated for each of the five performance areas that aligned with the overall statewide goals established by the LRTP. Based on stakeholder input, corridor goals, corridor objectives, and performance results, three “Emphasis Areas” were identified for the US 160 Corridor: Pavement, 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 US 160 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 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	US 160 Corridor Goals	US 160 Corridor Objectives	Performance Area	Primary Measure / Secondary Measure Indicators	Performance Objective: Corridor Average	Performance Objective: Segment
Improve Mobility, Reliability, and Accessibility **Make Cost Effective Investment Decisions and Support Economic Vitality**	Provide a safe and reliable route for tourist travel to/from four corners Provide safe, reliable and efficient connection to all communities along the corridor to permit efficient regional and local travel throughout the Navajo Indian Reservation	Maintain current levels of service for communities located along the corridor Plan to mitigate future congestion that accounts for anticipated growth and land use changes Reduce delays from recurring and non-recurring events to improve reliability Improve bicycle and pedestrian accommodations	Mobility (*Emphasis Area*)	Mobility Index	Good	Fair or better
				Future Daily V/C		
				Existing Peak Hour V/C		
				Closure Extent		
				Directional Travel Time Index		
				Directional Planning Time Index		
				% Bicycle Accommodation		
				% Non-SOV Trips		
	Provide a safe, reliable and efficient freight route between Arizona, Colorado, Utah and New Mexico	Reduce delays and restrictions to freight movement to improve reliability Improve travel time reliability (including impacts to motorists due to freight traffic)	Freight	Freight Index	Fair or better	Fair or better
				Directional Truck Travel Time Index		
				Directional Truck Planning Time Index		
				Closure Duration		
				Bridge Vertical Clearance		
Preserve and Maintain the System	Preserve and modernize highway infrastructure	Maintain structural integrity of bridges along the corridor	Bridge	Bridge Index	Fair or better	Fair or better
				Sufficiency Rating		
				% of Deck Area on Functionally Obsolete Bridges		
				Lowest Bridge Rating		
		Improve pavement ride quality for all corridor users Reduce long-term pavement maintenance costs	Pavement (*Emphasis Area)*	Pavement Index	Good	Fair or better
				Directional Pavement Serviceability Rating		
				% Area Failure		
Enhance Safety	Provide a safe, reliable, and efficient connection Tuba City, Kayenta, and Dennehotso Promote safety by implementing appropriate countermeasures	Reduce fatal and incapacitating injury crashes for all roadway users Maintain safety records to track performance over time	Safety (*Emphasis Area)*	Safety Index	Above Average	Average or better
				Directional Safety Index		
				% of Crashes Involving SHSP Top 5 Emphasis Areas Behaviors		
				% of Crashes Involving Crash Unit Types		

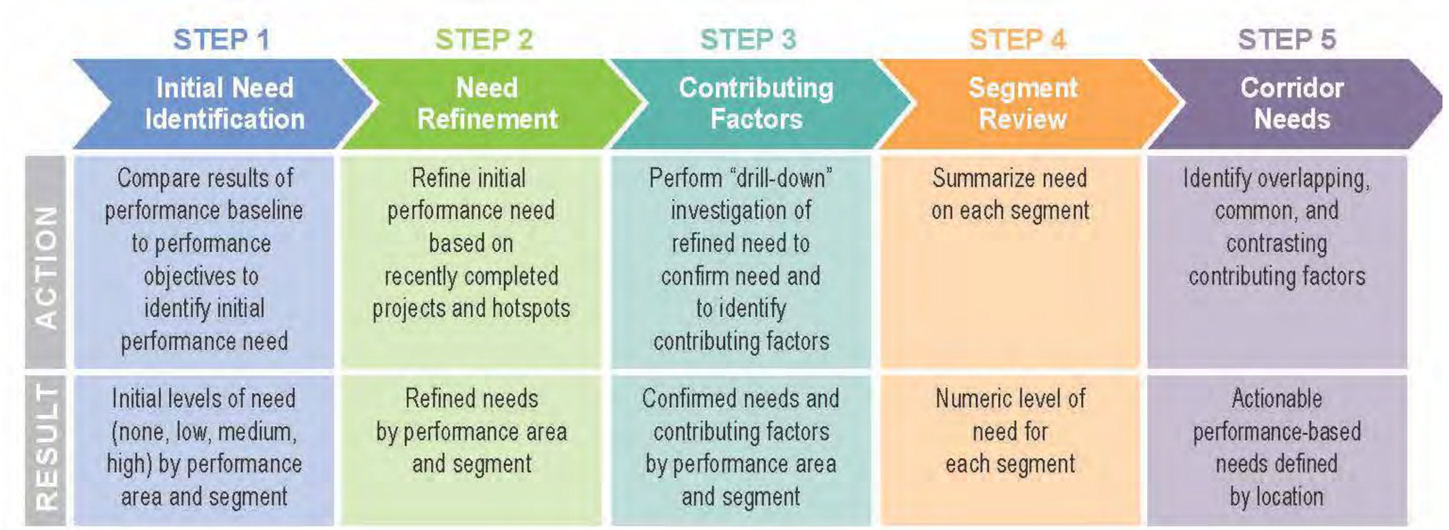
3.2 Needs Assessment Process

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
	Good	None*	All levels of Good and top 1/3 of Fair (>6.0)
	Good		
6.5	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 final need rating for each segment. Values of 0, 1, 2, and 3 are assigned to the initial need levels of None, Low, Medium, and High, respectively. A weight of 1.0 is applied to the Performance Index need and equal weights of 0.20 are applied to each need for each secondary performance measure. For directional secondary performance measures, each direction of travel receives a weight of 0.10.

Step 2: Need Refinement

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

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

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

Step 3: Contributing Factors

In Step 3, a more detailed review of the condition and performance data available from ADOT is conducted to identify contributing factors to the need. Typically, the same databases used to develop the baseline performance serve as the principle 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
- AZ Travel Demand Model (AZTDM)
- Real time traffic conditions database 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 were considered to help identify the contributing factors such as:

- Maintenance history (from ADOT PeCoS for pavement), the level of past investments, or trends in historical data were used to help provide context for pavement and bridge history.
- Field observations from ADOT district personnel could 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 were 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 was 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 will result 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 the analysis are shown in **Table 12** through **Table 16**.

Pavement Needs Refinements and Contributing Factors

- Pavement hot spots were identified in Segments 160-6, 160-9, and 160-10.
- There were no recently completed paving projects that addressed the Needs of the three identified segments; hence the final needs were similar to the initial segment needs.
- The final pavement needs for segments 160-6 and 160-11 was classified as Low, and segment 160-9 as Medium.
- 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				
		EB	WB					
160-1	4.04	3.76	3.76	0.00%	0.00	None	None	None*
160-2	3.87	3.59	3.59	0.00%	0.00	None	None	None*
160-3	3.66	3.51	3.51	0.00%	0.00	None	None	None*
160-4	4.16	4.04	4.04	0.00%	0.00	None	None	None*
160-5	4.39	4.17	4.17	0.00%	0.00	None	None	None*
160-6	3.60	3.40	3.40	11.80%	0.20	MP 379-381	None	Low
160-7	4.13	4.04	4.04	0.00%	0.00	None	None	None*
160-8	4.03	3.88	3.88	0.00%	0.00	None	None	None*
160-9	3.29	3.18	3.18	28.60%	1.80	MP 424-429, MP 433-434	None	Medium
160-10	3.45	3.76	3.76	11.80%	0.20	MP 438-440	None	Low
160-11	4.00	3.78	3.78	0.00%	0.00	None	None	None*
160-12	4.13	4.03	4.03	0.00%	0.00	None	None	None*

Level of Need (Score)	Performance Score Need Scale		Segment Level Need Scale
None* (0)	> 3.30	< 10%	0
Low (1)	3.10 – 3.30	10% - 15%	< 1.5
Medium (2)	2.70 – 3.10	15% - 25%	1.5 – 2.5
High (3)	< 2.70	> 25%	> 2.5

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

Bridge Needs Refinement and Contributing Factors

- Bridge needs occur due to under-performing bridges on four of the five segments with bridges.
- Bridge needs were identified at four of the total six bridges.
- Segments 160-4 and 160-9 were identified with Low needs, segment 160-1 with Medium needs, and 160-10 with High needs.
- Segment 160-9 has one recently completed project for the Laguna Creek Bridge, however, that does not change the final segment needs because the segment has one more bridge, Chinle Wash Bridge, with a deck rating of 5.
- Segment 160-10 has one bridge with a 100% functionally obsolete deck area which creates High needs for the segment.
- 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	% of Deck on Functionally Obsolete Bridges	Lowest Bridge Rating				
160-1	5.00	71.80	0.0%	5.0	2.2	None	None	Medium
160-2	No Bridges				None	None	None	None*
160-3	No Bridges				None	None	None	None*
160-4	6.00	64.30	100.0%	6.0	0.5	None	None	Low
160-5	No Bridges				None	None	None	None*
160-6	No Bridges				None	None	None	None*
160-7	No Bridges				None	None	None	None*
160-8	6.00	83.70	0.0%	6.0	0.0	None	None	None*
160-9	6.42	76.40	52.5%	5.0	0.5	None	FY17 H8913: Laguna Creek Bridge STR #20001, Construct Scour Retrofit (MP 420)	Low
160-10	5.00	62.70	100.0%	5.0	2.7	None	None	High
160-11	No Bridges				None	None	None	None*
160-12	No Bridges				None	None	None	None*

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

- Low Mobility needs were identified on eleven of the twelve segments.
- High Mobility needs were identified on segment 160-2 primarily due to the Mobility Index score and Future Daily V/C (congestion).
- A majority of the needs are due to lesser percentage of Bicycle Accommodation and directional PTI issues.
- 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			
			EB	WB	EB	WB	EB	WB	EB	WB				
160-1[b]	0.32	0.39	0.24	0.25	0.08	0.00	1.07	1.02	1.48	1.88	0%	0.6	None	Low
160-2[b]	0.72	0.87	0.51	0.67	0.10	0.00	1.12	1.17	3.75	3.25	84%	2.7	None	High
160-3[a]	0.18	0.21	0.15	0.15	0.24	0.05	1.01	1.01	1.30	1.35	19%	0.6	None	Low
160-4[a]	0.12	0.15	0.08	0.09	0.34	0.70	1.00	1.00	1.31	1.25	9%	0.8	None	Low
160-5[a]	0.17	0.20	0.12	0.13	0.00	0.05	1.01	1.00	1.33	1.23	0%	0.6	None	Low
160-6[a]	0.27	0.33	0.21	0.20	0.12	0.34	1.02	1.06	1.51	2.11	0%	1.1	None	Low
160-7[b]	0.41	0.53	0.26	0.27	0.10	0.15	1.12	1.16	3.26	3.07	6%	0.6	None	Low
160-8[a]	0.12	0.14	0.08	0.08	0.03	0.01	1.00	1.00	1.15	1.20	0%	0.6	None	Low
160-9[a]	0.11	0.13	0.10	0.10	0.04	0.04	1.01	1.02	1.37	1.37	1%	0.8	None	Low
160-10[a]	0.19	0.22	0.12	0.12	0.14	0.01	1.05	1.04	1.89	1.85	1%	1.2	None	Low
160-11[a]	0.18	0.21	0.11	0.11	0.00	0.07	1.02	1.01	2.27	1.83	0%	1.2	None	Low
160-12[b]	0.17	0.20	0.12	0.12	0.09	0.06	1.08	1.12	2.95	3.40	4%	0.6	None	Low

Level of Need (Score)	Performance Score Need Scale					Segment Level Need Scale
None* (0)	≤ 0.77 (Urban) ≤ 0.63 (Rural)	< 0.35	< 1.21[a] < 1.53[b]	< 1.37[a] < 4.00[b]	> 80%	0
Low (1)	0.77 - 0.83 (Urban) 0.63 - 0.69 (Rural)	0.35 – 0.49	1.21 – 1.27[a] 1.53 – 1.77[b]	1.37 – 1.43[a] 4.00 – 5.00[b]	70% - 80%	< 1.5
Medium (2)	0.83 - 0.95 (Urban) 0.69 - 0.83 (Rural)	0.49 – 0.75	1.27 – 1.39[a] 1.77 – 2.23[b]	1.43 – 1.57[a] 5.00 – 7.00[b]	50% - 70%	1.5 - 2.5
High (3)	≥ 0.95 (Urban) ≥ 0.83 (Rural)	> 0.75	> 1.39[a] > 2.23[b]	> 1.57[a] > 7.00[b]	< 50%	> 2.5

a: Uninterrupted b: Interrupted

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 Refinement and Contributing Factors

- High and Low Safety Needs were identified on six of the twelve segments.
- Segments 160-3, 160-4, 160-9, and 160-10 were identified with High final needs, and segments 160-1 and 160-11 were identified with Low final needs.
- There are no safety hot spots along the corridor.
- All the segment safety needs are mainly caused due to a higher Safety Index score.
- Segments 160-2, 160-7 and 160-8 had insufficient data due to the small number of crashes, making it difficult to provide reliable analysis results.
- 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				
		EB	WB					
160-1[e]	0.70	1.40	0.00	Insufficient Data	0.3	None	None	Low
160-2[e]	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.0	None	None	None*
160-3[e]	3.59	3.61	3.57	47%	3.6	None	FY15 H803701C: US 160 at N21, US 160/ N21 Intersection Lighting (MP 343/343.7) FY14 H8037: Tonalea, Install Intersection Lighting (MP 343.4)	High
160-4[e]	1.99	3.83	0.15	Insufficient Data	3.3	None	None	High
160-5[e]	0.04	0.00	0.07	Insufficient Data	0.0	None	None	None*
160-6[e]	0.39	0.69	0.10	Insufficient Data	0.0	None	None	None*
160-7[e]	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.0	None	None	None*
160-8[e]	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	0.0	None	None	None*
160-9[e]	1.43	0.72	2.14	Insufficient Data	3.3	None	None	High
160-10[e]	2.28	1.90	2.66	44%	3.6	None	None	High
160-11[e]	0.65	1.30	0.00	Insufficient Data	0.3	None	None	Low
160-12[e]	0.37	0.37	0.37	Insufficient Data	0.0	None	None	None*

Level of Need (Score)		Performance Score Needs Scale		Segment Level Need Scale
None* (0)	a	≤ 0.91	≤ 46%	0
	b	≤ 0.89	≤ 46%	
	c	≤ 0.92	≤ 47%	
	d	≤ 0.93	≤ 45%	
	e	≤ 0.98	< 53%	
Low (1)	a	0.91 - 1.09	46% - 49%	≤ 1.5
	b	0.89 - 1.1	46% - 51%	
	c	0.92 - 1.07	47% - 50%	
	d	0.93 - 1.06	45% - 48%	
	e	0.98 - 1.02	53% - 55%	
Medium (2)	a	1.09 – 1.45	49% - 56%	1.5 - 2.5
	b	1.1 – 1.53	51% - 52%	
	c	1.07 – 1.38	50% - 57%	
	d	1.06 - 1.33	48% - 54%	
	e	1.02 – 1.10	55% - 59%	
High (3)	a	≥ 1.45	≥ 56%	≥ 2.5
	b	≥ 1.53	≥ 62%	
	c	≥ 1.38	≥ 57%	
	d	≥ 1.33	≥ 54%	
	e	≥ 1.10	≥ 59%	

a: 4 Lane Freeway with Daily Volume <25,000
b: 4 Lane Freeway with Daily Volume >25,000
c: 2 or 3 or 4 Lane Divided Highway
d: 4 or 5 Lane Undivided Highway
e: 2 or 3 Lane Undivided Highway

**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 Refinement and Contributing Factors

- Freight needs were identified on six of the twelve segments.
- Freight needs are Medium for segments 160-3, 160-6, and 160-7, and Low for segment 160-4.
- Segments 160-10 and 160-11 showed elevated values for Freight Index and directional TPTI, thereby creating High needs for the segments.
- Closure durations are higher than the statewide average in segment 160-4, translating to Low needs.
- There are no underpasses along the corridor.
- 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				
		EB	WB	EB	WB	EB	WB					
160-1[b]	0.47	1.20	1.15	1.84	2.39	10.33	0.00	No UP	0.0	None	None	None*
160-2[b]	0.34	1.17	1.24	2.43	3.49	12.05	0.00	No UP	0.0	None	None	None*
160-3[a]	0.68	1.07	1.11	1.48	1.47	56.37	9.00	No UP	2.4	None	None	Medium
160-4[a]	0.76	1.07	1.08	1.24	1.40	74.91	93.23	No UP	0.3	None	None	Low
160-5[a]	0.77	1.09	1.06	1.36	1.25	0.00	15.85	No UP	0.0	None	None	None*
160-6[a]	0.69	1.10	1.13	1.41	1.48	22.76	59.93	No UP	2.3	None	None	Medium
160-7[b]	0.22	1.34	1.34	3.98	5.28	18.85	14.75	No UP	2.2	None	None	Medium
160-8[a]	0.82	1.05	1.08	1.18	1.26	9.33	5.26	No UP	0.0	None	None	None*
160-9[a]	0.81	1.06	1.06	1.21	1.25	10.24	8.38	No UP	0.0	None	None	None*
160-10[a]	0.49	1.13	1.10	2.25	1.86	35.48	4.65	No UP	3.6	None	None	High
160-11[a]	0.48	1.15	1.11	1.74	2.39	0.00	9.30	No UP	3.6	None	None	High
160-12[b]	0.44	1.19	1.17	2.17	2.33	19.89	26.43	No UP	0.0	None	None	None*

Level of Need (Score)		Performance Score Need Scale					Segment Level Need Scale
None* (0)	a b	> 0.74 > 0.28	< 1.21 < 1.53	< 1.37 < 4.00	< 71.07	> 16.33	0
Low (1)	a b	0.70 - 0.74 0.22 – 0.28	1.21 - 1.27 1.53 – 1.77	1.37 - 1.43 4.00 – 5.00	71.07 - 97.97	16.17 - 16.33	< 1.5
Medium (2)	a b	0.64 - 0.70 0.12 – 0.22	1.27 - 1.39 1.77 – 2.23	1.43 - 1.57 5.00 – 7.00	97.97 - 151.75	15.83 - 16.17	1.5 - 2.5
High (3)	a b	< 0.64 < 0.12	> 1.39 > 2.23	> 1.57 > 7.00	> 151.75	< 15.83	> 2.5

a: Uninterrupted Flow   b: Interrupted Flow

**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 (Pavement, Mobility, and Safety for the US 160 Corridor). There are eight segments with a Low overall average need, three segments with a Medium overall average need, and one segment with a High overall average need.

Table 17: Summary of Needs by Segment

Performance Area	Segment Number and Mileposts (MP)											
	160-1	160-2	160-3	160-4	160-5	160-6	160-7	160-8	160-9	160-10	160-11	160-12
	MP 311-319	MP 319-323	MP 323-344	MP 344-362	MP 362-374	MP 374-391	MP 391-395	MP 395-413	MP 413-434	MP 434-451	MP 451-463	MP 463-470
Pavement+	None*	None*	None*	None*	None*	Low	None*	None*	Medium	Low	None*	None*
Bridge	Medium	None*	None*	Low	None*	None*	None*	None*	Low	High	None*	None*
Mobility+	Low	High	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Safety+	Low	N/A#	High	High	None*	None*	N/A#	N/A#	High	High	Low	None*
Freight	None*	None*	Medium	Low	None*	Medium	Medium	None*	None*	High	High	None*
Average Need (0-3)	**0.77**	**0.90**	**1.23**	**1.23**	**0.23**	**0.77**	**0.70**	**0.30**	**1.54**	**2.08**	**0.92**	**0.23**

+ Identified as an emphasis area for the US 160 Corridor.

 # N/A indicates insufficient or no data available to determine level of need.

**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.*

Level of Need	Average Need Range
None*	< 0.1
Low	0.1 - 1.0
Medium	1.0 - 2.0
High	> 2.0

Summary of Corridor Needs

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

Pavement Needs

- The Pavement Performance Area is an emphasis area for US 160.
- Two of the twelve segments (160-6 and 160-10) exhibit a Low level of Pavement need.
- One of the twelve segments (160-9) exhibit a Medium level of Pavement need.
- Pavement hot spot failure needs were identified along the corridor.
- Segment 160-6 has a high level of PeCos history investment, meaning that some previous projects have proven to provide only temporary improvements and require frequent attention.

Bridge Needs

- The Bridge Performance Area is not an emphasis area for US 160.
- Bridge needs exist at four of the six bridges present along the corridor.
- Segment 160-4 and 160-9 exhibit Low level of need and segment 160-1 exhibit Medium level of need.
- 160-10 exhibits High level of need as it has one bridge, Walker Creek Bridge, with a 100% functionally obsolete deck area.
- There is one programmed bridge project,
  - Bridge Replacement programmed FY18 H849001C: Chinle Wash Bridge Replacement, STR #746 (MP 429-430)

Mobility Needs

- The Mobility Performance Area is an emphasis area for US 160.
- One segment (160-2) exhibits a High level of need, primarily due to the Mobility Index score and Future Daily V/C (congestion).
- All the remaining eleven segments exhibit a Low level of need.
- Bicycle accommodation needs are High on eleven segments, except segment 160-2 which is located in Tuba City.
- A majority of the needs are due to lesser percentage of Bicycle Accommodation and directional PTI issues.

Safety Needs

- The Safety Performance Area is an emphasis area for US 160.
- Safety needs exist on six of the twelve segments.
- Four of the twelve segments (160-3, 160-4, 160-9, and 160-10) exhibit a High level of need.
- Two of the twelve segments (160-1 and 160-11) exhibit a Low level of need.
- Three segments of the corridor (160-2, 160-7, and 160-8) have insufficient data (insufficient number of crashes to draw statistical conclusions) to determine a level of need, so their need value is not available (N/A).

Freight Needs

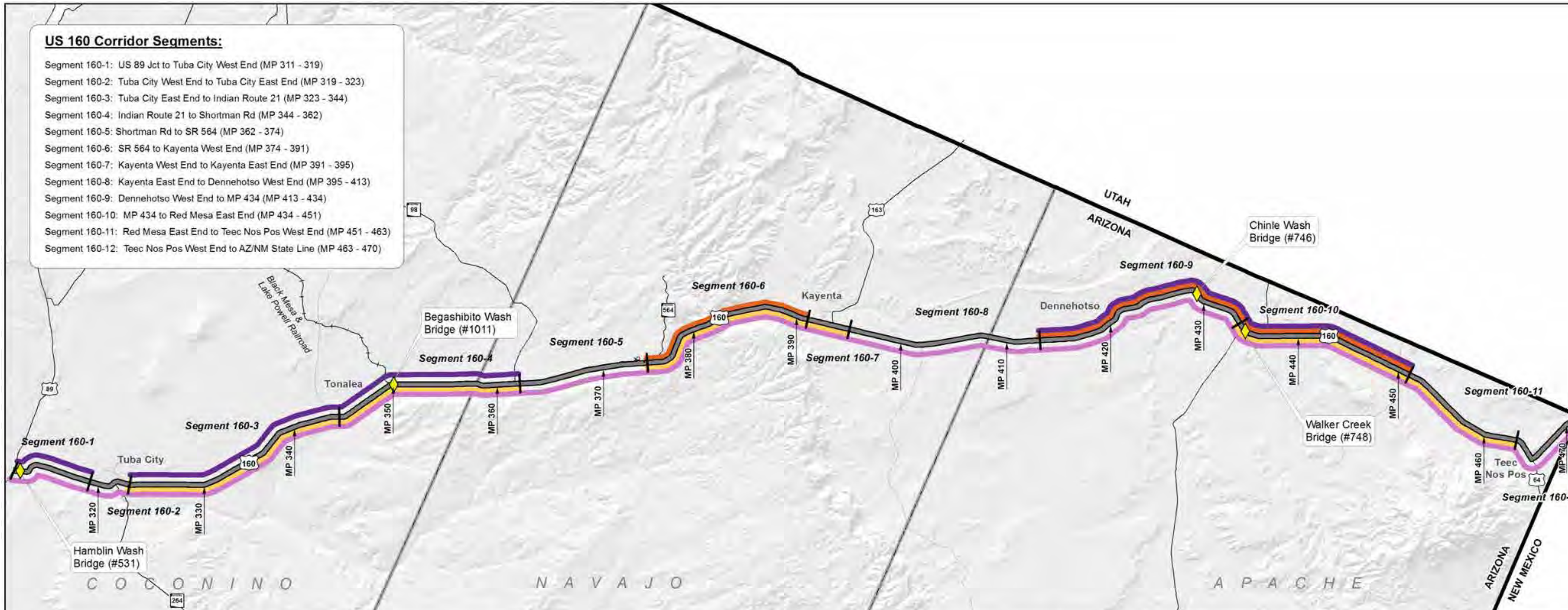
- The Freight Performance Area is not an emphasis area for US 160.
- Freight needs exist on six of the twelve segments.
- Two segments (160-10 and 160-11) exhibit a “High” level of need, as they have elevated values for Freight Index and directional TPTI.
- There are no underpasses along the corridor.

Overlapping Needs

This section identifies overlapping performance needs on the US 160 Corridor, which provides guidance to develop strategic solutions that address more than one performance area with elevated (i.e., Medium or High) 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:

- Segment 160-10 contains needs in all five performance areas
- Segments 160-3 and 160-9 have more than one elevated need
- Average needs of segments 160-3 and 160-4 exhibit Medium level, and exhibit High level for segment 160-10.

Figure 21: Corridor Needs Summary



Performance Area	160-1	160-2	160-3	160-4	160-5	160-6	160-7	160-8	160-9	160-10	160-11	160-12
	MP 311-319	MP 319-323	MP 323-344	MP 344-362	MP 362-374	MP 374-391	MP 391-395	MP 395-413	MP 413-434	MP 434-451	MP 451-463	MP 463-470
Pavement+	None*	None*	None*	None*	None*	Low	None*	None*	Medium	Low	None*	None*
Bridge	Medium	None*	None*	Low	None*	None*	None*	None*	Low	High	None*	None*
Mobility+	Low	High	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Safety+	Low	N/A	High	High	None*	None*	N/A	N/A	High	High	Low	None*
Freight	None*	None*	Medium	Low	None*	Medium	Medium	None*	None*	High	High	None*
Average Need	**0.77**	**0.90**	**1.23**	**1.23**	**0.23**	**0.77**	**0.70**	**0.30**	**1.54**	**2.08**	**0.92**	**0.23**

+ Identified as emphasis area for US 160 Corridor

*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.

US 160 Corridor Profile Study: US 89 to New Mexico State Line
Corridor Needs Summary

N
Miles
0 5 10 15 20

Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary

NEEDS SUMMARY
SAFETY
PAVEMENT
FREIGHT
MOBILITY
BRIDGE

Level of Need	Average Need Range
None*	< 0.1
Low	0.1 - 1.0
Medium	1.0 - 2.0
High	> 2.0

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 US 160 strategic investment areas (resulting from the elevated needs) are shown in **Figure 22**.

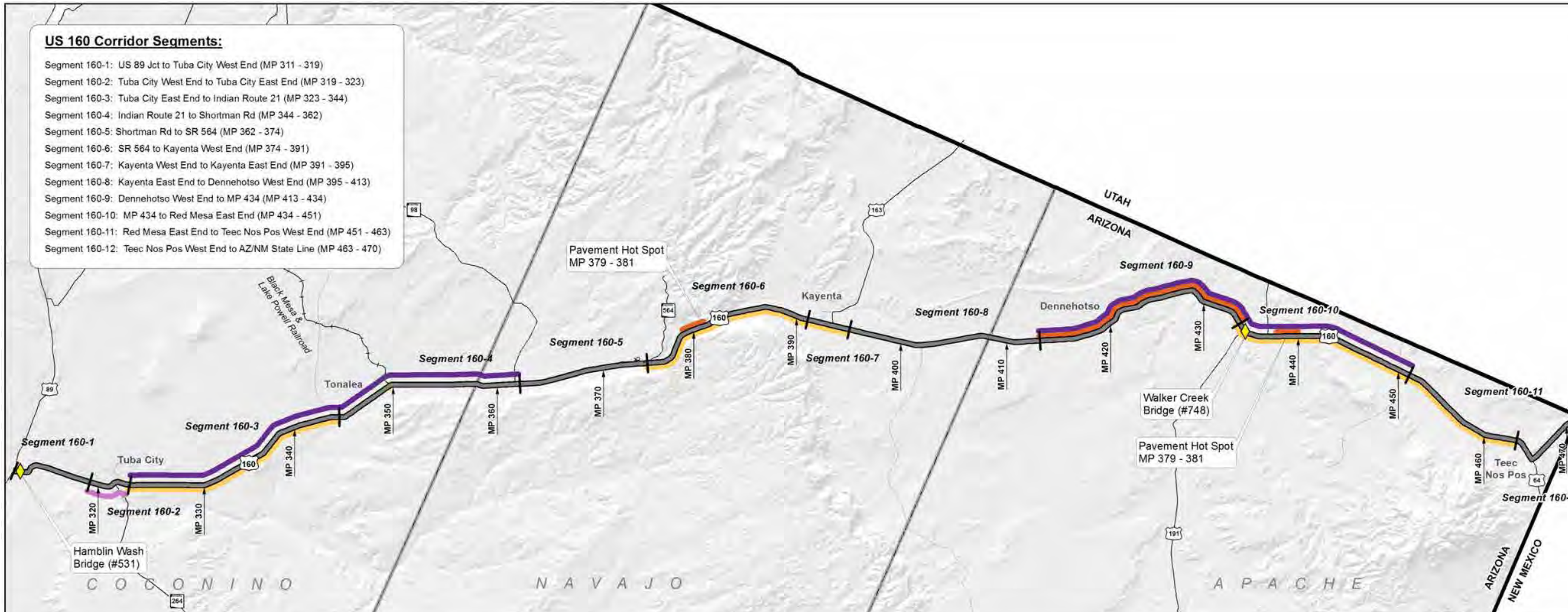
4.1 Screening Process

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

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

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

Figure 22: Strategic Investment Areas



Performance Area	160-1	160-2	160-3	160-4	160-5	160-6	160-7	160-8	160-9	160-10	160-11	160-12
	MP 311-319	MP 319-323	MP 323-344	MP 344-362	MP 362-374	MP 374-391	MP 391-395	MP 395-413	MP 413-434	MP 434-451	MP 451-463	MP 463-470
Pavement+	-	-	-	-	-	Hot Spot	-	-	Medium	Hot Spot	-	-
Bridge	Medium	-	-	-	-	-	-	-	-	High	-	-
Mobility+	-	High	-	-	-	-	-	-	-	-	-	-
Safety+	-	-	High	High	-	-	-	-	High	High	-	-
Freight	-	-	Medium	-	-	Medium	Medium	-	-	High	High	-

+ Identified as emphasis area for US 160 Corridor

Notes: Figure shows strategic investment areas, which are segments with Medium and High levels of need and locations of hot spots.

A "-" symbol indicates a segment level of need of Low, None or N/A, which is not considered strategic.

US 160 Corridor Profile Study: US 89 to New Mexico State Line

Strategic Investment Areas

Miles: 0, 5, 10, 15, 20

Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary

PERFORMANCE AREA NEEDS
SAFETY
PAVEMENT
FREIGHT
MOBILITY
BRIDGE

Level of Need	Average Need Range
None*	< 0.1
Low	0.1 - 1.0
Medium	1.0 - 2.0
High	> 2.0

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					
160-1 MP 311 - 319	-	Medium	-	-	-	L1	Bridge	Hamblin Wash Bridge (#531) has current structural evaluation rating of 5 without historical concerns	N	Bridge does not meet criteria for historical investment, and does not have multiple ratings of 5, therefore not considered strategic.
160-2 MP 319 - 323	-	-	High	-	-	L2	Mobility	Mobility needs primarily associated with elevated Future V/C and Westbound existing V/C levels. Projected future travel demand is anticipated to exceed current capacity.	Y	No programmed project to address Mobility need.
160-3 MP 323 - 344	-	-	-	High	Medium	L3	Safety	Crash trends show overturning (33%), collision with a pedestrian (27%), collision with motor vehicle (33%), and head on (20%) crashes. Driver conditions show influence of drugs or alcohol (33%), and road conditions show crash occurrences in dark or unlighted conditions (47%) and wet conditions (13%).	Y	No programmed project to address Safety need.
						L4	Freight	Freight Needs primarily associated with elevated TPTI levels.	Y	No programmed project to address Freight need.
160-4 MP 344 - 362	-	-	-	High	-	L5	Safety	Crash trends show collision with motor vehicle (70%), and head on (30%) crashes. Driver conditions show influence of drugs or alcohol (40%), and road conditions show crash occurrences in dark or unlighted conditions (30%) and gravel conditions (10%).	Y	No programmed project to address Safety need.
160-5 MP 362 - 374	-	-	-	-	-	No Strategic Needs Identified				
160-6 MP 374 - 391	Hot Spot	-	-	-	Medium	L6	Pavement	MP 379-381 with Medium level of previous investment.	N	Pavement preservation project programmed in FY 20 and does not meet criteria for previous investment, therefore not considered strategic.
						L7	Freight	Freight Needs primarily associated with elevated TPTI levels.	Y	No programmed project to address Freight need.
160-7 MP 391 - 395	-	-	-	-	Medium	L8	Freight	Freight Needs primarily associated with elevated Westbound TPTI levels.	N	Elevated levels likely due to truck stop locations at Kayenta.

Legend: [shaded] Strategic investment area screened out from further consideration.

Table 18: Strategic Investment Area Screening (continued)

Segment # and MP	Level of Strategic Need					Location #	Type	Need Description	Advance (Y/N)	Screening Description
	Pavement	Bridge	Mobility	Safety	Freight					
160-8 MP 395 - 413	-	-	-	-	-	No Strategic Needs Identified				
160-9 MP 413 - 434	Medium	-	-	High	-	L9	Pavement	MP 424-429 and 433-434 with Medium level of previous investment.	N	Does not meet criteria for historical investment, therefore not considered strategic.
						L10	Safety	Crash trends show overturn and ran off road crashes, and collisions involving speed too fast for conditions. Driver conditions show influence of drugs or alcohol (25%), and road conditions show crash occurrences in dark or unlighted conditions (50%).	Y	No programmed project to address Safety need.
160-10 MP 434 - 451	Hot Spot	High	-	High	High	L11	Pavement	MP 438-440 with Medium level of previous investment.	N	Does not meet criteria for historical investment, therefore not considered strategic.
						L12	Bridge	Walker Creek Bridge (#748) has current deck rating of 5 without historical concerns.	N	Bridge does not meet criteria for historical investment, and does not have multiple ratings of 5, therefore not considered strategic.
						L13	Safety	Crash trends show collision with motor vehicle (56%), overturning (33%), and rear end (22%) crashes. Driver conditions show influence of drugs or alcohol (33%), and road conditions show crash occurrences in dark or unlighted conditions (56%).	Y	No programmed project to address Safety need.
						L14	Freight	Freight Needs primarily associated with elevated TPTI levels.	N	Elevated levels likely due to trucks stopping at the Mexican Water gas station.
160-11 MP 451 - 463	-	-	-	-	High	L15	Freight	Freight Needs primarily associated with elevated TPTI levels.	N	Elevated levels likely due to trucks stopping at the weigh station.
160-12 MP 463 - 470	-	-	-	-	-	No Strategic Needs Identified				

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 US 160 Corridor will be considered along with other candidate projects in the ADOT statewide programming process.

Characteristics of Strategic Solutions

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

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

Candidate Solutions

A set of 9 candidate solutions are proposed to address the identified needs on the US 160 Corridor.

Table 19 identifies each strategic location that has been assigned a candidate solution with a number (e.g., CS160.1, CS160.2, etc.). Each candidate solution is comprised of one or more components to address the identified needs. The assigned candidate solution numbers are linked to the location number and provide tracking capability through the rest of the process. The locations of proposed solutions are shown on the map in **Figure 23**.

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

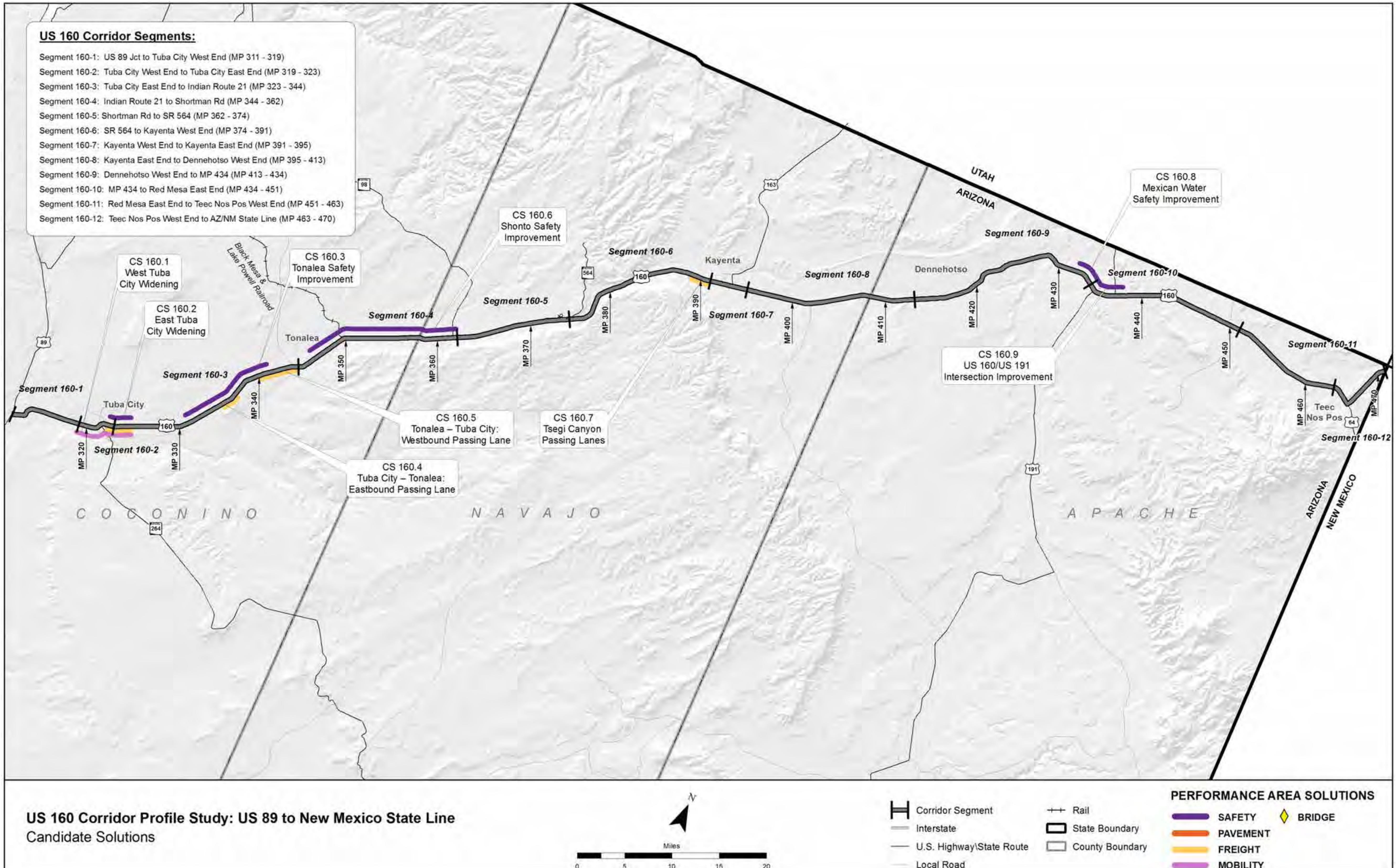
Candidate solutions that are recommended to expand or modify the scope of an already programmed project are noted and are not advanced to solution evaluation and prioritization. These solutions are directly recommended for programming.

Table 19: Candidate Solutions

Candidate Solution #	Segment #	Location #	Beginning Milepost	Ending Milepost	Candidate Solution Name	Option*	Candidate Solution Scope	Investment Category Preservation [P] Modernization [M] Expansion [E]
CS160.1	160-2	L2	319	321.6	West Tuba City Widening	-	Convert 2-Lane undivided highway to a 5-Lane highway	E
CS160.2	160-2 160-3	L2, L3, L4	322.4	325	East Tuba City Widening	-	Convert 2-Lane undivided highway to a 5-Lane highway Install lighting (connecting to existing power) in both directions	E
CS160.3	160-3	L3	331	341	Tonalea Safety Improvement	-	Widen shoulder in both directions (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips) Install curve warning signs in both directions Install chevrons on curve (MP 336 to MP 336.5)	M
CS160.4	160-3	L4	335	336.5	Tuba City – Tonalea: Eastbound Passing Lane	-	Construct eastbound passing lane from MP 335 – MP 336.5	M
CS160.5	160-3	L4	340	343	Tonalea – Tuba City: Westbound Passing Lane	-	Construct westbound passing lane from MP 340 – MP 341 Construct westbound passing lane from MP 342 – MP 343	M
CS160.6	160-4	L5	346	362	Shonto Safety Improvement	-	Widen shoulder in both directions (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips) Install lighting (solar powered LED) at SR 98 intersection (MP 361.6) Install curve warning signs in both directions Install chevrons on curve (MP 358 to MP 359)	M
CS160.7	160-6	L7	389	391	Tsegi Canyon Passing Lanes	-	Construct westbound passing lane from MP 389 – MP 390 Construct eastbound passing lane from MP 390 – MP 391	M
CS160.8	160-9 160-10	L10, L13	432	438	Mexican Water Safety Improvement	-	Widen shoulder in both directions (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips) Install curve warning signs in both directions Install chevrons on curves (MP 432.5 to MP 433.5 and MP 434.5 to MP 435.5)	M
CS160.9	160-10	L10	435	437	US 160/US 191 Intersection Improvement	-	Install eastbound acceleration lane at US 191 intersection (MP 434.8) Install eastbound deceleration lane at US 191 intersection (MP 434.8) Install westbound acceleration lane at US 191 intersection (MP 437.2) Install lighting (solar powered LED) at US 191 intersections (MP 434.8 and MP 437.2)	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.

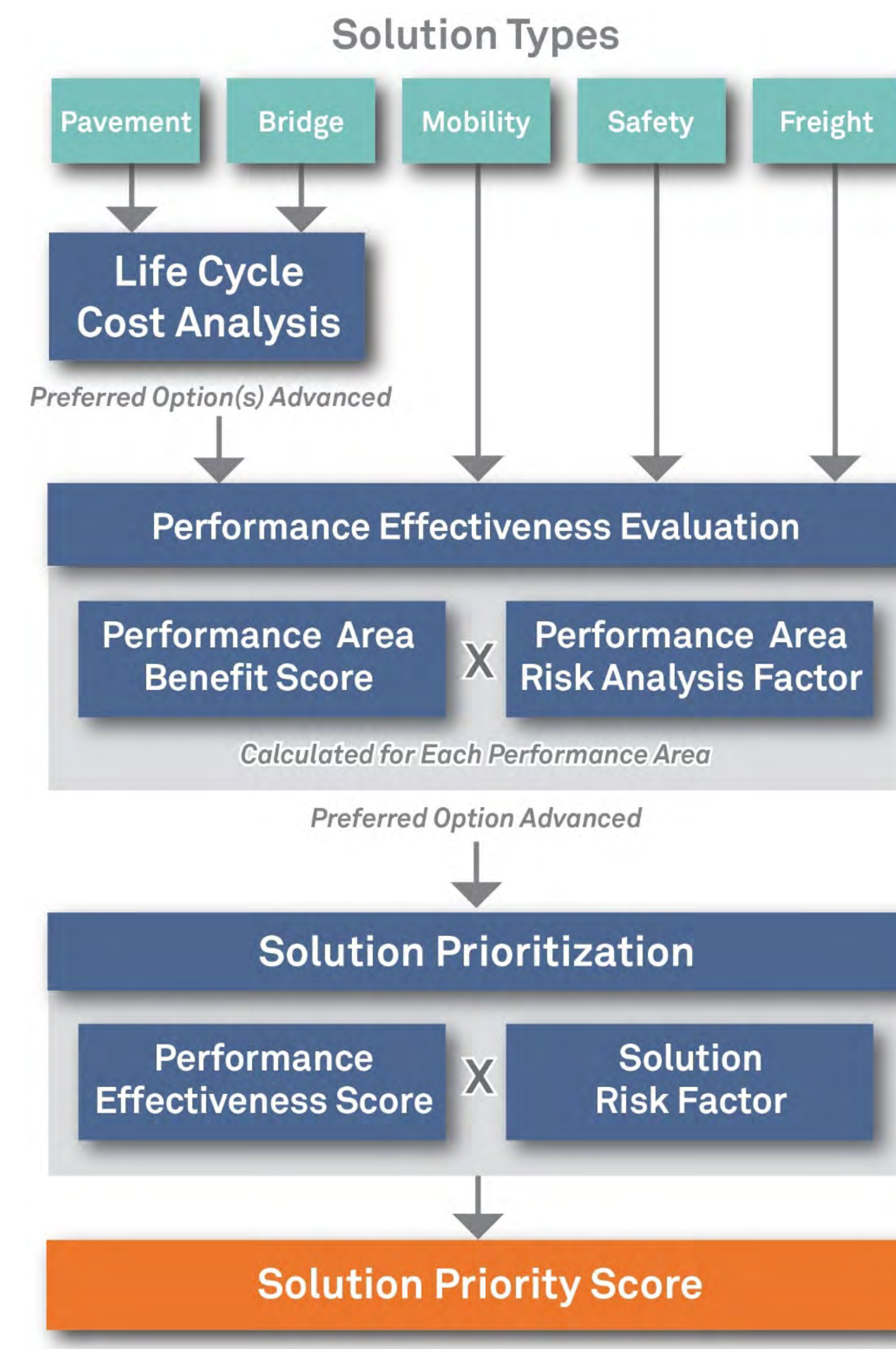
Solution Risk Analysis

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**, LCCA was not conducted for any bridges on the US 160 Corridor, as noted in **Table 20**. Additional information regarding the bridge LCCA is included in **Appendix E**.

Pavement LCCA

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

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

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

- The pavement LCCA only addresses the condition of the pavement and does not address other issues or costs
- The historical pavement rehabilitation frequencies at each location are used to estimate future rehabilitation frequencies
- Different pavement replacement and rehabilitation strategies have different costs and expected service life

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

Based on the candidate solutions presented in **Table 19**, LCCA was not conducted for pavement on the US 160 Corridor, as noted in **Table 21.** Additional information regarding the pavement LCCA is included in **Appendix E.**

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		
No LCCA conducted for any bridges on the US 160 Corridor.								

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 pavement on the US 160 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 others (more than twice the PES value and a difference in magnitude of at least 20 points) the lower scoring 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 US 160 Corridor, none of the candidate solutions have options.

Table 22: Performance Effectiveness Scores

Candidate Solution #	Segment #	Candidate Solution Name	Milepost Location	Estimated Cost* (in millions)	Risk Factored Benefit Score					Risk Factored Emphasis Area Scores			Total Factored Benefit Score	F^{VMT}	F^{NPV}	Performance Effectiveness Score
					Pavement	Bridge	Safety	Mobility	Freight	Pavement	Safety	Mobility				
CS160.1	160-2	West Tuba City Widening	319 to 321.6	$10.19	0.000	0.000	0.000	13.271	0.424	0.000	0.000	0.072	13.767	1.63	20.2	44.6
CS160.2	160-2 160-3	East Tuba City Widening	322.4 to 325	$13.68	0.000	0.000	6.849	9.378	2.507	0.000	1.352	0.059	20.146	0.98	20.2	29.2
CS160.3	160-3	Tonalea Safety Improvement	331 to 341	$7.87	0.000	0.000	7.453	4.452	2.656	0.000	1.472	0.000	16.033	2.35	15.3	73.4
CS160.4	160-3	Tuba City – Tonalea: Eastbound Passing Lane	335 to 336.5	$5.59	0.000	0.000	2.427	0.111	1.510	0.000	0.479	0.017	4.545	0.23	20.2	3.8
CS160.5	160-3	Tonalea – Tuba City: Westbound Passing Lane	340 to 343	$7.46	0.000	0.000	4.914	0.161	0.335	0.000	0.970	0.017	8.554	0.31	20.2	7.1
CS160.6	160-4	Shonto Safety Improvement	346 to 362	$14.57	0.000	0.000	8.880	5.551	3.087	0.000	1.512	0.003	19.032	2.59	15.3	51.7
CS160.7	160-6	Tsegi Canyon Passing Lanes	389 to 391	$7.46	0.000	0.000	0.265	1.399	8.078	0.000	0.263	0.016	10.021	0.37	20.2	10.1
CS160.8	160-9 160-10	Mexican Water Safety Improvement	432 to 438	$4.14	0.000	0.000	8.121	2.814	1.087	0.000	1.239	0.000	13.262	1.13	15.3	55.1
CS160.9	160-10	US 160/US 191 Intersection Improvement	435 to 437	$1.25	0.000	0.000	2.945	0.851	0.578	0.000	0.400	0.000	4.774	0.48	20.2	37.4

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

Frequency/Likelihood		Severity/Consequence				
		Insignificant	Minor	Significant	Major	Catastrophic
	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 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

Frequency/Likelihood			Severity/Consequence				
			Insignificant	Minor	Significant	Major	Catastrophic
		Weight	1.00	1.10	1.20	1.30	1.40
	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 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 level need score as shown in **Table 17***

The candidate solutions are prioritized based on the calculation above as shown in **Table 23**. 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. The prioritized list of candidate solutions is provided in the subsequent section. See **Appendix J** for additional information on the prioritization process

Table 23: Prioritization Scores

Candidate Solution #	Segment #	Option	Candidate Solution Name	Milepost Location	Estimated Cost (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
CS160.1	160-2	-	West Tuba City Widening	319 to 321.6	$10.19	44.6	1.360	0.90	**55**	-	-	0.0%	72.6%	17.6%
CS160.2	160-2 160-3	-	East Tuba City Widening	322.4 to 325	$13.68	29.2	1.531	1.15	**52**	-	-	15.8%	40.2%	12.4%
CS160.3	160-3	-	Tonalea Safety Improvement	331 to 341	$7.87	73.4	1.594	1.23	**144**	-	-	20.1%	54.0%	15.0%
CS160.4	160-3	-	Tuba City – Tonalea: Eastbound Passing Lane	335 to 336.5	$5.59	3.8	1.629	1.23	**8**	-	-	6.6%	1.5%	8.5%
CS160.5	160-3	-	Tonalea – Tuba City: Westbound Passing Lane	340 to 343	$7.46	7.1	1.649	1.23	**14**	-	-	13.3%	2.2%	14.1%
CS160.6	160-4	-	Shonto Safety Improvement	346 to 362	$14.57	51.7	1.589	1.23	**101**	-	0.0%	44.1%	56.5%	58.2%
CS160.7	160-6	-	Tsegi Canyon Passing Lanes	389 to 391	$7.46	10.1	1.382	0.77	**11**	0.0%	-	34.7%	8.8%	53.5%
CS160.8	160-9 160-10	-	Mexican Water Safety Improvement	432 to 438	$4.14	55.1	1.656	1.90	**174**	0.0%	0.0%	26.5%	12.2%	3.3%
CS160.9	160-10	-	US 160/US 191 Intersection Improvement	435 to 437	$1.25	37.4	1.654	2.08	**129**	0.0%	0.0%	14.8%	5.6%	1.8%

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 US 160 Corridor. Implementation of these solutions is anticipated to improve performance of the US 160 Corridor. The following observations were noted about the prioritized solutions:

- Most of the proposed improvements in performance are in the Mobility, Safety, and Freight performance areas
- The highest ranking solutions tended to have overlapping benefits in the Mobility, Safety, and Freight performance areas
- The highest priority solution address needs in the Mexican Water area (MP 432-438)

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 US 160 Corridor:

- When recommending future projects along the US 160 Corridor, review historical ratings and levels of investment. According to data used for this study, the following pavement location have exhibited high historical investment issues:
  - Pavement MP 362-374
- As the area continues to grow, continue to provide support for a standard Diamond Interchange with a structure over US 89 at the US 89/US 160 intersection as recommended in Final Design Concept Report - US 89 Antelope Hills to Jct. US 160 MP 442 to MP 484.

6.3 Policy and Initiative Recommendations

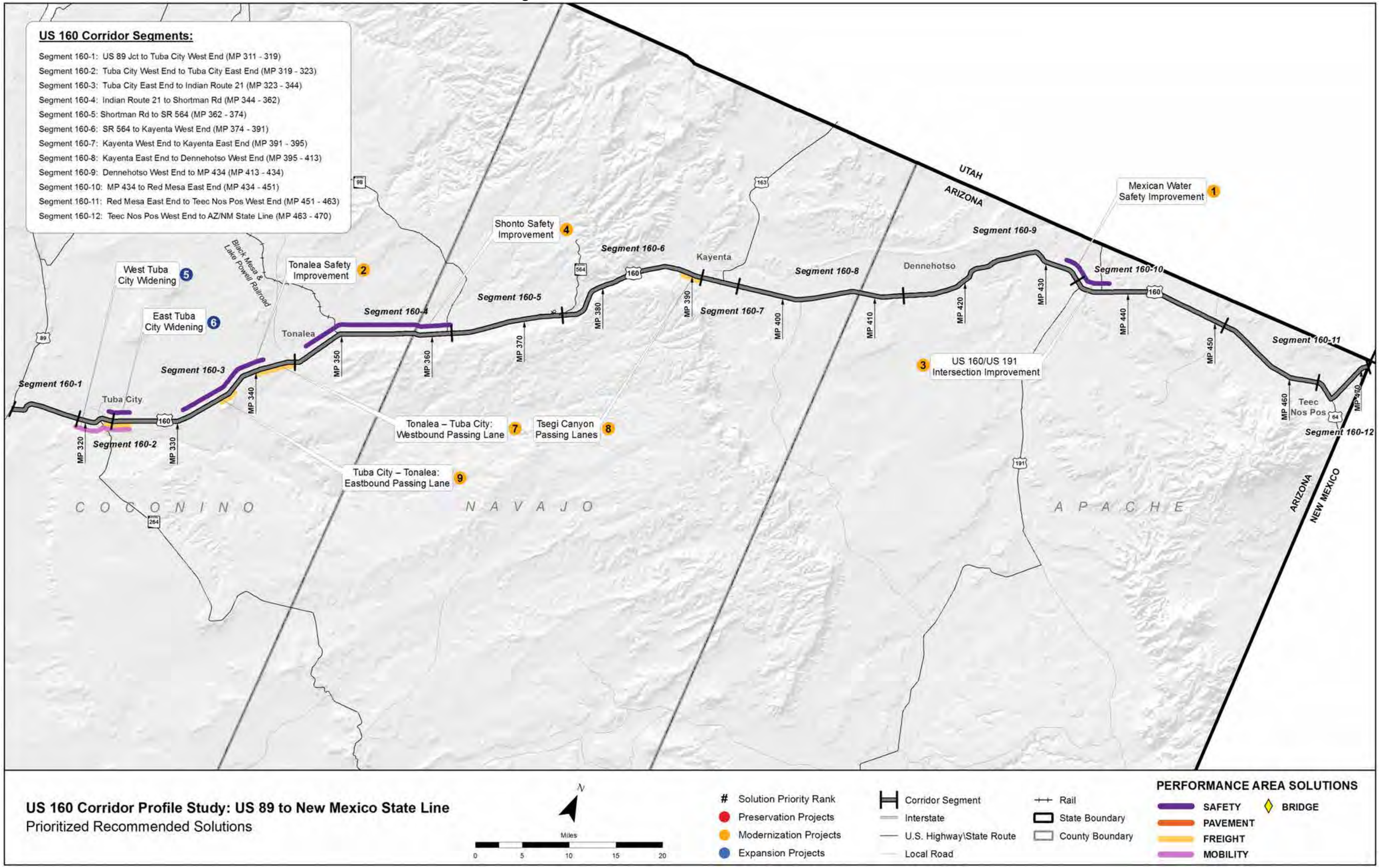
In addition to location-specific needs, general corridor and system-wide needs have also been identified through the CPS process. While these needs are more overarching and cannot be individually evaluated through this process, it is important to document them. A list of recommended policies and initiatives was developed for consideration when programming future projects not only on US 160, 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 four CPS rounds:

- 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
- At traffic interchanges with existing communication connectivity to the ADOT TOC, consideration should be given to adding thermal detection cameras for vehicle detection with the capability for wrong way vehicle detection.
- Improved vehicle detection systems, as recommended by ADOT Systems Technology group, should be deployed at traffic interchanges for improved traffic control.

Table 24: Prioritized Recommended Solutions

Rank	Candidate Solution #	Option	Candidate Solution Name	Candidate Solution Scope	Estimated Cost (in millions)	Investment Category ([P] Preservation [M] Modernization [E] Expansion)	Prioritization Score
1	CS160.8	-	Mexican Water Safety Improvement (MP 432 - 438)	Widen shoulder in both directions (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips) Install curve warning signs in both directions Install chevrons on curves (MP 432.5 to MP 433.5 and MP 434.5 to MP 435.5)	$4.14	M	**174**
2	CS160.3	-	Tonalea Safety Improvement (MP 331 - 341)	Widen shoulder in both directions (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips) Install curve warning signs in both directions Install chevrons on curve (MP 336 to MP 336.5)	$7.87	M	**144**
3	CS160.9	-	US 160/US 191 Intersection Improvement (MP 435 - 437)	Install eastbound acceleration lane at US 191 intersection (MP 434.8) Install eastbound deceleration lane at US 191 intersection (MP 434.8) Install westbound acceleration lane at US 191 intersection (MP 437.2) Install lighting (solar powered LED) at US 191 intersections (MP 434.8 and MP 437.2)	$1.25	M	**129**
4	CS160.6	-	Shonto Safety Improvement (MP 346 - 362)	Widen shoulder in both directions (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips) Install lighting (solar powered LED) at SR 98 intersection (MP 361.6) Install curve warning signs in both directions Install chevrons on curve (MP 358 to MP 359)	$14.57	M	**101**
5	CS160.1	-	West Tuba City Widening (MP 319 - 321.6)	Convert 2-Lane undivided highway to a 5-Lane highway	$10.19	E	**55**
6	CS160.2	-	East Tuba City Widening (MP 322.4 - 325)	Convert 2-Lane undivided highway to a 5-Lane highway Install lighting (connecting to existing power) in both directions	$13.68	E	**52**
7	CS160.5	-	Tonalea-Tuba City: Westbound Passing Lane (MP 340 - 343)	Construct westbound passing lane from MP 340 – MP 341 Construct westbound passing lane from MP 342 – MP 343	$7.46	M	**14**
8	CS160.7	-	Tsegi Canyon Passing Lanes (MP 389 - 391)	Construct westbound passing lane from MP 389 – MP 390 Construct eastbound passing lane from MP 390 – MP 391	$7.46	M	**11**
9	CS160.4	-	Tuba City-Tonalea: Eastbound Passing Lane (MP 335 - 336.5)	Construct eastbound passing lane from MP 335 – MP 336.5	$5.59	M	**8**

Figure 27: Prioritized Recommended Solutions

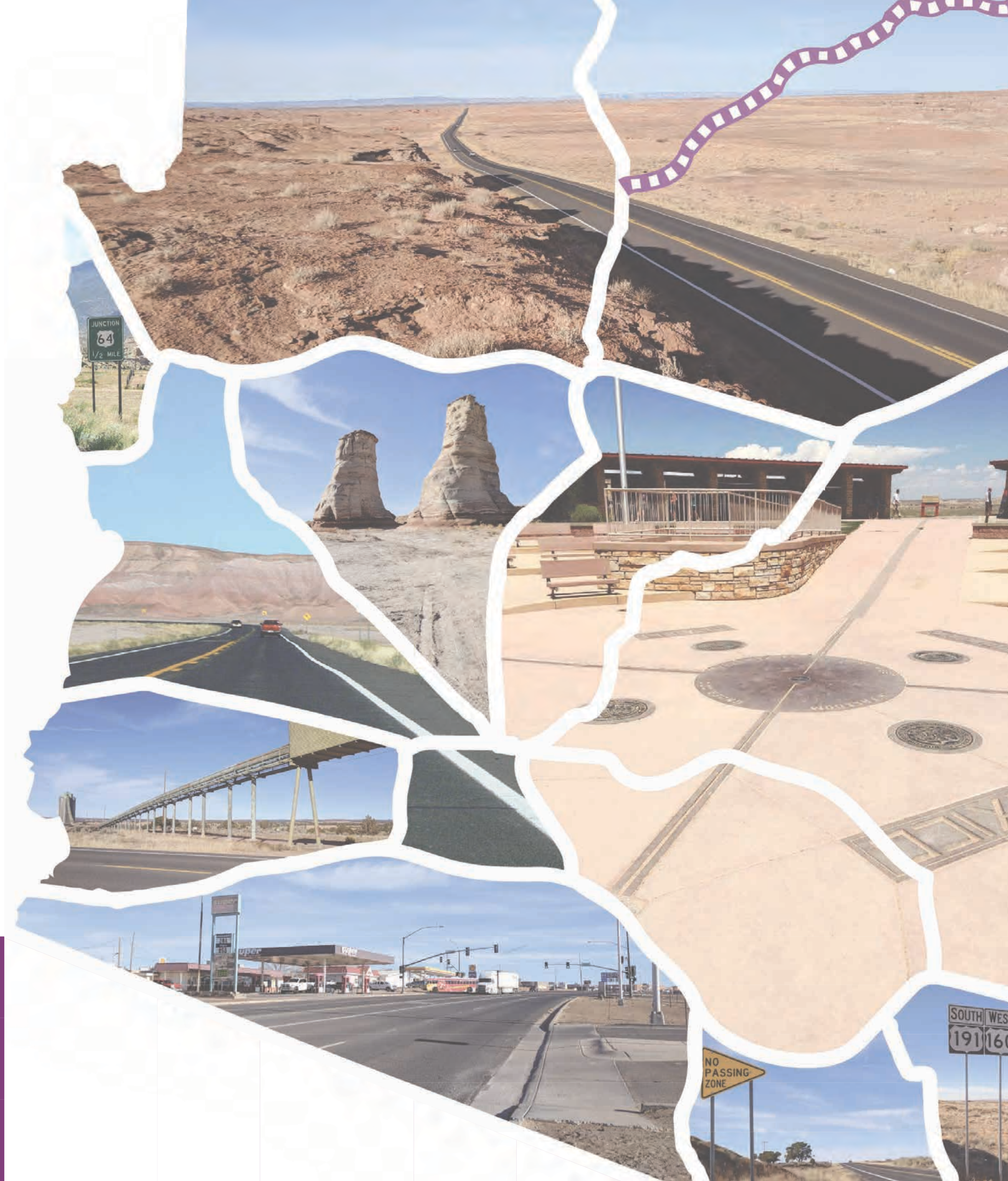


6.4 Next Steps

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 US 160 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 four 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

Appendix A: Corridor Performance Maps

This appendix contains maps of each primary and secondary measure associated with the five performance areas for the US 160 Corridor. The following are the areas and maps included:

Pavement Performance Area:

- Pavement Index and Hot Spots
- Pavement Serviceability (directional)
- Percentage 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:

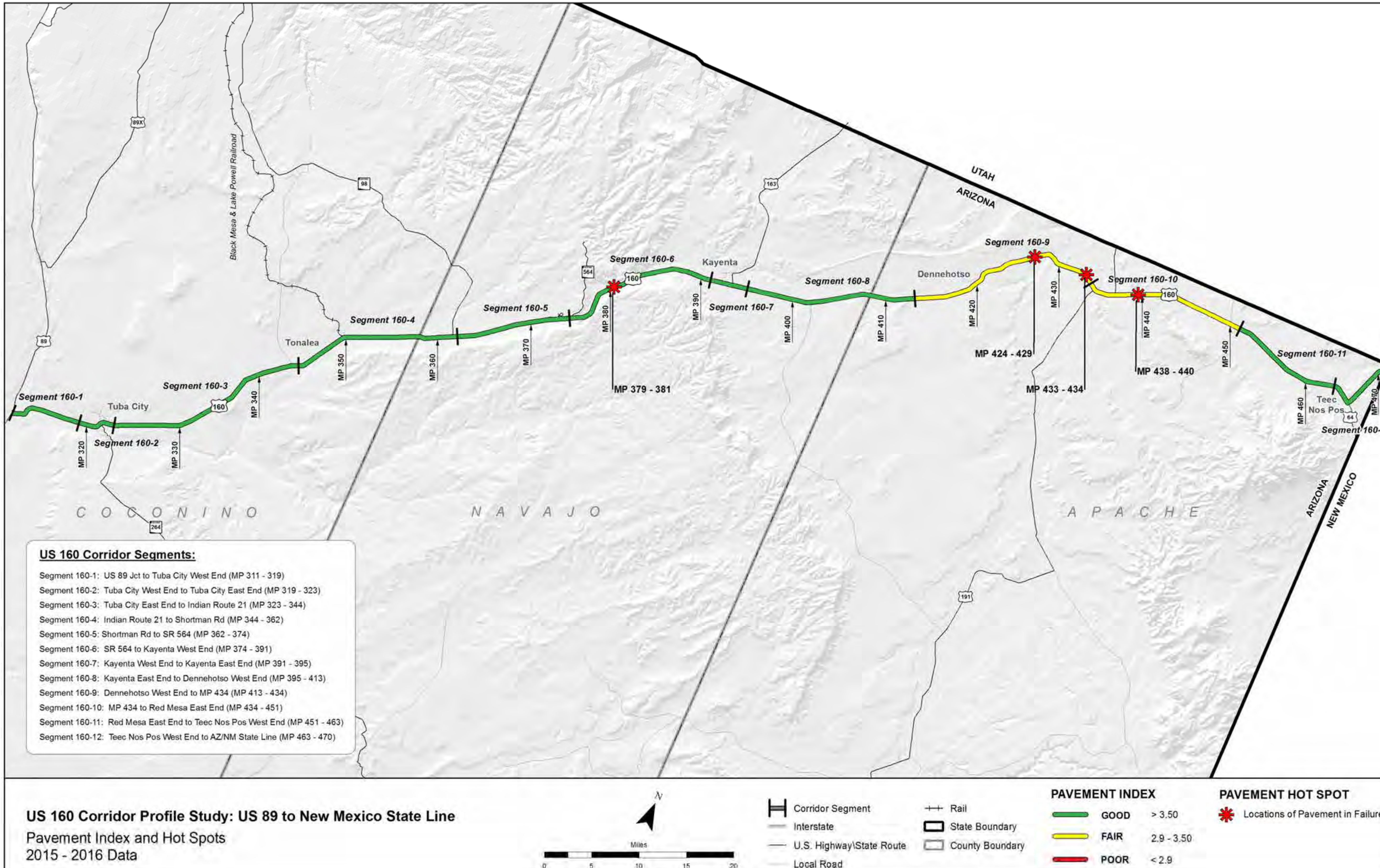
- Mobility Index
- Future Daily V/C Ratio
- Existing Peak Hour V/C (directional)
- Closure Frequency
- Directional Travel Time Index
- Directional Planning Time Index
- Multimodal Opportunities
- Percentage of Bicycle Accommodation

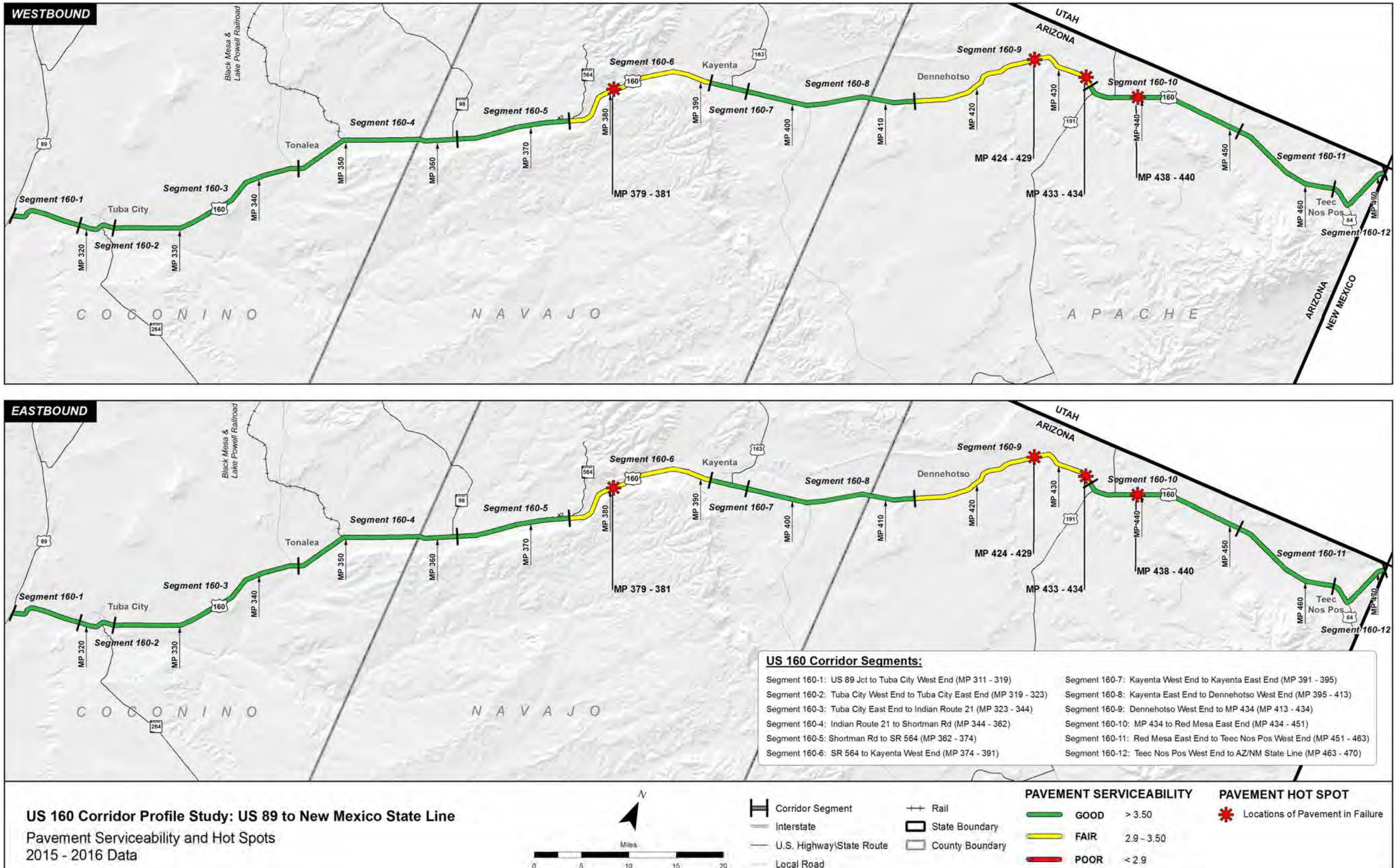
Safety Performance Area:

- Safety Index and Hot Spots
- Safety Index and Hot Spots (directional)
- Relative Frequency of Fatal & Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas

Freight Performance Area:

- Freight Index and Hot Spots
- Directional Truck Travel Time Index
- Directional Truck Planning Time Index
- Closure Duration
- Bridge Vertical Clearance


US 160 Corridor Profile Study: US 89 to New Mexico State Line
Pavement Index and Hot Spots
2015 - 2016 Data
US 160 Corridor Segments:
Segment 160-1: US 89 Jct to Tuba City West End (MP 311 - 319)
Segment 160-2: Tuba City West End to Tuba City East End (MP 319 - 323)
Segment 160-3: Tuba City East End to Indian Route 21 (MP 323 - 344)
Segment 160-4: Indian Route 21 to Shortman Rd (MP 344 - 362)
Segment 160-5: Shortman Rd to SR 564 (MP 362 - 374)
Segment 160-6: SR 564 to Kayenta West End (MP 374 - 391)
Segment 160-7: Kayenta West End to Kayenta East End (MP 391 - 395)
Segment 160-8: Kayenta East End to Dennehotso West End (MP 395 - 413)
Segment 160-9: Dennehotso West End to MP 434 (MP 413 - 434)
Segment 160-10: MP 434 to Red Mesa East End (MP 434 - 451)
Segment 160-11: Red Mesa East End to Teec Nos Pos West End (MP 451 - 463)
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
MP 379 - 381
MP 424 - 429
MP 433 - 434
MP 438 - 440
Black Mesa & Lake Powell Railroad
UTAH
ARIZONA
NEW MEXICO
COCONINO
NAVAJO
APACHE
89
89X
98
160
163
191
264
564
64
N
Miles
0
5
10
15
20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
PAVEMENT INDEX
GOOD > 3.50
FAIR 2.9 - 3.50
POOR < 2.9
PAVEMENT HOT SPOT
Locations of Pavement in Failure


WESTBOUND
EASTBOUND
UTAH
ARIZONA
NEW MEXICO
Black Mesa & Lake Powell Railroad
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
MP 379 - 381
MP 424 - 429
MP 433 - 434
MP 438 - 440
C O C O N I N O
N A V A J O
A P A C H E
US 160 Corridor Segments:
Segment 160-1: US 89 Jct to Tuba City West End (MP 311 - 319)
Segment 160-2: Tuba City West End to Tuba City East End (MP 319 - 323)
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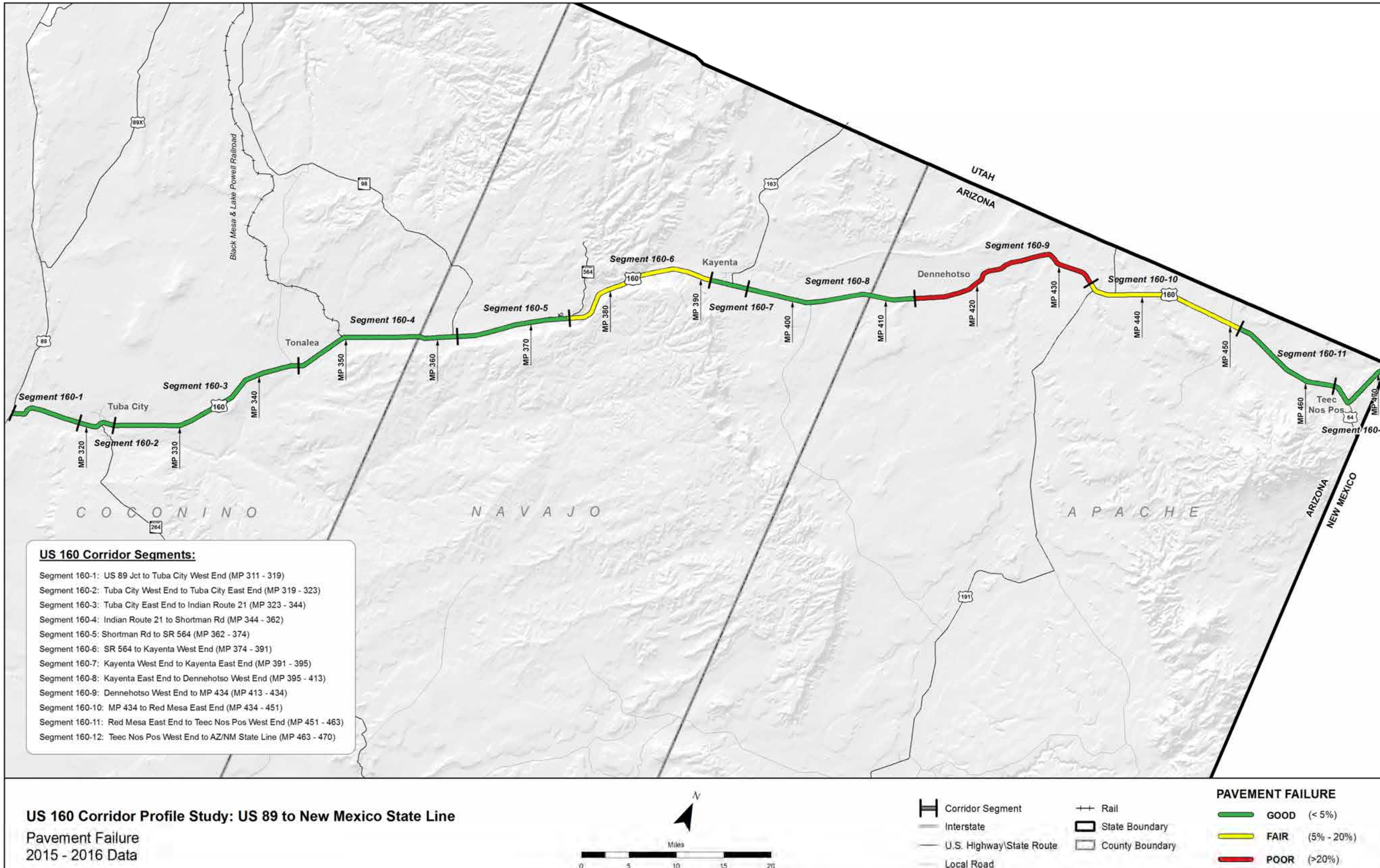
Segment 160-8: Kayenta East End to Dennehotso West End (MP 395 - 413)
Segment 160-9: Dennehotso West End to MP 434 (MP 413 - 434)
Segment 160-10: MP 434 to Red Mesa East End (MP 434 - 451)
Segment 160-11: Red Mesa East End to Teec Nos Pos West End (MP 451 - 463)
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Pavement Serviceability and Hot Spots
2015 - 2016 Data
N
Miles
0 5 10 15 20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
PAVEMENT SERVICEABILITY
GOOD > 3.50
FAIR 2.9 - 3.50
POOR < 2.9
PAVEMENT HOT SPOT
Locations of Pavement in Failure


UTAH
ARIZONA
NEW MEXICO
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Black Mesa & Lake Powell Railroad
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
C O C O N I N O
N A V A J O
A P A C H E
US 160 Corridor Segments:
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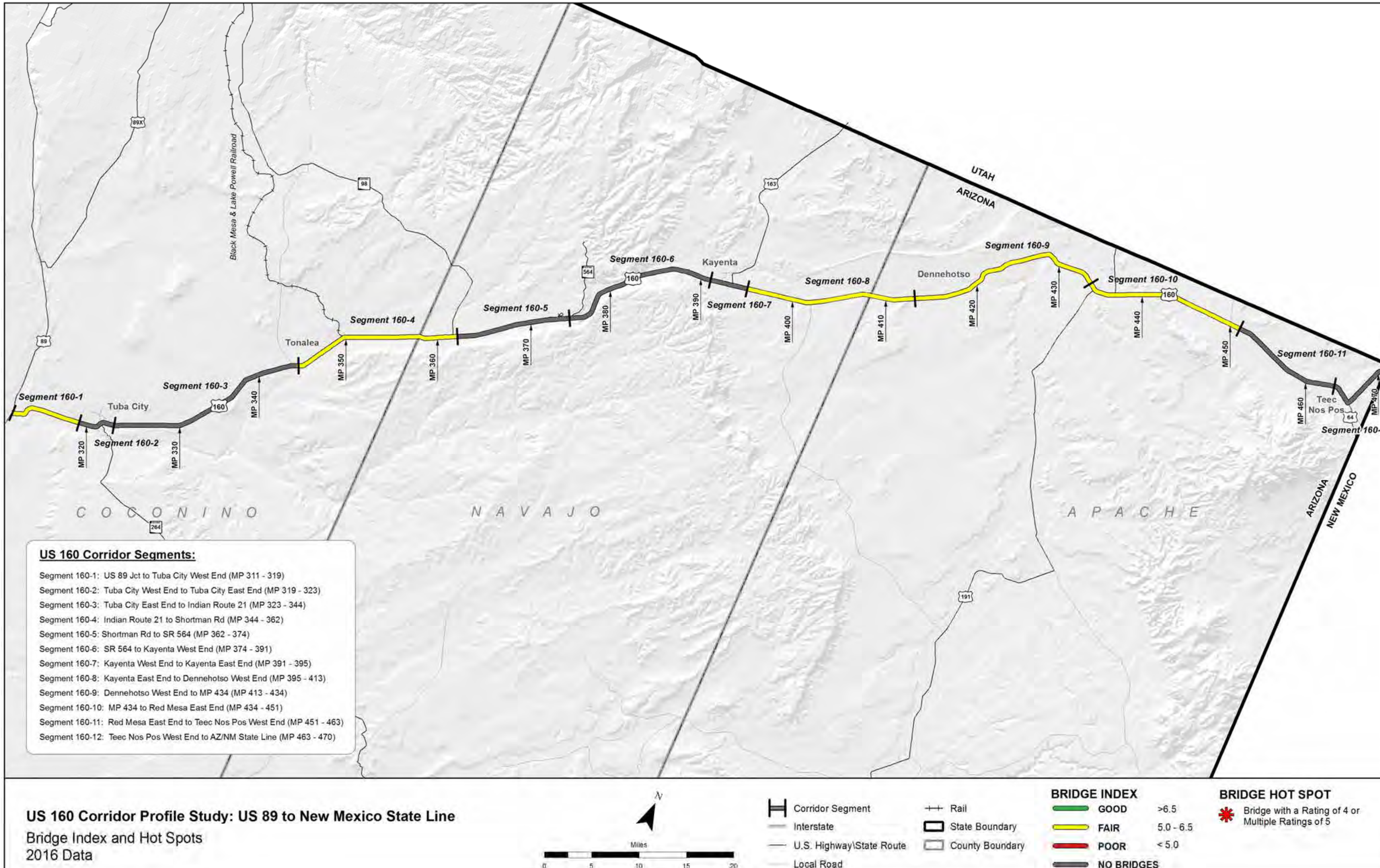
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Pavement Failure
2015 - 2016 Data
N
Miles
0 5 10 15 20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
PAVEMENT FAILURE
GOOD (< 5%)
FAIR (5% - 20%)
POOR (>20%)


US 160 Corridor Segments:
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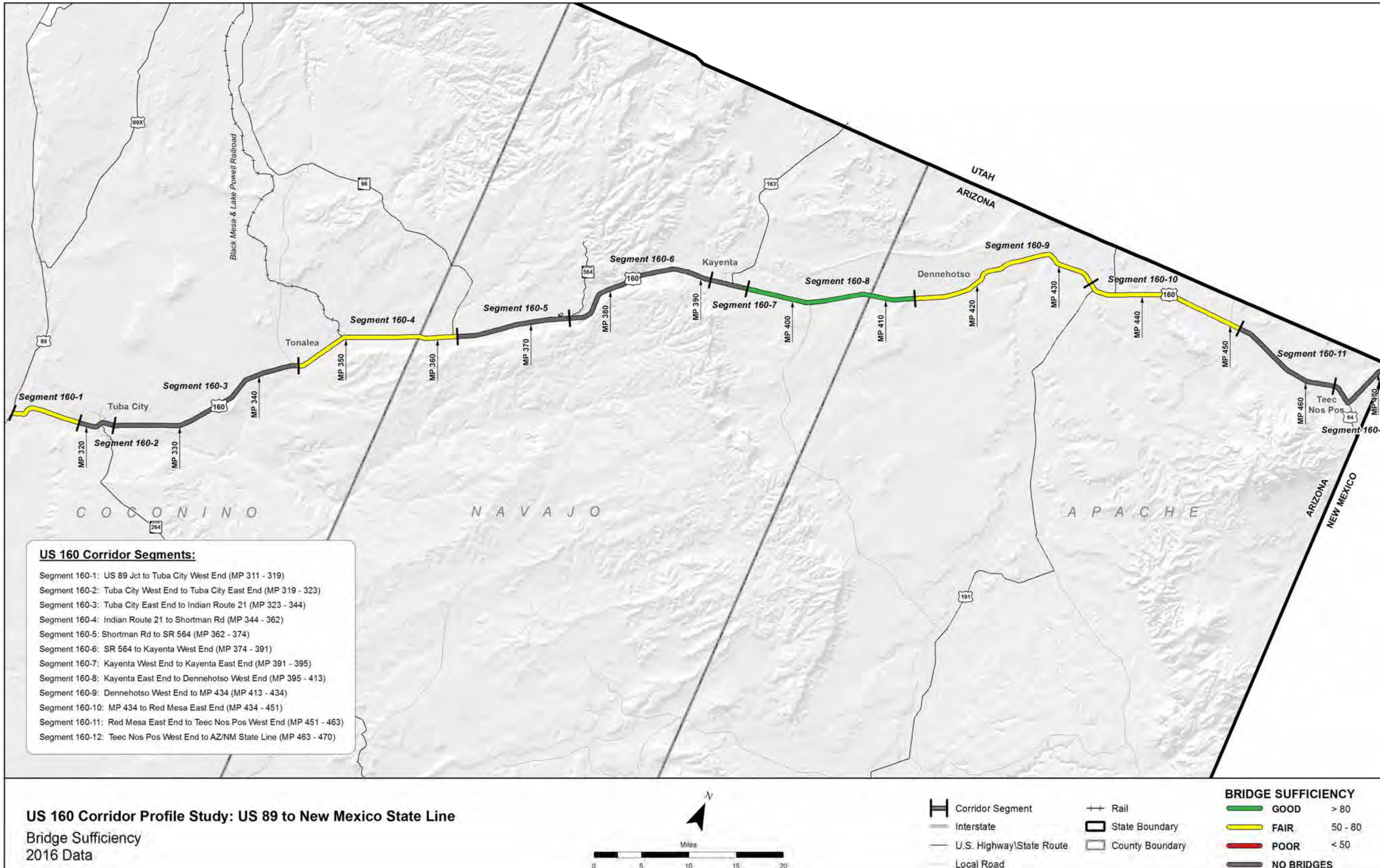
Segment 160-11: Red Mesa East End to Teec Nos Pos West End (MP 451 - 463)
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
UTAH
ARIZONA
NEW MEXICO
C O C O N I N O
N A V A J O
A P A C H E
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Black Mesa & Lake Powell Railroad
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Bridge Index and Hot Spots
2016 Data
Miles
0 5 10 15 20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
BRIDGE INDEX
GOOD >6.5
FAIR 5.0 - 6.5
POOR < 5.0
NO BRIDGES
BRIDGE HOT SPOT
Bridge with a Rating of 4 or Multiple Ratings of 5


UTAH
ARIZONA
Segment 160-1
Tuba City
Segment 160-2
Segment 160-3
Tonalea
Segment 160-4
Segment 160-5
Segment 160-6
Kayenta
Segment 160-7
Segment 160-8
Dennehotso
Segment 160-9
Segment 160-10
Segment 160-11
Teec Nos Pos
Segment 160-12
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
Black Mesa & Lake Powell Railroad
C O C O N I N O
N A V A J O
A P A C H E
ARIZONA
NEW MEXICO
US 160 Corridor Segments:
Segment 160-1: US 89 Jct to Tuba City West End (MP 311 - 319)
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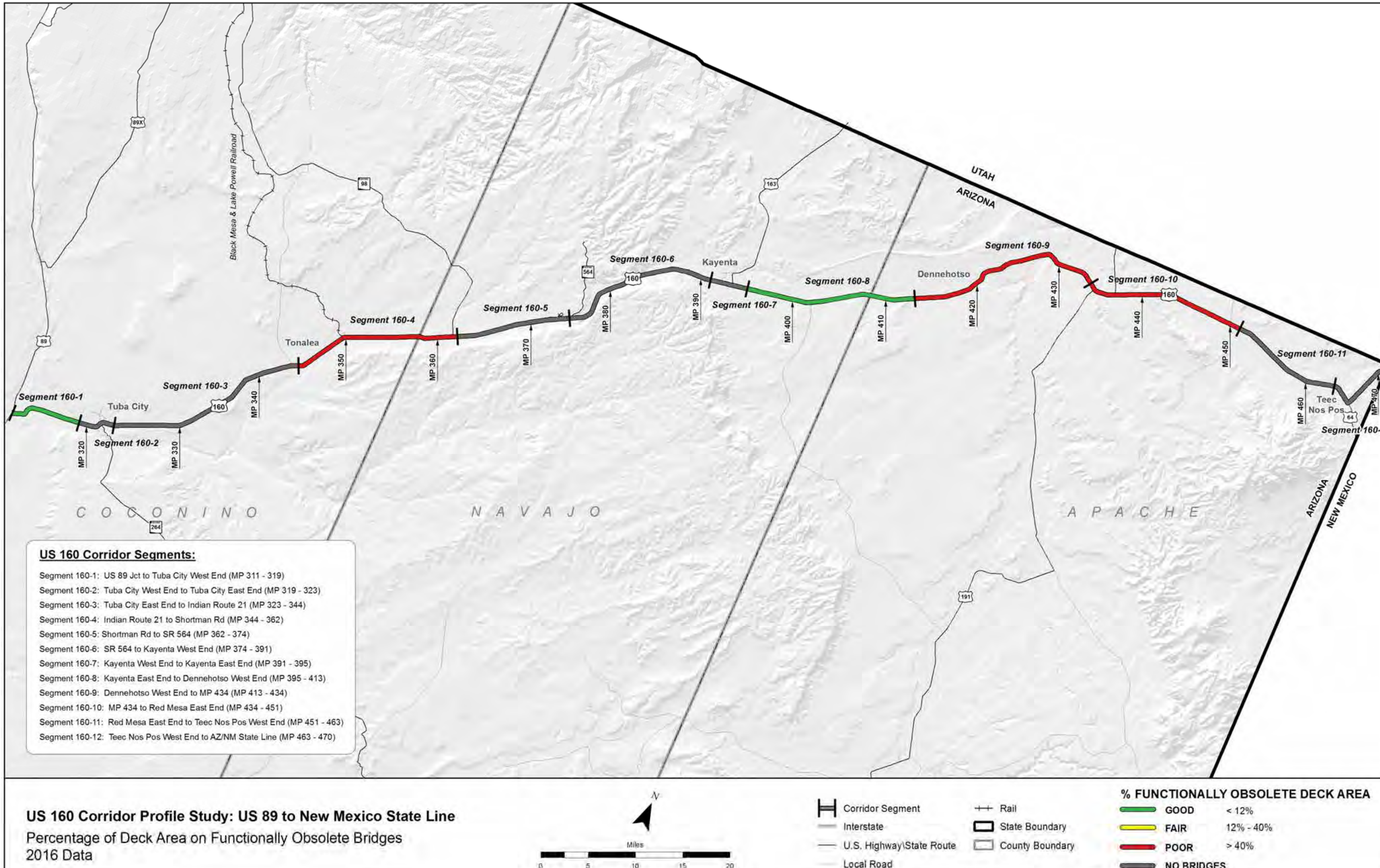
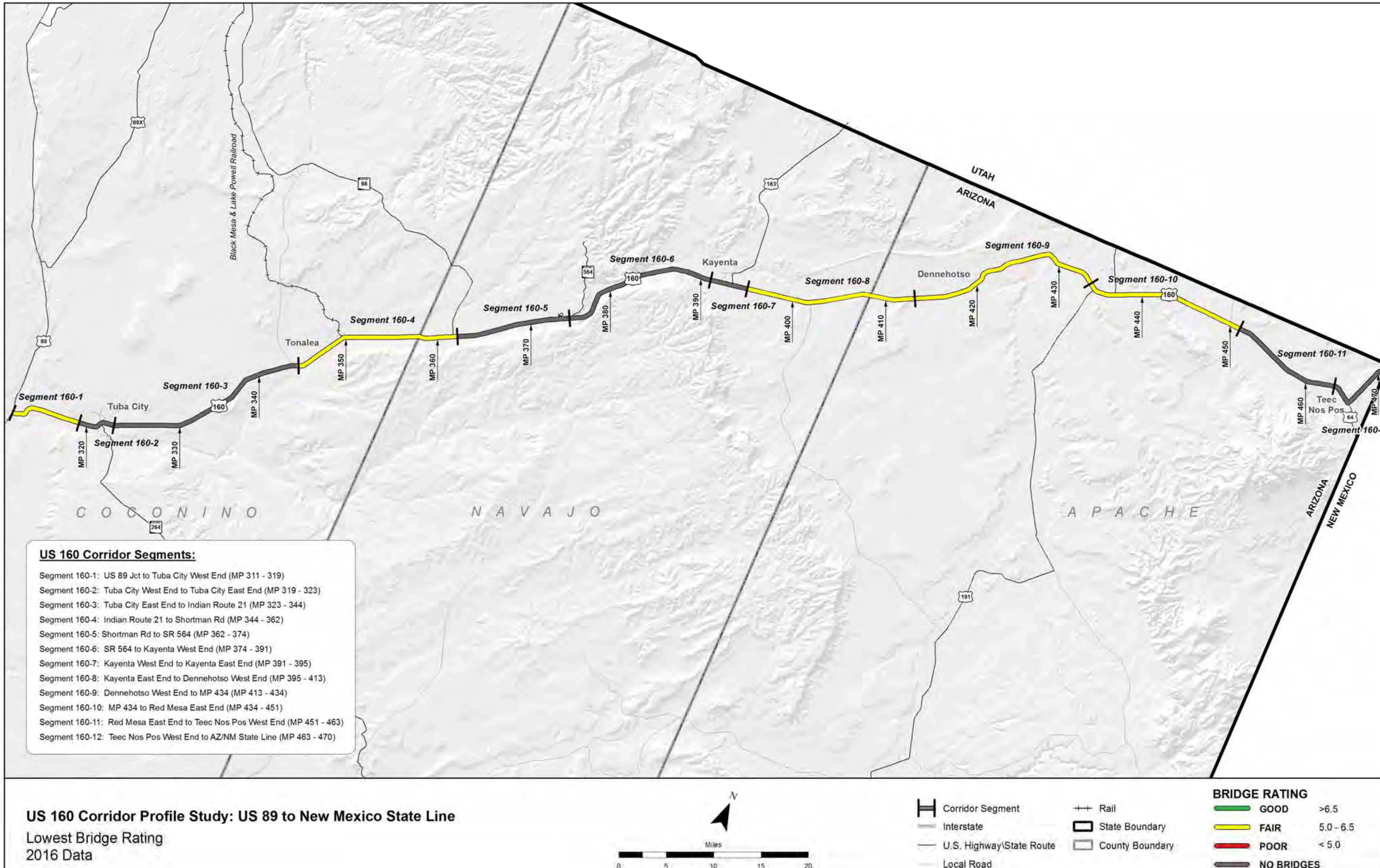
Segment 160-11: Red Mesa East End to Teec Nos Pos West End (MP 451 - 463)
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Bridge Sufficiency
2016 Data
N
Miles
0 5 10 15 20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
BRIDGE SUFFICIENCY
GOOD > 80
FAIR 50 - 80
POOR < 50
NO BRIDGES



US 160 Corridor Profile Study: US 89 to New Mexico State Line

Percentage of Deck Area on Functionally Obsolete Bridges

2016 Data



UTAH
ARIZONA
NEW MEXICO
C O C O N I N O
N A V A J O
A P A C H E
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Black Mesa & Lake Powell Railroad
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
MP 320
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MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
US 160 Corridor Segments:
Segment 160-1: US 89 Jct to Tuba City West End (MP 311 - 319)
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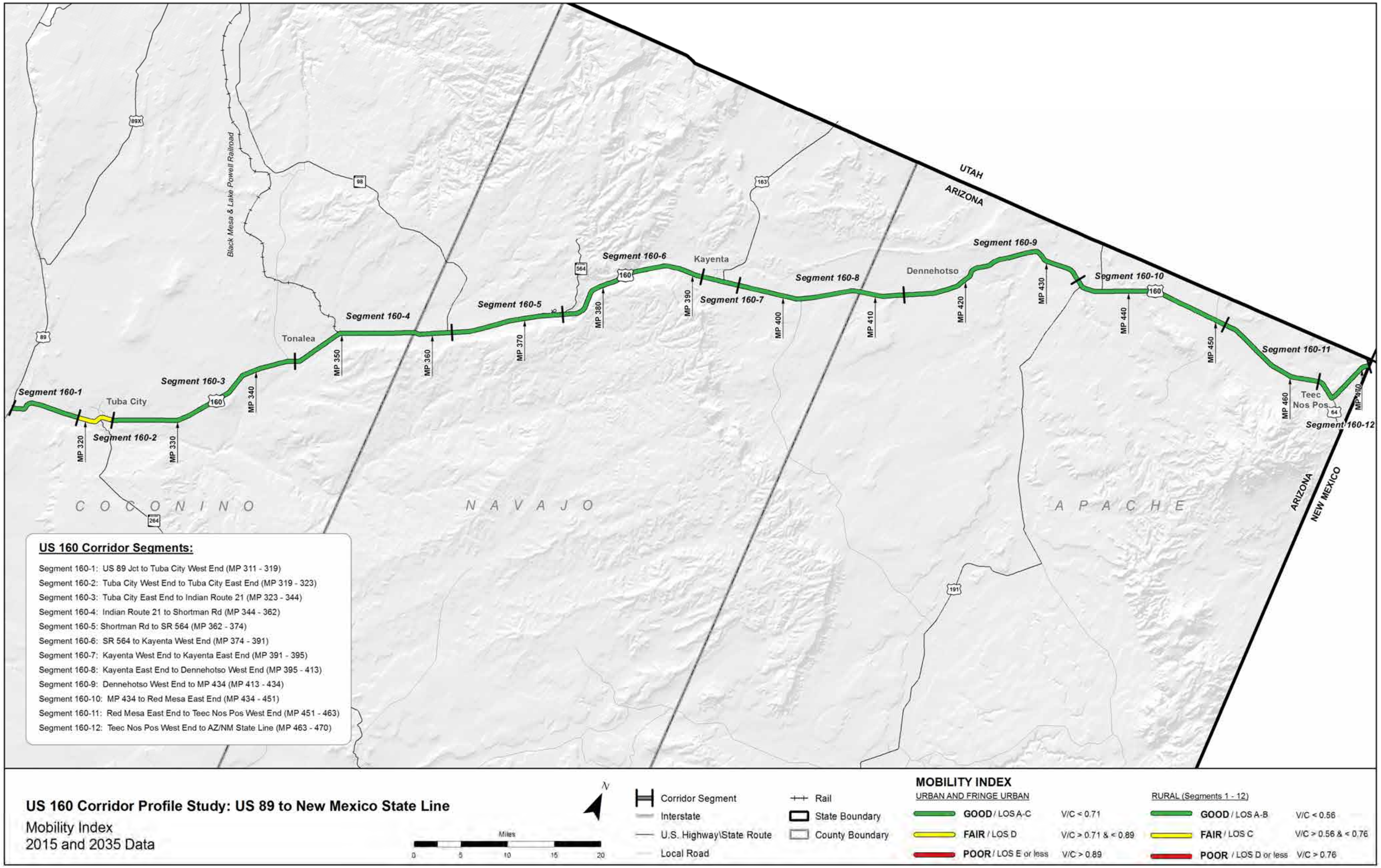
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Lowest Bridge Rating
2016 Data
N
Miles
0 5 10 15 20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
BRIDGE RATING
GOOD >6.5
FAIR 5.0 - 6.5
POOR < 5.0
NO BRIDGES


UTAH
ARIZONA
NEW MEXICO
C O C O N I N O
N A V A J O
A P A C H E
Black Mesa & Lake Powell Railroad
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
US 160 Corridor Segments:
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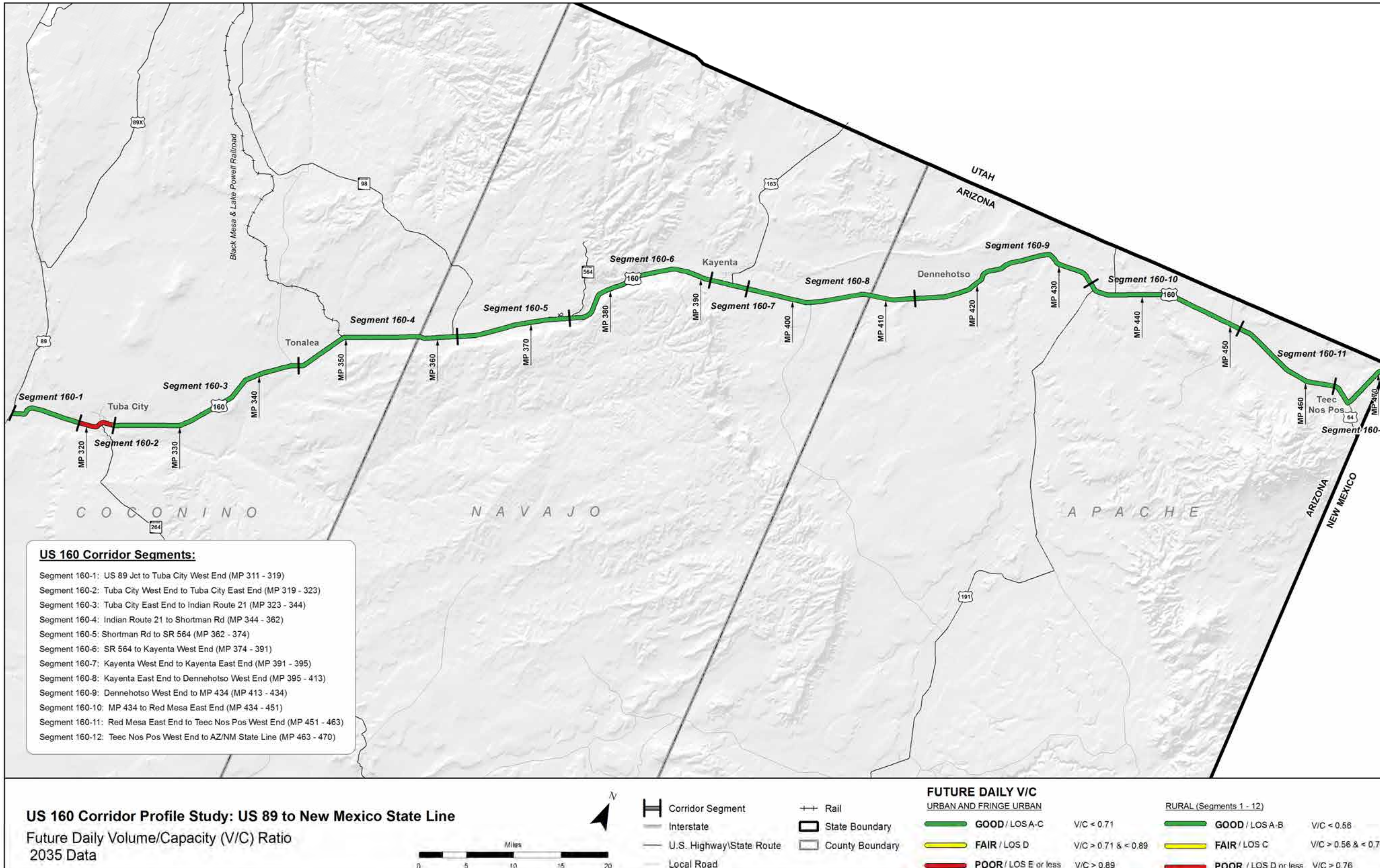
Segment 160-10: MP 434 to Red Mesa East End (MP 434 - 451)
Segment 160-11: Red Mesa East End to Teec Nos Pos West End (MP 451 - 463)
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Mobility Index
2015 and 2035 Data
Miles
0 5 10 15 20
N
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
MOBILITY INDEX
URBAN AND FRINGE URBAN
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 1 - 12)
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


US 160 Corridor Profile Study: US 89 to New Mexico State Line
Future Daily Volume/Capacity (V/C) Ratio
2035 Data
US 160 Corridor Segments:
Segment 160-1: US 89 Jct to Tuba City West End (MP 311 - 319)
Segment 160-2: Tuba City West End to Tuba City East End (MP 319 - 323)
Segment 160-3: Tuba City East End to Indian Route 21 (MP 323 - 344)
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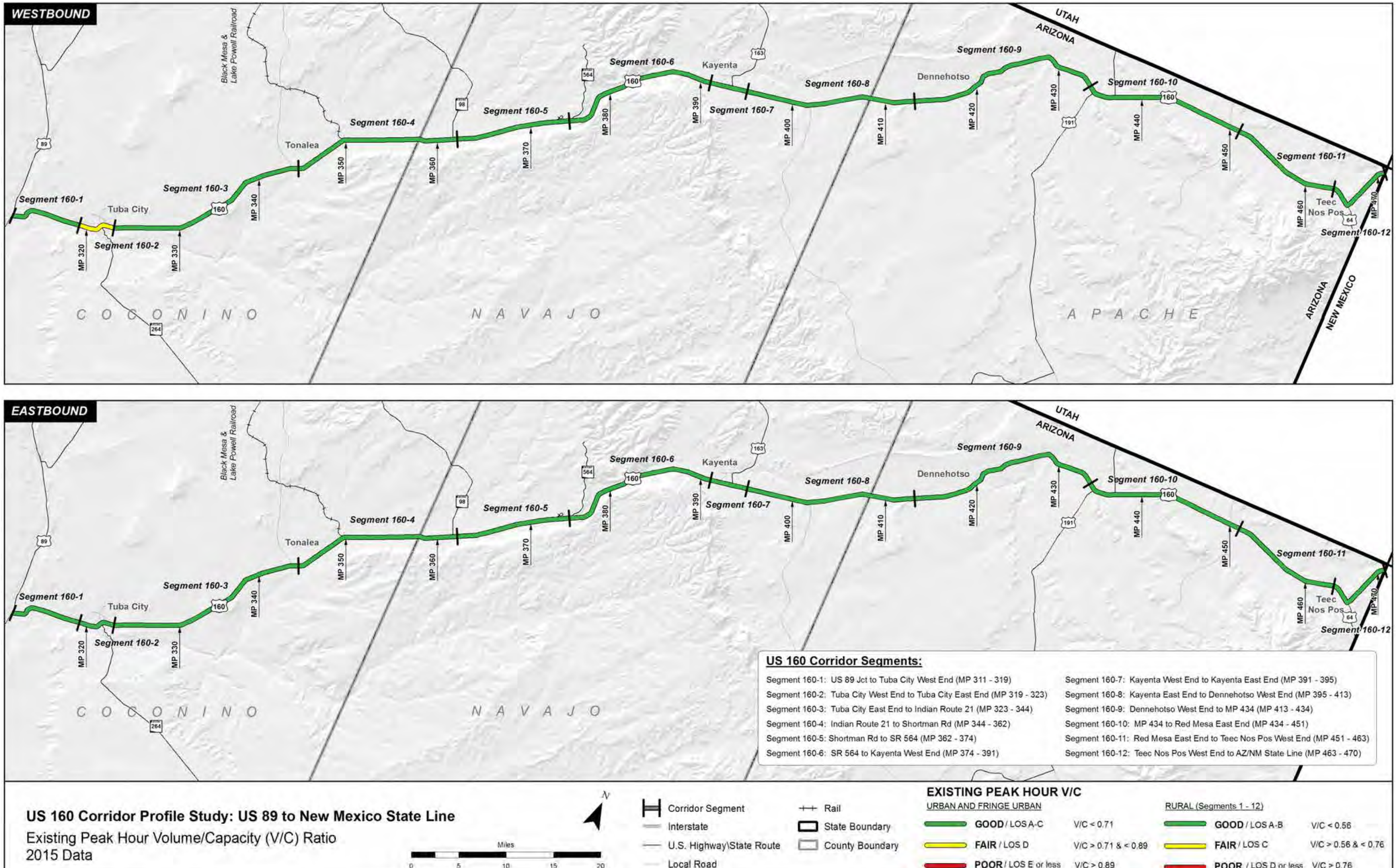
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
Black Mesa & Lake Powell Railroad
UTAH
ARIZONA
NEW MEXICO
C O C O N I N O
N A V A J O
A P A C H E
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
Miles
0 5 10 15 20
FUTURE DAILY V/C
URBAN AND FRINGE URBAN
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 1 - 12)
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


WESTBOUND
EASTBOUND
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Black Mesa & Lake Powell Railroad
UTAH
ARIZONA
NEW MEXICO
COCONINO
NAVAJO
APACHE
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
US 160 Corridor Segments:
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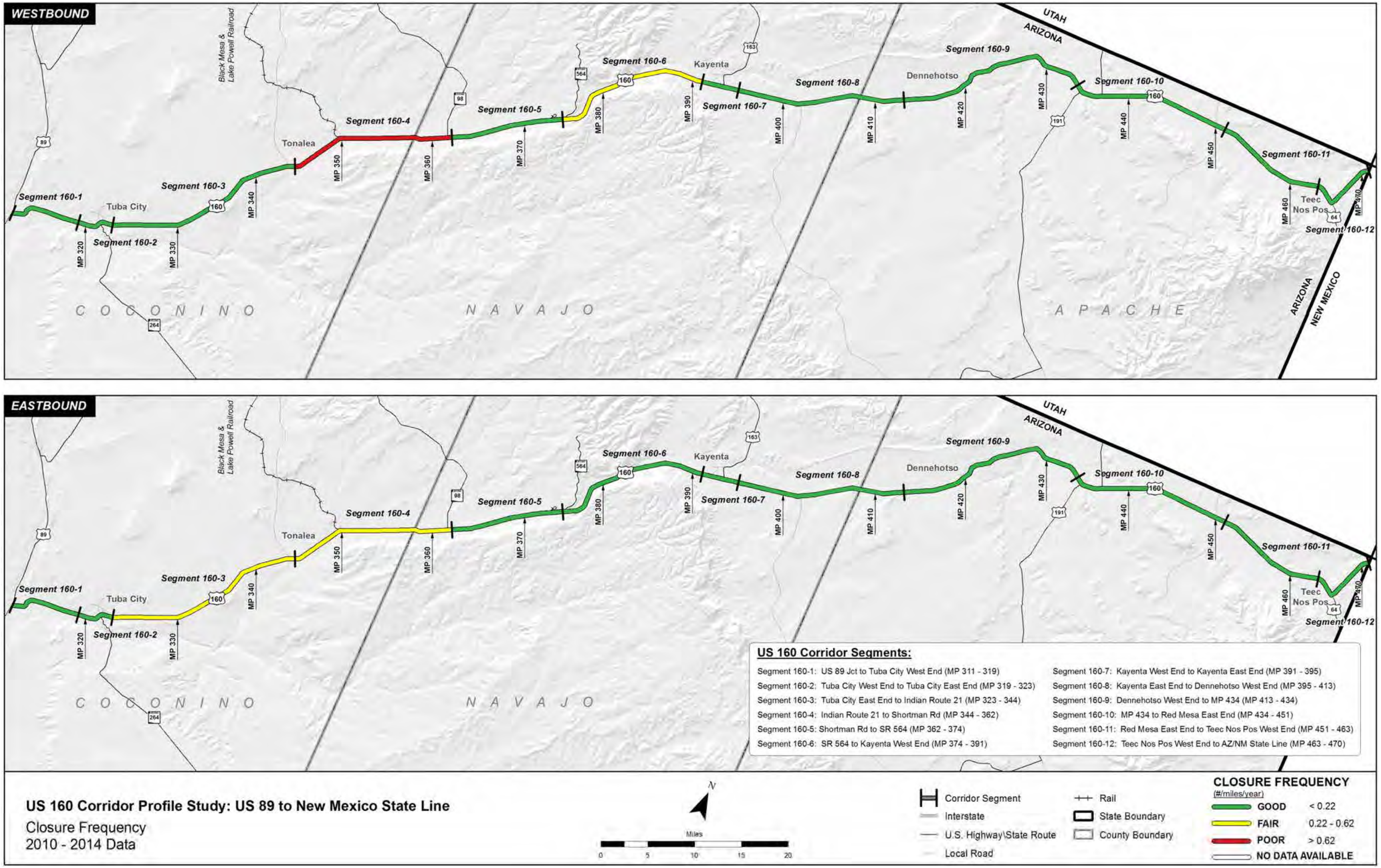
Segment 160-11: Red Mesa East End to Teec Nos Pos West End (MP 451 - 463)
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Existing Peak Hour Volume/Capacity (V/C) Ratio
2015 Data
Miles
0 5 10 15 20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
EXISTING PEAK HOUR V/C
URBAN AND FRINGE URBAN
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 1 - 12)
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


WESTBOUND
EASTBOUND
UTAH
ARIZONA
NEW MEXICO
Black Mesa & Lake Powell Railroad
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
C O C O N I N O
N A V A J O
A P A C H E
US 160 Corridor Segments:
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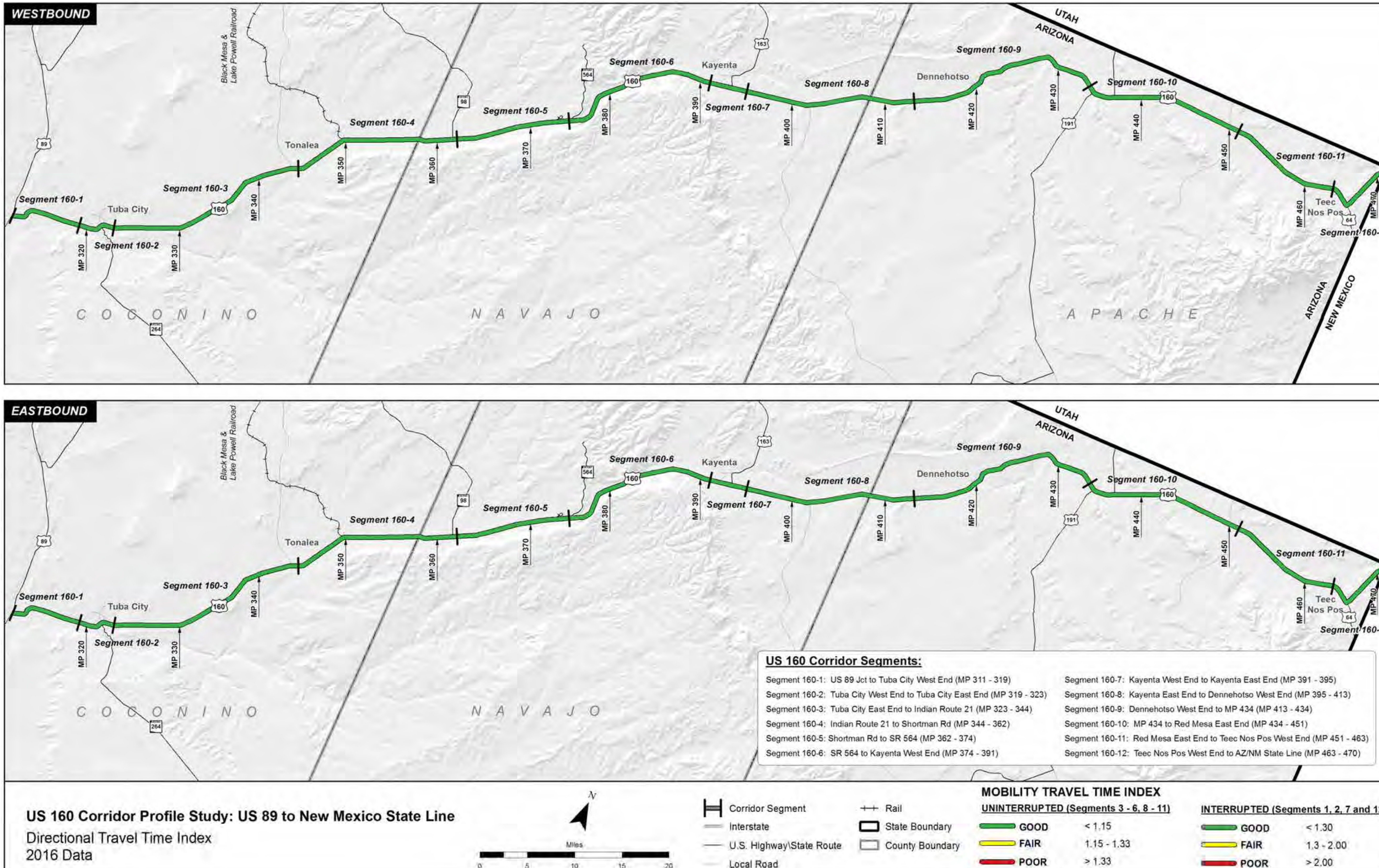
Segment 160-5: Shortman Rd to SR 564 (MP 362 - 374)
Segment 160-6: SR 564 to Kayenta West End (MP 374 - 391)
Segment 160-7: Kayenta West End to Kayenta East End (MP 391 - 395)
Segment 160-8: Kayenta East End to Dennehotso West End (MP 395 - 413)
Segment 160-9: Dennehotso West End to MP 434 (MP 413 - 434)
Segment 160-10: MP 434 to Red Mesa East End (MP 434 - 451)
Segment 160-11: Red Mesa East End to Teec Nos Pos West End (MP 451 - 463)
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Closure Frequency
2010 - 2014 Data
N
Miles
0 5 10 15 20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
CLOSURE FREQUENCY
(#/miles/year)
GOOD < 0.22
FAIR 0.22 - 0.62
POOR > 0.62
NO DATA AVAILABLE


WESTBOUND
EASTBOUND
Black Mesa & Lake Powell Railroad
UTAH
ARIZONA
NEW MEXICO
COCONINO
NAVAJO
APACHE
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
US 160 Corridor Segments:
Segment 160-1: US 89 Jct to Tuba City West End (MP 311 - 319)
Segment 160-2: Tuba City West End to Tuba City East End (MP 319 - 323)
Segment 160-3: Tuba City East End to Indian Route 21 (MP 323 - 344)
Segment 160-4: Indian Route 21 to Shortman Rd (MP 344 - 362)
Segment 160-5: Shortman Rd to SR 564 (MP 362 - 374)
Segment 160-6: SR 564 to Kayenta West End (MP 374 - 391)
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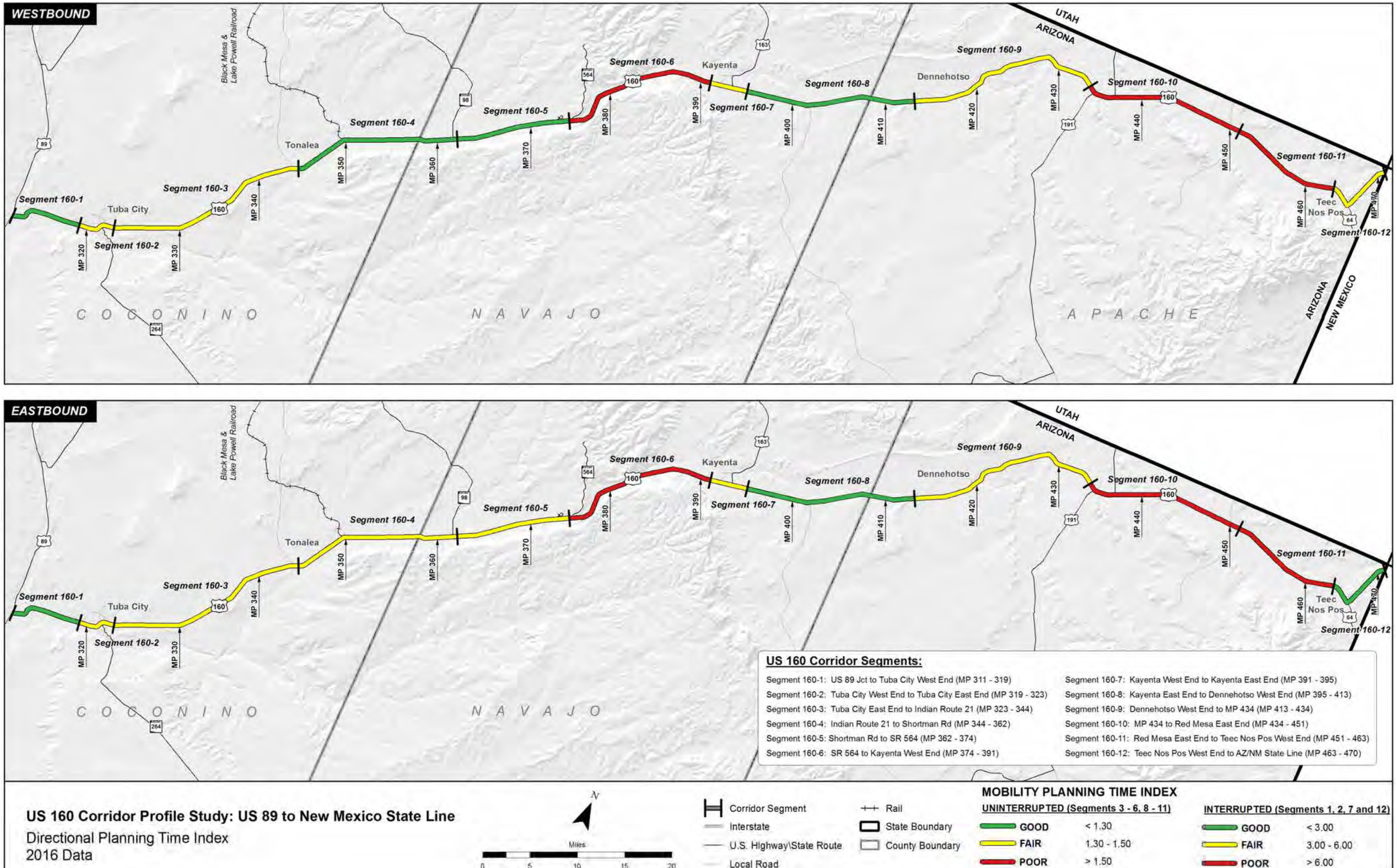
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Directional Travel Time Index
2016 Data
N
Miles
0 5 10 15 20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
MOBILITY TRAVEL TIME INDEX
UNINTERRUPTED (Segments 3 - 6, 8 - 11)
GOOD < 1.15
FAIR 1.15 - 1.33
POOR > 1.33
INTERRUPTED (Segments 1, 2, 7 and 12)
GOOD < 1.30
FAIR 1.3 - 2.00
POOR > 2.00


WESTBOUND
EASTBOUND
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Black Mesa & Lake Powell Railroad
UTAH
ARIZONA
NEW MEXICO
C O C O N I N O
N A V A J O
A P A C H E
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
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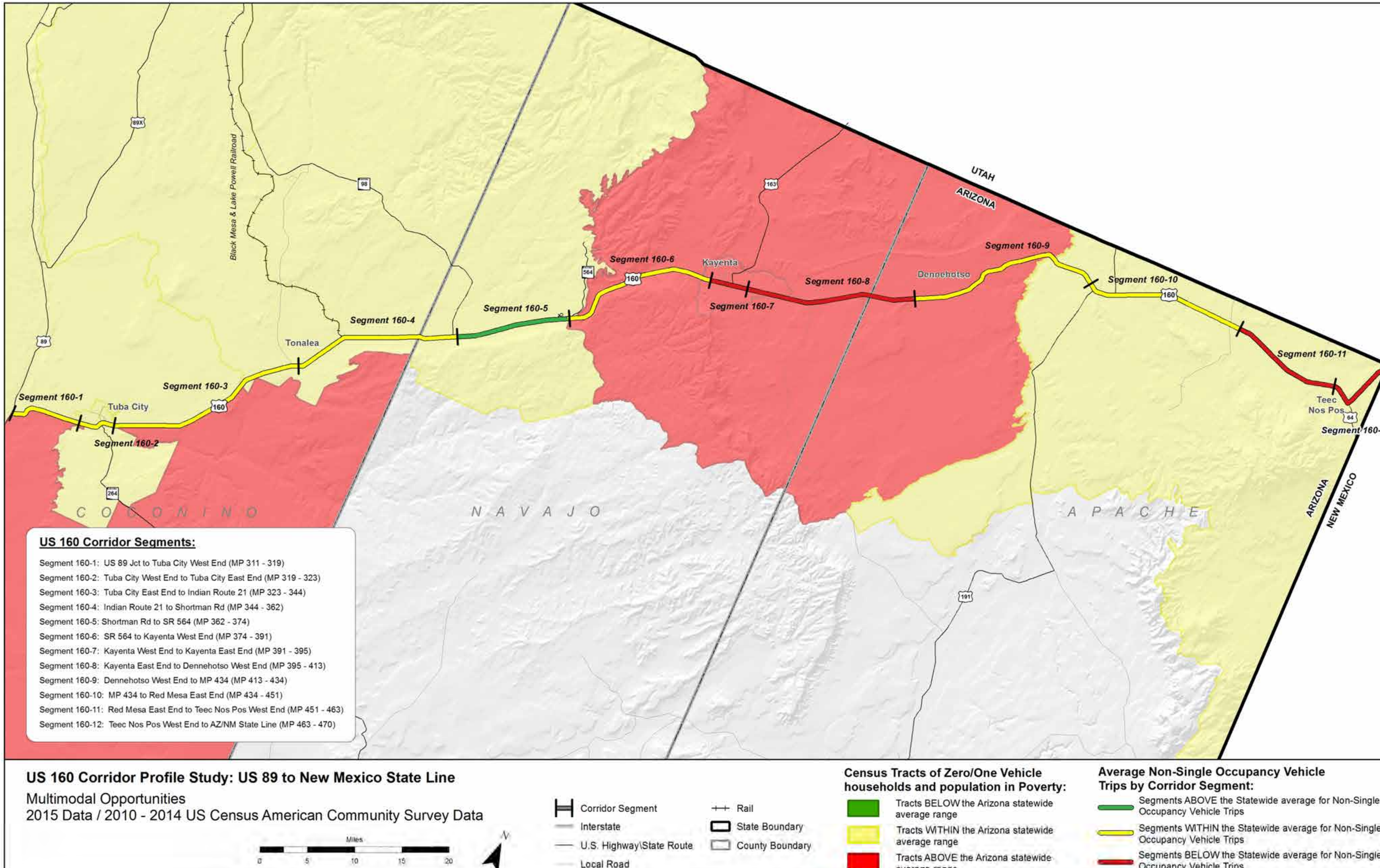
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Directional Planning Time Index
2016 Data
Miles
0 5 10 15 20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
MOBILITY PLANNING TIME INDEX
UNINTERRUPTED (Segments 3 - 6, 8 - 11)
GOOD < 1.30
FAIR 1.30 - 1.50
POOR > 1.50
INTERRUPTED (Segments 1, 2, 7 and 12)
GOOD < 3.00
FAIR 3.00 - 6.00
POOR > 6.00


UTAH
ARIZONA
NEW MEXICO
C O C O N I N O
N A V A J O
A P A C H E
Black Mesa & Lake Powell Railroad
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
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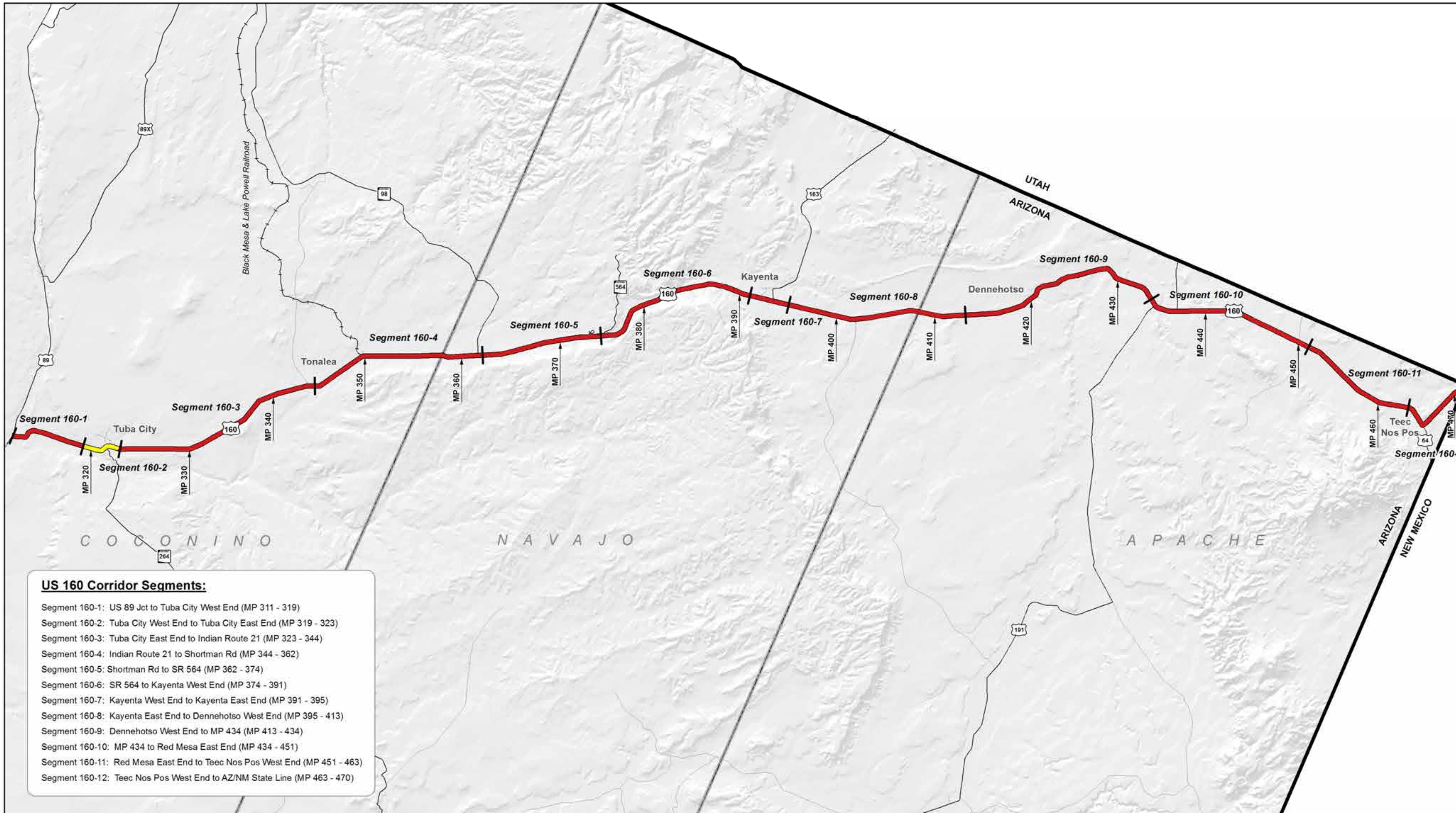
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Multimodal Opportunities
2015 Data / 2010 - 2014 US Census American Community Survey Data
Miles
0 5 10 15 20
N
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
Census Tracts of Zero/One Vehicle households and population in Poverty:
Tracts BELOW the Arizona statewide average range
Tracts WITHIN the Arizona statewide average range
Tracts ABOVE the Arizona statewide average range
Average Non-Single Occupancy Vehicle Trips by Corridor Segment:
Segments ABOVE the Statewide average for Non-Single Occupancy Vehicle Trips
Segments WITHIN the Statewide average for Non-Single Occupancy Vehicle Trips
Segments BELOW the Statewide average for Non-Single Occupancy Vehicle Trips



US 160 Corridor Segments:

Segment 160-1: US 89 Jct to Tuba City West End (MP 311 - 319)
Segment 160-2: Tuba City West End to Tuba City East End (MP 319 - 323)
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Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)

US 160 Corridor Profile Study: US 89 to New Mexico State Line

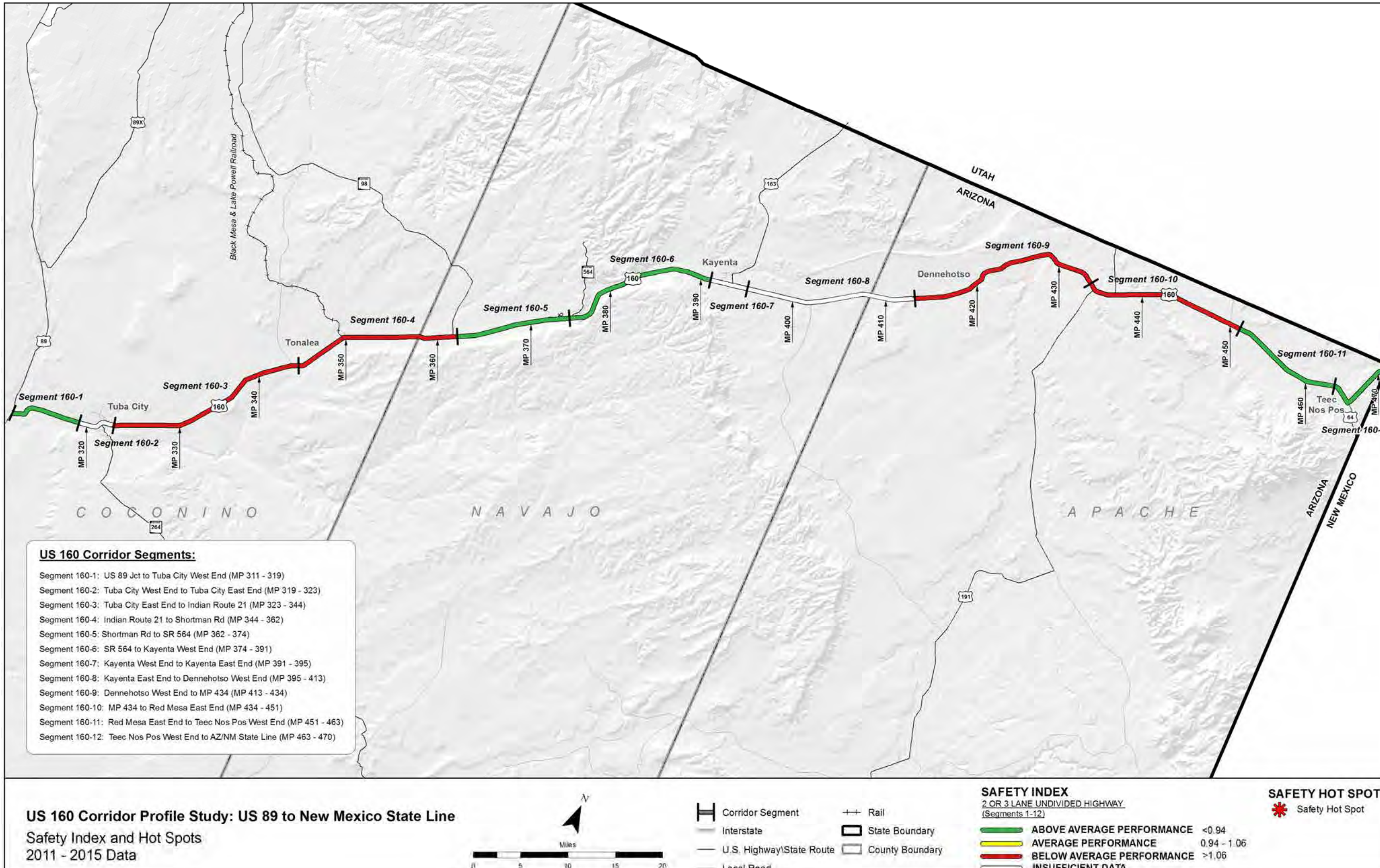
Percentage of Bicycle Accommodation
2015 Data

Miles 0 5 10 15 20

Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary

% BICYCLE ACCOMMODATION

GOOD	≥ 90%
FAIR	60% - 90%
POOR	< 60%



UTAH
ARIZONA
NEW MEXICO
COCONINO
NAVAJO
APACHE
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Black Mesa & Lake Powell Railroad
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
US 160 Corridor Segments:
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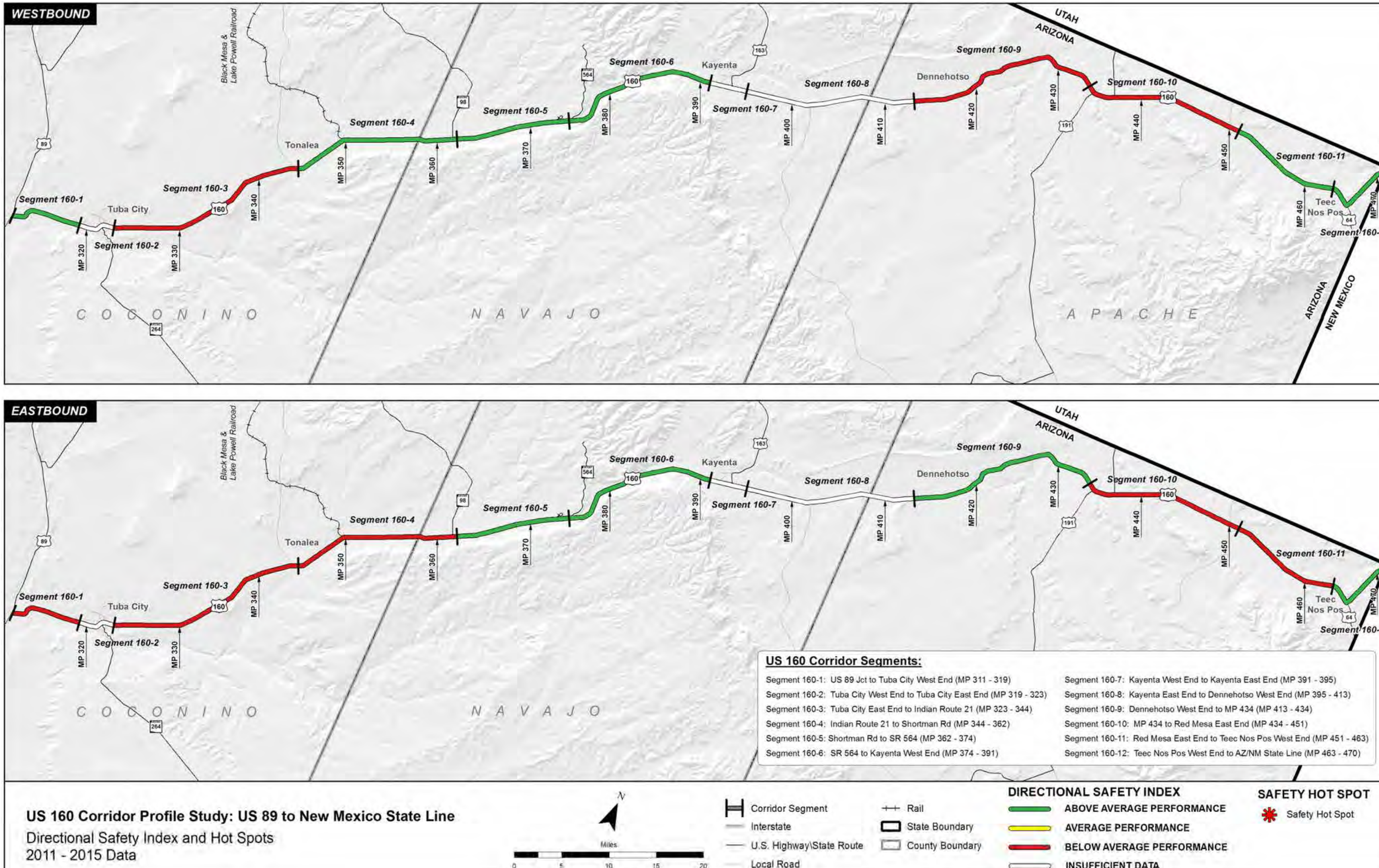
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Safety Index and Hot Spots
2011 - 2015 Data
Miles
0
5
10
15
20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
SAFETY INDEX
2 OR 3 LANE UNDIVIDED HIGHWAY
(Segments 1-12)
ABOVE AVERAGE PERFORMANCE <0.94
AVERAGE PERFORMANCE 0.94 - 1.06
BELOW AVERAGE PERFORMANCE >1.06
INSUFFICIENT DATA
SAFETY HOT SPOT
Safety Hot Spot


WESTBOUND
EASTBOUND
UTAH
ARIZONA
NEW MEXICO
Black Mesa & Lake Powell Railroad
Tonalea
Tuba City
Kayenta
Dennehotso
Teec Nos Pos
C O C O N I N O
N A V A J O
A P A C H E
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
US 160 Corridor Segments:
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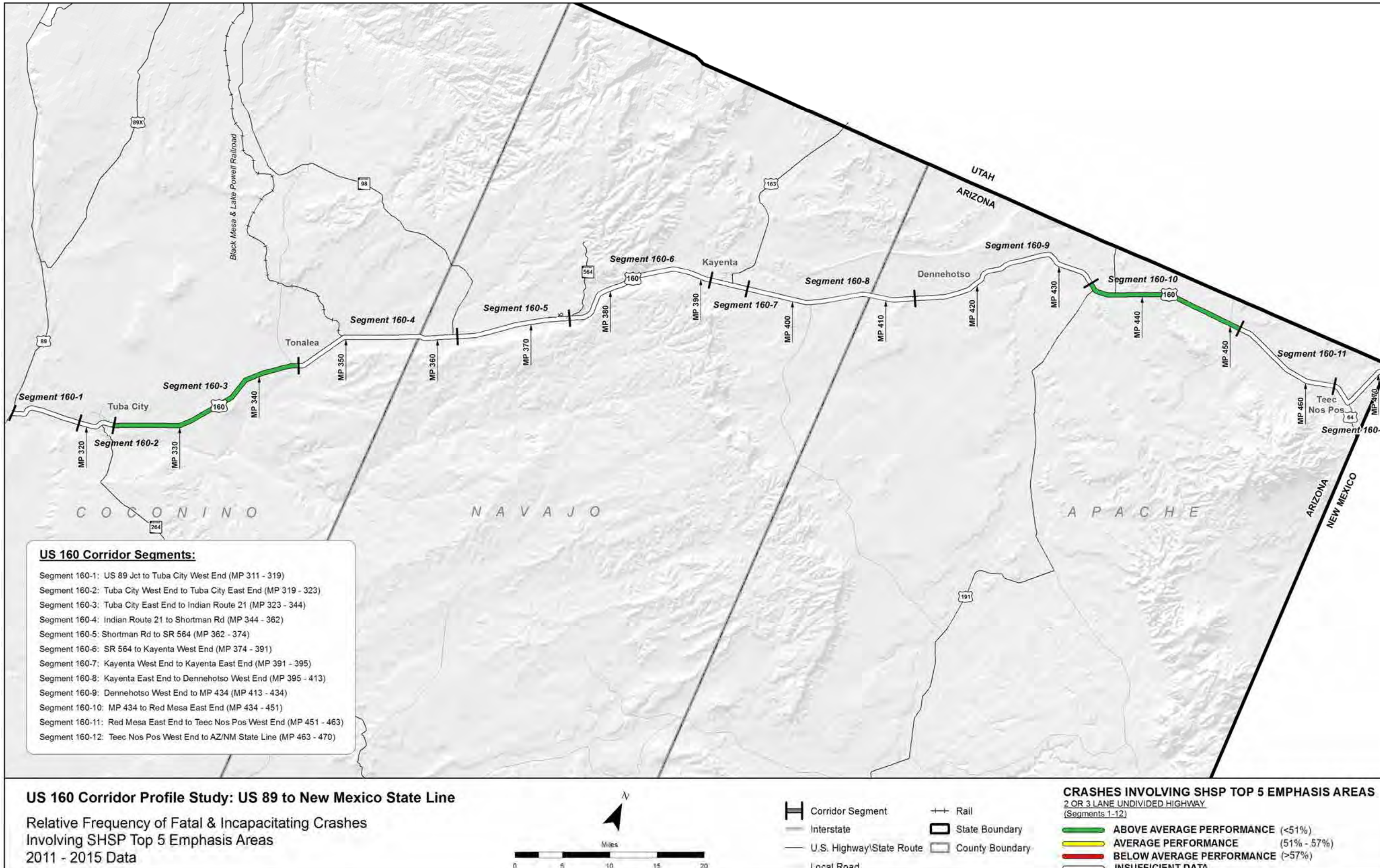
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Directional Safety Index and Hot Spots
2011 - 2015 Data
N
Miles
0 5 10 15 20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
DIRECTIONAL SAFETY INDEX
ABOVE AVERAGE PERFORMANCE
AVERAGE PERFORMANCE
BELOW AVERAGE PERFORMANCE
INSUFFICIENT DATA
SAFETY HOT SPOT
Safety Hot Spot


UTAH
ARIZONA
NEW MEXICO
C O C O N I N O
N A V A J O
A P A C H E
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Black Mesa & Lake Powell Railroad
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
89X
89
98
160
163
564
264
191
64
US 160 Corridor Segments:
Segment 160-1: US 89 Jct to Tuba City West End (MP 311 - 319)
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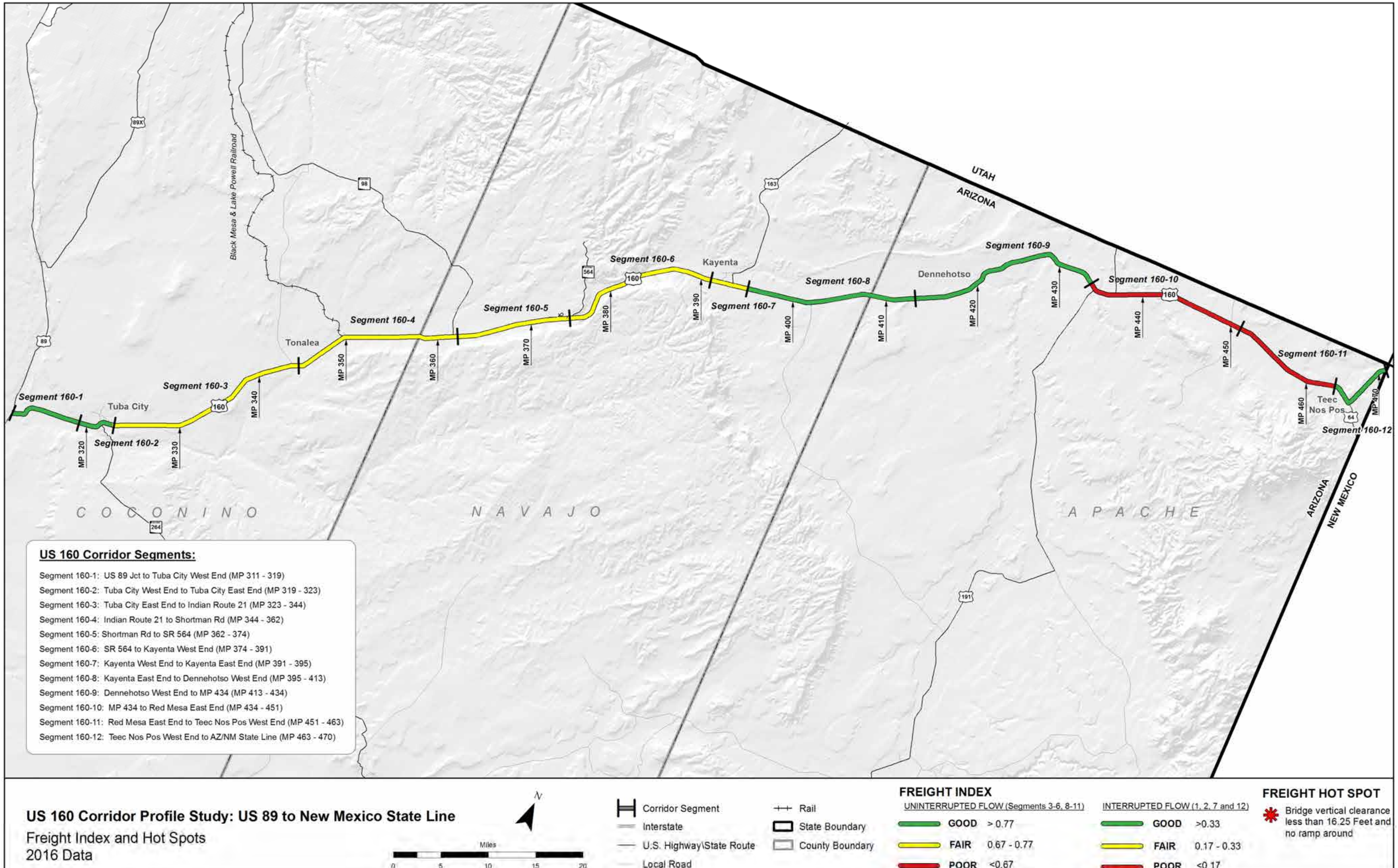
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Relative Frequency of Fatal & Incapacitating Crashes
Involving SHSP Top 5 Emphasis Areas
2011 - 2015 Data
N
Miles
0
5
10
15
20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
CRASHES INVOLVING SHSP TOP 5 EMPHASIS AREAS
2 OR 3 LANE UNDIVIDED HIGHWAY
(Segments 1-12)
ABOVE AVERAGE PERFORMANCE (<51%)
AVERAGE PERFORMANCE (51% - 57%)
BELOW AVERAGE PERFORMANCE (>57%)
INSUFFICIENT DATA


US 160 Corridor Profile Study: US 89 to New Mexico State Line
Freight Index and Hot Spots
2016 Data
US 160 Corridor Segments:
Segment 160-1: US 89 Jct to Tuba City West End (MP 311 - 319)
Segment 160-2: Tuba City West End to Tuba City East End (MP 319 - 323)
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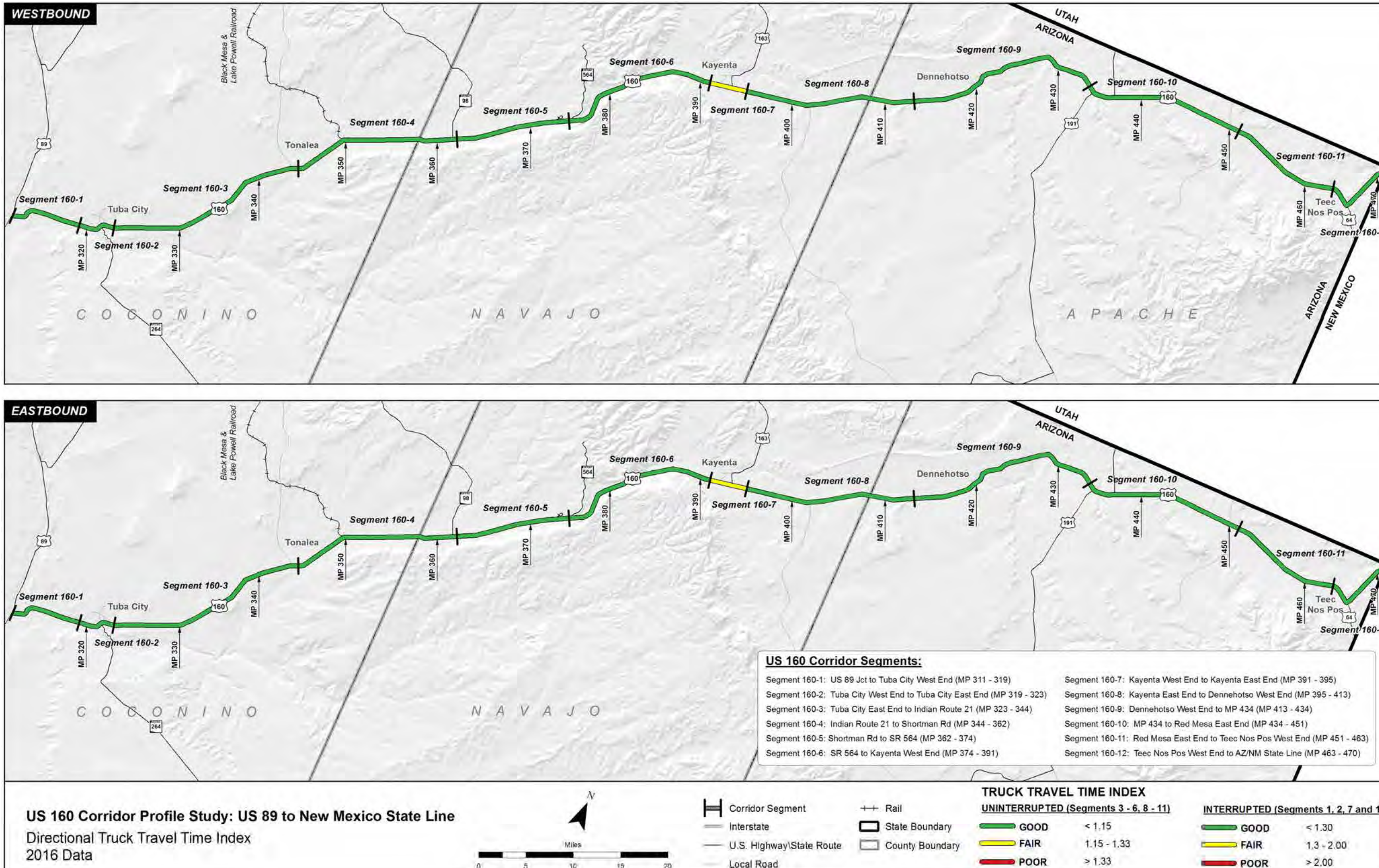
Segment 160-11: Red Mesa East End to Teec Nos Pos West End (MP 451 - 463)
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
FREIGHT INDEX
UNINTERRUPTED FLOW (Segments 3-6, 8-11)
GOOD > 0.77
FAIR 0.67 - 0.77
POOR <0.67
INTERRUPTED FLOW (1, 2, 7 and 12)
GOOD >0.33
FAIR 0.17 - 0.33
POOR <0.17
FREIGHT HOT SPOT
Bridge vertical clearance less than 16.25 Feet and no ramp around
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
Miles
0 5 10 15 20
N
COCONINO
NAVAJO
APACHE
UTAH
ARIZONA
NEW MEXICO
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Black Mesa & Lake Powell Railroad
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
89X
89
98
160
264
564
163
191
64


WESTBOUND
EASTBOUND
UTAH
ARIZONA
NEW MEXICO
COCONINO
NAVAJO
APACHE
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Black Mesa & Lake Powell Railroad
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
MP 320
MP 330
MP 340
MP 350
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MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
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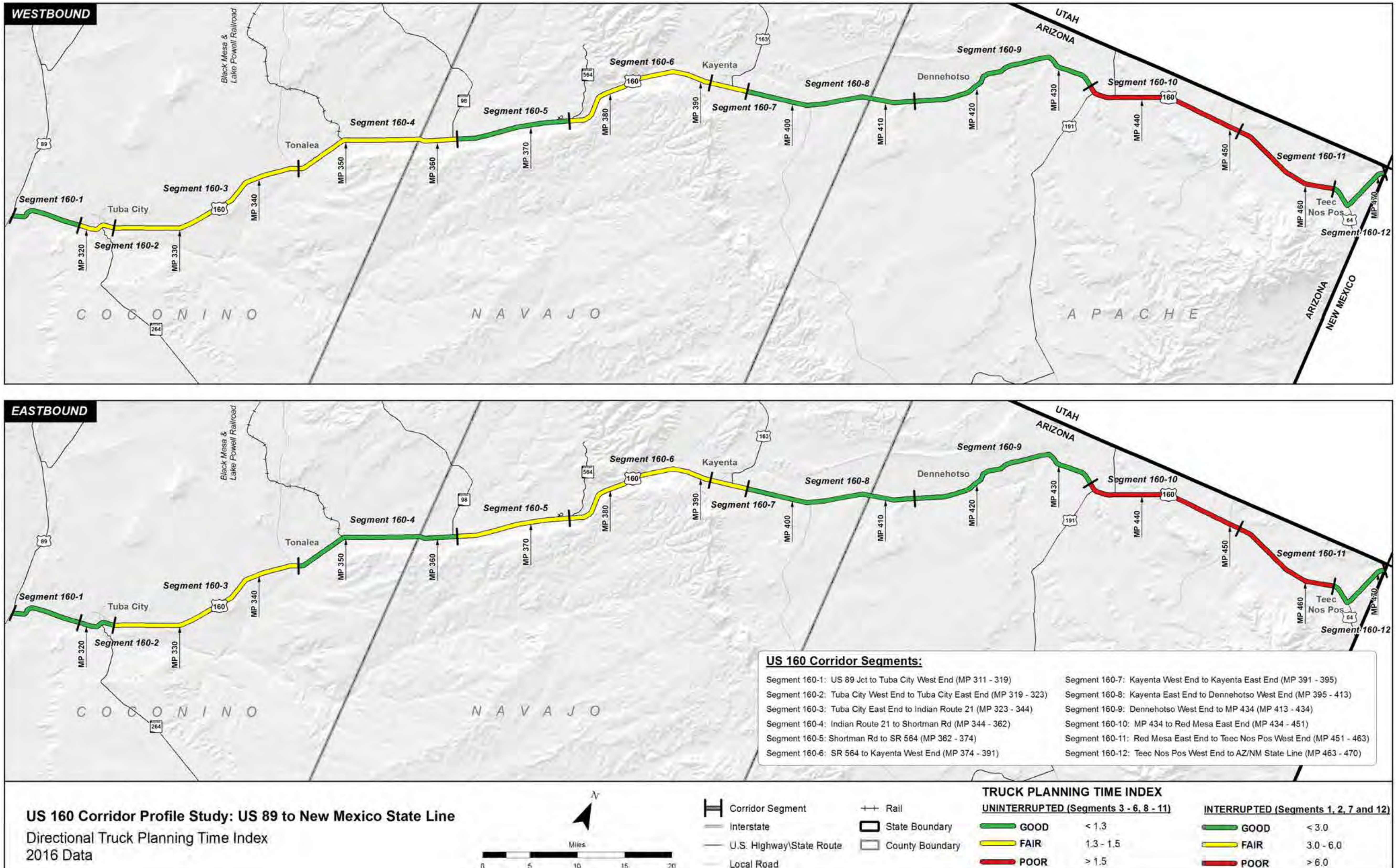
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Directional Truck Travel Time Index
2016 Data
N
Miles
0 5 10 15 20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
TRUCK TRAVEL TIME INDEX
UNINTERRUPTED (Segments 3 - 6, 8 - 11)
GOOD < 1.15
FAIR 1.15 - 1.33
POOR > 1.33
INTERRUPTED (Segments 1, 2, 7 and 12)
GOOD < 1.30
FAIR 1.3 - 2.00
POOR > 2.00



WESTBOUND
EASTBOUND
UTAH
ARIZONA
NEW MEXICO
COCONINO
NAVAJO
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Black Mesa & Lake Powell Railroad
Tuba City
Tonalea
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Dennehotso
Teec Nos Pos
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
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Segment 160-10
Segment 160-11
Segment 160-12
MP 320
MP 330
MP 340
MP 350
MP 360
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MP 380
MP 390
MP 400
MP 410
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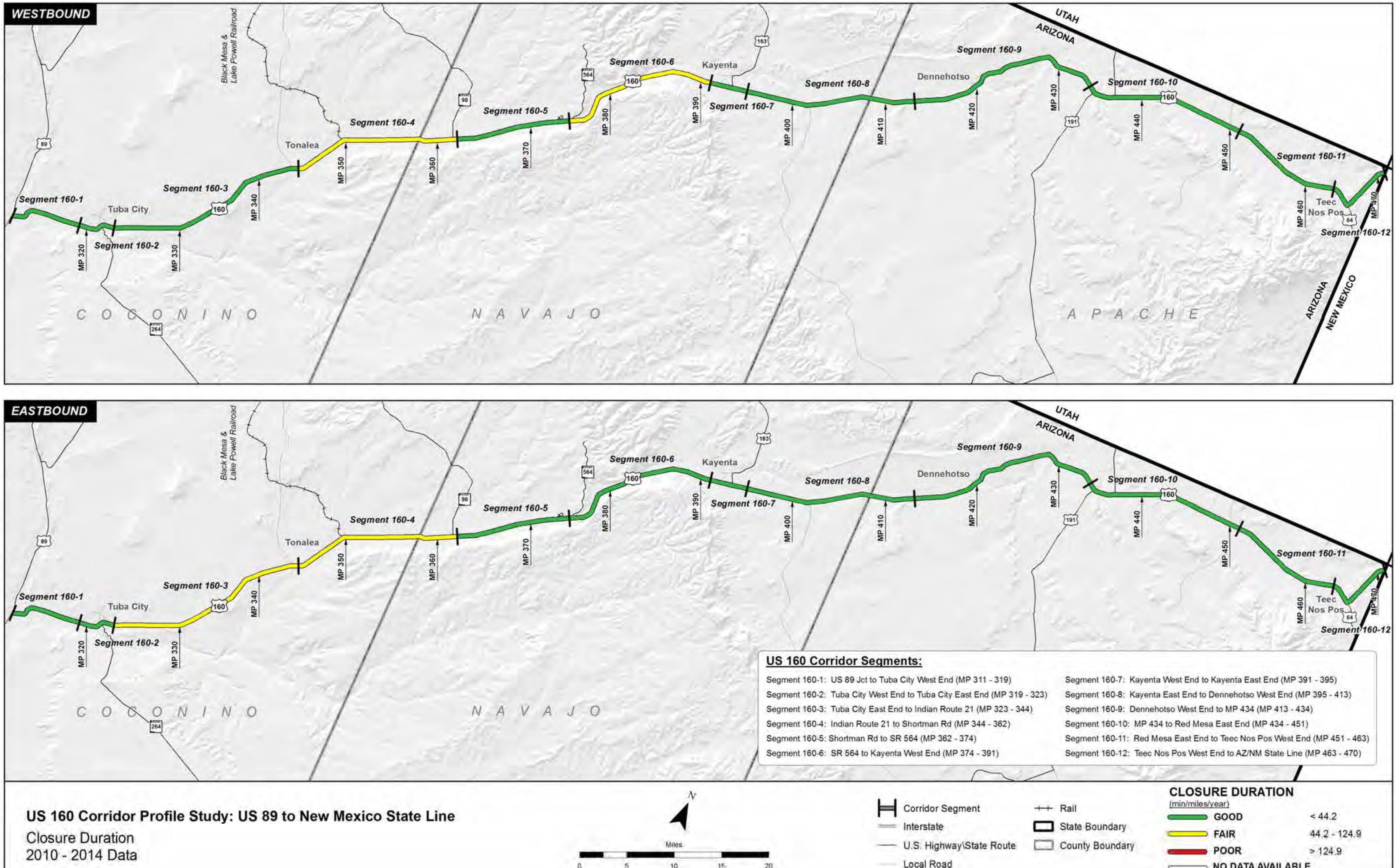
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Directional Truck Planning Time Index
2016 Data
N
Miles
0
5
10
15
20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
TRUCK PLANNING TIME INDEX
UNINTERRUPTED (Segments 3 - 6, 8 - 11)
GOOD < 1.3
FAIR 1.3 - 1.5
POOR > 1.5
INTERRUPTED (Segments 1, 2, 7 and 12)
GOOD < 3.0
FAIR 3.0 - 6.0
POOR > 6.0


WESTBOUND
EASTBOUND
UTAH
ARIZONA
NEW MEXICO
C O C O N I N O
N A V A J O
A P A C H E
Black Mesa & Lake Powell Railroad
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
MP 320
MP 330
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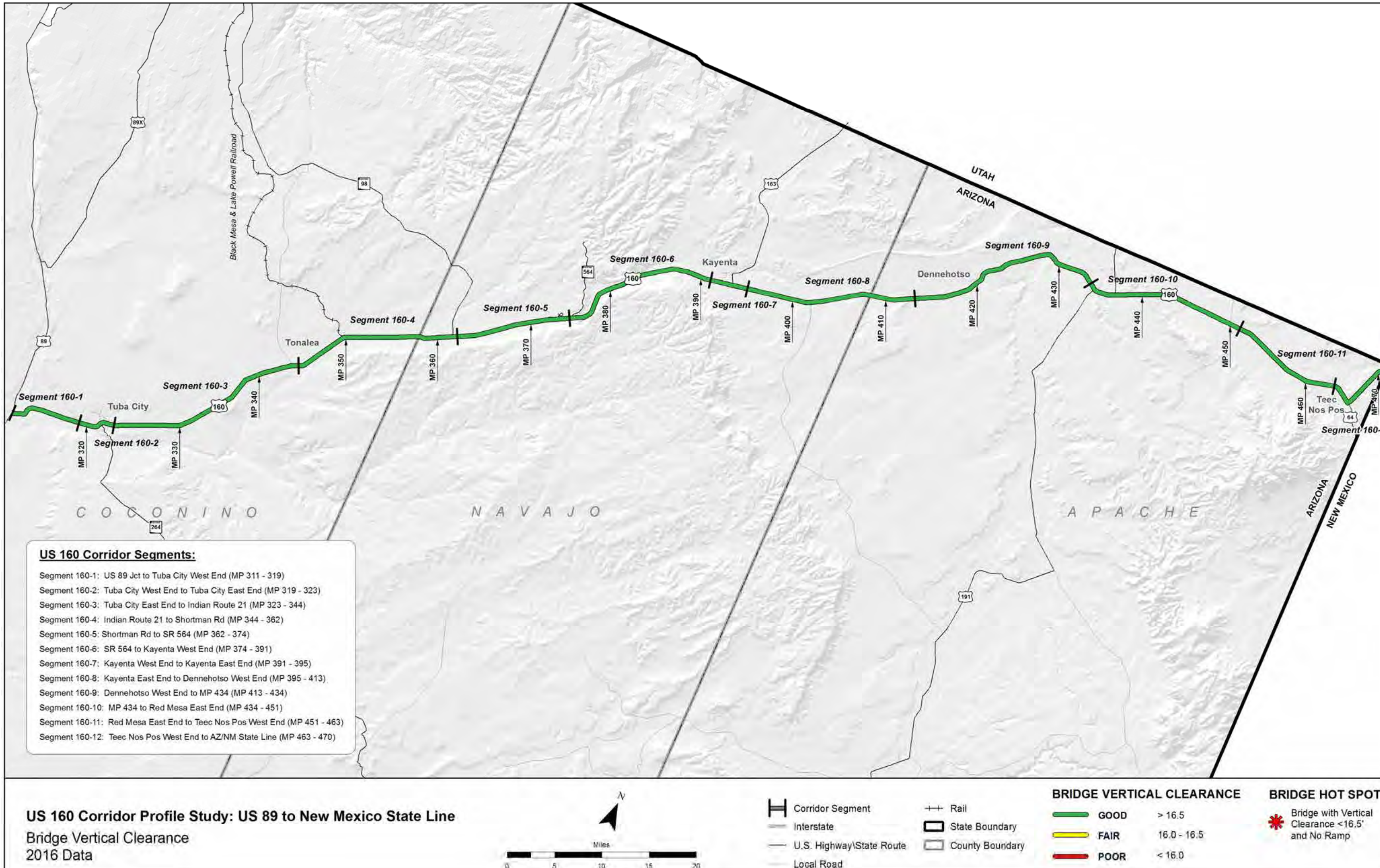
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460
MP 470
US 160 Corridor Segments:
Segment 160-1: US 89 Jct to Tuba City West End (MP 311 - 319)
Segment 160-2: Tuba City West End to Tuba City East End (MP 319 - 323)
Segment 160-3: Tuba City East End to Indian Route 21 (MP 323 - 344)
Segment 160-4: Indian Route 21 to Shortman Rd (MP 344 - 362)
Segment 160-5: Shortman Rd to SR 564 (MP 362 - 374)
Segment 160-6: SR 564 to Kayenta West End (MP 374 - 391)
Segment 160-7: Kayenta West End to Kayenta East End (MP 391 - 395)
Segment 160-8: Kayenta East End to Dennehotso West End (MP 395 - 413)
Segment 160-9: Dennehotso West End to MP 434 (MP 413 - 434)
Segment 160-10: MP 434 to Red Mesa East End (MP 434 - 451)
Segment 160-11: Red Mesa East End to Teec Nos Pos West End (MP 451 - 463)
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
US 160 Corridor Profile Study: US 89 to New Mexico State Line
Closure Duration
2010 - 2014 Data
N
Miles
0
5
10
15
20
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
CLOSURE DURATION
(min/miles/year)
GOOD < 44.2
FAIR 44.2 - 124.9
POOR > 124.9
NO DATA AVAILABLE



US 160 Corridor Profile Study: US 89 to New Mexico State Line
Bridge Vertical Clearance
2016 Data
US 160 Corridor Segments:
Segment 160-1: US 89 Jct to Tuba City West End (MP 311 - 319)
Segment 160-2: Tuba City West End to Tuba City East End (MP 319 - 323)
Segment 160-3: Tuba City East End to Indian Route 21 (MP 323 - 344)
Segment 160-4: Indian Route 21 to Shortman Rd (MP 344 - 362)
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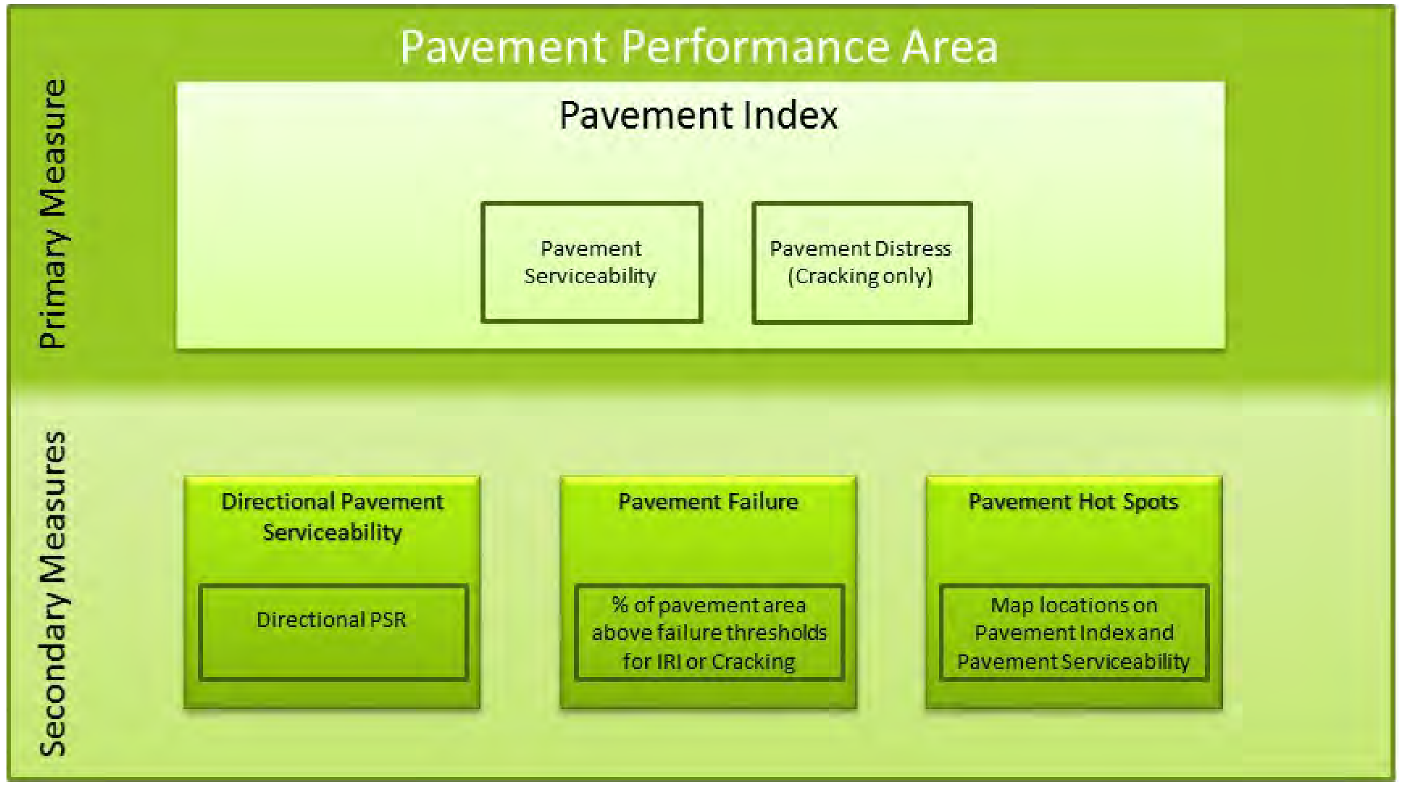
Segment 160-11: Red Mesa East End to Teec Nos Pos West End (MP 451 - 463)
Segment 160-12: Teec Nos Pos West End to AZ/NM State Line (MP 463 - 470)
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
BRIDGE VERTICAL CLEARANCE
GOOD > 16.5
FAIR 16.0 - 16.5
POOR < 16.0
BRIDGE HOT SPOT
Bridge with Vertical Clearance <16.5' and No Ramp
Miles
0 5 10 15 20
UTAH
ARIZONA
NEW MEXICO
COCONINO
NAVAJO
APACHE
Tuba City
Tonalea
Kayenta
Dennehotso
Teec Nos Pos
Black Mesa & Lake Powell Railroad
Segment 160-1
Segment 160-2
Segment 160-3
Segment 160-4
Segment 160-5
Segment 160-6
Segment 160-7
Segment 160-8
Segment 160-9
Segment 160-10
Segment 160-11
Segment 160-12
MP 320
MP 330
MP 340
MP 350
MP 360
MP 370
MP 380
MP 390
MP 400
MP 410
MP 420
MP 430
MP 440
MP 450
MP 460

Appendix B: Performance Area Detailed Calculation Methodologies

Pavement Performance Area Calculation Methodologies

This 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 Pavement Index

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 for interstates and non-interstates shown in the tables below were used for the PSR and PDI.

Performance Level for Interstates	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)

Performance Level for Non-Interstates	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 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.

Secondary Pavement Measures

Three secondary measures are evaluated:

- Directional Pavement Serviceability
- Pavement Failure
- Pavement Hot Spots

Directional Pavement Serviceability: Similar to the Pavement Index, the Directional Pavement Serviceability is calculated as a weighted average (based on number of lanes) for each segment. However, this rating only utilizes the PSR and is 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.

Pavement Failure: The percentage of pavement area rated above the failure thresholds for IRI or Cracking is calculated for each segment. In addition, the Standard score (z-score) is 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) than average.

Pavement Hot Spots: The Pavement Index map identifies 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 previously. For non-interstates, an IRI rating above 142 or a Cracking rating above 15 will be used as the thresholds.

Scoring

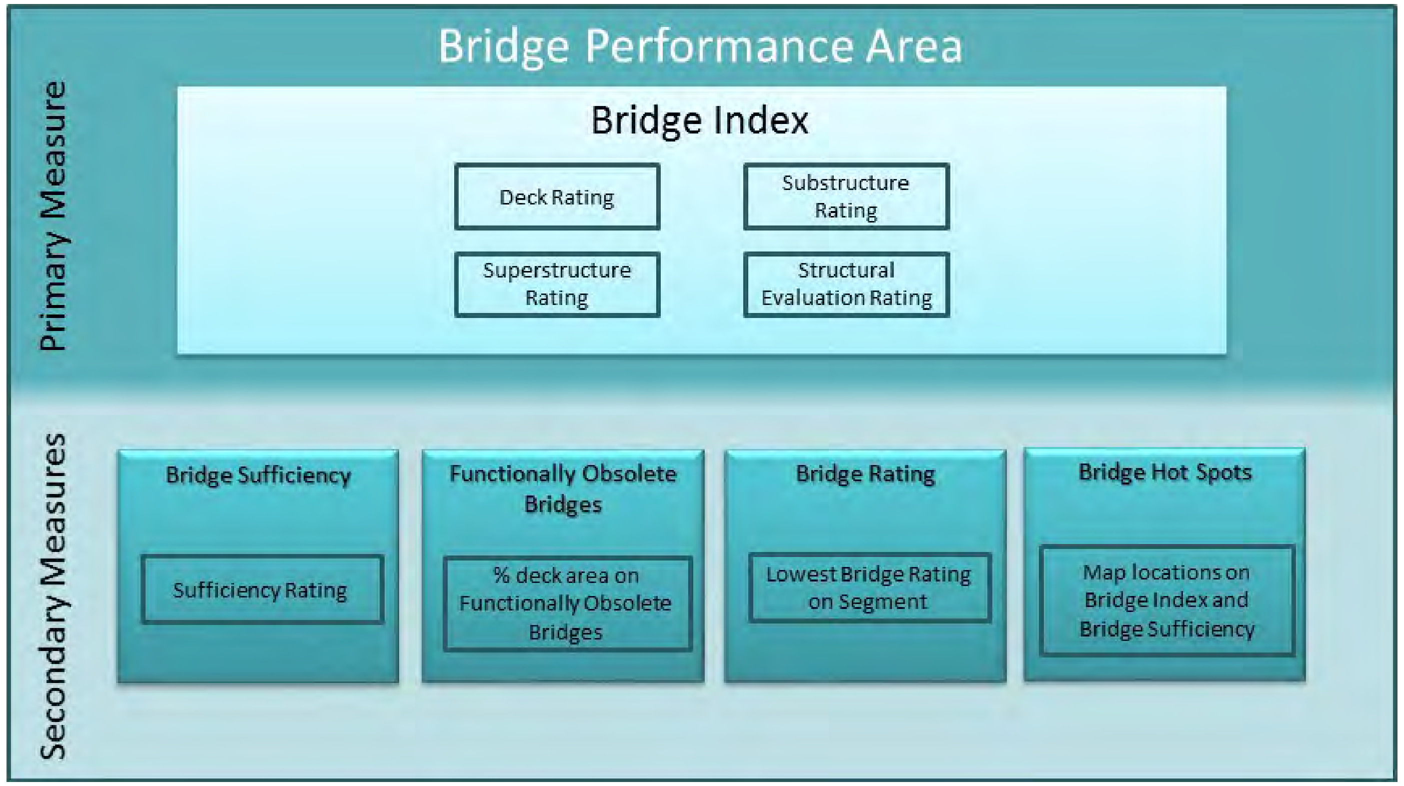
Performance Level	Pavement Index	
	Interstates	Non-Interstates
Good	>3.75	>3.5
Fair	3.2 - 3.75	2.9 - 3.5
Poor	<3.2	<2.9

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%

Bridge Performance Area Calculation Methodologies

This 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.

<u>Primary Bridge Index</u>

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, Substructure Rating, Superstructure Rating, and Structural Evaluation Rating. 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.

<u>Secondary Bridge Measures</u>

Four secondary measures will be evaluated:

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

Bridge Sufficiency: Similar to the Bridge Index, the Bridge Sufficiency rating is calculated as a weighted average (based on deck area) for each segment. The Bridge 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.

Functionally Obsolete Bridges: The percentage of total deck area in a segment that is on functionally obsolete bridges is calculated for each segment. The deck area for each bridge within each segment that has been identified as functionally obsolete is 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 thresholds for this performance measure are 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.

Bridge Rating: The Bridge Rating simply identifies 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. Each of the four condition ratings use a 0 to 9 scale with 0 representing the lowest performance and 9 representing the highest performance.

Bridge Hot Spots: The Bridge Index map identifies individual bridge locations that are identified as hot spots. Hot spots are bridges that have a single rating of 4 in any of the four ratings, or multiple ratings of 5 in the deck, substructure or superstructure ratings.

Scoring:

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

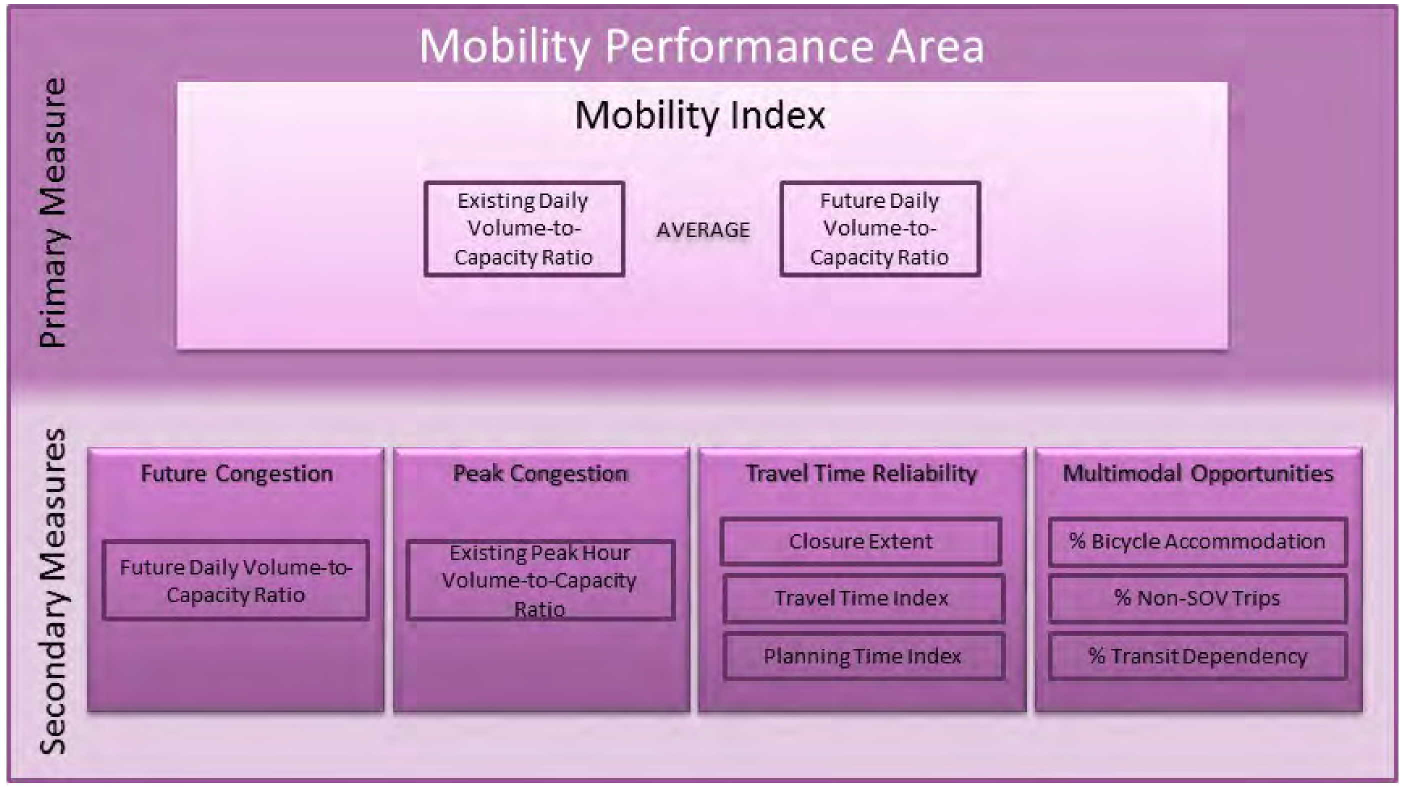
Performance Level	Sufficiency Rating
Good	>80
Fair	50-80
Poor	<50

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 Mobility Index

The primary Mobility Index is an average of the existing daily volume-to-capacity (V/C) ratio and the future daily V/C ratio for each segment of 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 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 is 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 daily V/C ratio for each segment is calculated by dividing the 2035 AADT volume for each segment by the 2014 LOS E capacity. The capacity volume used in this calculation is the same as is utilized in the existing daily V/C equation.

The future AADT daily volumes are generated by applying an average annual compound growth rate (ACGR) to each 2014 AADT segment volume. The following equation is used to apply the average annual compound growth rate:

2035 AADT = 2014 AADT x ((1+ACGR)^(2035-2014))

The ACGR for each segment is 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 is defined using the same weighted average equation described in the *Existing Daily V/*C section above and then summing the directional volumes for each location. The following equation is used to determine the ACGR for each segment:

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

Secondary Mobility Measures

Four secondary measures are evaluated:

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

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

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 previously. 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.

Travel Time Reliability: Travel time reliability is a secondary measure that includes three indicators. The three indicators are the number of times a piece of a corridor is closed for any specific reason, the directional Travel Time Index (TTI), and the directional Planning Time Index (PTI).

<u>Closure Extent</u>*:* 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.

<u>Directional Travel Time and Planning Time Index</u>*:* 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 95^{th} 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 95^{th} percentile highest travel time corresponds to the 5^{th} 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 5^{th} 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/5^{th} 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.

<u>Percent Bicycle Accommodation</u>: 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

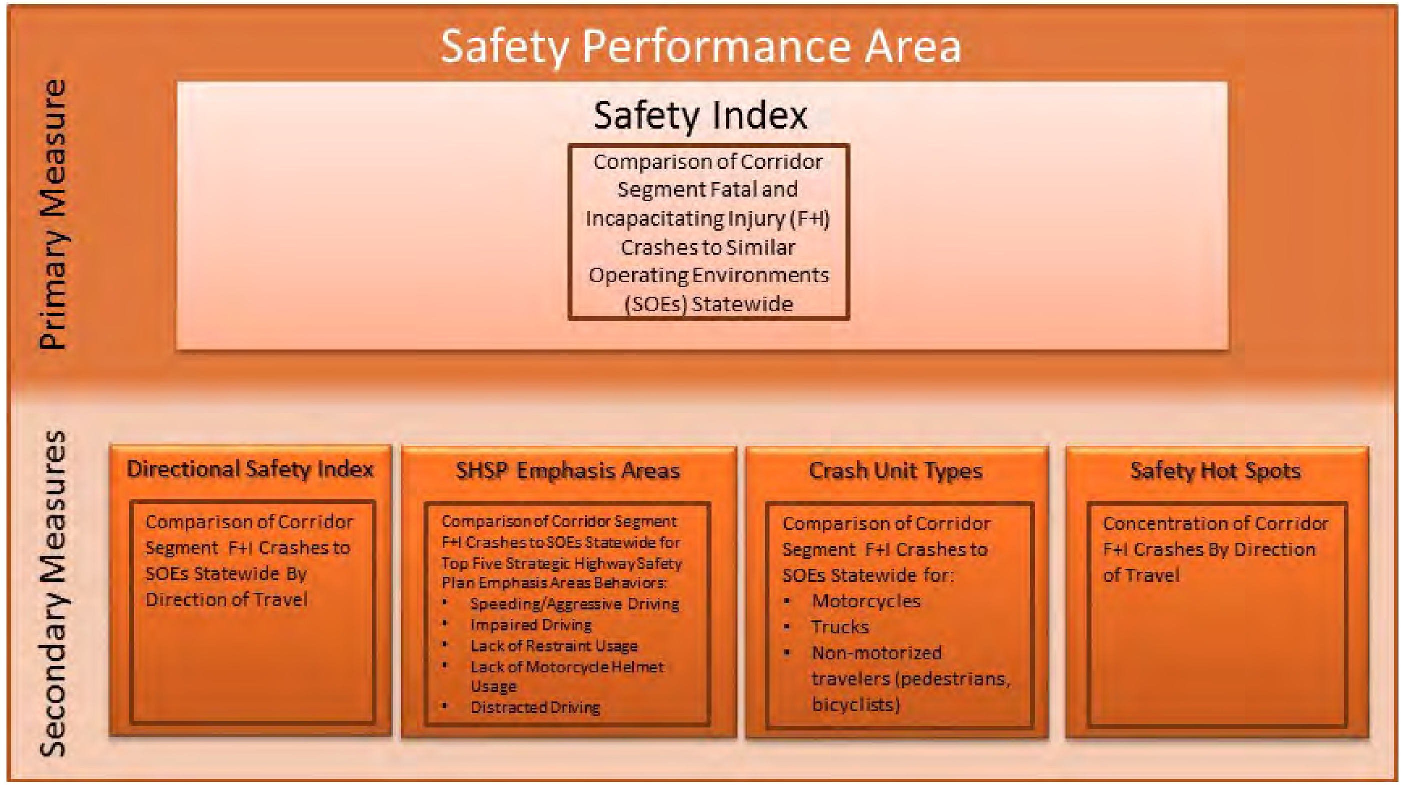
Performance Level	Percent Bicycle Accommodation
Good	≥ 90%
Fair	> 60% & ≤ 90%
Poor	< 60%

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:



<u>Primary Safety Index</u>

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 incapacitating 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 is 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.

<u>Scoring:</u>

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), the segment has "insufficient data" and Safety Index performance ratings are unreliable.

Secondary Safety 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
- Crash Unit Types
- 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

This section summarizes the approach for developing the primary and secondary performance measures in the Freight performance area as shown in the following graphic:

<u>Primary Freight Index</u>

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 95^{th} percentile highest travel time corresponds to the 5^{th} percentile lowest speed. The speed-based TPTI is calculated using the following formula:

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

Observed 5^{th} 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 is calculated using the following formula to invert the overall TPTI:

Freight Index = 1 / Bi-directional TPTI

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. The scale for rating the Freight Index differs between uninterrupted and interrupted flow facilities.

<u>Secondary Freight Measures</u>

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.

<u>Scoring:</u>

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

				Direction 1 (Eastbound)			Direction 2 (Westbound)			Direction 1 (Eastbound)		Direction 2 (Westbound)		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	Dir 1 (EB)	Dir 2 (WB)		Dir 1 (EB)	Dir 2 (WB)
Segment 1		***Interstate?***		**No**														
Milepost	312	to	313	2	77.63	1.00	0	0.00	0.00	3.72	4.7	-	-	4.00	-		0	0
Milepost	313	to	314	2	90.12	2.00	0	0.00	0.00	3.55	4.5	-	-	3.82	-		0	0
Milepost	314	to	315	2	67.22	1.00	0	0.00	0.00	3.87	4.7	-	-	4.11	-		0	0
Milepost	315	to	316	2	71.78	1.00	0	0.00	0.00	3.81	4.7	-	-	4.06	-		0	0
Milepost	316	to	317	2	61.01	2.00	0	0.00	0.00	3.97	4.5	-	-	4.11	-		0	0
Milepost	317	to	318	2	75.19	0.00	0	0.00	0.00	3.76	5.0	-	-	4.13	-		0	0
Milepost	318	to	319	2	84.62	0.00	0	0.00	0.00	3.63	5.0	-	-	4.04	-		0	0
			Total	14			0											0
			Weighted Average							3.76	4.70	-	-	4.04	-			
			Factor							1.00		1.00						
			Indicator Score							**3.76**		-						**0.0%**
			Pavement Index													**4.04**		
Segment 2		***Interstate?***		**No**														
Milepost	319	to	320	4	96.93	1.00	0	0.00	0.00	3.46	4.7	-	-	3.82	-		0	0
Milepost	320	to	321	4	61.04	3.00	0	0.00	0.00	3.96	4.3	-	-	4.06	-		0	0
Milepost	321	to	322	4	112.44	0.00	0	0.00	0.00	3.26	5.0	-	-	3.78	-		0	0
Milepost	322	to	323	4	82.36	4.00	0	0.00	0.00	3.66	4.1	-	-	3.80	-		0	0
			Total	16			0											0
			Weighted Average							3.59	4.52	-	-	3.87	-			
			Factor							1.00		1.00						
			Indicator Score							**3.59**		-						**0.0%**
			Pavement Index													**3.87**		
Segment 3		***Interstate?***		**No**														
Milepost	323	to	324	2	96.39	10.00	0	0.00	0.00	3.47	3.4	-	-	3.44	-		0	0
Milepost	324	to	325	2	105.52	2.00	0	0.00	0.00	3.35	4.5	-	-	3.68	-		0	0
Milepost	325	to	326	2	112.49	4.00	0	0.00	0.00	3.26	4.1	-	-	3.52	-		0	0
Milepost	326	to	327	2	111.11	8.00	0	0.00	0.00	3.28	3.6	-	-	3.39	-		0	0
Milepost	327	to	328	2	95.41	4.00	0	0.00	0.00	3.48	4.1	-	-	3.68	-		0	0
Milepost	328	to	329	2	113.44	5.00	0	0.00	0.00	3.25	4.0	-	-	3.47	-		0	0
Milepost	329	to	330	2	117.18	4.00	0	0.00	0.00	3.20	4.1	-	-	3.48	-		0	0
Milepost	330	to	331	2	113.24	8.00	0	0.00	0.00	3.25	3.6	-	-	3.37	-		0	0
Milepost	331	to	332	2	99.96	1.00	0	0.00	0.00	3.42	4.7	-	-	3.79	-		0	0
Milepost	332	to	333	2	88.24	8.00	0	0.00	0.00	3.58	3.6	-	-	3.59	-		0	0
Milepost	333	to	334	2	101.70	0.00	0	0.00	0.00	3.40	5.0	-	-	3.88	-		0	0
Milepost	334	to	335	2	116.59	7.00	0	0.00	0.00	3.21	3.8	-	-	3.37	-		0	0
Milepost	335	to	336	2	100.89	1.00	0	0.00	0.00	3.41	4.7	-	-	3.78	-		0	0
Milepost	336	to	337	2	91.77	1.00	0	0.00	0.00	3.53	4.7	-	-	3.87	-		0	0

				Direction 1 (Eastbound)			Direction 2 (Westbound)			Direction 1 (Eastbound)		Direction 2 (Westbound)		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	Dir 1 (EB)	Dir 2 (WB)		Dir 1 (EB)	Dir 2 (WB)
Milepost	337	to	338	2	77.85	7.00	0	0.00	0.00	3.72	3.8	-	-	3.73	-		0	0
Milepost	338	to	339	2	89.17	12.00	0	0.00	0.00	3.56	3.2	-	-	3.32	-		0	0
Milepost	339	to	340	2	86.35	5.00	0	0.00	0.00	3.60	4.0	-	-	3.72	-		0	0
Milepost	340	to	341	2	87.88	10.00	0	0.00	0.00	3.58	3.4	-	-	3.47	-		0	0
Milepost	341	to	342	2	57.95	4.00	0	0.00	0.00	4.01	4.1	-	-	4.05	-		0	0
Milepost	342	to	343	2	46.65	2.00	0	0.00	0.00	4.19	4.5	-	-	4.27	-		0	0
Milepost	343	to	344	2	66.47	5.00	0	0.00	0.00	3.88	4.0	-	-	3.92	-		0	0
			Total	42			0											0
			Weighted Average							3.51	4.04	-	-	3.66	-			
			Factor							1.00		1.00						
			Indicator Score							**3.51**		**-**						**0.0%**
			Pavement Index													**3.66**		
Segment 4		***Interstate?***		**No**														
Milepost	344	to	345	2	60.23	5.00	0	0.00	0.00	3.98	4.0	-	-	3.98	-		0	0
Milepost	345	to	346	2	57.28	1.00	0	0.00	0.00	4.02	4.7	-	-	4.21	-		0	0
Milepost	346	to	347	2	64.10	1.00	0	0.00	0.00	3.92	4.7	-	-	4.14	-		0	0
Milepost	347	to	348	2	51.81	2.00	0	0.00	0.00	4.11	4.5	-	-	4.21	-		0	0
Milepost	348	to	349	2	56.35	3.00	0	0.00	0.00	4.04	4.3	-	-	4.11	-		0	0
Milepost	349	to	350	2	66.05	5.00	0	0.00	0.00	3.89	4.0	-	-	3.92	-		0	0
Milepost	350	to	351	2	60.49	4.00	0	0.00	0.00	3.97	4.1	-	-	4.02	-		0	0
Milepost	351	to	352	2	51.64	2.00	0	0.00	0.00	4.11	4.5	-	-	4.21	-		0	0
Milepost	352	to	353	2	59.59	1.00	0	0.00	0.00	3.99	4.7	-	-	4.19	-		0	0
Milepost	353	to	354	2	53.36	4.00	0	0.00	0.00	4.08	4.1	-	-	4.10	-		0	0
Milepost	354	to	355	2	61.81	2.00	0	0.00	0.00	3.95	4.5	-	-	4.10	-		0	0
Milepost	355	to	356	2	64.46	5.00	0	0.00	0.00	3.91	4.0	-	-	3.94	-		0	0
Milepost	356	to	357	2	58.83	1.00	0	0.00	0.00	4.00	4.7	-	-	4.20	-		0	0
Milepost	357	to	358	2	62.63	3.00	0	0.00	0.00	3.94	4.3	-	-	4.04	-		0	0
Milepost	358	to	359	2	47.12	1.00	0	0.00	0.00	4.18	4.7	-	-	4.32	-		0	0
Milepost	359	to	360	2	42.26	1.00	0	0.00	0.00	4.26	4.7	-	-	4.38	-		0	0
Milepost	360	to	361	2	47.99	0.00	0	0.00	0.00	4.17	5.0	-	-	4.42	-		0	0
Milepost	361	to	362	2	48.67	0.00	0	0.00	0.00	4.16	5.0	-	-	4.41	-		0	0
			Total	36			0											0
			Weighted Average							4.04	4.45	-	-	4.16	-			
			Factor							1.00		1.00						
			Indicator Score							**4.04**		**-**						**0.0%**
			Pavement Index													**4.16**		
Segment 5		***Interstate?***		**No**														
Milepost	362	to	363	2	41.11	0.00	0	0.00	0.00	4.28	5.0	-	-	4.49	-		0	0
Milepost	363	to	364	2	36.98	0.00	0	0.00	0.00	4.34	5.0	-	-	4.54	-		0	0
Milepost	364	to	365	2	38.44	0.00	0	0.00	0.00	4.32	5.0	-	-	4.52	-		0	0

				Direction 1 (Eastbound)			Direction 2 (Westbound)			Direction 1 (Eastbound)		Direction 2 (Westbound)		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	Dir 1 (EB)	Dir 2 (WB)		Dir 1 (EB)	Dir 2 (WB)
Milepost	365	to	366	2	38.28	0.00	0	0.00	0.00	4.32	5.0	-	-	4.53	-		0	0
Milepost	366	to	367	2	36.12	0.00	0	0.00	0.00	4.36	5.0	-	-	4.55	-		0	0
Milepost	367	to	368	2	42.31	0.00	0	0.00	0.00	4.26	5.0	-	-	4.48	-		0	0
Milepost	368	to	369	2	52.93	0.00	0	0.00	0.00	4.09	5.0	-	-	4.36	-		0	0
Milepost	369	to	370	2	49.22	0.00	0	0.00	0.00	4.15	5.0	-	-	4.40	-		0	0
Milepost	370	to	371	2	42.80	0.00	0	0.00	0.00	4.25	5.0	-	-	4.47	-		0	0
Milepost	371	to	372	2	40.66	0.00	0	0.00	0.00	4.28	5.0	-	-	4.50	-		0	0
Milepost	372	to	373	2	63.92	0.00	0	0.00	0.00	3.92	5.0	-	-	4.25	-		0	0
Milepost	373	to	374	2	92.77	7.00	0	0.00	0.00	3.51	3.8	-	-	3.59	-		0	0
			Total	24			0											0
			Weighted Average							4.17	4.90	-	-	4.39	-			
			Factor							1.00		1.00						
			Indicator Score							**4.17**		**-**						**0.0%**
			Pavement Index													**4.39**		
Segment 6		***Interstate?***		**No**														
Milepost	374	to	375	2	104.62	6.00	0	0.00	0.00	3.36	3.9	-	-	3.51	-		0	0
Milepost	375	to	376	2	65.47	3.00	0	0.00	0.00	3.90	4.3	-	-	4.02	-		0	0
Milepost	376	to	377	2	60.77	0.00	0	0.00	0.00	3.97	5.0	-	-	4.28	-		0	0
Milepost	377	to	378	2	129.83	0.00	0	0.00	0.00	3.05	5.0	-	-	3.64	-		0	0
Milepost	378	to	379	2	110.76	4.00	0	0.00	0.00	3.28	4.1	-	-	3.54	-		0	0
Milepost	379	to	380	2	146.63	12.00	0	0.00	0.00	2.86	3.2	-	-	2.86	-		2	0
Milepost	380	to	381	2	154.10	7.00	0	0.00	0.00	2.78	3.8	-	-	2.78	-		2	0
Milepost	381	to	382	2	97.98	5.00	0	0.00	0.00	3.45	4.0	-	-	3.61	-		0	0
Milepost	382	to	383	2	98.76	1.00	0	0.00	0.00	3.44	4.7	-	-	3.80	-		0	0
Milepost	383	to	384	2	122.11	5.00	0	0.00	0.00	3.14	4.0	-	-	3.40	-		0	0
Milepost	384	to	385	2	135.03	6.00	0	0.00	0.00	2.99	3.9	-	-	3.26	-		0	0
Milepost	385	to	386	2	89.26	4.00	0	0.00	0.00	3.56	4.1	-	-	3.73	-		0	0
Milepost	386	to	387	2	87.78	2.00	0	0.00	0.00	3.58	4.5	-	-	3.84	-		0	0
Milepost	387	to	388	2	107.09	4.00	0	0.00	0.00	3.33	4.1	-	-	3.57	-		0	0
Milepost	388	to	389	2	115.30	10.00	0	0.00	0.00	3.23	3.4	-	-	3.29	-		0	0
Milepost	389	to	390	2	81.28	4.00	0	0.00	0.00	3.67	4.1	-	-	3.81	-		0	0
Milepost	390	to	391	2	48.12	1.00	0	0.00	0.00	4.16	4.7	-	-	4.31	-		0	0
			Total	34			0											4
			Weighted Average							3.40	4.16	-	-	3.60	-			
			Factor							1.00		1.00						
			Indicator Score							**3.40**		**-**						**11.8%**
			Pavement Index													**3.60**		
Segment 7		***Interstate?***		**No**														
Milepost	391	to	392	4	46.17	5.00	0	0.00	0.00	4.20	4.0	-	-	4.06	-		0	0
Milepost	392	to	393	4	49.50	2.00	0	0.00	0.00	4.14	4.5	-	-	4.24	-		0	0

				Direction 1 (Eastbound)			Direction 2 (Westbound)			Direction 1 (Eastbound)		Direction 2 (Westbound)		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	Dir 1 (EB)	Dir 2 (WB)		Dir 1 (EB)	Dir 2 (WB)
Milepost	393	to	394	4	70.97	1.00	0	0.00	0.00	3.82	4.7	-	-	4.07	-		0	0
Milepost	394	to	395	4	57.33	2.00	0	0.00	0.00	4.02	4.5	-	-	4.15	-		0	0
			Total	16			0											0
			Weighted Average							4.04	4.39	-	-	4.13	-			
			Factor							1.00		1.00						
			Indicator Score							**4.04**		**-**						**0.0%**
			Pavement Index													**4.13**		
Segment 8		***Interstate?***		**No**														
Milepost	395	to	396	2	59.26	2.00	0	0.00	0.00	3.99	4.5	-	-	4.13	-		0	0
Milepost	396	to	397	2	60.18	1.00	0	0.00	0.00	3.98	4.7	-	-	4.18	-		0	0
Milepost	397	to	398	2	44.07	1.00	0	0.00	0.00	4.23	4.7	-	-	4.36	-		0	0
Milepost	398	to	399	2	47.91	1.00	0	0.00	0.00	4.17	4.7	-	-	4.31	-		0	0
Milepost	399	to	400	2	56.95	2.00	0	0.00	0.00	4.03	4.5	-	-	4.16	-		0	0
Milepost	400	to	401	2	76.27	1.00	0	0.00	0.00	3.74	4.7	-	-	4.02	-		0	0
Milepost	401	to	402	2	67.87	0.00	0	0.00	0.00	3.86	5.0	-	-	4.20	-		0	0
Milepost	402	to	403	2	58.32	2.00	0	0.00	0.00	4.01	4.5	-	-	4.14	-		0	0
Milepost	403	to	404	2	65.35	4.00	0	0.00	0.00	3.90	4.1	-	-	3.97	-		0	0
Milepost	404	to	405	2	70.84	6.00	0	0.00	0.00	3.82	3.9	-	-	3.84	-		0	0
Milepost	405	to	406	2	73.15	4.00	0	0.00	0.00	3.79	4.1	-	-	3.89	-		0	0
Milepost	406	to	407	2	69.23	4.00	0	0.00	0.00	3.84	4.1	-	-	3.93	-		0	0
Milepost	407	to	408	2	76.96	5.00	0	0.00	0.00	3.73	4.0	-	-	3.81	-		0	0
Milepost	408	to	409	2	73.48	6.00	0	0.00	0.00	3.78	3.9	-	-	3.81	-		0	0
Milepost	409	to	410	2	79.05	2.00	0	0.00	0.00	3.70	4.5	-	-	3.93	-		0	0
Milepost	410	to	411	2	75.78	3.00	0	0.00	0.00	3.75	4.3	-	-	3.91	-		0	0
Milepost	411	to	412	2	72.82	3.00	0	0.00	0.00	3.79	4.3	-	-	3.94	-		0	0
Milepost	412	to	413	2	81.11	0.00	0	0.00	0.00	3.67	5.0	-	-	4.07	-		0	0
			Total	36			0											0
			Weighted Average							3.88	4.40	-	-	4.03	-			
			Factor							1.00		1.00						
			Indicator Score							**3.88**		**-**						**0.0%**
			Pavement Index													**4.03**		
Segment 9		***Interstate?***		**No**														
Milepost	413	to	414	2	71.99	1.00	0	0.00	0.00	3.80	4.7	-	-	4.06	-		0	0
Milepost	414	to	415	2	74.30	3.00	0	0.00	0.00	3.77	4.3	-	-	3.93	-		0	0
Milepost	415	to	416	2	114.25	4.00	0	0.00	0.00	3.24	4.1	-	-	3.51	-		0	0
Milepost	416	to	417	2	99.13	4.00	0	0.00	0.00	3.43	4.1	-	-	3.64	-		0	0
Milepost	417	to	418	2	108.27	12.00	0	0.00	0.00	3.31	3.2	-	-	3.25	-		0	0
Milepost	418	to	419	2	98.99	8.00	0	0.00	0.00	3.43	3.6	-	-	3.49	-		0	0
Milepost	419	to	420	2	83.91	10.00	0	0.00	0.00	3.63	3.4	-	-	3.49	-		0	0
Milepost	420	to	421	2	117.22	0.00	0	0.00	0.00	3.20	5.0	-	-	3.74	-		0	0

				Direction 1 (Eastbound)			Direction 2 (Westbound)			Direction 1 (Eastbound)		Direction 2 (Westbound)		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	Dir 1 (EB)	Dir 2 (WB)		Dir 1 (EB)	Dir 2 (WB)
Milepost	421	to	422	2	90.51	12.00	0	0.00	0.00	3.54	3.2	-	-	3.32	-		0	0
Milepost	422	to	423	2	124.03	10.00	0	0.00	0.00	3.12	3.4	-	-	3.21	-		0	0
Milepost	423	to	424	2	134.37	9.00	0	0.00	0.00	3.00	3.5	-	-	3.16	-		0	0
Milepost	424	to	425	2	211.18	3.00	0	0.00	0.00	2.24	4.3	-	-	2.24	-		2	0
Milepost	425	to	426	2	160.15	3.00	0	0.00	0.00	2.72	4.3	-	-	2.72	-		2	0
Milepost	426	to	427	2	155.32	9.00	0	0.00	0.00	2.77	3.5	-	-	2.77	-		2	0
Milepost	427	to	428	2	150.31	5.00	0	0.00	0.00	2.82	4.0	-	-	2.82	-		2	0
Milepost	428	to	429	2	148.60	5.00	0	0.00	0.00	2.84	4.0	-	-	2.84	-		2	0
Milepost	429	to	430	2	131.62	9.00	0	0.00	0.00	3.03	3.5	-	-	3.18	-		0	0
Milepost	430	to	431	2	111.03	3.00	0	0.00	0.00	3.28	4.3	-	-	3.58	-		0	0
Milepost	431	to	432	2	92.27	2.00	0	0.00	0.00	3.52	4.5	-	-	3.80	-		0	0
Milepost	432	to	433	2	120.01	2.00	0	0.00	0.00	3.17	4.5	-	-	3.55	-		0	0
Milepost	433	to	434	2	146.95	4.00	0	0.00	0.00	2.86	4.1	-	-	2.86	-		2	0
			Total	42			0											12
			Weighted Average							3.18	3.98	-	-	3.29	-			
			Factor							1.00		1.00						
			Indicator Score							**3.18**		**-**						**28.6%**
			Pavement Index													**3.29**		
Segment 10		***Interstate?***		**No**														
Milepost	434	to	435	2	125.69	2.00	0	0.00	0.00	3.10	4.5	-	-	3.51	-		0	0
Milepost	435	to	436	2	110.45	3.00	0	0.00	0.00	3.29	4.3	-	-	3.59	-		0	0
Milepost	436	to	437	2	89.69	12.00	0	0.00	0.00	3.56	3.2	-	-	3.32	-		0	0
Milepost	437	to	438	2	63.30	10.00	0	0.00	0.00	3.93	3.4	-	-	3.58	-		0	0
Milepost	438	to	439	2	60.51	30.00	0	0.00	0.00	3.97	1.7	-	-	1.74	-		2	0
Milepost	439	to	440	2	63.94	25.00	0	0.00	0.00	3.92	2.1	-	-	2.11	-		2	0
Milepost	440	to	441	2	68.21	10.00	0	0.00	0.00	3.86	3.4	-	-	3.55	-		0	0
Milepost	441	to	442	2	99.59	7.00	0	0.00	0.00	3.42	3.8	-	-	3.52	-		0	0
Milepost	442	to	443	2	108.08	10.00	0	0.00	0.00	3.32	3.4	-	-	3.35	-		0	0
Milepost	443	to	444	2	111.27	12.00	0	0.00	0.00	3.28	3.2	-	-	3.24	-		0	0
Milepost	444	to	445	2	78.61	8.00	0	0.00	0.00	3.71	3.6	-	-	3.66	-		0	0
Milepost	445	to	446	2	45.78	12.00	0	0.00	0.00	4.20	3.2	-	-	3.52	-		0	0
Milepost	446	to	447	2	48.24	12.00	0	0.00	0.00	4.16	3.2	-	-	3.50	-		0	0
Milepost	447	to	448	2	54.73	5.00	0	0.00	0.00	4.06	4.0	-	-	4.02	-		0	0
Milepost	448	to	449	2	58.64	3.00	0	0.00	0.00	4.00	4.3	-	-	4.09	-		0	0
Milepost	449	to	450	2	54.88	1.00	0	0.00	0.00	4.06	4.7	-	-	4.24	-		0	0
Milepost	450	to	451	2	55.97	4.00	0	0.00	0.00	4.04	4.1	-	-	4.07	-		0	0
			Total	34			0											4
			Weighted Average							3.76	3.54	-	-	3.45	-			
			Factor							1.00		1.00						
			Indicator Score							**3.76**		**-**						**11.8%**

	Direction 1 (Eastbound)			Direction 2 (Westbound)			Direction 1 (Eastbound)		Direction 2 (Westbound)		Composite		Pavement Index	% Pavement Failure	
	# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	Dir 1 (EB)	Dir 2 (WB)		Dir 1 (EB)	Dir 2 (WB)
Pavement Index													**3.45**		
Segment 11 *Interstate?*	**No**														
Milepost 451 to 452	2	51.06	7.00	0	0.00	0.00	4.12	3.8	-	-	3.86	-		0	0
Milepost 452 to 453	2	57.51	15.00	0	0.00	0.00	4.02	2.9	-	-	3.26	-		0	0
Milepost 453 to 454	2	89.62	0.00	0	0.00	0.00	3.56	5.0	-	-	3.99	-		0	0
Milepost 454 to 455	2	93.77	1.00	0	0.00	0.00	3.50	4.7	-	-	3.85	-		0	0
Milepost 455 to 456	2	98.35	0.00	0	0.00	0.00	3.44	5.0	-	-	3.91	-		0	0
Milepost 456 to 457	2	98.08	0.00	0	0.00	0.00	3.44	5.0	-	-	3.91	-		0	0
Milepost 457 to 458	2	64.73	0.00	0	0.00	0.00	3.91	5.0	-	-	4.24	-		0	0
Milepost 458 to 459	2	69.31	0.00	0	0.00	0.00	3.84	5.0	-	-	4.19	-		0	0
Milepost 459 to 460	2	69.79	0.00	0	0.00	0.00	3.84	5.0	-	-	4.18	-		0	0
Milepost 460 to 461	2	77.01	0.00	0	0.00	0.00	3.73	5.0	-	-	4.11	-		0	0
Milepost 461 to 462	2	77.67	1.00	0	0.00	0.00	3.72	4.7	-	-	4.00	-		0	0
Milepost 462 to 463	2	46.53	0.00	0	0.00	0.00	4.19	5.0	-	-	4.43	-		0	0
Total	24			0											0
Weighted Average							3.78	4.67	-	-	4.00	-			
Factor							1.00		1.00						
Indicator Score							**3.78**		**-**						**0.0%**
Pavement Index													**4.00**		
Segment 12 *Interstate?*	**No**														
Milepost 463 to 464	2	42.93	2.00	0	0.00	0.00	4.25	4.5	-	-	4.31	-		0	0
Milepost 464 to 465	2	43.95	0.00	0	0.00	0.00	4.23	5.0	-	-	4.46	-		0	0
Milepost 465 to 466	2	51.11	2.00	0	0.00	0.00	4.12	4.5	-	-	4.22	-		0	0
Milepost 466 to 467	2	52.78	1.00	0	0.00	0.00	4.09	4.7	-	-	4.26	-		0	0
Milepost 467 to 468	2	73.17	3.00	0	0.00	0.00	3.79	4.3	-	-	3.94	-		0	0
Milepost 468 to 469	2	67.20	6.00	0	0.00	0.00	3.87	3.9	-	-	3.87	-		0	0
Milepost 469 to 470	2	69.63	6.00	0	0.00	0.00	3.84	3.9	-	-	3.85	-		0	0
Total	14			0											0
Weighted Average							4.03	4.37	-	-	4.13	-			
Factor							1.00		1.00						
Indicator Score							**4.03**		**-**						**0.0%**
Pavement Index													**4.13**		

Bridge Performance Area Data

Structure Name (A209)	Structure # (N8)	Milepost (A232)	Area (A225)	Bridge Sufficiency	Bridge Index					Functionally Obsolete Bridges	Bridge Rating	Hot Spots on Bridge Index map
				Sufficiency Rating	Deck (N58)	Sub (N59)	Super (N60)	Eval (N67)	Lowest	Deck Area on Func Obsolete		
Segment 1												
Hamblin Wash Br	531	312.20	886	71.80	6.00	6.00	6.00	5.00	5.0	0		
Total			886									
Weighted Average				71.80					5.00	0.00%		
Factor				1.00					1.00	1.00		
Indicator Score				**71.80**						**0.00%**	**5**	
Bridge Index									**5.00**			
Segment 2												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			
Segment 3												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			
Segment 4												
Begashbito Wash Br	1011	349.90	307	64.30	6.00	6.00	6.00	6.00	6.0	307		
Total			307									
Weighted Average				64.30					6.00	100.00%		
Factor				1.00					1.00	1.00		
Indicator Score				**64.30**						**100.00%**	**6**	
Bridge Index									**6.00**			
Segment 5												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			

				Bridge Sufficiency	Bridge Index					Functionally Obsolete Bridges	Bridge Rating	Hot Spots on Bridge Index map
Structure Name (A209)	Structure # (N8)	Milepost (A232)	Area (A225)	Sufficiency Rating	Deck (N58)	Sub (N59)	Super (N60)	Eval (N67)	Lowest	Deck Area on Func Obsolete		
Segment 6												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			
Segment 7												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			
Segment 8												
Church Rock Wash Br	747	400.53	431	83.70	6.00	6.00	7.00	6.00	6.0	0		
Total			431									
Weighted Average				83.70					6.00	0.00%		
Factor				1.00					1.00	1.00		
Indicator Score				**83.70**						**0.00%**	**6**	
Bridge Index									**6.00**			
Segment 9												
Laguna Creek Bridge	20001	420.10	634	89.90	8.00	8.00	8.00	8.00	8.0	0		
Chinle Wash Bridge	746	429.06	702	64.20	5.00	6.00	6.00	6.00	5.0	702		
Total			1,336									
Weighted Average				76.40					6.42	52.52%		
Factor				1.00					1.00	1.00		
Indicator Score				**76.40**						**52.52%**	**5**	
Bridge Index									**6.42**			
Segment 10												
Walker Creek Bridge	748	435.33	755	62.70	5.00	7.00	6.00	6.00	5.0	755		
Total			755									
Weighted Average				62.70					5.00	100.00%		
Factor				1.00					1.00	1.00		
Indicator Score				**62.70**						**100.00%**	**5**	
Bridge Index									**5.00**			

Structure Name (A209)	Structure # (N8)	Milepost (A232)	Area (A225)	Bridge Sufficiency	Bridge Index					Functionally Obsolete Bridges	Bridge Rating	Hot Spots on Bridge Index map
				Sufficiency Rating	Deck (N58)	Sub (N59)	Super (N60)	Eval (N67)	Lowest	Deck Area on Func Obsolete		
Segment 11												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			
Segment 12												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			

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)	Weighted Average Posted Speed Limit (mph)	Divided or Undivided	Access Points (per mile)	% No-Passing Zone	Street Parking
1	311	319	8	Rural	Interrupted	Rolling	2	Rural Two-Lane, Non-Signalized	12.00	63	Undivided	1.5	32%	N/A
2	319	323	4	Rural	Interrupted	Rolling	2.375	Urban/Rural Single or Multilane Signalized	12.00	49	Undivided	N/A	42%	N/A
3	323	344	21	Rural	Uninterrupted	Level	2	Rural Two-Lane, Non-Signalized	12.00	64	Undivided	1.7	12%	N/A
4	344	362	18	Rural	Uninterrupted	Level	2	Rural Two-Lane, Non-Signalized	12.00	65	Undivided	1.6	33%	N/A
5	362	374	12	Rural	Uninterrupted	Level	2	Rural Two-Lane, Non-Signalized	12.00	65	Undivided	2.3	14%	N/A
6	374	391	17	Rural	Uninterrupted	Rolling	2	Rural Two-Lane, Non-Signalized	12.00	64	Undivided	1.9	24%	N/A
7	391	395	4	Rural	Interrupted	Rolling	2.235	Urban/Rural Single or Multilane Signalized	12.00	60	Undivided	N/A	47%	N/A
8	395	413	18	Rural	Uninterrupted	Level	2	Rural Two-Lane, Non-Signalized	12.00	65	Undivided	0.4	9%	N/A
9	413	434	21	Rural	Uninterrupted	Level	2	Rural Two-Lane, Non-Signalized	12.00	65	Undivided	1.5	20%	N/A
10	434	451	17	Rural	Uninterrupted	Rolling	2	Rural Two-Lane, Non-Signalized	12.00	64	Undivided	1.3	25%	N/A
11	451	463	12	Rural	Uninterrupted	Rolling	2	Rural Two-Lane, Non-Signalized	12.00	65	Undivided	1.7	21%	N/A
12	463	470	7	Rural	Interrupted	Rolling	2	Rural Two-Lane, Non-Signalized	12.00	60	Undivided	3.6	31%	N/A

TTI and PTI Eastbound

Segment	TMC	Time Period	Week Type	Road Number	Road Dir	Cars Mean Speed	Trucks Mean Speed	Cars 5^{th} Perct Speed	Trucks 5^{th} Perct Speed	Assumed car free-flow speed	Assumed truck free-flow speed	Cars TTI	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
1	115P06556	1 AM Peak	Weekday	US-160	NB	60.6	50.4	42.3	28.0	65	65	1.07	1.29	1.54	2.32	1.10	1.29	1.69	2.32	1.07	1.20	1.48	1.84
	115P06556	2 Mid Day	Weekday	US-160	NB	60.0	51.3	42.4	28.2	65	65	1.08	1.27	1.53	2.30								
	115P06556	3 PM Peak	Weekday	US-160	NB	60.8	51.2	42.9	28.0	65	65	1.07	1.27	1.51	2.32								
	115P06556	4 Evening	Weekday	US-160	NB	59.0	50.9	38.5	28.6	65	65	1.10	1.28	1.69	2.27								
	115P06557	1 AM Peak	Weekday	US-160	NB	64.3	60.0	54.2	51.0	65	65	1.01	1.08	1.20	1.27	1.04	1.10	1.27	1.36				
	115P06557	2 Mid Day	Weekday	US-160	NB	62.7	59.7	51.0	50.8	65	65	1.04	1.09	1.27	1.28								
	115P06557	3 PM Peak	Weekday	US-160	NB	63.2	59.8	52.1	49.7	65	65	1.03	1.09	1.25	1.31								
	115P06557	4 Evening	Weekday	US-160	NB	62.7	59.0	51.0	47.8	65	65	1.04	1.10	1.27	1.36								
2	115P06557	1 AM Peak	Weekday	US-160	NB	64.3	60.0	54.2	51.0	65	65	1.01	1.08	1.20	1.27	1.04	1.10	1.27	1.36	1.12	1.17	3.75	2.43
	115P06557	2 Mid Day	Weekday	US-160	NB	62.7	59.7	51.0	50.8	65	65	1.04	1.09	1.27	1.28								
	115P06557	3 PM Peak	Weekday	US-160	NB	63.2	59.8	52.1	49.7	65	65	1.03	1.09	1.25	1.31								
	115P06557	4 Evening	Weekday	US-160	NB	62.7	59.0	51.0	47.8	65	65	1.04	1.10	1.27	1.36								
	115P06558	1 AM Peak	Weekday	US-160	NB	32.8	32.7	11.8	15.6	40	40	1.22	1.22	3.39	2.57	1.26	1.22	5.37	2.67				

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
	115P06558	2 Mid Day	Weekday	US-160	NB	32.0	33.6	9.3	15.0	40	40	1.25	1.19	4.29	2.67								
	115P06558	3 PM Peak	Weekday	US-160	NB	32.1	34.3	7.5	16.8	40	40	1.25	1.16	5.37	2.38								
	115P06558	4 Evening	Weekday	US-160	NB	31.9	33.7	9.9	15.0	40	40	1.26	1.19	4.02	2.67								
	115P06559	1 AM Peak	Weekday	US-160	NB	53.3	50.0	29.9	31.6	60	60	1.12	1.20	2.01	1.90	1.16	1.20	2.32	1.96				
	115P06559	2 Mid Day	Weekday	US-160	NB	51.9	50.3	25.9	30.5	60	60	1.16	1.19	2.32	1.96								
	115P06559	3 PM Peak	Weekday	US-160	NB	53.7	52.3	37.8	40.4	60	60	1.12	1.15	1.59	1.48								
	115P06559	4 Evening	Weekday	US-160	NB	53.3	49.9	35.4	36.8	60	60	1.13	1.20	1.69	1.63								
	115P05878	1 AM Peak	Weekday	US-160	NB	45.3	38.6	10.0	12.1	45	45	1.00	1.16	4.52	3.71	1.04	1.16	6.03	3.71				
	115P05878	2 Mid Day	Weekday	US-160	NB	43.3	39.2	7.5	12.4	45	45	1.04	1.15	6.03	3.62								
	115P05878	3 PM Peak	Weekday	US-160	NB	44.2	39.9	8.7	21.8	45	45	1.02	1.13	5.18	2.07								
	115P05878	4 Evening	Weekday	US-160	NB	43.5	38.8	12.4	18.6	45	45	1.03	1.16	3.62	2.41								
3	115P06560	1 AM Peak	Weekday	US-160	NB	66.4	59.8	56.0	51.2	65	65	1.00	1.09	1.16	1.27	1.00	1.09	1.21	1.27	1.01	1.07	1.30	1.48
	115P06560	2 Mid Day	Weekday	US-160	NB	66.3	60.1	57.2	52.2	65	65	1.00	1.08	1.14	1.25								
	115P06560	3 PM Peak	Weekday	US-160	NB	66.6	60.5	57.8	53.2	65	65	1.00	1.07	1.13	1.22								
	115P06560	4 Evening	Weekday	US-160	NB	65.9	60.1	53.9	51.2	65	65	1.00	1.08	1.21	1.27								
	115P06561	1 AM Peak	Weekday	US-160	NB	64.7	58.8	48.1	43.5	65	65	1.00	1.10	1.35	1.49	1.02	1.11	1.39	1.49				
	115P06561	2 Mid Day	Weekday	US-160	NB	64.5	59.4	49.7	46.1	65	65	1.01	1.09	1.31	1.41								
	115P06561	3 PM Peak	Weekday	US-160	NB	64.0	59.4	47.8	46.3	65	65	1.02	1.09	1.36	1.40								
	115P06561	4 Evening	Weekday	US-160	NB	63.5	58.5	46.7	43.6	65	65	1.02	1.11	1.39	1.49								
	115P06562	1 AM Peak	Weekday	US-160	NB	56.0	47.2	40.1	26.7	45	45	1.00	1.00	1.12	1.68	1.00	1.00	1.31	1.68				
	115P06562	2 Mid Day	Weekday	US-160	NB	54.5	48.0	41.5	30.1	45	45	1.00	1.00	1.09	1.50								
	115P06562	3 PM Peak	Weekday	US-160	NB	54.1	48.9	38.8	40.1	45	45	1.00	1.00	1.16	1.12								
	115P06562	4 Evening	Weekday	US-160	NB	53.3	47.1	34.3	28.6	45	45	1.00	1.00	1.31	1.57								
4	115P05879	1 AM Peak	Weekday	US-160	NB	65.3	61.3	45.6	56.0	65	65	1.00	1.06	1.43	1.16	1.00	1.07	1.43	1.25	1.00	1.07	1.31	1.24
	115P05879	2 Mid Day	Weekday	US-160	NB	65.4	61.2	53.4	56.0	65	65	1.00	1.06	1.22	1.16								
	115P05879	3 PM Peak	Weekday	US-160	NB	65.6	61.4	53.4	55.4	65	65	1.00	1.06	1.22	1.17								
	115P05879	4 Evening	Weekday	US-160	NB	64.9	60.6	50.9	52.0	65	65	1.00	1.07	1.28	1.25								
	115P06563	1 AM Peak	Weekday	US-160	NB	66.4	61.1	55.0	54.7	65	65	1.00	1.06	1.18	1.19	1.00	1.08	1.22	1.26				
	115P06563	2 Mid Day	Weekday	US-160	NB	66.6	61.2	57.2	55.6	65	65	1.00	1.06	1.14	1.17								
	115P06563	3 PM Peak	Weekday	US-160	NB	66.7	61.5	57.2	55.3	65	65	1.00	1.06	1.14	1.18								
	115P06563	4 Evening	Weekday	US-160	NB	65.3	60.3	53.4	51.6	65	65	1.00	1.08	1.22	1.26								
	115P06564	1 AM Peak	Weekday	US-160	NB	66.0	61.1	51.0	55.6	65	65	1.00	1.06	1.28	1.17	1.00	1.07	1.28	1.22				
	115P06564	2 Mid Day	Weekday	US-160	NB	67.0	61.1	57.8	56.4	65	65	1.00	1.06	1.13	1.15								
	115P06564	3 PM Peak	Weekday	US-160	NB	67.2	61.3	58.1	55.1	65	65	1.00	1.06	1.12	1.18								
	115P06564	4 Evening	Weekday	US-160	NB	65.9	60.6	55.3	53.1	65	65	1.00	1.07	1.17	1.22								
5	115P06565	1 AM Peak	Weekday	US-160	NB	64.6	61.5	47.5	56.4	65	65	1.01	1.06	1.37	1.15	1.01	1.07	1.37	1.26	1.01	1.09	1.33	1.36
	115P06565	2 Mid Day	Weekday	US-160	NB	65.5	61.2	54.7	54.7	65	65	1.00	1.06	1.19	1.19								
	115P06565	3 PM Peak	Weekday	US-160	NB	66.0	61.2	55.3	54.1	65	65	1.00	1.06	1.18	1.20								
	115P06565	4 Evening	Weekday	US-160	NB	64.7	60.7	50.8	51.5	65	65	1.00	1.07	1.28	1.26								

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
	115P06566	1 AM Peak	Weekday	US-160	NB	64.8	59.0	51.0	47.0	65	65	1.00	1.10	1.27	1.38	1.01	1.11	1.29	1.45				
	115P06566	2 Mid Day	Weekday	US-160	NB	64.4	59.0	51.8	47.8	65	65	1.01	1.10	1.26	1.36								
	115P06566	3 PM Peak	Weekday	US-160	NB	65.0	59.6	54.6	50.0	65	65	1.00	1.09	1.19	1.30								
	115P06566	4 Evening	Weekday	US-160	NB	64.4	58.8	50.4	44.7	65	65	1.01	1.11	1.29	1.45								
6	115P06567	1 AM Peak	Weekday	US-160	NB	64.7	60.7	49.4	51.2	65	65	1.00	1.07	1.32	1.27	1.00	1.09	1.32	1.36	1.02	1.10	1.51	1.41
	115P06567	2 Mid Day	Weekday	US-160	NB	65.3	60.4	53.2	48.8	65	65	1.00	1.08	1.22	1.33								
	115P06567	3 PM Peak	Weekday	US-160	NB	66.0	60.7	55.3	51.5	65	65	1.00	1.07	1.18	1.26								
	115P06567	4 Evening	Weekday	US-160	NB	64.9	59.8	51.3	47.9	65	65	1.00	1.09	1.27	1.36								
	115P06568	1 AM Peak	Weekday	US-160	NB	62.3	59.0	38.2	44.2	65	65	1.04	1.10	1.70	1.47	1.04	1.11	1.70	1.47				
	115P06568	2 Mid Day	Weekday	US-160	NB	63.9	59.7	50.8	50.3	65	65	1.02	1.09	1.28	1.29								
	115P06568	3 PM Peak	Weekday	US-160	NB	64.1	60.3	50.3	50.8	65	65	1.01	1.08	1.29	1.28								
	115P06568	4 Evening	Weekday	US-160	NB	63.5	58.7	47.2	44.4	65	65	1.02	1.11	1.38	1.46								
7	115P05880	1 AM Peak	Weekday	US-160	NB	56.7	52.2	16.4	18.0	65	65	1.15	1.25	3.97	3.61	1.15	1.25	3.97	3.61	1.12	1.34	3.26	3.98
	115P05880	2 Mid Day	Weekday	US-160	NB	57.1	52.2	20.5	19.9	65	65	1.14	1.25	3.17	3.27								
	115P05880	3 PM Peak	Weekday	US-160	NB	58.6	53.7	26.7	24.4	65	65	1.11	1.21	2.43	2.66								
	115P05880	4 Evening	Weekday	US-160	NB	58.6	53.7	25.5	23.6	65	65	1.11	1.21	2.55	2.75								
	115P06569	1 AM Peak	Weekday	US-160	NB	61.6	46.8	34.2	20.9	65	65	1.06	1.39	1.90	3.11	1.09	1.44	2.55	4.36				
	115P06569	2 Mid Day	Weekday	US-160	NB	59.5	45.6	29.8	16.8	65	65	1.09	1.43	2.18	3.87								
	115P06569	3 PM Peak	Weekday	US-160	NB	61.0	46.3	34.8	17.4	65	65	1.07	1.40	1.87	3.74								
	115P06569	4 Evening	Weekday	US-160	NB	59.9	45.2	25.5	14.9	65	65	1.09	1.44	2.55	4.36								
8	115P06570	1 AM Peak	Weekday	US-160	NB	68.7	62.3	59.7	57.9	65	65	1.00	1.04	1.09	1.12	1.00	1.05	1.16	1.19	1.00	1.05	1.15	1.18
	115P06570	2 Mid Day	Weekday	US-160	NB	67.3	62.1	58.6	57.9	65	65	1.00	1.05	1.11	1.12								
	115P06570	3 PM Peak	Weekday	US-160	NB	67.6	62.6	59.0	58.0	65	65	1.00	1.04	1.10	1.12								
	115P06570	4 Evening	Weekday	US-160	NB	66.6	61.8	55.9	54.7	65	65	1.00	1.05	1.16	1.19								
	115P06571	1 AM Peak	Weekday	US-160	NB	68.7	62.5	59.8	58.0	65	65	1.00	1.04	1.09	1.12	1.00	1.05	1.13	1.16				
	115P06571	2 Mid Day	Weekday	US-160	NB	67.9	62.1	60.3	58.2	65	65	1.00	1.05	1.08	1.12								
	115P06571	3 PM Peak	Weekday	US-160	NB	67.7	62.5	59.6	58.4	65	65	1.00	1.04	1.09	1.11								
	115P06571	4 Evening	Weekday	US-160	NB	66.4	62.1	57.4	55.9	65	65	1.00	1.05	1.13	1.16								
9	115P06571	1 AM Peak	Weekday	US-160	NB	68.7	62.5	59.8	58.0	65	65	1.00	1.04	1.09	1.12	1.00	1.05	1.13	1.16	1.01	1.06	1.37	1.21
	115P06571	2 Mid Day	Weekday	US-160	NB	67.9	62.1	60.3	58.2	65	65	1.00	1.05	1.08	1.12								
	115P06571	3 PM Peak	Weekday	US-160	NB	67.7	62.5	59.6	58.4	65	65	1.00	1.04	1.09	1.11								
	115P06571	4 Evening	Weekday	US-160	NB	66.4	62.1	57.4	55.9	65	65	1.00	1.05	1.13	1.16								
	115P06572	1 AM Peak	Weekday	US-160	NB	65.0	62.1	42.9	57.5	65	65	1.00	1.05	1.51	1.13	1.05	1.05	1.90	1.21				
	115P06572	2 Mid Day	Weekday	US-160	NB	63.7	62.2	40.0	57.8	65	65	1.02	1.05	1.62	1.12								
	115P06572	3 PM Peak	Weekday	US-160	NB	62.6	62.3	34.2	56.9	65	65	1.04	1.04	1.90	1.14								
	115P06572	4 Evening	Weekday	US-160	NB	61.9	61.6	37.3	53.5	65	65	1.05	1.05	1.74	1.21								
	115P06573	1 AM Peak	Weekday	US-160	NB	67.6	61.0	58.5	52.7	65	65	1.00	1.07	1.11	1.23	1.00	1.07	1.23	1.26				
	115P06573	2 Mid Day	Weekday	US-160	NB	66.5	61.2	56.6	53.3	65	65	1.00	1.06	1.15	1.22								
	115P06573	3 PM Peak	Weekday	US-160	NB	66.9	61.6	57.8	54.7	65	65	1.00	1.06	1.12	1.19								

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
	115P06573	4 Evening	Weekday	US-160	NB	65.3	61.0	52.9	51.5	65	65	1.00	1.07	1.23	1.26								
	115P05881	1 AM Peak	Weekday	US-160	NB	67.8	61.2	57.8	55.1	65	65	1.00	1.06	1.13	1.18	1.00	1.06	1.24	1.22				
	115P05881	2 Mid Day	Weekday	US-160	NB	66.1	61.5	52.6	55.7	65	65	1.00	1.06	1.24	1.17								
	115P05881	3 PM Peak	Weekday	US-160	NB	67.0	62.0	57.2	56.6	65	65	1.00	1.05	1.14	1.15								
	115P05881	4 Evening	Weekday	US-160	NB	66.1	61.8	55.1	53.4	65	65	1.00	1.05	1.18	1.22								
10	115P05881	1 AM Peak	Weekday	US-160	NB	67.8	61.2	57.8	55.1	65	65	1.00	1.06	1.13	1.18	1.00	1.06	1.24	1.22	1.05	1.13	1.89	2.25
	115P05881	2 Mid Day	Weekday	US-160	NB	66.1	61.5	52.6	55.7	65	65	1.00	1.06	1.24	1.17								
	115P05881	3 PM Peak	Weekday	US-160	NB	67.0	62.0	57.2	56.6	65	65	1.00	1.05	1.14	1.15								
	115P05881	4 Evening	Weekday	US-160	NB	66.1	61.8	55.1	53.4	65	65	1.00	1.05	1.18	1.22								
	115P05882	1 AM Peak	Weekday	US-160	NB	59.5	48.9	25.5	15.5	65	65	1.09	1.33	2.55	4.19	1.19	1.36	3.32	5.23				
	115P05882	2 Mid Day	Weekday	US-160	NB	57.4	47.7	22.0	5.6	65	65	1.13	1.36	2.96									
	115P05882	3 PM Peak	Weekday	US-160	NB	56.8	52.9	22.0	18.2	65	65	1.15	1.23	2.95	3.58								
	115P05882	4 Evening	Weekday	US-160	NB	54.6	49.7	19.6	12.4	65	65	1.19	1.31	3.32	5.23								
	115P06574	1 AM Peak	Weekday	US-160	NB	67.9	61.0	56.5	50.7	65	65	1.00	1.07	1.15	1.28	1.01	1.08	1.32	1.29				
	115P06574	2 Mid Day	Weekday	US-160	NB	65.9	60.3	52.6	50.5	65	65	1.00	1.08	1.24	1.29								
	115P06574	3 PM Peak	Weekday	US-160	NB	65.7	60.6	52.6	52.8	65	65	1.00	1.07	1.24	1.23								
	115P06574	4 Evening	Weekday	US-160	NB	64.4	60.5	49.1	50.5	65	65	1.01	1.07	1.32	1.29								
	115P06575	1 AM Peak	Weekday	US-160	NB	63.4	60.0	47.8	51.6	62	62	1.00	1.03	1.30	1.20	1.02	1.04	1.69	1.25				
	115P06575	2 Mid Day	Weekday	US-160	NB	61.0	60.4	36.7	52.8	62	62	1.02	1.03	1.69	1.17								
	115P06575	3 PM Peak	Weekday	US-160	NB	61.9	60.3	41.3	53.2	62	62	1.00	1.03	1.50	1.17								
	115P06575	4 Evening	Weekday	US-160	NB	60.9	59.7	45.4	49.5	62	62	1.02	1.04	1.37	1.25								
11	115P06576	1 AM Peak	Weekday	US-160	NB	62.0	61.6	32.3	54.3	65	65	1.05	1.06	2.01	1.20	1.05	1.06	2.01	1.24	1.02	1.15	2.27	1.74
	115P06576	2 Mid Day	Weekday	US-160	NB	63.0	61.7	39.8	54.8	65	65	1.03	1.05	1.63	1.19								
	115P06576	3 PM Peak	Weekday	US-160	NB	65.0	61.5	50.9	55.1	65	65	1.00	1.06	1.28	1.18								
	115P06576	4 Evening	Weekday	US-160	NB	63.8	61.2	48.5	52.2	65	65	1.02	1.06	1.34	1.24								
	115P05883	1 AM Peak	Weekday	US-160	NB	57.0	49.4	30.5	11.8	55	55	1.00	1.11	1.81		1.00	1.24	2.53	2.23				
	115P05883	2 Mid Day	Weekday	US-160	NB	55.4	44.5	21.8	7.1	55	55	1.00	1.24	2.53									
	115P05883	3 PM Peak	Weekday	US-160	NB	57.8	54.5	32.5	28.3	55	55	1.00	1.01	1.69	1.95								
	115P05883	4 Evening	Weekday	US-160	NB	58.6	53.8	36.2	24.7	55	55	1.00	1.02	1.52	2.23								
12	115P05883	1 AM Peak	Weekday	US-160	NB	57.0	49.4	30.5	11.8	55	55	1.00	1.11	1.81		1.00	1.24	2.53	2.23	1.08	1.19	2.95	2.17
	115P05883	2 Mid Day	Weekday	US-160	NB	55.4	44.5	21.8	7.1	55	55	1.00	1.24	2.53									
	115P05883	3 PM Peak	Weekday	US-160	NB	57.8	54.5	32.5	28.3	55	55	1.00	1.01	1.69	1.95								
	115P05883	4 Evening	Weekday	US-160	NB	58.6	53.8	36.2	24.7	55	55	1.00	1.02	1.52	2.23								
	115P06577	1 AM Peak	Weekday	US-160	NB	56.7	58.4	20.5	39.4	65	65	1.15	1.11	3.17	1.65	1.15	1.15	3.37	2.11				
	115P06577	2 Mid Day	Weekday	US-160	NB	56.3	56.7	23.0	30.9	65	65	1.15	1.15	2.83	2.11								
	115P06577	3 PM Peak	Weekday	US-160	NB	56.4	57.0	19.3	31.7	65	65	1.15	1.14	3.37	2.05								
	115P06577	4 Evening	Weekday	US-160	NB	57.8	57.5	26.7	34.8	65	65	1.12	1.13	2.43	1.87								

TTI & PTI Westbound

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
1	115N06556	1 AM Peak	Weekday	US-160	SB	64.4	53.6	52.7	20.5	65	65	1.01	1.21	1.23		1.05	1.21	1.31	1.40	1.02	1.15	1.88	2.39
	115N06556	2 Mid Day	Weekday	US-160	SB	62.4	59.2	51.0	47.8	65	65	1.04	1.10	1.27	1.36								
	115N06556	3 PM Peak	Weekday	US-160	SB	62.0	59.3	51.0	48.8	65	65	1.05	1.10	1.27	1.33								
	115N06556	4 Evening	Weekday	US-160	SB	62.7	58.6	49.7	46.4	65	65	1.04	1.11	1.31	1.40								
	115N05877	1 AM Peak	Weekday	US-160	SB	59.4	52.0	32.3	16.3	55	55	1.00	1.06	1.70	3.37	1.00	1.08	2.46	3.37				
	115N05877	2 Mid Day	Weekday	US-160	SB	56.5	51.4	22.4	19.6	55	55	1.00	1.07	2.46	2.81								
	115N05877	3 PM Peak	Weekday	US-160	SB	56.3	50.8	25.5	11.0	55	55	1.00	1.08	2.16									
	115N05877	4 Evening	Weekday	US-160	SB	57.3	51.3	31.1	25.5	55	55	1.00	1.07	1.77	2.16								
2	115N06556	1 AM Peak	Weekday	US-160	SB	64.4	53.6	52.7	20.5	65	65	1.01	1.21	1.23		1.05	1.21	1.31	1.40	1.17	1.24	3.25	3.49
	115N06556	2 Mid Day	Weekday	US-160	SB	62.4	59.2	51.0	47.8	65	65	1.04	1.10	1.27	1.36								
	115N06556	3 PM Peak	Weekday	US-160	SB	62.0	59.3	51.0	48.8	65	65	1.05	1.10	1.27	1.33								
	115N06556	4 Evening	Weekday	US-160	SB	62.7	58.6	49.7	46.4	65	65	1.04	1.11	1.31	1.40								
	115N06557	1 AM Peak	Weekday	US-160	SB	49.4	38.0	23.0	4.4	45	45	1.00	1.18	1.95		1.00	1.18	2.50	2.90				
	115N06557	2 Mid Day	Weekday	US-160	SB	47.2	42.4	18.9	15.5	45	45	1.00	1.06	2.38	2.90								
	115N06557	3 PM Peak	Weekday	US-160	SB	46.9	44.2	18.0	23.0	45	45	1.00	1.02	2.50	1.95								
	115N06557	4 Evening	Weekday	US-160	SB	47.4	42.0	22.8	18.6	45	45	1.00	1.07	1.97	2.41								
	115N06558	1 AM Peak	Weekday	US-160	SB	54.3	51.6	35.0	39.9	60	60	1.11	1.16	1.71	1.50	1.14	1.17	2.05	1.63				
	115N06558	2 Mid Day	Weekday	US-160	SB	52.7	51.2	29.3	36.8	60	60	1.14	1.17	2.05	1.63								
	115N06558	3 PM Peak	Weekday	US-160	SB	54.0	52.5	35.0	40.4	60	60	1.11	1.14	1.71	1.48								
	115N06558	4 Evening	Weekday	US-160	SB	53.6	51.1	35.4	37.8	60	60	1.12	1.17	1.69	1.59								
	115N05878	1 AM Peak	Weekday	US-160	SB	30.0	30.7	6.2	6.8	40	40	1.33	1.30	6.44	5.85	1.51	1.39	7.16	8.04				
	115N05878	2 Mid Day	Weekday	US-160	SB	27.8	28.7	5.6	5.0	40	40	1.44	1.39	7.16	8.04								
	115N05878	3 PM Peak	Weekday	US-160	SB	26.5	29.4	5.6	7.5	40	40	1.51	1.36	7.16	5.37								
	115N05878	4 Evening	Weekday	US-160	SB	28.0	29.7	6.8	5.6	40	40	1.43	1.35	5.85	7.16								
3	115N06559	1 AM Peak	Weekday	US-160	SB	68.1	62.8	59.6	57.8	65	65	1.00	1.03	1.09	1.13	1.00	1.04	1.14	1.18	1.01	1.11	1.35	1.47
	115N06559	2 Mid Day	Weekday	US-160	SB	66.7	62.3	58.4	56.6	65	65	1.00	1.04	1.11	1.15								
	115N06559	3 PM Peak	Weekday	US-160	SB	66.2	62.7	57.2	57.4	65	65	1.00	1.04	1.14	1.13								
	115N06559	4 Evening	Weekday	US-160	SB	66.6	62.5	57.4	55.0	65	65	1.00	1.04	1.13	1.18								
	115N06560	1 AM Peak	Weekday	US-160	SB	66.0	60.0	50.3	49.2	65	65	1.00	1.08	1.29	1.32	1.03	1.12	1.49	1.65				
	115N06560	2 Mid Day	Weekday	US-160	SB	64.5	59.4	47.8	46.7	65	65	1.01	1.09	1.36	1.39								
	115N06560	3 PM Peak	Weekday	US-160	SB	63.9	59.7	45.9	46.7	65	65	1.02	1.09	1.41	1.39								
	115N06560	4 Evening	Weekday	US-160	SB	63.1	57.8	43.5	39.5	65	65	1.03	1.12	1.49	1.65								
	115N06561	1 AM Peak	Weekday	US-160	SB	56.2	42.3	38.8	30.8	45	45	1.00	1.06	1.16	1.46	1.00	1.15	1.42	1.57				
	115N06561	2 Mid Day	Weekday	US-160	SB	52.9	43.4	36.4	31.6	45	45	1.00	1.04	1.24	1.42								
	115N06561	3 PM Peak	Weekday	US-160	SB	51.2	43.8	33.4	30.8	45	45	1.00	1.03	1.35	1.46								
	115N06561	4 Evening	Weekday	US-160	SB	50.4	39.1	31.6	28.6	45	45	1.00	1.15	1.42	1.57								
4	115N06562	1 AM Peak	Weekday	US-160	SB	68.4	59.6	57.8	39.7	65	65	1.00	1.09	1.12	1.64	1.00	1.10	1.24	1.64	1.00	1.08	1.25	1.40

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
	115N06562	2 Mid Day	Weekday	US-160	SB	67.0	60.4	56.6	49.2	65	65	1.00	1.08	1.15	1.32								
	115N06562	3 PM Peak	Weekday	US-160	SB	66.3	60.8	52.9	51.3	65	65	1.00	1.07	1.23	1.27								
	115N06562	4 Evening	Weekday	US-160	SB	65.3	59.0	52.2	41.3	65	65	1.00	1.10	1.24	1.57								
	115N06563	1 AM Peak	Weekday	US-160	SB	69.1	62.1	60.3	55.9	65	65	1.00	1.05	1.08	1.16	1.00	1.05	1.15	1.20				
	115N06563	2 Mid Day	Weekday	US-160	SB	67.9	61.9	59.1	55.5	65	65	1.00	1.05	1.10	1.17								
	115N06563	3 PM Peak	Weekday	US-160	SB	67.4	62.7	56.8	58.1	65	65	1.00	1.04	1.14	1.12								
	115N06563	4 Evening	Weekday	US-160	SB	66.7	61.9	56.3	54.3	65	65	1.00	1.05	1.15	1.20								
	115N06564	1 AM Peak	Weekday	US-160	SB	68.0	61.1	54.8	53.9	65	65	1.00	1.06	1.19	1.21	1.00	1.08	1.35	1.36				
	115N06564	2 Mid Day	Weekday	US-160	SB	66.6	60.5	54.8	50.7	65	65	1.00	1.07	1.19	1.28								
	115N06564	3 PM Peak	Weekday	US-160	SB	65.3	61.4	48.2	55.4	65	65	1.00	1.06	1.35	1.17								
	115N06564	4 Evening	Weekday	US-160	SB	65.6	60.2	49.7	47.8	65	65	1.00	1.08	1.31	1.36								
5	115N06565	1 AM Peak	Weekday	US-160	SB	67.7	61.2	54.6	53.5	65	65	1.00	1.06	1.19	1.21	1.00	1.08	1.23	1.31	1.00	1.06	1.23	1.25
	115N06565	2 Mid Day	Weekday	US-160	SB	66.6	60.7	56.3	52.2	65	65	1.00	1.07	1.16	1.25								
	115N06565	3 PM Peak	Weekday	US-160	SB	66.1	61.6	54.5	54.4	65	65	1.00	1.06	1.19	1.20								
	115N06565	4 Evening	Weekday	US-160	SB	65.9	60.2	52.8	49.8	65	65	1.00	1.08	1.23	1.31								
	115N05879	1 AM Peak	Weekday	US-160	SB	67.9	62.4	56.6	55.9	65	65	1.00	1.04	1.15	1.16	1.00	1.05	1.23	1.20				
	115N05879	2 Mid Day	Weekday	US-160	SB	66.4	62.4	55.9	56.3	65	65	1.00	1.04	1.16	1.15								
	115N05879	3 PM Peak	Weekday	US-160	SB	65.9	62.6	54.7	56.6	65	65	1.00	1.04	1.19	1.15								
	115N05879	4 Evening	Weekday	US-160	SB	66.0	62.1	52.8	54.3	65	65	1.00	1.05	1.23	1.20								
6	115N06566	1 AM Peak	Weekday	US-160	SB	65.7	59.4	54.9	49.7	65	65	1.00	1.09	1.18	1.31	1.03	1.12	1.31	1.44	1.06	1.13	2.11	1.48
	115N06566	2 Mid Day	Weekday	US-160	SB	64.1	58.9	52.8	48.5	65	65	1.01	1.10	1.23	1.34								
	115N06566	3 PM Peak	Weekday	US-160	SB	63.7	59.7	52.5	50.3	65	65	1.02	1.09	1.24	1.29								
	115N06566	4 Evening	Weekday	US-160	SB	63.2	58.2	49.7	45.2	65	65	1.03	1.12	1.31	1.44								
	115N06567	1 AM Peak	Weekday	US-160	SB	63.6	58.0	47.2	48.6	65	65	1.02	1.12	1.38	1.34	1.10	1.14	2.91	1.52				
	115N06567	2 Mid Day	Weekday	US-160	SB	62.7	58.1	46.5	46.5	65	65	1.04	1.12	1.40	1.40								
	115N06567	3 PM Peak	Weekday	US-160	SB	61.0	58.9	40.6	49.8	65	65	1.06	1.10	1.60	1.30								
	115N06567	4 Evening	Weekday	US-160	SB	59.3	56.9	22.4	42.9	65	65	1.10	1.14	2.91	1.52								
7	115N06568	1 AM Peak	Weekday	US-160	SB	59.0	50.5	24.9	13.7	65	65	1.10	1.29	2.61	4.75	1.18	1.29	3.32	4.75	1.16	1.34	3.07	5.28
	115N06568	2 Mid Day	Weekday	US-160	SB	56.6	51.3	19.9	18.6	65	65	1.15	1.27	3.27	3.49								
	115N06568	3 PM Peak	Weekday	US-160	SB	55.2	52.5	19.6	20.0	65	65	1.18	1.24	3.32	3.24								
	115N06568	4 Evening	Weekday	US-160	SB	56.4	51.0	20.3	15.5	65	65	1.15	1.27	3.20	4.18								
	115N05880	1 AM Peak	Weekday	US-160	SB	59.4	47.6	27.3	14.9	65	65	1.09	1.36	2.38	4.36	1.14	1.39	2.83	5.81				
	115N05880	2 Mid Day	Weekday	US-160	SB	57.2	48.0	23.0	14.9	65	65	1.14	1.35	2.83	4.36								
	115N05880	3 PM Peak	Weekday	US-160	SB	57.3	48.1	24.4	12.4	65	65	1.13	1.35	2.66	5.23								
	115N05880	4 Evening	Weekday	US-160	SB	57.6	46.8	24.2	11.2	65	65	1.13	1.39	2.68	5.81								
8	115N06569	1 AM Peak	Weekday	US-160	SB	66.8	59.7	56.7	52.2	65	65	1.00	1.09	1.15	1.24	1.00	1.10	1.22	1.30	1.00	1.08	1.20	1.26
	115N06569	2 Mid Day	Weekday	US-160	SB	66.0	59.5	55.9	52.0	65	65	1.00	1.09	1.16	1.25								
	115N06569	3 PM Peak	Weekday	US-160	SB	65.7	59.9	54.7	51.4	65	65	1.00	1.08	1.19	1.26								

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
	115N06569	4 Evening	Weekday	US-160	SB	64.9	59.0	53.5	50.0	65	65	1.00	1.10	1.22	1.30								
	115N06570	1 AM Peak	Weekday	US-160	SB	67.2	62.2	59.1	56.8	65	65	1.00	1.05	1.10	1.15	1.00	1.05	1.19	1.22				
	115N06570	2 Mid Day	Weekday	US-160	SB	66.8	62.0	58.7	57.0	65	65	1.00	1.05	1.11	1.14								
	115N06570	3 PM Peak	Weekday	US-160	SB	66.3	62.4	57.8	56.9	65	65	1.00	1.04	1.13	1.14								
	115N06570	4 Evening	Weekday	US-160	SB	65.6	61.9	54.7	53.5	65	65	1.00	1.05	1.19	1.22								
9	115N06570	1 AM Peak	Weekday	US-160	SB	67.2	62.2	59.1	56.8	65	65	1.00	1.05	1.10	1.15	1.00	1.05	1.19	1.22	1.02	1.06	1.37	1.25
	115N06570	2 Mid Day	Weekday	US-160	SB	66.8	62.0	58.7	57.0	65	65	1.00	1.05	1.11	1.14								
	115N06570	3 PM Peak	Weekday	US-160	SB	66.3	62.4	57.8	56.9	65	65	1.00	1.04	1.13	1.14								
	115N06570	4 Evening	Weekday	US-160	SB	65.6	61.9	54.7	53.5	65	65	1.00	1.05	1.19	1.22								
	115N06571	1 AM Peak	Weekday	US-160	SB	62.0	61.2	36.9	54.7	65	65	1.05	1.06	1.76	1.19	1.06	1.07	1.88	1.25				
	115N06571	2 Mid Day	Weekday	US-160	SB	62.5	61.7	39.7	56.0	65	65	1.04	1.05	1.64	1.16								
	115N06571	3 PM Peak	Weekday	US-160	SB	61.9	62.1	34.5	55.8	65	65	1.05	1.05	1.88	1.17								
	115N06571	4 Evening	Weekday	US-160	SB	61.1	60.8	35.4	51.9	65	65	1.06	1.07	1.83	1.25								
	115N06572	1 AM Peak	Weekday	US-160	SB	65.3	60.4	53.7	51.9	65	65	1.00	1.08	1.21	1.25	1.01	1.09	1.24	1.30				
	115N06572	2 Mid Day	Weekday	US-160	SB	65.6	60.4	55.3	52.0	65	65	1.00	1.08	1.17	1.25								
	115N06572	3 PM Peak	Weekday	US-160	SB	66.1	60.8	56.6	52.5	65	65	1.00	1.07	1.15	1.24								
	115N06572	4 Evening	Weekday	US-160	SB	64.3	59.8	52.5	50.0	65	65	1.01	1.09	1.24	1.30								
	115N06573	1 AM Peak	Weekday	US-160	SB	66.2	61.9	54.6	56.2	65	65	1.00	1.05	1.19	1.16	1.00	1.05	1.19	1.22				
	115N06573	2 Mid Day	Weekday	US-160	SB	66.3	61.9	56.6	55.9	65	65	1.00	1.05	1.15	1.16								
	115N06573	3 PM Peak	Weekday	US-160	SB	67.3	62.7	57.8	56.6	65	65	1.00	1.04	1.13	1.15								
	115N06573	4 Evening	Weekday	US-160	SB	66.2	61.9	55.9	53.4	65	65	1.00	1.05	1.16	1.22								
10	115N05881	1 AM Peak	Weekday	US-160	SB	57.9	53.5	19.9	22.7	65	65	1.12	1.22	3.27	2.86	1.14	1.24	3.27	3.73	1.04	1.10	1.85	1.86
	115N05881	2 Mid Day	Weekday	US-160	SB	58.6	52.5	23.6	17.4	65	65	1.11	1.24	2.75	3.73								
	115N05881	3 PM Peak	Weekday	US-160	SB	59.2	54.5	20.5	20.5	65	65	1.10	1.19	3.17	3.17								
	115N05881	4 Evening	Weekday	US-160	SB	56.9	53.0	21.8	20.5	65	65	1.14	1.23	2.99	3.17								
	115N05882	1 AM Peak	Weekday	US-160	SB	65.8	62.0	56.5	54.7	65	65	1.00	1.05	1.15	1.19	1.00	1.05	1.22	1.22				
	115N05882	2 Mid Day	Weekday	US-160	SB	66.5	62.3	57.4	55.9	65	65	1.00	1.04	1.13	1.16								
	115N05882	3 PM Peak	Weekday	US-160	SB	67.0	62.4	57.8	55.3	65	65	1.00	1.04	1.12	1.18								
	115N05882	4 Evening	Weekday	US-160	SB	65.6	62.1	53.4	53.1	65	65	1.00	1.05	1.22	1.22								
	115N06574	1 AM Peak	Weekday	US-160	SB	60.4	59.2	38.5	51.0	62	62	1.03	1.05	1.61	1.22	1.03	1.05	1.72	1.28				
	115N06574	2 Mid Day	Weekday	US-160	SB	60.3	59.3	36.0	49.0	62	62	1.03	1.05	1.72	1.26								
	115N06574	3 PM Peak	Weekday	US-160	SB	61.9	59.3	43.7	51.0	62	62	1.00	1.05	1.42	1.22								
	115N06574	4 Evening	Weekday	US-160	SB	61.5	58.8	43.2	48.5	62	62	1.01	1.05	1.43	1.28								
	115N06573	1 AM Peak	Weekday	US-160	SB	66.2	61.9	54.6	56.2	65	65	1.00	1.05	1.19	1.16	1.00	1.05	1.19	1.22				
	115N06573	2 Mid Day	Weekday	US-160	SB	66.3	61.9	56.6	55.9	65	65	1.00	1.05	1.15	1.16								
	115N06573	3 PM Peak	Weekday	US-160	SB	67.3	62.7	57.8	56.6	65	65	1.00	1.04	1.13	1.15								
	115N06573	4 Evening	Weekday	US-160	SB	66.2	61.9	55.9	53.4	65	65	1.00	1.05	1.16	1.22								
11	115N06575	1 AM Peak	Weekday	US-160	SB	63.6	62.0	44.7	55.5	65	65	1.02	1.05	1.45	1.17	1.03	1.06	1.61	1.23	1.01	1.11	1.83	2.39

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
	115N06575	2 Mid Day	Weekday	US-160	SB	63.1	62.1	40.4	55.7	65	65	1.03	1.05	1.61	1.17								
	115N06575	3 PM Peak	Weekday	US-160	SB	64.5	62.2	50.8	55.1	65	65	1.01	1.04	1.28	1.18								
	115N06575	4 Evening	Weekday	US-160	SB	63.9	61.6	51.0	52.7	65	65	1.02	1.06	1.28	1.23								
	115N06576	1 AM Peak	Weekday	US-160	SB	55.1	48.1	26.7	15.5	55	55	1.00	1.14	2.06	3.54	1.00	1.16	2.06	3.54				
	115N06576	2 Mid Day	Weekday	US-160	SB	55.8	47.6	29.2	13.7	55	55	1.00	1.16	1.88									
	115N06576	3 PM Peak	Weekday	US-160	SB	57.4	52.9	36.1	30.5	55	55	1.00	1.04	1.52	1.81								
	115N06576	4 Evening	Weekday	US-160	SB	56.3	52.1	34.8	28.0	55	55	1.00	1.06	1.58	1.97								
12	115N05883	1 AM Peak	Weekday	US-160	SB	51.9	47.5	16.2	26.7	55	55	1.06	1.16	3.40	2.06	1.12	1.17	3.40	2.33	1.12	1.17	3.40	2.33
	115N05883	2 Mid Day	Weekday	US-160	SB	50.2	47.6	18.6	25.5	55	55	1.10	1.16	2.95	2.16								
	115N05883	3 PM Peak	Weekday	US-160	SB	49.5	47.3	16.8	24.9	55	55	1.11	1.16	3.28	2.21								
	115N05883	4 Evening	Weekday	US-160	SB	49.1	46.9	20.5	23.6	55	55	1.12	1.17	2.68	2.33								

Closure Data

Segment	Length (miles)	# of closures	# F&I	Total miles of closures		Avg Occurrences/Mile/Year	
				EB	WB	EB	EB
160-1	8	3	2	3.0	0.0	0.08	0.00
160-2	4	2	1	2.0	0.0	0.10	0.00
160-3	21	10	9	25.0	5.0	0.24	0.05
160-4	18	14	4	31.0	63.0	0.34	0.70
160-5	12	3	1	0.0	3.0	0.00	0.05
160-6	17	18	3	10.0	28.5	0.12	0.34
160-7	4	5	1	2.0	3.0	0.10	0.15
160-8	18	4	2	3.0	1.0	0.03	0.01
160-9	21	8	2	4.0	4.0	0.04	0.04
160-10	17	13	6	12.0	1.0	0.14	0.01
160-11	12	4	2	0.0	4.0	0.00	0.07
160-12	7	5	2	3.0	2.0	0.09	0.06

	ITIS Category Description											
	Closures		Incidents/Accidents		Incidents/Crashes		Obstruction Hazards		Winds		Winter Storm Codes	
Segment	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
160-1	0	0	3	0	0	0	0	0	0	0	0	0
160-2	0	0	1	0	0	0	1	0	0	0	0	0
160-3	0	0	4	5	0	0	0	0	0	0	1	0
160-4	0	0	4	8	0	0	0	0	0	0	1	1
160-5	0	0	0	2	0	0	0	1	0	0	0	0
160-6	0	0	9	3	0	0	1	2	0	0	0	3
160-7	0	0	2	3	0	0	0	0	0	0	0	0
160-8	0	0	3	1	0	0	0	0	0	0	0	0
160-9	0	0	4	4	0	0	0	0	0	0	0	0
160-10	0	0	12	1	0	0	0	0	0	0	0	0
160-11	0	0	0	4	0	0	0	0	0	0	0	0
160-12	0	0	3	2	0	0	0	0	0	0	0	0

HPMS Data

Segment	MP From	MP To	Weighted Average NB/WB AADT	Weighted Average SB/EB AADT	Weighted Average AADT	NB/WB AADT	SB/EB AADT	2015 AADT	K Factor	D-Factor	T-Factor
160-1	311	319	2925	2958	5884	3080	3223	6303	10	51	8
160-2	319	323	5560	6154	11714	4722	6220	10942	11	56	9
160-3	323	344	2203	2186	4389	2288	2292	4581	11	50	13
160-4	344	362	1776	1806	3582	1584	1694	3278	9	52	12
160-5	362	374	2235	2253	4488	2138	2241	4379	10	51	11
160-6	374	391	2577	2538	5115	2838	2738	5577	10	51	10
160-7	391	395	2226	2234	4461	2523	2582	5106	10	51	10
160-8	395	413	1452	1471	2924	1553	1628	3181	9	51	11
160-9	413	434	1370	1395	2766	1526	1541	3068	11	50	11
160-10	434	451	1453	1433	2886	1522	1533	3055	8	50	11
160-11	451	463	1458	1440	2898	1513	1533	3046	8	50	11
160-12	463	470	904	898	1802	1147	1153	2299	9	50	11

Segment	Loc ID	BMP	EMP	Length	Pos Dir AADT	Neg Dir AADT	Corrected Pos Dir AADT	Corrected Neg Dir AADT	2015 AADT	K Factor	D-Factor	D-Factor Adjusted	T-Factor
160-1	102171	311.46	318.49	7.03	2933	2946	2933	2946	5880	10	60	50	8
	102172	318.49	319.00	0.51	5099	7035	5099	7035	12134	11	61	58	9
160-2	102172	319.00	321.95	2.95	5099	7035	5099	7035	12134	11	61	58	9
	102173	321.95	322.35	0.40	5877	6569	5877	6569	12446	11	62	53	9
	102174	322.35	323.00	0.65	2303	2304	2303	2304	4608	11	54	50	13
160-3	102174	323.00	343.58	20.58	2303	2304	2303	2304	4608	11	54	50	13
	102175	343.58	344.00	0.42	1572	1682	1572	1682	3254	9	50	52	12
160-4	102175	344.00	361.62	17.62	1572	1682	1572	1682	3254	9	50	52	12
	102176	361.62	362.00	0.38	2138	2241	2138	2241	4379	10	55	51	11
160-5	102176	362.00	374.00	12.00	2138	2241	2138	2241	4379	10	55	51	11
160-6	102176	374.00	374.28	0.28	2138	2241	2138	2241	4379	10	55	51	11
	102177	374.28	382.27	7.99	2865	2689	2865	2689	5554	9	51	52	10
	102178	382.97	391.00	8.03	2835	2804	2835	2804	5641	11	63	50	10
160-7	102178	391.00	393.55	2.55	2835	2804	2835	2804	5641	11	63	50	10
	102286	393.55	395.00	1.45	1975	2191	1975	2191	4166	9	61	53	10
160-8	102179	401.46	413.00	11.54	1317	1313	1317	1313	2630	9	62	50	11
	102286	395.00	401.45	6.45	1975	2191	1975	2191	4166	9	61	53	10
160-9	102287	413.00	434.00	21.00	1526	1541	1526	1541	3068	11	64	50	11
160-10	102287	434.00	434.83	0.83	1526	1541	1526	1541	3068	11	64	50	11
	102180	434.83	437.15	2.32	1575	1528	1575	1528	3103	9	54	51	11
	102181	437.15	451.00	13.85	1513	1533	1513	1533	3046	8	51	50	11
160-11	102181	451.00	463.00	12.00	1513	1533	1513	1533	3046	8	51	50	11
160-12	102181	463.00	465.40	2.40	1513	1533	1513	1533	3046	8	51	50	11
	102182	465.40	470.73	5.33	0	1007	982	982	1963	9	58	50	11

Bicycle Accommodation Data

Segment	BMP	EMP	Divided or Non	EB Right Shoulder Width	WB Right Shoulder Width	EB Left Shoulder Width	WB Left Shoulder Width	EB Effective Length of Shoulder	WB Effective Length of Shoulder	% Bicycle Accommodation
160-1	311	319	Undivided	5.0	5.0	N/A	N/A	0.0	0.0	0%
160-2	319	323	Undivided	5.1	6.1	N/A	N/A	2.9	3.8	84%
160-3	323	344	Undivided	5.0	6.1	N/A	N/A	0.3	7.9	19%
160-4	344	362	Undivided	5.2	5.5	N/A	N/A	1.4	2.0	9%
160-5	362	374	Undivided	5.0	5.0	N/A	N/A	0.0	0.0	0%
160-6	374	391	Undivided	5.0	5.0	N/A	N/A	0.0	0.0	0%
160-7	391	395	Undivided	4.1	4.1	N/A	N/A	0.2	0.2	6%
160-8	395	413	Undivided	5.0	5.0	N/A	N/A	0.1	0.0	0%
160-9	413	434	Undivided	5.0	5.0	N/A	N/A	0.1	0.1	1%
160-10	434	451	Undivided	4.9	5.0	N/A	N/A	0.0	0.2	1%
160-11	451	463	Undivided	5.0	5.0	N/A	N/A	0.0	0.0	0%
160-12	463	470	Undivided	5.0	5.3	N/A	N/A	0.3	0.3	4%

AZTDM Data

SEGMENT	Growth Rate	% Non-SOV
1	2.22%	14.2%
2	2.22%	14.2%
3	2.09%	12.7%
4	2.06%	14.7%
5	1.98%	17.5%
6	2.01%	15.9%
7	3.25%	6.9%
8	1.82%	7.2%
9	1.82%	12.1%
10	1.72%	16.7%
11	1.73%	0.0%
12	1.77%	0.0%

HERS Capacity Calculation Data

Segment	Facility Type	Terrain	Lane Width (Rounded, feet)	EB Rt. Shoulder	WB Rt. Shoulder	F_{lw} or f_w or f_{LS}	EB F_{lc}	WB F_{lc}	Total Ramp Density[1]	PHF	E_T	f_{HV}	f_M	f_A	g/C[2]	f_G	f_{NP}	Nm	f_p	EB FFS	WB FFS	EB Peak-Hour Capacity	WB Peak-Hour Capacity	Major Direction Peak-Hour Capacity	Daily Capacity[3]
1	Rural	Rolling	12.00	5.00	5.00	0.0	N/A	N/A	N/A	0.88	2.1	0.919	N/A	0.38	N/A	0.83	2.35	N/A	N/A	72.63	72.63	N/A	N/A	1309.56	24,944
2	Rural	Rolling	12.00	5.09	6.09	1.0	N/A	N/A	N/A	0.9	2	0.917	N/A	N/A	0.55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1024.63	19,517
3	Rural	Level	12.00	5.04	6.13	0.0	N/A	N/A	N/A	0.88	1.4	0.951	N/A	0.43	N/A	1	1.90	N/A	N/A	73.58	73.58	N/A	N/A	1707.23	32,519
4	Rural	Level	12.00	5.22	5.54	0.0	N/A	N/A	N/A	0.88	1.5	0.943	N/A	0.4	N/A	1	1.65	N/A	N/A	74.60	74.60	N/A	N/A	1762.55	33,572
5	Rural	Level	12.00	5.00	5.00	0.0	N/A	N/A	N/A	0.88	1.5	0.948	N/A	0.58	N/A	1	2.20	N/A	N/A	74.43	74.43	N/A	N/A	1731.93	32,989
6	Rural	Rolling	12.00	5.00	5.00	0.0	N/A	N/A	N/A	0.88	2.1	0.901	N/A	0.48	N/A	0.83	1.90	N/A	N/A	73.53	73.53	N/A	N/A	1340.84	25,540
7	Rural	Rolling	12.00	4.13	4.12	1.0	N/A	N/A	N/A	0.9	2	0.909	N/A	N/A	0.55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	955.46	18,199
8	Rural	Level	12.00	4.99	4.95	0.0	N/A	N/A	N/A	0.88	1.9	0.910	N/A	0.1	N/A	1	1.10	N/A	N/A	74.90	74.90	N/A	N/A	1743.85	33,216
9	Rural	Level	12.00	5.02	5.01	0.0	N/A	N/A	N/A	0.88	1.5	0.948	N/A	0.38	N/A	1	2.20	N/A	N/A	74.63	74.63	N/A	N/A	1742.68	33,194
10	Rural	Rolling	12.00	4.94	4.99	0.0	N/A	N/A	N/A	0.88	2.7	0.842	N/A	0.33	N/A	0.67	1.65	N/A	N/A	73.68	73.68	N/A	N/A	1024.95	19,523
11	Rural	Rolling	12.00	5.00	5.00	0.0	N/A	N/A	N/A	0.88	2.7	0.842	N/A	0.43	N/A	0.67	1.10	N/A	N/A	74.58	74.58	N/A	N/A	1071.36	20,407
12	Rural	Rolling	12.00	5.04	5.26	0.0	N/A	N/A	N/A	0.88	2.7	0.842	N/A	0.9	N/A	0.67	1.65	N/A	N/A	69.10	69.10	N/A	N/A	878.53	16,734

Safety Performance Area Data

Segment	Segment Similar Operating Environment Type	Segment Length (miles)	EB Fatal Crashes 2011-2015	WB Fatal Crashes 2011-2015	EB Incapacitating Injury Crashes 2011-2015	WB Incapacitating Injury Crashes 2011-2015	Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors
160-1	2 or 3 Lane Undivided Highway	8	1	0	0	0	0
160-2	2 or 3 Lane Undivided Highway	4	1	0	0	0	0
160-3	2 or 3 Lane Undivided Highway	21	6	6	2	1	7
160-4	2 or 3 Lane Undivided Highway	18	5	0	2	3	5
160-5	2 or 3 Lane Undivided Highway	12	0	0	0	1	0
160-6	2 or 3 Lane Undivided Highway	17	1	0	0	2	3
160-7	2 or 3 Lane Undivided Highway	4	1	0	0	2	1
160-8	2 or 3 Lane Undivided Highway	18	0	3	0	1	2
160-9	2 or 3 Lane Undivided Highway	21	1	3	0	0	2
160-10	2 or 3 Lane Undivided Highway	17	2	3	3	1	4
160-11	2 or 3 Lane Undivided Highway	12	1	0	1	0	1
160-12	2 or 3 Lane Undivided Highway	7	0	0	2	2	2

Segment	Segment Similar Operating Environment Type	Fatal + Incapacitating Injury Crashes Involving Trucks	Fatal + Incapacitating Injury Crashes Involving Motorcycles	Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers	Weighted 5-Year Average EB AADT	Weighted 5-Year Average WB AADT	Weighted 5-Year Average Total AADT
160-1	2 or 3 Lane Undivided Highway	0	0	0	2925	2958	5883
160-2	2 or 3 Lane Undivided Highway	0	0	1	5560	6154	11714
160-3	2 or 3 Lane Undivided Highway	1	0	1	2203	2186	4388
160-4	2 or 3 Lane Undivided Highway	1	3	0	1776	1806	3582
160-5	2 or 3 Lane Undivided Highway	0	0	0	2235	2253	4488
160-6	2 or 3 Lane Undivided Highway	0	0	1	2577	2538	5115
160-7	2 or 3 Lane Undivided Highway	0	1	0	2226	2234	4460
160-8	2 or 3 Lane Undivided Highway	0	0	0	1452	1471	2924
160-9	2 or 3 Lane Undivided Highway	0	0	1	1370	1395	2765
160-10	2 or 3 Lane Undivided Highway	2	0	1	1453	1433	2886
160-11	2 or 3 Lane Undivided Highway	0	0	0	1458	1440	2899
160-12	2 or 3 Lane Undivided Highway	0	0	0	904	898	1802

Freight Performance Area Data

				Total minutes of closures		Avg Mins/Mile/Year	
Segment	Length (miles)	# of closures	# F&I	EB	WB	EB	WB
160-1	8	3	2	413.0	0.0	10.33	0.00
160-2	4	2	1	241.0	0.0	12.05	0.00
160-3	21	10	9	5919.0	945.0	56.37	9.00
160-4	18	14	4	6742.0	8391.0	74.91	93.23
160-5	12	3	1	0.0	951.0	0.00	15.85
160-6	17	18	3	1935.0	5094.0	22.76	59.93
160-7	4	5	1	377.0	295.0	18.85	14.75
160-8	18	4	2	840.0	473.0	9.33	5.26
160-9	21	8	2	1075.0	880.0	10.24	8.38
160-10	17	13	6	3016.0	395.0	35.48	4.65
160-11	12	4	2	0.0	558.0	0.00	9.30
160-12	7	5	2	696.0	925.0	19.89	26.43

	ITIS Category Description											
	Closures		Incidents/Accidents		Incidents/Crashes		Obstruction Hazards		Winds		Winter Storm Codes	
Segment	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
160-1	0	0	3	0	0	0	0	0	0	0	0	0
160-2	0	0	1	0	0	0	1	0	0	0	0	0
160-3	0	0	4	5	0	0	0	0	0	0	1	0
160-4	0	0	4	8	0	0	0	0	0	0	1	1
160-5	0	0	0	2	0	0	0	1	0	0	0	0
160-6	0	0	9	3	0	0	1	2	0	0	0	3
160-7	0	0	2	3	0	0	0	0	0	0	0	0
160-8	0	0	3	1	0	0	0	0	0	0	0	0
160-9	0	0	4	4	0	0	0	0	0	0	0	0
160-10	0	0	12	1	0	0	0	0	0	0	0	0
160-11	0	0	0	4	0	0	0	0	0	0	0	0
160-12	0	0	3	2	0	0	0	0	0	0	0	0

See the **Mobility Performance Area Data** section for other Freight Performance Area related data

Appendix D: Performance Area Data

Pavement Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Pavement Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for Pavement. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scales" within the Step 1 template.

To develop an aggregate Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Enter the appropriate segment information into the columns titled "Segment", "Segment Length", "Segment Mileposts" and "Facility Type".

Step 1.2

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Existing Performance Analysis into the appropriate "Performance Score" columns. Copy the performance score for each segment to the appropriate "Performance Score" column. Paste only the "values" and do not overwrite the formatting.

Step 1.3

Indicate if Pavement is an Emphasis Area by selecting "Yes" or "No" in the row immediately below the segment information.

Step 1.4

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the segment information and the initial needs from the Step 1 template to the "Initial Need" column of the Step 2 template.

Step 2.2

Note in the "Hot Spots" column any pavement failure hot spots identified as part of the baseline corridor performance. For each entry, include the milepost limits of the hot spot. Hot spots are identified in the Pavement Index spreadsheet by the red cells in the columns titled "% Pavement Failure". These locations are based on the following criteria:

Interstates: IRI > 105 or Cracking > 15

Non-Interstates: IRI > 142 or Cracking > 15

Every segment that has a % Pavement Failure greater than 0% will have at least one hot spot. Hot spot locations should be described as extending over consecutive miles. For example, if there is a pavement failure location that extends 5 consecutive miles, it should be identified as one hot spot, not 5 separate hot spots.

Step 2.3

Identify recently completed or under construction paving projects in the "Previous Projects" column. Include only projects that were completed after the pavement condition data period (check dates in pavement condition data provided by ADOT) that would supersede the results of the performance system.

Step 2.5

Update the "Final Need" column using the following criteria:

- If "None" but have a hot spot (or hot spots), the Final Need = Low, and note the reason for the change in the "Comments" column (column H).

- If a recent project has superseded the performance rating data, change the Final Need to "None" and note the reason for the change in the "Comments" column.

Example Scales for Level of Need

Performance Thresholds		Initial Need	Description
3.75		None	(>3.57)
		Low	Middle 1/3rd of Fair Perf. (3.38 - 3.57)
3.2		Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance (3.02-3.38)
		High	Lower 2/3rd of Poor Performance (<3.02)

Need Scale for Interstates

Measure	None >=	Low >=	> Medium <		High <=
Pavement Index (corridor non-emphasis area)	3.57	3.38	3.38	3.02	3.02
Pavement Index (corridor emphasis area)	3.93	3.57	3.57	3.20	3.20
Pavement Index (segments)	3.57	3.38	3.38	3.02	3.02
Directional PSR	3.57	3.38	3.38	3.02	3.02
%Pavement Failure	10%	15%	15%	25%	25%

Need Scale for Highways (Non-Interstates)

Measure	None >=	Low >=	> Medium <		High <=
Pavement Index (corridor non-emphasis area)	3.30	3.10	3.10	2.70	2.70
Pavement Index (corridor emphasis area)	3.70	3.30	3.30	2.90	2.90
Pavement Index (segments)	3.30	3.10	3.10	2.70	2.70
Directional PSR	3.30	3.10	3.10	2.70	2.70
%Pavement Failure	10%	15%	15%	25%	25%

Step 2.6

Note any programmed projects that could have the potential to mitigate pavement needs in in the "Comments" column. Programmed projects are provided as information and do not impact the need rating. The program information can be found in ADOT's 5-year construction program. If there are other comments relevant to the needs analysis (such as information from previous reports), they can be entered in the "Comments" column. However, only include information related to needs that have been identified through this process. Do not add or create needs from other sources.

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab. The steps to complete Step 3 include:

Step 3.1

Input the level of historical investment for each segment. This will be determined from the numeric score from the Pavement History Table based on the following thresholds:

- Low = < 4.60
- Medium = 4.60 – 6.60
- High = > 6.60

If the PeCoS data shows a high level of maintenance investment, increase the historical investment rating by one level.

Step 3.2

Note the milepost ranges of pavement failure hot spots into the column titled "Contributing Factors and Comments."

Step 3.3

Note any other information that may be contributing to the deficiency, or supplemental information, in the "Contributing Factors and Comments" column. This could come from discussions with ADOT District staff, ADOT Materials/Pavement Group, previous reports, or the historical investment data.

Step 3.4

Include any programmed projects from ADOT's 5-year construction program in the "Contributing Factors and Comments" column.

Bridge Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Bridge Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for Bridge. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scales" within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial level of need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Enter the appropriate segment information into the columns titled "Segment", "Segment Length", "Segment Mileposts" and "Number of Bridges."

Step 1.2

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Existing Performance Analysis into the appropriate "Performance Score" columns. Copy the performance score for each segment to the appropriate "Performance Score" column. Paste only the "values" and do not overwrite the formatting.

Step 1.3

Indicate if Bridge is an Emphasis Area by selecting "Yes" or "No" in the row immediately below the segment information.

Step 1.4

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2 .The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial needs from the Step 1 template to the "Initial Need" column of the Step 2 template.

Step 2.2

Note in the column titled "Hot Spots" any bridge hot spots identified as part of the baseline corridor performance. For each entry, note the specific location. Hot spots are identified as having any bridge rating of 4 or less, or multiple ratings of 5 in the deck, substructure, or superstructure ratings.

Step 2.3

Identify recently completed or under construction bridge projects in the "Previous Projects" column. Include only projects that were completed after the bridge condition data period (check dates in bridge condition data provided by ADOT) that would supersede the results of the performance system.

Step 2.4

Update the Final Need on each segment based on the following criteria:

- If the Initial Need is "None" and there is at least one hot spot located on the segment, change the Final Need to "Low".
- If a recent project has superseded the performance rating data, the performance data should be adjusted to increase the specific ratings and the resulting need should be reduced to account for the project.
- Note the reason for any change in the "Comments" column.

Step 2.5

Historical bridge rating data was tabulated and graphed to find any bridges that had fluctuations in the ratings. Note in the "Historical Review" column any bridge that was identified as having a potential historical rating concern based on the following criteria:

- Ratings increase or decrease (bar chart) more than 2 times
- Sufficiency rating drops more than 20 points

This is for information only and does not affect the level of need.

Step 2.6

Note the number of functionally obsolete bridges in each segment in the column titled "# Functionally Obsolete Bridges". This is for information only and does not affect the level of need.

Step 2.7

Identify each bridge "of concern" in the "Comments" column. Note any programmed projects that could have the potential to mitigate bridge needs. Programmed projects are provided as information and do not impact the need rating. The program information can be found in ADOT's 5-year construction program. If there are other comments relevant to the needs analysis (such as information from previous reports), they can be entered in the "Comments" column. However, only include information related to needs that have been identified through this process. Do not add or create needs from other sources.

Example Scales for Level of Need

Bridge Index Performance Thresholds	Level of Need		Description
	Good	None	All of Good Performance and upper 1/3rd of Fair Performance
	Good		
	Good		
6.5	Fair		
	Fair	Low	Middle 1/3rd of Fair Performance
	Fair	Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance
5.0	Poor		
	Poor	High	Lower 2/3rd of Poor Performance
	Poor		

Need Scale

Measure	None >=	Low >=	> Medium <		High <=
Bridge Index (corridor non-emphasis area)	6.0	5.5	5.5	4.5	4.5
Bridge Index (corridor emphasis area)	7.0	6.0	6.0	5.0	5.0
Bridge Index (segments)	6.0	5.5	5.5	4.5	4.5
Bridge Sufficiency	70	60	60	40	40
Bridge Rating	6.0	5.0	4.0	4.0	3.0
%Functionally Obsolete Bridges	21.0%	31.0%	31.0%	49.0%	49.0%

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab. The steps to compete Step 3 include:

Step 3.1

Input the bridge name, structure number, and milepost information for each bridge "of concern" resulting from Step 2.

Step 3.2

For bridges that have a current rating of 5 or less, enter the specific rating, or state "No current ratings less than 6".

Step 3.3

For bridges that were identified for a historical review (step 2.5), state "Could have a repetitive investment issue". If a bridge was not identified for a historical review, state "This structure was not identified in historical review".

Step 3.4

Input any programmed projects from ADOT's 5-year construction program. Note any other information that may be contributing to the deficiency, or supplemental information. This could come from discussions with ADOT District staff, ADOT Bridge Group, or previous reports.

Mobility Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Mobility Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Refined Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate "Performance Score" columns from Existing Performance Analysis. This includes the primary and secondary measures for Mobility. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scales" in the Step 1 tab.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scores, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Input the accurate number of segments for your corridor in the column titled 'Segment' and the appropriate segment milepost limits and segment lengths in adjacent columns.

Step 1.2

Select the appropriate 'Environment Type' and 'Facility Operation Type' from the drop down menus as defined in Existing Performance Analysis.

Step 1.3

Select 'Yes' or 'No' form the drop down list to not if the Mobility Performance Area is an Emphasis Area for your corridor.

Step 1.4

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Existing Performance Analysis. Copy the performance score for each segment to the appropriate "Performance Score" column.

Step 1.5

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2 The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial deficiencies from the Step 1 template to the Step 2 template.

Step 2.2

Identify recently completed or under construction projects that would be considered relevant to mobility performance. Include only projects that were constructed after 2015 for which the 2015 HPMS data used for traffic volumes would not include. Any completed or under construction roadway project after 2015 that has the potential to mitigate a mobility issue on a corridor segment should be listed in the template. Such projects should include the construction of new travel lanes or speed limit changes on the main corridor only. Do not include projects involving frontage roads or crossings as they would not impact the corridor level performance.

Step 2.3

Update the Final Need using the following criteria:

- If a recent project has superseded the performance rating data and it is certain the project addressed the deficiency, change the need rating to "None".
- If a recent project has superseded the performance rating data but it is uncertain that a project addressed the need, maintain the current deficiency rating and note the uncertainty as a comment.

Step 2.4

Note any programmed or planned projects that have the potential to mitigate any mobility needy on the segment. Programmed and Planned projects are provided as information and do not impact the deficiency rating. Future projects will be reviewed in the development of solution sets for identified needs and deficiencies. The source of future projects can be found in ADOT's 5-year construction program or other planning documents. Other comments relevant to the needs analysis can be entered.

Example Scales for Level of Need

Performance Thresholds	Initial Need	Description
0.71	None	(<0.77)
	Low	Middle 1/3rd of Fair Perf. (0.77 - 0.83)
0.89	Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance (0.83-0.95)
	High	Lower 2/3rd of Poor Performance (>0.95)

Needs Scale

Measure		None <=	Low >=	> Medium <		High <=
Mobility Index (Corridor Emphasis Area)		Weighted calculation for the segment totals in corridor (urban vs. rural)				
Mobility Index (Corridor Non-Emphasis Area)		Weighted calculation for the segment totals in corridor (urban vs. rural)				
Mobility Index (Segment)	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Future Daily V/C	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Existing Peak hour V/C	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Closure Extent		0.35	0.49	0.49	0.75	0.75
Directional TTI	Uninterrupted	1.21	1.27	1.27	1.39	1.39
	Interrupted	1.53	1.77	1.77	2.23	2.23
Directional PTI	Uninterrupted	1.37	1.43	1.43	1.57	1.57
	Interrupted	4.00	5.00	5.00	7.00	7.00
Bicycle Accommodation		80%	70%	70%	50%	50%

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab. The steps to compete Step 3 include:

Step 3.1

Input data from Mobility Index worksheet and corridor observations in appropriate columns for Roadway Variables.

Step 3.2

Input traffic variable data in appropriate columns as indicated, Buffer Index scores will auto populate.

Step 3.3

Input relevant mobility related infrastructure located within each segment as appropriate

Step 3.4

Input the Closure Extents that have occurred along the study corridor. Road closure information can be detailed out by the reason for the closure as documented in Highway Condition Reporting System (HCRS) data analyzed as part of the baseline corridor performance. Closure reasons include incident/accidents, winter storms, obstruction hazards, and undefined closures. Statewide average percentages for the various closure reasons have been calculated for 2010-2015 on ADOT's designated strategic corridors. Compare these statewide average percentages to the corridor percentages for the various closure reasons to identify higher than average percentages of one or more closure reasons on any given segment. Input the closures as follows and use red text to indicate that the segment percentage exceeds statewide averages:

- Total Number of Closures
- % Incidents/Accidents
- % Obstructions/Hazards
- % Weather Related

Step 3.5

List the non-actionable conditions that are present within each segment by milepost if possible. Non-Actionable conditions are conditions that exist within the environment of each segment that cannot be improved through an engineered solution. For example, the border patrol check point in Segment 3 of I-19 is a non-actionable condition.

Step 3.6

Considering all information input, identify and list the contributing factors to the Final Need score.

Safety Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Safety Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

<u>Step 1: Initial Needs</u>

The input required to populate the Step 1 template includes transferring the corridor characteristics and existing performance score for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for safety. As each performance score is input into the template, the Level of Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Scale" within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Populate the Step 1 template with the corridor characteristics information. This includes segment operating environments and segment length. Also specify if the safety performance area is an emphasis area as determined in Goals and Objectives. The "Level of Need" is dependent on the input of the operating environment and "Emphasis Area" as the thresholds dynamically update accordingly.

Input the existing (baseline) performance scores for all primary and secondary performance measures from Existing Performance Analysis. Copy the performance score (paste values only) for each segment to the appropriate "Performance Score" column and conditional formatting should color each cell green, yellow, or red based on the corresponding performance thresholds.

Step 1.2

The thresholds for the corridor safety index are based on the segments' operating environments. To ensure that the correct corridor safety index threshold is applied, input the unique segment operating environments that exist with the corridor. Once the input is complete, the average of the Good/Fair and Fair/Poor thresholds for each of the operating environments is calculated and the "Level of Need" thresholds will be derived and applied to the main Step 1 Table.

Step 1.3

Confirm that the following criteria for "Insufficient Data" have been applied and that the resulting Level of Need has been shown as "N/A" where applicable.

- Crash frequency for a segment is less than 5 crashes over the 5-year crash analysis period.
- The change in +/- 1 crash results in the change of need level of 2 levels (i.e., changes from Good to Poor or changes from Poor to Good).
- The average segment crash frequency for the overall corridor (total fatal plus incapacitating injury crash frequency divided by the number of corridor segments) is less than 2 per segment over the 5-year crash analysis period.

Step 1.4

Confirm that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

<u>Step 2: Final Needs</u>

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial needs from the Step 1 template to the Step 2 template**.**

Step 2.2

Using the crash concentration (hot spot) map developed as part of the baseline corridor performance, note the direction of travel and approximate milepost limits of each hot spot.

Step 2.3

Identify recently completed or under construction projects that would be considered relevant to safety performance. Include only projects that were not taken into account during the crash data analysis period (2011 – 2015). Any completed or under construction roadway project after 2015 that has the potential to mitigate a safety issue on a corridor segment should be listed in the template. Sources of recent or current project activity can include ADOT MPD staff, ADOT public notices, and ADOT District staff.

Step 2.4

Update the Final Need based on the following criteria:

- If there is a crash hot spot concentration on a "None" segment, upgrade the need rating to "Low."

Step 2.5

Note any programmed projects that could have the potential to mitigate any safety need on the segment. Programmed projects are provided as information and do not impact the need rating. Programmed projects will be reviewed in the development of solution sets for identified needs. The source of the programming information can be found in ADOT's 5-year construction program. Any other relevant issues identified in previous reports should also be reported.

Needs Scale

Measure		None <=	Low <=	< Medium >		High >=	Good/Fair Threshold	Fair/Poor Threshold
Corridor Safety Index (Emphasis Area)		Weighted average based on operating environment type						
Corridor Safety Index (Non-Emphasis Area)		# Weighted average based on operating environment type					#DIV/0!	#DIV/0!
Safety Index and Directional Safety Index (Segment)	2 or 3 Lane Undivided Highway	0.98	1.02	1.02	1.10	1.10	0.94	1.06
	2 or 3 or 4 Lane Divided Highway	0.92	1.07	1.07	1.38	1.38	0.77	1.23
	4 or 5 Lane Undivided Highway	0.93	1.06	1.06	1.33	1.33	0.8	1.2
	6 Lane Highway	0.85	1.14	1.14	1.73	1.73	0.56	1.44
	Rural 4 Lane Freeway with Daily Volume < 25,000	0.91	1.09	1.09	1.45	1.45	0.73	1.27
	Rural 4 Lane Freeway with Daily Volume > 25,000	0.89	1.1	1.1	1.53	1.53	0.68	1.32
	Urban 4 Lane Freeway	0.93	1.07	1.07	1.35	1.35	0.79	1.21
	Urban or Rural 6 Lane Freeway	0.94	1.06	1.06	1.3	1.3	0.82	1.18
	Urban > 6 Lane Freeway	0.93	1.06	1.06	1.33	1.33	0.8	1.2
% of Fatal + Incap. Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	2 or 3 Lane Undivided Highway	53%	55%	55%	59%	59%	51%	57%
	2 or 3 or 4 Lane Divided Highway	47%	50%	50%	57%	57%	44%	54%
	4 or 5 Lane Undivided Highway	45%	48%	48%	54%	54%	42%	51%
	6 Lane Highway	39%	43%	43%	50%	50%	35%	46%
	Rural 4 Lane Freeway with Daily Volume < 25,000	46%	49%	49%	56%	56%	43%	53%
	Rural 4 Lane Freeway with Daily Volume > 25,000	46%	51%	51%	62%	62%	41%	57%
	Urban 4 Lane Freeway	52%	55%	55%	62%	62%	49%	59%
	Urban or Rural 6 Lane Freeway	42%	50%	50%	65%	65%	34%	57%
	Urban > 6 Lane Freeway	47%	51%	51%	59%	59%	43%	55%
% of Fatal + Incap. Injury Crashes Involving Trucks	2 or 3 Lane Undivided Highway	6%	7%	7%	8%	8%	5%	7%
	2 or 3 or 4 Lane Divided Highway	5%	6%	6%	8%	8%	4%	7%
	4 or 5 Lane Undivided Highway	7%	8%	8%	11%	11%	6%	10%
	6 Lane Highway	3%	6%	6%	12%	12%	0%	9%
	Rural 4 Lane Freeway with Daily Volume < 25,000	14%	15%	15%	18%	18%	13%	17%
	Rural 4 Lane Freeway with Daily Volume > 25,000	9%	11%	11%	15%	15%	7%	13%
	Urban 4 Lane Freeway	8%	9%	9%	12%	12%	7%	11%
	Urban or Rural 6 Lane Freeway	8%	10%	10%	13%	13%	6%	11%
	Urban > 6 Lane Freeway	4%	5%	5%	7%	7%	3%	6%
% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	2 or 3 Lane Undivided Highway	22%	25%	25%	30%	30%	19%	27%
	2 or 3 or 4 Lane Divided Highway	19%	22%	22%	29%	29%	16%	26%
	4 or 5 Lane Undivided Highway	7%	8%	8%	10%	10%	6%	9%
	6 Lane Highway	7%	14%	14%	27%	27%	0%	20%
	Rural 4 Lane Freeway with Daily Volume < 25,000	6%	7%	7%	9%	9%	5%	8%
	Rural 4 Lane Freeway with Daily Volume > 25,000	11%	14%	14%	20%	20%	8%	17%
	Urban 4 Lane Freeway	10%	11%	11%	13%	13%	9%	12%
	Urban or Rural 6 Lane Freeway	9%	11%	11%	15%	15%	7%	13%
	Urban > 6 Lane Freeway	15%	17%	17%	22%	22%	13%	20%
% of Fatal _ Incapacitating Injury Crashes Involving Non-Motorized Travelers	2 or 3 Lane Undivided Highway	3%	4%	4%	5%	5%	2%	4%
	2 or 3 or 4 Lane Divided Highway	3%	4%	4%	5%	5%	2%	4%
	4 or 5 Lane Undivided Highway	6%	7%	7%	9%	9%	5%	8%
	6 Lane Highway	11%	14%	14%	20%	20%	8%	17%
	Rural 4 Lane Freeway with Daily Volume < 25,000	2%	2%	2%	3%	3%	1.7%	2.5%
	Rural 4 Lane Freeway with Daily Volume > 25,000	0%	0%	0%	0%	0%	0%	0%
	Urban 4 Lane Freeway	7%	9%	9%	12%	12%	5%	10%
	Urban or Rural 6 Lane Freeway	3%	5%	5%	9%	9%	1%	7%
	Urban > 6 Lane Freeway	1%	1%	1%	2%	2%	0.5%	1.5%

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab.

Table 3 - Step 3 Template

A separate *Crash Summary Sheet* file contains summaries for 8 crash attributes for the entire corridor, for each corridor segment, and for statewide roadways with similar operating environments (the database of crashes on roadways with similar operating environments was developed in Existing Performance Analysis (the baseline corridor performance)). The crash attribute summaries are consistent with the annual ADOT Publication, *Crash Facts*. The 8 crash attribute summaries consist of the following:

- First Harmful Event (FHET)
- Crash Type (CT)
- Violation or Behavior (VB)
- Lighting Condition (LC)
- Roadway Surface Type (RST)
- First Unit Event (FUE)
- Driver Physical Condition (Impairment)
- Safety Device Usage (Safety Device)

Non-colored tabs in this spreadsheet auto-populate with filtered crash attributes. Each tab is described below:

- **Step_3_Summary** – This tab contains the filtered summary of crashes that exceed statewide thresholds for crashes on roadways with similar operating environments. Data in this tab are copied into the Step 3 template.
- **Statewide** – This tab contains a summary of statewide crashes from roadways with similar operating environments filtered by the 8 crash type summaries listed above. The crash type summaries calculate statewide crash thresholds (% total for fatal plus incapacitating crashes). The crash thresholds were developed to provide a statewide expected proportion of crash attributes against which the corridor segments' crash attributes can be compared. The crash thresholds were developed using the *Probability of Specific Crash Types Exceeding a Threshold Proportion* as shown in the Highway Safety Manual, Volume 1 (2010). The thresholds are automatically calculated within the spreadsheet. The threshold proportion was calculated as follows:

$$p*_i = \frac{\sum N_{Observed,i}}{\sum N_{Observed,i(total)}}$$

Where:

$p*_i$ = Threshold proportion

$\sum N_{Observed,i}$ = Sum of observed target crash frequency within the population

$\sum N_{Observed,i(total)}$ = Sum of total observed crash frequency within the population

A minimum crash sample size of 5 crashes over the 5-year crash analysis period is required for a threshold exceedance to be displayed in the Step 3 template. The probability of exceeding the crash threshold was not calculated to simplify the process.

- **Corridor** – A summary of corridor-wide crashes filtered by the 8 crash attribute summaries listed above.
- **Segment FHET** – A segment-by-segment summary of crashes filtered by first harmful event attributes.
- **Segment CT** – A segment-by-segment summary of crashes filtered by crash type attributes.
- **Segment VB** - A segment-by-segment summary of crashes filtered by violation or behavior attributes.
- **Segment LC** – A segment-by-segment summary of crashes filtered by lighting condition attributes.
- **Segment RST** – A segment-by-segment summary of crashes filtered by roadway surface attributes.
- **Segment FUE** – A segment-by-segment summary of crashes filtered by first unit event attributes.
- **Segment Impairment** – A segment-by-segment summary of crashes filtered by driver physical condition attributes related to impairment.
- **Segment Safety Device** – A segment-by-segment summary of crashes filtered by safety device usage attributes.

The steps to compete Step 3 include:

Step 3.1

Using the Crash_Summary_Sheet.xlsx, go to the "Step_3_Summary" tab. Input the operating environments for each segment in the table.

Step 3.2

Filter data from the ADOT database for the “CORRIDOR_DATA” tab by inserting the following data in the appropriate columns that are highlighted in gray for the “INPUT_CORRIDOR_DATA” tab:

- Incident ID
- Incident Crossing Feature (MP)
- Segment Number (Non-native ADOT data – must be manually assigned based on the location of the crash)
- Operating Environment (Non-native ADOT data – should already be assigned but if for some reason it isn’t, it will need to be manually assigned)
- Incident Injury Severity
- Incident First Harmful Description
- Incident Collision Manner
- Incident Lighting Condition Description
- Unit Body Style
- Surface Condition
- First Unit Event Sequence
- Person Safety Equipment
- Personal Violation or Behavior
- Impairment

Note that columns highlighted in yellow perform a calculated input to aggregate specific crash descriptions. For example, crashes can contain various attributes for animal-involved crashes. The crash attributes that involve an animal were combined into a common attribute, such as “ANIMAL”. This will allow the summaries to be consistent with the ADOT *Crash Facts*.

The data in the Impairment category contains blank descriptions if it was found that there was “No Apparent Influence” or if it was “Unknown”. Using the crash data fields “PersonPhysicalDescription” 0 - 99, fill in the blank columns to reflect if the physical description is described as “No Apparent Influence” or “Unknown”. Note that the native physical description data from the ADOT database may need to be combined to a single column.

Step 3.3

Confirm that the crash database is being properly filtered by comparing crash frequencies from the summary tables with the frequencies developed in Existing Performance Analysis. For example, the lookup function will fail if the filter is for “NO IMPROPER ACTION” if the database has the attribute of “NO_IMPROPER_ACTION”.

Step 3.4

Copy and paste the Step_3_Summary into the Safety Needs Assessment spreadsheet in the Step 3 tab. Paste values only and remove the summaries with “0%s” for a clean display. Where duplicate values exist, go to the "Calcs" tab in the Crash_Summary_Sheet file to determine which categories have the same %. If there are more crash types with the same % than there is space in the table, select the crash type with the highest difference between the segment % and the statewide average %

Step 3.5

The Step 3 table in the Safety Needs Assessment spreadsheet should be similar to the Step 3 template. In the Segment Crash Summaries row, the top three crash attributes are displayed. Change the font color of the crash attributes that exceed the statewide crash threshold to red for emphasis. The attributes with a red font in the “Calcs” tab have exceeded statewide crash thresholds. Note that corridor-wide values are not compared to statewide values as corridor-wide values are typically a blend of multiple similar operating environments while the statewide values apply to one specific similar operating environment.

Step 3.6

Provide a summary of any observable patterns found within the crash Hot Spots, if any exist in the segments.

Step 3.7

Input any historic projects (going no further back than 2000) that can be related to improving safety. Projects more than five years old may have exceeded their respective design life and could be contributing factors to safety performance needs.

Step 3.8

Input key points from District interviews or any important information from past discussions with District staff that is consistent with needs and crash patterns identified as part of the performance and needs assessment as this may be useful in identifying contributing causes. This information may be obtained from District Maintenance personnel by requesting the mile post locations that may be considered safety issues.

Step 3.9

For segments with one or more of the following characteristics, review crashes of all severity levels (not just fatal and incapacitating injury crashes). Identify likely contributing factors and compare that to the above statewide average comparison findings already calculated for fatal and incapacitating injury crashes. Refine the contributing factors list accordingly.

- Segments with Medium or High need
- Segments with a crash hot spot concentration (but only review crashes at the concentration areas)

- Segments with no apparent predominant contributing factors based on the comparison of fatal and incapacitating crashes to statewide averages if the segment has a Medium or High need.

Step 3.10

Considering all information in Steps 1-3, list the contributing factors using engineering judgment and the information on contributing factors available in Section 6.2 of the 2010 Highway Safety Manual. Additional sources for determining contributing factors may include aerial, “streetview”, and/or ADOT photologs. Other documents such as Design Concept Reports (DCR) or Road Safety Assessments can provide insight into the study corridor’s contributing factors.

Add comments as needed on additional information related to contributing factors that may have been provided by input from ADOT staff.

Freight Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Freight Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

<u>Step 1: Initial Needs</u>

The input required to populate the Step 1 template includes transferring the existing performance score and color for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for Freight. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scale" within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted score, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Existing Performance Analysis. Copy the performance score for each segment to the appropriate "Performance Score" column. Select the *Facility Operations* for each segment from the drop-down list and input whether or not the performance area is an emphasis area. The corridor needs assessment scales will be updated automatically.

Step 1.2

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

<u>Step 2: Final Needs</u>

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial need from the Step 1 template to the Step 2 template.

Step 2.2

Note any truck height restriction hot spots (clearance < 16.25') identified as part of the baseline corridor performance. For each entry, note the milepost of the height restriction and if the height restriction can be detoured by ramping around the obstruction. If it is not possible for a truck to ramp around the height restriction, note the existing height as well.

Step 2.3

Identify recently completed or under construction projects that would be considered relevant to freight performance. Include only projects that were not taken into account during the freight data analysis period. Any completed or under construction roadway project after the date of the data that has the potential to mitigate a freight issue on a corridor segment should be listed in the template. Such projects can include the construction of climbing lanes or Dynamic Message Signs (DMS) installation. Sources of recent or current project activity can be ADOT MPD staff, ADOT public notices, and ADOT District staff.

Step 2.4

Update the Final Need using the following criteria:

- If there is one or more truck height restriction hot spots where a truck cannot ramp around on a 'None' segment, increase (i.e., worsen) the need rating to 'Low'.
- If a recent project has superseded the performance rating data and it is certain the project addressed the need, change the need rating to "None".
- If a recent project has superseded the performance rating data but it is uncertain that a project addressed the need, maintain the current need rating and note the uncertainty as a comment.

Step 2.5

Note any programmed projects that could have the potential to mitigate any freight need on the segment. Programmed projects are provided as information and do not impact the need rating. Programmed projects will be reviewed in the development of solution sets for identified needs.

The source of the programming information can be found in ADOT's 5-year construction program. If there are other comments relevant to the needs analysis, they can be entered in the right-most column.

Example Scales for Level of Need - Freight Index

Performance Score Thresholds	Performance Level	Initial Performance Level of Need	Description (Non-emphasis Area)
	Good	None	All levels of Good and the top third of Fair (>0.74)
	Good		
0.77	Good		
0.74	Fair		
0.70	Fair	Low	Middle third of Fair (0.70-0.74)
0.67	Fair	Medium	Lower third of Fair and top third of Poor (0.64-0.70)
0.64	Poor		
	Poor	High	Lower two-thirds of Poor (<0.64)
	Poor		

Needs Scale

Measure	None >=	> Low <		> Medium <		High <=
Corridor Freight Index (Emphasis Area)	Dependent on weighted average of interrupted vs. uninterrupted segments					
Corridor Freight Index (Non-Emphasis Area)	Dependent on weighted average of interrupted vs. uninterrupted segments					
Freight Index (Segment)						
Measure	**None >=**	**> Low <**		**> Medium <**		**High <=**
Interrupted	0.28	0.28	0.22	0.22	0.12	0.12
Uninterrupted	0.74	0.74	0.70	0.70	0.64	0.64
Measure	**None <=**	**< Low >**		**< Medium >**		**High >=**
Directional TTI						
Interrupted	1.53	1.53	1.77	1.77	2.23	2.23
Uninterrupted	1.21	1.21	1.27	1.27	1.39	1.39
Directional PTI						
Interrupted	4.00	4.00	5.00	5.00	7.00	7.00
Uninterrupted	1.37	1.367	1.43	1.43	1.57	1.57
Closure Duration						
All Facility Operations	71.07	71.07	97.97	97.97	151.75	151.75
Measure	**None >=**	**> Low <**		**> Medium <**		**High <=**
Bridge Clearance (feet)						
All Bridges	16.33	16.33	16.17	16.17	15.83	15.83

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab.

The steps to compete Step 3 include:

Step 3.1

Input all roadway variable data that describe each segment into the appropriate columns. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Needs Assessment.

Step 3.2

Input all traffic variables for each segment into the appropriate columns. The Buffer Index will auto populate based on the TPTI and TTTI input in the Step 1 tab. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Needs Assessment.

Step 3.3

Input any freight-related infrastructure that currently exists on the corridor for each segment. The relevant infrastructure can include DMS locations, weigh stations, Ports of Entry (POE), rest areas, parking areas, and climbing lanes. Include the mileposts of the listed infrastructure. This data can be extracted from the most recent Highway Log and the 2015 Climbing and Passing Lane Prioritization Study.

Step 3.4

Input the Closure Extents that have occurred along the study corridor. Road closure information can be detailed out by the reason for the closure as documented in Highway Condition Reporting System (HCRS) data analyzed as part of the baseline corridor performance. Closure reasons include incident/accidents, winter storms, obstruction hazards, and undefined closures. Statewide average percentages for the various closure reasons have been calculated for the analysis period on ADOT's designated strategic corridors. Compare these statewide average percentages to the corridor percentages for the various closure reasons to identify higher than average percentages of one or more closure reasons on any given segment. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Needs Assessment. Input the closures as follows and use red text to indicate that the segment percentage exceeds statewide averages:

- Total Number of Closures
- % Closures (No Reason)
- % Incidents/Accidents
- % Obstructions/Hazards
- % Weather Related

Step 3.5

List the non-actionable conditions that are present within each segment by milepost if possible. Non-Actionable conditions are conditions that exist within the environment of each segment that cannot be improved through an engineered solution. Examples of Non-Actionable conditions can include border patrol check points and other closures/restrictions not controlled by ADOT. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Needs Assessment.

Step 3.6

Input any programmed and planned projects or issues that have been identified from previous documents or studies that are relevant to the Final Need. Sources for this data include the current Highway Log, the 2015 Climbing and Passing Lane Prioritization Study, and ADOT's 5-year construction program.

Step 3.7

Considering all information in Steps 1-3, identify the contributing factors to the Final Need column. Potential contributing factors to freight performance needs include roadway vertical grade, number of lanes, traffic volume-to-capacity ratios, presence/lack of a climbing lanes, and road closures. Also identify higher than average percentages of one or more closure reasons on any given segment.

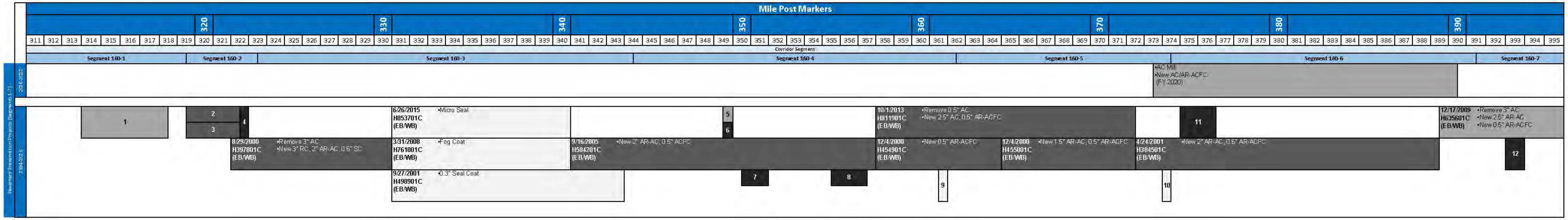
Pavement Performance Area - Needs Analysis Step 1

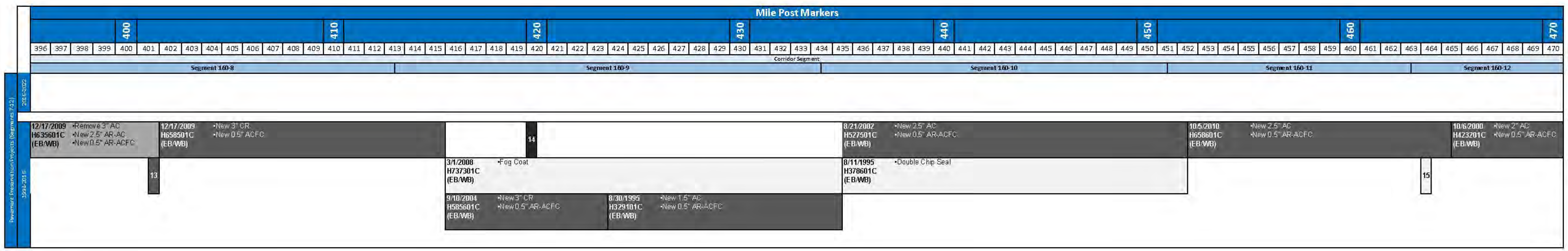
Segment #	Segment Length (miles)	Segment Mileposts (MP)	Facility Type	Pavement Index			Directional PSR					% Area Failure			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
							EB	WB		EB	WB				
160-1	8	311-319	Highway	4.04	Fair or Better	None	3.76	3.76	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-2	4	319-323	Highway	3.87	Fair or Better	None	3.59	3.59	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-3	21	323-344	Highway	3.66	Fair or Better	None	3.51	3.51	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-4	18	344-362	Highway	4.16	Fair or Better	None	4.04	4.04	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-5	12	362-374	Highway	4.39	Fair or Better	None	4.17	4.17	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-6	17	374-391	Highway	3.60	Fair or Better	None	3.40	3.40	Fair or Better	None	None	12.00%	Fair or Better	Low	Low
160-7	4	391-395	Highway	4.13	Fair or Better	None	4.04	4.04	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-8	18	395-413	Highway	4.03	Fair or Better	None	3.88	3.88	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-9	21	413-434	Highway	3.29	Fair or Better	Low	3.18	3.18	Fair or Better	Low	Low	29.00%	Fair or Better	High	Medium
160-10	17	434-451	Highway	3.45	Fair or Better	None	3.76	3.76	Fair or Better	None	None	12.00%	Fair or Better	Low	Low
160-11	12	451-463	Highway	4.00	Fair or Better	None	3.78	3.78	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-12	7	463-470	Highway	4.13	Fair or Better	None	4.03	4.03	Fair or Better	None	None	0.00%	Fair or Better	None	None
Emphasis Area?	Yes	Weighted Average		3.82	Good	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)		
160-1	8	311-319	None		None	None	No Previous Completed or Programmed Projects that supersede condtion data
160-2	4	319-323	None		None	None	No Previous Completed or Programmed Projects that supersede condtion data
160-3	21	323-344	None		None	None	No Previous Completed or Programmed Projects that supersede condtion data
160-4	18	344-362	None		None	None	No Previous Completed or Programmed Projects that supersede condtion data
160-5	12	362-374	None		None	None	**FY20 F014401C**: Long House Valley - Kayenta, Pavement Rehabilitation (MP 373-390)
160-6	17	374-391	Low	MP 379-381	None	Low	**FY20 F014401C**: Long House Valley - Kayenta, Pavement Rehabilitation (MP 373-390), May address pavement hotspot (MP 379-381)
160-7	4	391-395	None		None	None	No Previous Completed or Programmed Projects that supersede condtion data
160-8	18	395-413	None		None	None	No Previous Completed or Programmed Projects that supersede condtion data
160-9	21	413-434	Medium	MP 424-429 MP 433-434	None	Medium	No Previous Completed or Programmed Projects that supersede condtion data
160-10	17	434-451	Low	MP 438-440	None	Low	No Previous Completed or Programmed Projects that supersede condtion data
160-11	12	451-463	None		None	None	
160-12	7	463-470	None		None	None	

Pavement History





Pavement Treatment Reference Numbers

1. 2/23/2012 H798801C (EB/WB): Remove 0.5" AC, New 0.5" ACFC
2. 9/8/2008 H460101C (EB): Remove 0.5" AC, New 6" AB, New 4" AC, New 0.5" AR-ACFC
3. 9/8/2008 H460101C (WB): New 6" AB, New 4" AC, New 2" AC, New 0.5" AR-ACFC
4. 8/29/2000 H397801C (EB/WB): New 4" AB, 9" AC, 0.6" SC
5. 8/19/2011 H709101C (EB): Remove 0.5", New 0.5" AR-ACFC
6. 8/19/2011 H709101C (WB): New 8" AB, 5"AC, 0.5" ACFC
7. 9/16/2005 H584201C (EB): New 6" AB, 2.5"AC, 2" AR, 0.5" AR-ACFC
8. 9/16/2005 H584201C (WB): New 6" AB, 2.5" AC, 2" AR, 0.5" AR-ACFC
9. 7/11/1996 H328901C (EB/WB): New 0.3" Seal Coat, Fog Coat
10. 7/11/1996 H329001C (EB/WB): Fog Coat
11. 6/11/2014 H512001C (EB/WB): Remove 0.5" AC, New 6" AB, 6.5" AC, 0.5" AR-ACFC
12. 6/26/1997 H315501C (EB/WB): New 6" AB, 5" AC, 0.5" AR-ACFC
13. 7/21/1997 H374101C (EB/WB): New 0.5" ACFC
14. 10/13/2013 H757101 (EB/WB): New 8" AB, 4" AC, 0.5" ACFC
15. 4/15/1998 H063104C (EB/WB): New 0.3" Seal Coat

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

Value	Level	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						56%		3%		4%								84%		6%		15%		6%
1							56%														89%				
1							72%																		
1																									
3	L2		50%					3%					11%		100%		33%								
3																									
3																									
3																									
3																									
3																									
4	L3			60%	25%		40%		71%		77%		83%				64%		11%		6%		15%		37%
4				60%			17%		24%		19%						3%		36%		89%		85%		63%
4									24%		58%								48%						
4											15%														
6	L4				10%			3%					11%		20%				2%						
6								8%																	
6								10%																	
6																									
6																									
6																									
Sub-Total		0.0	1.5	4.8	1.6	0.0	4.1	1.4	4.8	0.0	6.8	0.0	4.3	0.0	4.2	0.0	3.7	0.0	4.8	0.0	4.8	0.0	4.2	0.0	4.1
Total		**1.5**		**4.0**		**4.1**		**5.5**		**6.8**		**4.3**		**4.2**		**3.7**		**4.8**		**4.8**		**4.2**		**4.1**	

Pavement Historical Investment

Segment #	Segment Length (miles)	Segment Mileposts (MP)	Bid History Value	Bid History Score	Bid History Investment	Pecos ($/mile/yr)	PeCos Score	PeCos History Investment	Resulting Historical Investment
160-1	8	311-319	1.5	-1.02	Low	$6	-0.90	Low	Low
160-2	4	319-323	4.0	0.06	Low	$32	-0.88	Low	Low
160-3	21	323-344	4.1	0.10	Low	$117	-0.82	Low	Low
160-4	18	344-362	5.5	0.71	Medium	$198	-0.76	Low	Medium
160-5	12	362-374	6.8	1.27	High	$291	-0.70	Low	High
160-6	17	374-391	4.3	0.19	Low	$4,224	2.12	High	Medium
160-7	4	391-395	4.2	0.15	Low	$3,669	1.72	Medium	Low
160-8	18	395-413	3.7	-0.07	Low	$2,875	1.15	Medium	Low
160-9	21	413-434	4.8	0.41	Medium	$2,638	0.98	Medium	Medium
160-10	17	434-451	4.8	0.41	Medium	$1,477	0.15	Medium	Medium
160-11	12	451-463	4.2	0.15	Low	$0	-0.90	Low	Low
160-12	7	463-470	4.1	0.10	Low	$1,165	-0.07	Medium	Low

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
160-1	8	311-319	None	Low	Low	Low	No identified need District Notes: Humps, dips and sinking of pavement (MP 312.7 – 313.5)
160-2	4	319-323	None	Low	Low	Low	No identified need District Notes: Pavement unravelling, depressions and potholes (MP 322.5 - 323)
160-3	21	323-344	None	Low	Low	Low	No identified need District Notes: Pavement unravelling, depressions and potholes (MP 323 - 331) District Notes: Pavement cracking on recent microseal job (MP 331 - 341)
160-4	18	344-362	None	Medium	Low	Medium	No identified need
160-5	12	362-374	None	High	Low	High	No identified need
160-6	17	374-391	Low	Low	High	Medium	Failure hot spots identified MP 379-381. Historical investment increased to 'Medium' based on PeCos investment. Project programmed for FY20 (MP 373-390) should mitigate issues District Notes: Concerned about the current pavement conditions within Kayenta town limits.
160-7	4	391-395	None	Low	Medium	Low	No identified need
160-8	18	395-413	None	Low	Medium	Low	No identified need
160-9	21	413-434	Medium	Medium	Medium	Medium	Failure hot spots identified MP 424-429 and 433-434. Historical investment is 'Low'; no programmed projects have been identified
160-10	17	434-451	Low	Medium	Medium	Medium	Failure hot spots identified MP 438-440. Historical investment is 'Medium"; no programmed projects have bene identified
160-11	12	451-463	None	Low	Low	Low	No identified need
160-12	7	463-470	None	Low	Medium	Low	No identified need

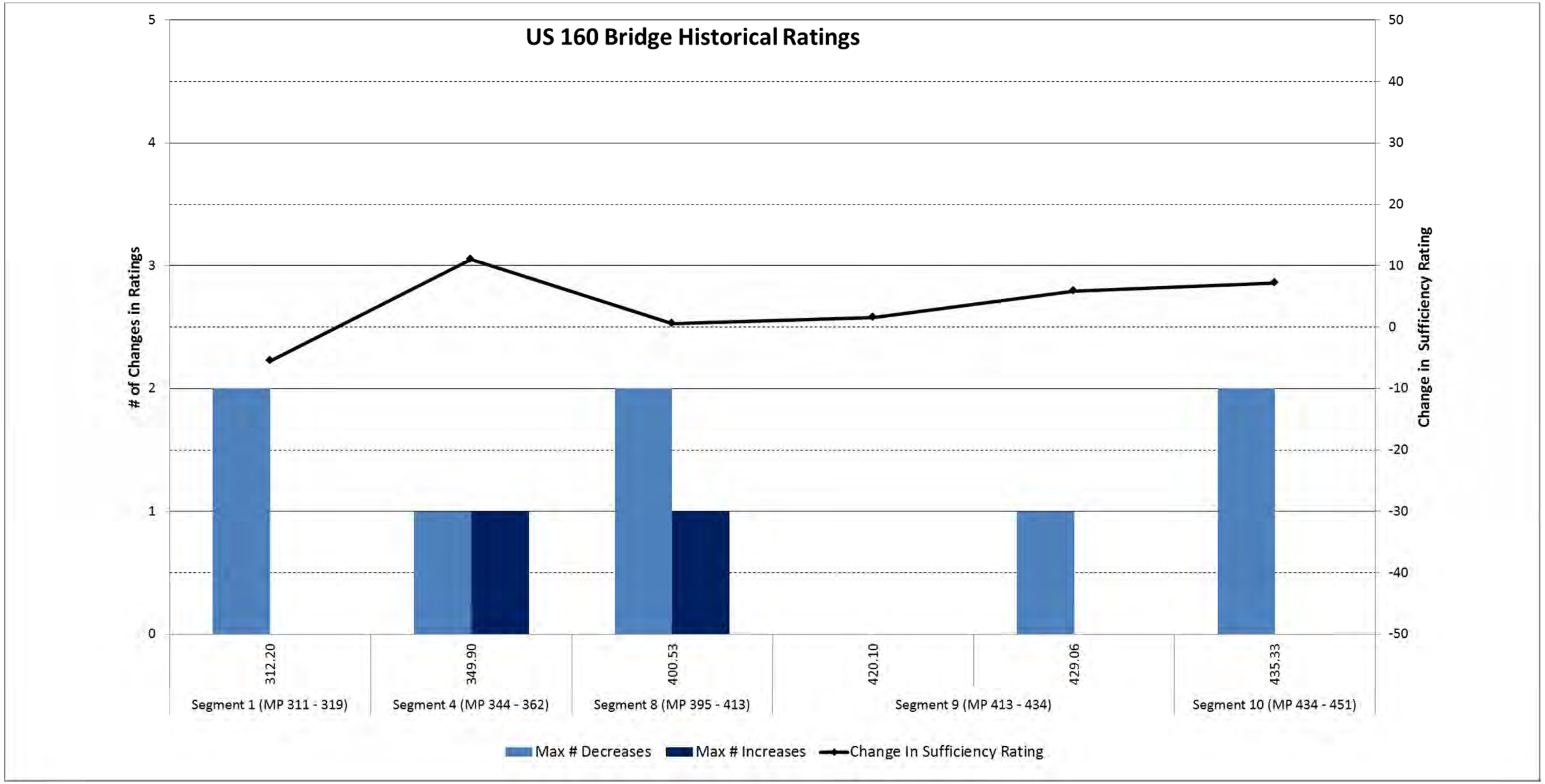
Bridge Performance Area - Needs Analysis Step 1

Segment #	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Bridge Index			Lowest Bridge Rating			Sufficiency Rating			% of Deck Area on 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	
160-1	8	311-319	1	5.00	Fair or Better	Medium	5	Fair or Better	Low	71.80	Fair or Better	None	0.00%	Fair or Better	None	Medium
160-2	4	319-323	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
160-3	21	323-344	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
160-4	18	344-362	1	6.00	Fair or Better	None	6	Fair or Better	None	64.3	Fair or Better	Low	100.0%	Fair or Better	High	Low
160-5	12	362-374	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
160-6	17	374-391	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
160-7	4	391-395	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
160-8	18	395-413	1	6.00	Fair or Better	None	6	Fair or Better	None	83.7	Fair or Better	None	0.0%	Fair or Better	None	None
160-9	21	413-434	2	6.42	Fair or Better	None	5	Fair or Better	Low	76.4	Fair or Better	None	52.5%	Fair or Better	High	Low
160-10	17	434-451	1	5.00	Fair or Better	Medium	5	Fair or Better	Low	62.7	Fair or Better	Low	100.0%	Fair or Better	High	High
160-11	12	451-463	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
160-12	7	463-470	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
Emphasis Area?	No	Weighted Average		5.81	Fair or Better	Low										

Bridge Performance Area - Needs Analysis Step 2

Segment #	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Initial Need	Need Adjustments: Hot Spots (Rating of 4 or multiple 5's)	Need Adjustments: Previous Projects (which supersede condition data)	Final Need	Historical Review	# Functionally Obsolete Bridges	Comments
160-1	8	311-319	1	Medium	None		Medium	None	0	Hamblin Wash Bridge Evaluation Rating of 5; no historical issues; no programmed projects
160-2	4	319-323	0	N/A	None		None	None	0	No bridges in segment
160-3	21	323-344	0	N/A	None		None	None	0	No bridges in segment
160-4	18	344-362	1	Low	None		Low	None	1	Begashibito Wash Bridge is the only bridge in the segment and 'Low' need based on % Functionally Obsolete Deck Area; no historical issues; no programmed projects.
160-5	12	362-374	0	N/A	None		None	None	0	No bridges in segment
160-6	17	374-391	0	N/A	None		None	None	0	No bridges in segment
160-7	4	391-395	0	N/A	None		None	None	0	No bridges in segment
160-8	18	395-413	1	None	None		None	None	0	No bridges with current ratings of 4 or 5 and no historical issues
160-9	21	413-434	2	Low	None	FY17 H8913: Laguna Creek Bridge STR #20001, Construct Scour Retrofit (MP 420)	Low	None	1	Chinle Wash Bridge Deck Rating of 5; Bridge Replacement programmed FY18 H849001C: Chinle Wash Bridge Replacement, STR #746 (MP 429-430); no historical issues
160-10	17	434-451	1	High	None		High	None	1	Walker Creek Bridge Deck Rating of 5; no historical issues; no programmed projects. 'High' need based on % Functionally Obsolete Deck Area and only bridge in segment
160-11	12	451-463	0	N/A	None		None	None	0	No bridges in segment
160-12	7	463-470	0	N/A	None		None	None	0	No bridges in segment

Bridge Rating History



identifies the bridge indicated is of concern from a historical ratings perspective

Maximum # of Decreases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating decreased from 1997 to 2014. (Higher number could indicate a more dramatic decline in the performance of the bridge)

Maximum # of Increases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating increased from 1997 to 2014. (Higher number could indicate a higher level of investment

Change in Sufficiency Rating: Cumulative change in Sufficiency Rating from 1997 to 2014. (Bigger negative number could indicate a more dramatic decline in the performance of the bridge)

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	
160-1	8	311-319	1	0	Medium	Hamblin Wash Br (#531)(MP 312.20)	Structural Evaluation Rating of 5	This structure was not identified for historical review	
160-2	4	319-323	0	0	None	No bridges with current ratings less than 6 and no historical issues			
160-3	21	323-344	0	0	None	No bridges with current ratings less than 6 and no historical issues			
160-4	18	344-362	1	1	Low	Begashibito Wash Br (#1011)(MP 349.90)	No bridges with current ratings less than 6 and no historical issues		Percentage of deck area on functionally obsolete bridge in segment cause 'low' need. Only bridge in segment.
160-5	12	362-374	0	0	None	No bridges with current ratings less than 6 and no historical issues			
160-6	17	374-391	0	0	None	No bridges with current ratings less than 6 and no historical issues			
160-7	4	391-395	0	0	None	No bridges with current ratings less than 6 and no historical issues			
160-8	18	395-413	1	0	None	No bridges with current ratings less than 6 and no historical issues			
160-9	21	413-434	2	1	Low	Chinle Wash Bridge (#746)(MP 429.06)	Deck Rating of 5	This structure was not identified for historical review	
160-10	17	434-451	1	1	High	Walker Creek Bridge (#748)(MP 435.33)	Deck Rating of 5	This structure was not identified for historical review	Percentage of deck area on funtionally obsolete bridge and Bridge Index performance score of 5 in segment cause 'high' need. Only bridge in segment.
160-11	12	451-463	0	0	None	No bridges with current ratings less than 6 and no historical issues			
160-12	7	463-470	0	0	None	No bridges with current ratings less than 6 and no historical issues			

ADOT

Mobility Performance Area - Needs Analysis Step 1

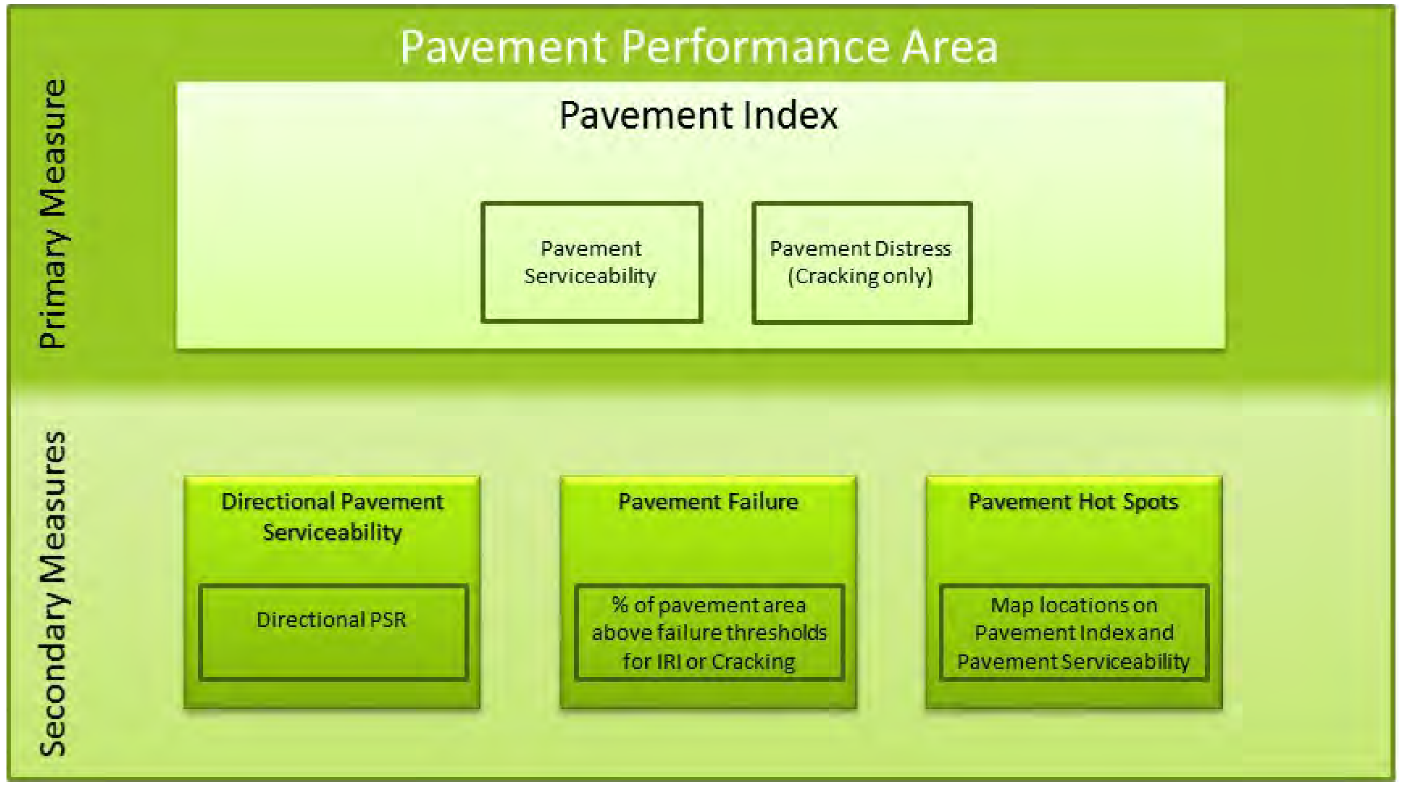
Segment #	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Mobility Index			Future Daily V/C			Existing Peak Hour V/C					Closure Extent (occurrences/year/mile)				
					Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
											EB	WB		EB	WB	EB	WB		EB	WB
160-1	311-319	8	Rural	Interrupted	0.32	Fair or Better	None	0.39	Fair or Better	None	0.24	0.25	Fair or Better	None	None	0.08	0.00	Fair or Better	None	None
160-2	319-323	4	Rural	Interrupted	0.72	Fair or Better	Medium	0.87	Fair or Better	High	0.51	0.67	Fair or Better	None	Low	0.10	0.00	Fair or Better	None	None
160-3	323-344	21	Rural	Uninterrupted	0.18	Fair or Better	None	0.21	Fair or Better	None	0.15	0.15	Fair or Better	None	None	0.24	0.05	Fair or Better	None	None
160-4	344-362	18	Rural	Uninterrupted	0.12	Fair or Better	None	0.15	Fair or Better	None	0.08	0.09	Fair or Better	None	None	0.34	0.70	Fair or Better	None	Medium
160-5	362-374	12	Rural	Uninterrupted	0.17	Fair or Better	None	0.20	Fair or Better	None	0.12	0.13	Fair or Better	None	None	0.00	0.05	Fair or Better	None	None
160-6	374-391	17	Rural	Uninterrupted	0.27	Fair or Better	None	0.33	Fair or Better	None	0.21	0.20	Fair or Better	None	None	0.12	0.34	Fair or Better	None	None
160-7	391-395	4	Rural	Interrupted	0.41	Fair or Better	None	0.53	Fair or Better	None	0.26	0.27	Fair or Better	None	None	0.10	0.15	Fair or Better	None	None
160-8	395-413	18	Rural	Uninterrupted	0.12	Fair or Better	None	0.14	Fair or Better	None	0.08	0.08	Fair or Better	None	None	0.03	0.01	Fair or Better	None	None
160-9	413-434	21	Rural	Uninterrupted	0.11	Fair or Better	None	0.13	Fair or Better	None	0.10	0.10	Fair or Better	None	None	0.04	0.04	Fair or Better	None	None
160-10	434-451	17	Rural	Uninterrupted	0.19	Fair or Better	None	0.22	Fair or Better	None	0.12	0.12	Fair or Better	None	None	0.14	0.01	Fair or Better	None	None
160-11	451-463	12	Rural	Uninterrupted	0.18	Fair or Better	None	0.21	Fair or Better	None	0.11	0.11	Fair or Better	None	None	0.00	0.07	Fair or Better	None	None
160-12	463-470	7	Rural	Interrupted	0.17	Fair or Better	None	0.20	Fair or Better	None	0.12	0.12	Fair or Better	None	None	0.09	0.06	Fair or Better	None	None
Mobility Emphasis Area		Yes	Weighted Average		0.19	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	
					EB	WB		EB	WB	EB	WB		EB	WB				
160-1	311-319	8	Rural	Interrupted	1.07	1.02	Fair or Better	None	None	1.48	1.88	Fair or Better	None	None	0%	Fair or Better	High	Low
160-2	319-323	4	Rural	Interrupted	1.12	1.17	Fair or Better	None	None	3.75	3.25	Fair or Better	None	None	84%	Fair or Better	None	High
160-3	323-344	21	Rural	Uninterrupted	1.01	1.01	Fair or Better	None	None	1.30	1.35	Fair or Better	None	None	19%	Fair or Better	High	Low
160-4	344-362	18	Rural	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.31	1.25	Fair or Better	None	None	9%	Fair or Better	High	Low
160-5	362-374	12	Rural	Uninterrupted	1.01	1.00	Fair or Better	None	None	1.33	1.23	Fair or Better	None	None	0%	Fair or Better	High	Low
160-6	374-391	17	Rural	Uninterrupted	1.02	1.06	Fair or Better	None	None	1.51	2.11	Fair or Better	Medium	High	0%	Fair or Better	High	Low
160-7	391-395	4	Rural	Interrupted	1.12	1.16	Fair or Better	None	None	3.26	3.07	Fair or Better	None	None	6%	Fair or Better	High	Low
160-8	395-413	18	Rural	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.15	1.20	Fair or Better	None	None	0%	Fair or Better	High	Low
160-9	413-434	21	Rural	Uninterrupted	1.01	1.02	Fair or Better	None	None	1.37	1.37	Fair or Better	Low	Low	1%	Fair or Better	High	Low
160-10	434-451	17	Rural	Uninterrupted	1.05	1.04	Fair or Better	None	None	1.89	1.85	Fair or Better	High	High	1%	Fair or Better	High	Low
160-11	451-463	12	Rural	Uninterrupted	1.02	1.01	Fair or Better	None	None	2.27	1.83	Fair or Better	High	High	0%	Fair or Better	High	Low
160-12	463-470	7	Rural	Interrupted	1.08	1.12	Fair or Better	None	None	2.95	3.40	Fair or Better	None	None	4%	Fair or Better	High	Low

Appendix B: Performance Area Detailed Calculation Methodologies

Pavement Performance Area Calculation Methodologies

This 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 Pavement Index

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 for interstates and non-interstates shown in the tables below were used for the PSR and PDI.

Performance Level for Interstates	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)

Performance Level for Non-Interstates	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 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.

Secondary Pavement Measures

Three secondary measures are evaluated:

- Directional Pavement Serviceability
- Pavement Failure
- Pavement Hot Spots

Directional Pavement Serviceability: Similar to the Pavement Index, the Directional Pavement Serviceability is calculated as a weighted average (based on number of lanes) for each segment. However, this rating only utilizes the PSR and is 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.

Pavement Failure: The percentage of pavement area rated above the failure thresholds for IRI or Cracking is calculated for each segment. In addition, the Standard score (z-score) is 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) than average.

Pavement Hot Spots: The Pavement Index map identifies 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 previously. For non-interstates, an IRI rating above 142 or a Cracking rating above 15 will be used as the thresholds.

Scoring

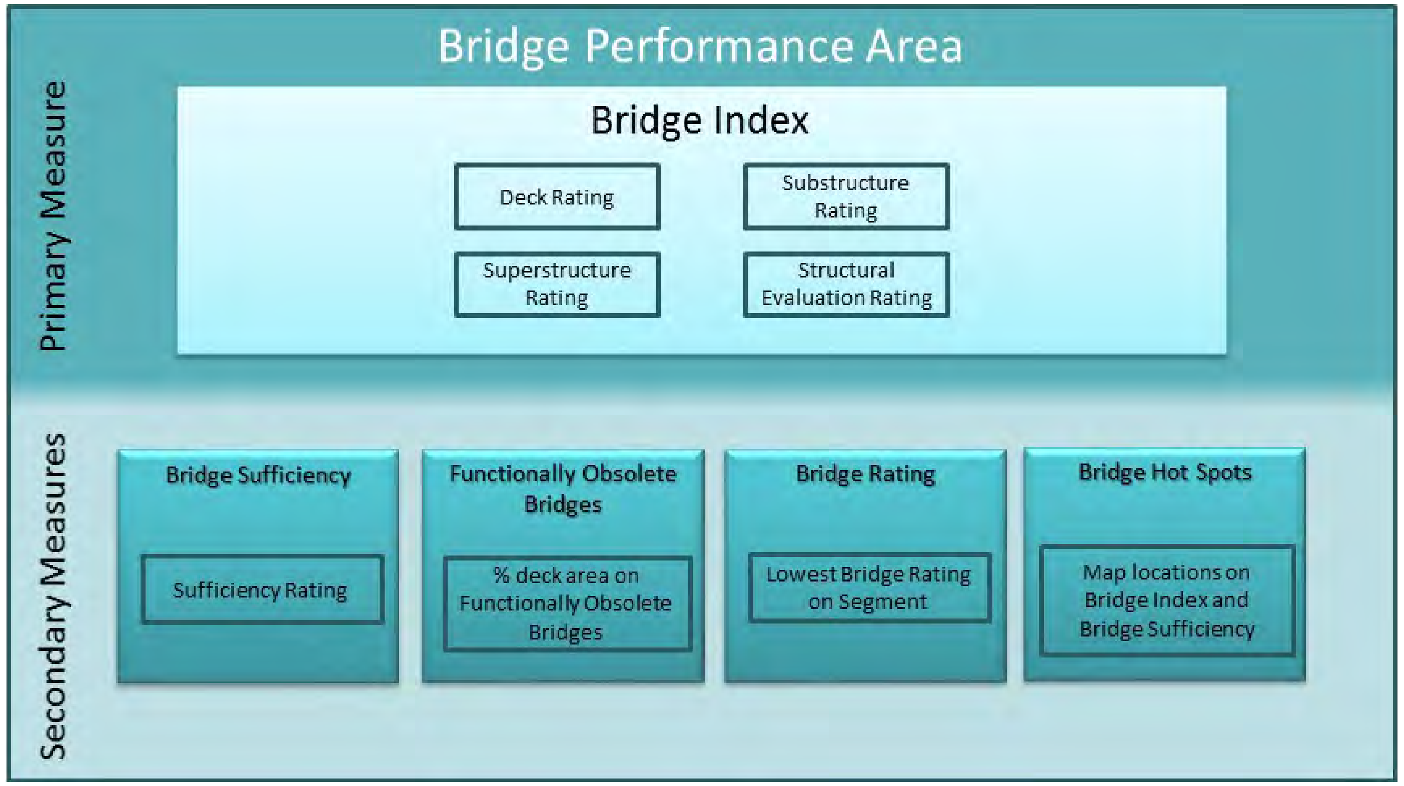
Performance Level	Pavement Index	
	Interstates	Non-Interstates
Good	>3.75	>3.5
Fair	3.2 - 3.75	2.9 - 3.5
Poor	<3.2	<2.9

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%

Bridge Performance Area Calculation Methodologies

This 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 Bridge Index

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, Substructure Rating, Superstructure Rating, and Structural Evaluation Rating. 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.

Secondary Bridge Measures

Four secondary measures will be evaluated:

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

Bridge Sufficiency: Similar to the Bridge Index, the Bridge Sufficiency rating is calculated as a weighted average (based on deck area) for each segment. The Bridge 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.

Functionally Obsolete Bridges: The percentage of total deck area in a segment that is on functionally obsolete bridges is calculated for each segment. The deck area for each bridge within each segment that has been identified as functionally obsolete is 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 thresholds for this performance measure are 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.

Bridge Rating: The Bridge Rating simply identifies 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. Each of the four condition ratings use a 0 to 9 scale with 0 representing the lowest performance and 9 representing the highest performance.

Bridge Hot Spots: The Bridge Index map identifies individual bridge locations that are identified as hot spots. Hot spots are bridges that have a single rating of 4 in any of the four ratings, or multiple ratings of 5 in the deck, substructure or superstructure ratings.

Scoring:

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

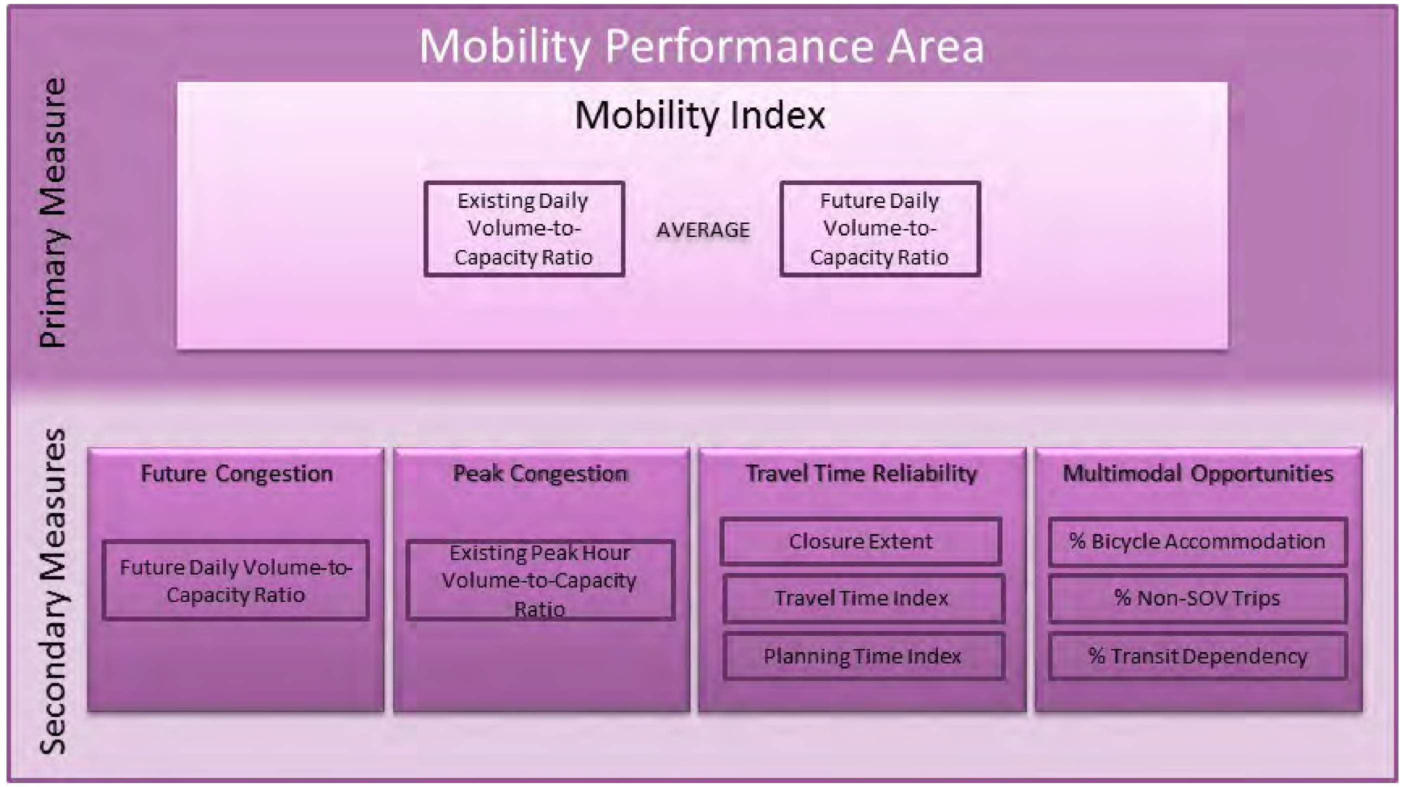
Performance Level	Sufficiency Rating
Good	>80
Fair	50-80
Poor	<50

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:



<u>Primary Mobility Index</u>

The primary Mobility Index is an average of the existing daily volume-to-capacity (V/C) ratio and the future daily V/C ratio for each segment of 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 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 is 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 daily V/C ratio for each segment is calculated by dividing the 2035 AADT volume for each segment by the 2014 LOS E capacity. The capacity volume used in this calculation is the same as is utilized in the existing daily V/C equation.

The future AADT daily volumes are generated by applying an average annual compound growth rate (ACGR) to each 2014 AADT segment volume. The following equation is used to apply the average annual compound growth rate:

2035 AADT = 2014 AADT x ((1+ACGR)^(2035-2014))

The ACGR for each segment is 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 is defined using the same weighted average equation described in the *Existing Daily V/*C section above and then summing the directional volumes for each location. The following equation is used to determine the ACGR for each segment:

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

<u>Secondary Mobility Measures</u>

Four secondary measures are evaluated:

- Future Congestion
- Peak 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

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

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 previously. 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.

Travel Time Reliability: Travel time reliability is a secondary measure that includes three indicators. The three indicators are the number of times a piece of a corridor is closed for any specific reason, the directional Travel Time Index (TTI), and the directional Planning Time Index (PTI).

<u>Closure Extent</u>: 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.

<u>Directional Travel Time and Planning Time Index</u>: 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.

<u>Percent Bicycle Accommodation</u>: 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

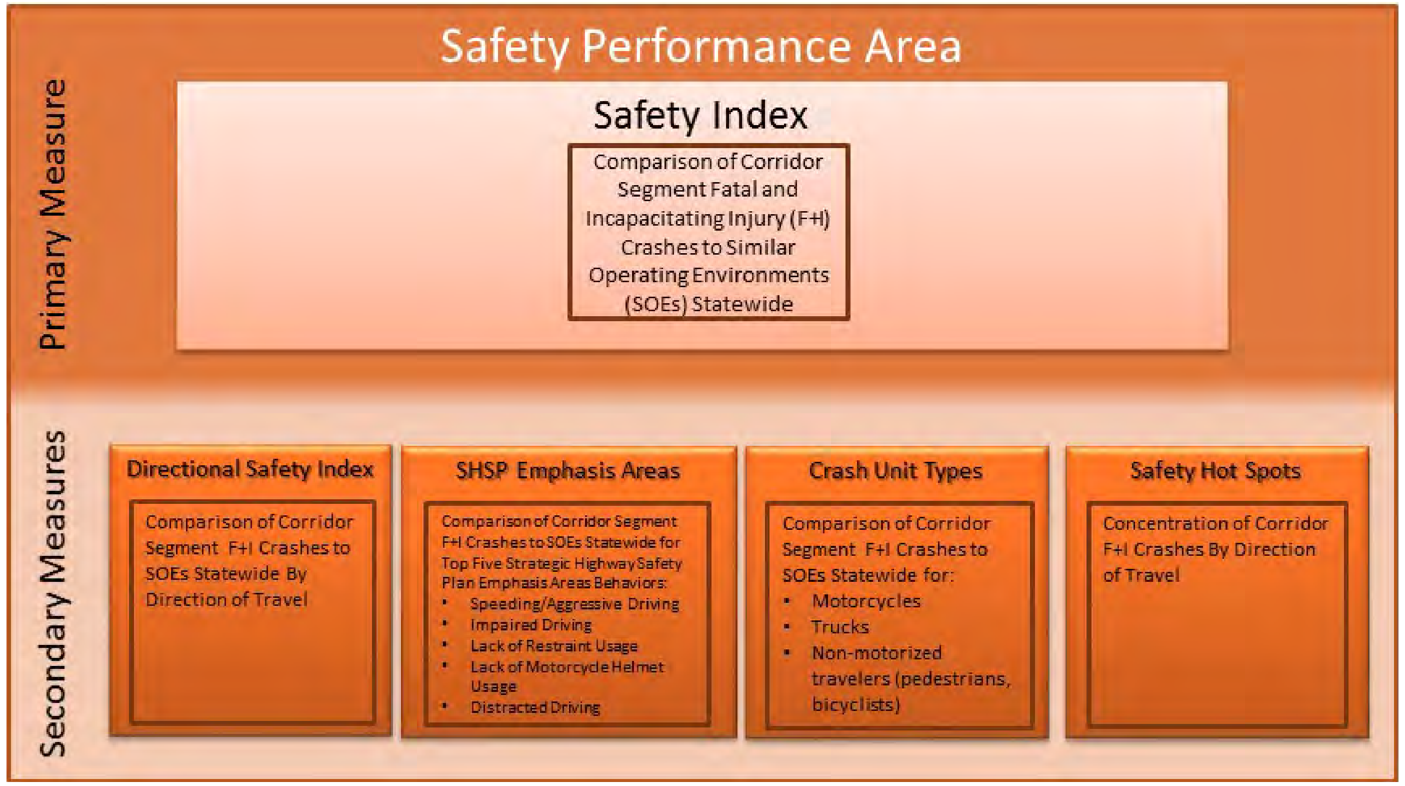
Performance Level	Percent Bicycle Accommodation
Good	$\geq$ 90%
Fair	> 60% & ≤ 90%
Poor	< 60%

Performance Level	Percent Non-SOV Trips
Good	$\geq$ 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 Safety Index

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 incapacitating 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 is 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.

Scoring:

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), the segment has "insufficient data" and Safety Index performance ratings are unreliable.

Secondary Safety 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
- Crash Unit Types
- 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

This section summarizes the approach for developing the primary and secondary performance measures in the Freight performance area as shown in the following graphic:

<u>Primary Freight Index</u>

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 is calculated using the following formula to invert the overall TPTI:

Freight Index = 1 / Bi-directional TPTI

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. The scale for rating the Freight Index differs between uninterrupted and interrupted flow facilities.

<u>Secondary Freight Measures</u>

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.

<u>Scoring:</u>

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

				Direction 1 (Eastbound)			Direction 2 (Westbound)			Direction 1 (Eastbound)		Direction 2 (Westbound)		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	Dir 1 (EB)	Dir 2 (WB)		Dir 1 (EB)	Dir 2 (WB)
Segment 1		***Interstate?***		**No**														
Milepost	312	to	313	2	77.63	1.00	0	0.00	0.00	3.72	4.7	-	-	4.00	-		0	0
Milepost	313	to	314	2	90.12	2.00	0	0.00	0.00	3.55	4.5	-	-	3.82	-		0	0
Milepost	314	to	315	2	67.22	1.00	0	0.00	0.00	3.87	4.7	-	-	4.11	-		0	0
Milepost	315	to	316	2	71.78	1.00	0	0.00	0.00	3.81	4.7	-	-	4.06	-		0	0
Milepost	316	to	317	2	61.01	2.00	0	0.00	0.00	3.97	4.5	-	-	4.11	-		0	0
Milepost	317	to	318	2	75.19	0.00	0	0.00	0.00	3.76	5.0	-	-	4.13	-		0	0
Milepost	318	to	319	2	84.62	0.00	0	0.00	0.00	3.63	5.0	-	-	4.04	-		0	0
			Total	14			0											0
			Weighted Average							3.76	4.70	-	-	4.04	-			
			Factor							1.00		1.00						
			Indicator Score							**3.76**		-						**0.0%**
			Pavement Index													**4.04**		
Segment 2		***Interstate?***		**No**														
Milepost	319	to	320	4	96.93	1.00	0	0.00	0.00	3.46	4.7	-	-	3.82	-		0	0
Milepost	320	to	321	4	61.04	3.00	0	0.00	0.00	3.96	4.3	-	-	4.06	-		0	0
Milepost	321	to	322	4	112.44	0.00	0	0.00	0.00	3.26	5.0	-	-	3.78	-		0	0
Milepost	322	to	323	4	82.36	4.00	0	0.00	0.00	3.66	4.1	-	-	3.80	-		0	0
			Total	16			0											0
			Weighted Average							3.59	4.52	-	-	3.87	-			
			Factor							1.00		1.00						
			Indicator Score							**3.59**		-						**0.0%**
			Pavement Index													**3.87**		
Segment 3		***Interstate?***		**No**														
Milepost	323	to	324	2	96.39	10.00	0	0.00	0.00	3.47	3.4	-	-	3.44	-		0	0
Milepost	324	to	325	2	105.52	2.00	0	0.00	0.00	3.35	4.5	-	-	3.68	-		0	0
Milepost	325	to	326	2	112.49	4.00	0	0.00	0.00	3.26	4.1	-	-	3.52	-		0	0
Milepost	326	to	327	2	111.11	8.00	0	0.00	0.00	3.28	3.6	-	-	3.39	-		0	0
Milepost	327	to	328	2	95.41	4.00	0	0.00	0.00	3.48	4.1	-	-	3.68	-		0	0
Milepost	328	to	329	2	113.44	5.00	0	0.00	0.00	3.25	4.0	-	-	3.47	-		0	0
Milepost	329	to	330	2	117.18	4.00	0	0.00	0.00	3.20	4.1	-	-	3.48	-		0	0
Milepost	330	to	331	2	113.24	8.00	0	0.00	0.00	3.25	3.6	-	-	3.37	-		0	0
Milepost	331	to	332	2	99.96	1.00	0	0.00	0.00	3.42	4.7	-	-	3.79	-		0	0
Milepost	332	to	333	2	88.24	8.00	0	0.00	0.00	3.58	3.6	-	-	3.59	-		0	0
Milepost	333	to	334	2	101.70	0.00	0	0.00	0.00	3.40	5.0	-	-	3.88	-		0	0
Milepost	334	to	335	2	116.59	7.00	0	0.00	0.00	3.21	3.8	-	-	3.37	-		0	0
Milepost	335	to	336	2	100.89	1.00	0	0.00	0.00	3.41	4.7	-	-	3.78	-		0	0
Milepost	336	to	337	2	91.77	1.00	0	0.00	0.00	3.53	4.7	-	-	3.87	-		0	0

				Direction 1 (Eastbound)			Direction 2 (Westbound)			Direction 1 (Eastbound)		Direction 2 (Westbound)		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	Dir 1 (EB)	Dir 2 (WB)		Dir 1 (EB)	Dir 2 (WB)
Milepost	337	to	338	2	77.85	7.00	0	0.00	0.00	3.72	3.8	-	-	3.73	-		0	0
Milepost	338	to	339	2	89.17	12.00	0	0.00	0.00	3.56	3.2	-	-	3.32	-		0	0
Milepost	339	to	340	2	86.35	5.00	0	0.00	0.00	3.60	4.0	-	-	3.72	-		0	0
Milepost	340	to	341	2	87.88	10.00	0	0.00	0.00	3.58	3.4	-	-	3.47	-		0	0
Milepost	341	to	342	2	57.95	4.00	0	0.00	0.00	4.01	4.1	-	-	4.05	-		0	0
Milepost	342	to	343	2	46.65	2.00	0	0.00	0.00	4.19	4.5	-	-	4.27	-		0	0
Milepost	343	to	344	2	66.47	5.00	0	0.00	0.00	3.88	4.0	-	-	3.92	-		0	0
		Total		42			0											0
		Weighted Average								3.51	4.04	-	-	3.66	-			
		Factor								1.00		1.00						
		Indicator Score								**3.51**		**-**						**0.0%**
		Pavement Index														**3.66**		
Segment 4		***Interstate?***		**No**														
Milepost	344	to	345	2	60.23	5.00	0	0.00	0.00	3.98	4.0	-	-	3.98	-		0	0
Milepost	345	to	346	2	57.28	1.00	0	0.00	0.00	4.02	4.7	-	-	4.21	-		0	0
Milepost	346	to	347	2	64.10	1.00	0	0.00	0.00	3.92	4.7	-	-	4.14	-		0	0
Milepost	347	to	348	2	51.81	2.00	0	0.00	0.00	4.11	4.5	-	-	4.21	-		0	0
Milepost	348	to	349	2	56.35	3.00	0	0.00	0.00	4.04	4.3	-	-	4.11	-		0	0
Milepost	349	to	350	2	66.05	5.00	0	0.00	0.00	3.89	4.0	-	-	3.92	-		0	0
Milepost	350	to	351	2	60.49	4.00	0	0.00	0.00	3.97	4.1	-	-	4.02	-		0	0
Milepost	351	to	352	2	51.64	2.00	0	0.00	0.00	4.11	4.5	-	-	4.21	-		0	0
Milepost	352	to	353	2	59.59	1.00	0	0.00	0.00	3.99	4.7	-	-	4.19	-		0	0
Milepost	353	to	354	2	53.36	4.00	0	0.00	0.00	4.08	4.1	-	-	4.10	-		0	0
Milepost	354	to	355	2	61.81	2.00	0	0.00	0.00	3.95	4.5	-	-	4.10	-		0	0
Milepost	355	to	356	2	64.46	5.00	0	0.00	0.00	3.91	4.0	-	-	3.94	-		0	0
Milepost	356	to	357	2	58.83	1.00	0	0.00	0.00	4.00	4.7	-	-	4.20	-		0	0
Milepost	357	to	358	2	62.63	3.00	0	0.00	0.00	3.94	4.3	-	-	4.04	-		0	0
Milepost	358	to	359	2	47.12	1.00	0	0.00	0.00	4.18	4.7	-	-	4.32	-		0	0
Milepost	359	to	360	2	42.26	1.00	0	0.00	0.00	4.26	4.7	-	-	4.38	-		0	0
Milepost	360	to	361	2	47.99	0.00	0	0.00	0.00	4.17	5.0	-	-	4.42	-		0	0
Milepost	361	to	362	2	48.67	0.00	0	0.00	0.00	4.16	5.0	-	-	4.41	-		0	0
		Total		36			0											0
		Weighted Average								4.04	4.45	-	-	4.16	-			
		Factor								1.00		1.00						
		Indicator Score								**4.04**		**-**						**0.0%**
		Pavement Index														**4.16**		
Segment 5		***Interstate?***		**No**														
Milepost	362	to	363	2	41.11	0.00	0	0.00	0.00	4.28	5.0	-	-	4.49	-		0	0
Milepost	363	to	364	2	36.98	0.00	0	0.00	0.00	4.34	5.0	-	-	4.54	-		0	0
Milepost	364	to	365	2	38.44	0.00	0	0.00	0.00	4.32	5.0	-	-	4.52	-		0	0

				Direction 1 (Eastbound)			Direction 2 (Westbound)			Direction 1 (Eastbound)		Direction 2 (Westbound)		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	Dir 1 (EB)	Dir 2 (WB)		Dir 1 (EB)	Dir 2 (WB)
Milepost	365	to	366	2	38.28	0.00	0	0.00	0.00	4.32	5.0	-	-	4.53	-		0	0
Milepost	366	to	367	2	36.12	0.00	0	0.00	0.00	4.36	5.0	-	-	4.55	-		0	0
Milepost	367	to	368	2	42.31	0.00	0	0.00	0.00	4.26	5.0	-	-	4.48	-		0	0
Milepost	368	to	369	2	52.93	0.00	0	0.00	0.00	4.09	5.0	-	-	4.36	-		0	0
Milepost	369	to	370	2	49.22	0.00	0	0.00	0.00	4.15	5.0	-	-	4.40	-		0	0
Milepost	370	to	371	2	42.80	0.00	0	0.00	0.00	4.25	5.0	-	-	4.47	-		0	0
Milepost	371	to	372	2	40.66	0.00	0	0.00	0.00	4.28	5.0	-	-	4.50	-		0	0
Milepost	372	to	373	2	63.92	0.00	0	0.00	0.00	3.92	5.0	-	-	4.25	-		0	0
Milepost	373	to	374	2	92.77	7.00	0	0.00	0.00	3.51	3.8	-	-	3.59	-		0	0
			Total	24			0											0
			Weighted Average							4.17	4.90	-	-	4.39	-			
			Factor							1.00		1.00						
			Indicator Score							**4.17**		**-**						**0.0%**
			Pavement Index													**4.39**		
Segment 6		***Interstate?***		**No**														
Milepost	374	to	375	2	104.62	6.00	0	0.00	0.00	3.36	3.9	-	-	3.51	-		0	0
Milepost	375	to	376	2	65.47	3.00	0	0.00	0.00	3.90	4.3	-	-	4.02	-		0	0
Milepost	376	to	377	2	60.77	0.00	0	0.00	0.00	3.97	5.0	-	-	4.28	-		0	0
Milepost	377	to	378	2	129.83	0.00	0	0.00	0.00	3.05	5.0	-	-	3.64	-		0	0
Milepost	378	to	379	2	110.76	4.00	0	0.00	0.00	3.28	4.1	-	-	3.54	-		0	0
Milepost	379	to	380	2	146.63	12.00	0	0.00	0.00	2.86	3.2	-	-	2.86	-		2	0
Milepost	380	to	381	2	154.10	7.00	0	0.00	0.00	2.78	3.8	-	-	2.78	-		2	0
Milepost	381	to	382	2	97.98	5.00	0	0.00	0.00	3.45	4.0	-	-	3.61	-		0	0
Milepost	382	to	383	2	98.76	1.00	0	0.00	0.00	3.44	4.7	-	-	3.80	-		0	0
Milepost	383	to	384	2	122.11	5.00	0	0.00	0.00	3.14	4.0	-	-	3.40	-		0	0
Milepost	384	to	385	2	135.03	6.00	0	0.00	0.00	2.99	3.9	-	-	3.26	-		0	0
Milepost	385	to	386	2	89.26	4.00	0	0.00	0.00	3.56	4.1	-	-	3.73	-		0	0
Milepost	386	to	387	2	87.78	2.00	0	0.00	0.00	3.58	4.5	-	-	3.84	-		0	0
Milepost	387	to	388	2	107.09	4.00	0	0.00	0.00	3.33	4.1	-	-	3.57	-		0	0
Milepost	388	to	389	2	115.30	10.00	0	0.00	0.00	3.23	3.4	-	-	3.29	-		0	0
Milepost	389	to	390	2	81.28	4.00	0	0.00	0.00	3.67	4.1	-	-	3.81	-		0	0
Milepost	390	to	391	2	48.12	1.00	0	0.00	0.00	4.16	4.7	-	-	4.31	-		0	0
			Total	34			0											4
			Weighted Average							3.40	4.16	-	-	3.60	-			
			Factor							1.00		1.00						
			Indicator Score							**3.40**		**-**						**11.8%**
			Pavement Index													**3.60**		
Segment 7		***Interstate?***		**No**														
Milepost	391	to	392	4	46.17	5.00	0	0.00	0.00	4.20	4.0	-	-	4.06	-		0	0
Milepost	392	to	393	4	49.50	2.00	0	0.00	0.00	4.14	4.5	-	-	4.24	-		0	0

				Direction 1 (Eastbound)			Direction 2 (Westbound)			Direction 1 (Eastbound)		Direction 2 (Westbound)		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	Dir 1 (EB)	Dir 2 (WB)		Dir 1 (EB)	Dir 2 (WB)
Milepost	393	to	394	4	70.97	1.00	0	0.00	0.00	3.82	4.7	-	-	4.07	-		0	0
Milepost	394	to	395	4	57.33	2.00	0	0.00	0.00	4.02	4.5	-	-	4.15	-		0	0
		Total		16			0											0
		Weighted Average								4.04	4.39	-	-	4.13	-			
		Factor								1.00		1.00						
		Indicator Score								**4.04**		**-**						**0.0%**
		Pavement Index														**4.13**		
Segment 8		***Interstate?***		**No**														
Milepost	395	to	396	2	59.26	2.00	0	0.00	0.00	3.99	4.5	-	-	4.13	-		0	0
Milepost	396	to	397	2	60.18	1.00	0	0.00	0.00	3.98	4.7	-	-	4.18	-		0	0
Milepost	397	to	398	2	44.07	1.00	0	0.00	0.00	4.23	4.7	-	-	4.36	-		0	0
Milepost	398	to	399	2	47.91	1.00	0	0.00	0.00	4.17	4.7	-	-	4.31	-		0	0
Milepost	399	to	400	2	56.95	2.00	0	0.00	0.00	4.03	4.5	-	-	4.16	-		0	0
Milepost	400	to	401	2	76.27	1.00	0	0.00	0.00	3.74	4.7	-	-	4.02	-		0	0
Milepost	401	to	402	2	67.87	0.00	0	0.00	0.00	3.86	5.0	-	-	4.20	-		0	0
Milepost	402	to	403	2	58.32	2.00	0	0.00	0.00	4.01	4.5	-	-	4.14	-		0	0
Milepost	403	to	404	2	65.35	4.00	0	0.00	0.00	3.90	4.1	-	-	3.97	-		0	0
Milepost	404	to	405	2	70.84	6.00	0	0.00	0.00	3.82	3.9	-	-	3.84	-		0	0
Milepost	405	to	406	2	73.15	4.00	0	0.00	0.00	3.79	4.1	-	-	3.89	-		0	0
Milepost	406	to	407	2	69.23	4.00	0	0.00	0.00	3.84	4.1	-	-	3.93	-		0	0
Milepost	407	to	408	2	76.96	5.00	0	0.00	0.00	3.73	4.0	-	-	3.81	-		0	0
Milepost	408	to	409	2	73.48	6.00	0	0.00	0.00	3.78	3.9	-	-	3.81	-		0	0
Milepost	409	to	410	2	79.05	2.00	0	0.00	0.00	3.70	4.5	-	-	3.93	-		0	0
Milepost	410	to	411	2	75.78	3.00	0	0.00	0.00	3.75	4.3	-	-	3.91	-		0	0
Milepost	411	to	412	2	72.82	3.00	0	0.00	0.00	3.79	4.3	-	-	3.94	-		0	0
Milepost	412	to	413	2	81.11	0.00	0	0.00	0.00	3.67	5.0	-	-	4.07	-		0	0
		Total		36			0											0
		Weighted Average								3.88	4.40	-	-	4.03	-			
		Factor								1.00		1.00						
		Indicator Score								**3.88**		**-**						**0.0%**
		Pavement Index														**4.03**		
Segment 9		***Interstate?***		**No**														
Milepost	413	to	414	2	71.99	1.00	0	0.00	0.00	3.80	4.7	-	-	4.06	-		0	0
Milepost	414	to	415	2	74.30	3.00	0	0.00	0.00	3.77	4.3	-	-	3.93	-		0	0
Milepost	415	to	416	2	114.25	4.00	0	0.00	0.00	3.24	4.1	-	-	3.51	-		0	0
Milepost	416	to	417	2	99.13	4.00	0	0.00	0.00	3.43	4.1	-	-	3.64	-		0	0
Milepost	417	to	418	2	108.27	12.00	0	0.00	0.00	3.31	3.2	-	-	3.25	-		0	0
Milepost	418	to	419	2	98.99	8.00	0	0.00	0.00	3.43	3.6	-	-	3.49	-		0	0
Milepost	419	to	420	2	83.91	10.00	0	0.00	0.00	3.63	3.4	-	-	3.49	-		0	0
Milepost	420	to	421	2	117.22	0.00	0	0.00	0.00	3.20	5.0	-	-	3.74	-		0	0

				Direction 1 (Eastbound)			Direction 2 (Westbound)			Direction 1 (Eastbound)		Direction 2 (Westbound)		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	Dir 1 (EB)	Dir 2 (WB)		Dir 1 (EB)	Dir 2 (WB)
Milepost	421	to	422	2	90.51	12.00	0	0.00	0.00	3.54	3.2	-	-	3.32	-		0	0
Milepost	422	to	423	2	124.03	10.00	0	0.00	0.00	3.12	3.4	-	-	3.21	-		0	0
Milepost	423	to	424	2	134.37	9.00	0	0.00	0.00	3.00	3.5	-	-	3.16	-		0	0
Milepost	424	to	425	2	211.18	3.00	0	0.00	0.00	2.24	4.3	-	-	2.24	-		2	0
Milepost	425	to	426	2	160.15	3.00	0	0.00	0.00	2.72	4.3	-	-	2.72	-		2	0
Milepost	426	to	427	2	155.32	9.00	0	0.00	0.00	2.77	3.5	-	-	2.77	-		2	0
Milepost	427	to	428	2	150.31	5.00	0	0.00	0.00	2.82	4.0	-	-	2.82	-		2	0
Milepost	428	to	429	2	148.60	5.00	0	0.00	0.00	2.84	4.0	-	-	2.84	-		2	0
Milepost	429	to	430	2	131.62	9.00	0	0.00	0.00	3.03	3.5	-	-	3.18	-		0	0
Milepost	430	to	431	2	111.03	3.00	0	0.00	0.00	3.28	4.3	-	-	3.58	-		0	0
Milepost	431	to	432	2	92.27	2.00	0	0.00	0.00	3.52	4.5	-	-	3.80	-		0	0
Milepost	432	to	433	2	120.01	2.00	0	0.00	0.00	3.17	4.5	-	-	3.55	-		0	0
Milepost	433	to	434	2	146.95	4.00	0	0.00	0.00	2.86	4.1	-	-	2.86	-		2	0
			Total	42			0											12
			Weighted Average							3.18	3.98	-	-	3.29	-			
			Factor							1.00		1.00						
			Indicator Score							**3.18**		**-**						**28.6%**
			Pavement Index													**3.29**		
Segment 10		***Interstate?***		**No**														
Milepost	434	to	435	2	125.69	2.00	0	0.00	0.00	3.10	4.5	-	-	3.51	-		0	0
Milepost	435	to	436	2	110.45	3.00	0	0.00	0.00	3.29	4.3	-	-	3.59	-		0	0
Milepost	436	to	437	2	89.69	12.00	0	0.00	0.00	3.56	3.2	-	-	3.32	-		0	0
Milepost	437	to	438	2	63.30	10.00	0	0.00	0.00	3.93	3.4	-	-	3.58	-		0	0
Milepost	438	to	439	2	60.51	30.00	0	0.00	0.00	3.97	1.7	-	-	1.74	-		2	0
Milepost	439	to	440	2	63.94	25.00	0	0.00	0.00	3.92	2.1	-	-	2.11	-		2	0
Milepost	440	to	441	2	68.21	10.00	0	0.00	0.00	3.86	3.4	-	-	3.55	-		0	0
Milepost	441	to	442	2	99.59	7.00	0	0.00	0.00	3.42	3.8	-	-	3.52	-		0	0
Milepost	442	to	443	2	108.08	10.00	0	0.00	0.00	3.32	3.4	-	-	3.35	-		0	0
Milepost	443	to	444	2	111.27	12.00	0	0.00	0.00	3.28	3.2	-	-	3.24	-		0	0
Milepost	444	to	445	2	78.61	8.00	0	0.00	0.00	3.71	3.6	-	-	3.66	-		0	0
Milepost	445	to	446	2	45.78	12.00	0	0.00	0.00	4.20	3.2	-	-	3.52	-		0	0
Milepost	446	to	447	2	48.24	12.00	0	0.00	0.00	4.16	3.2	-	-	3.50	-		0	0
Milepost	447	to	448	2	54.73	5.00	0	0.00	0.00	4.06	4.0	-	-	4.02	-		0	0
Milepost	448	to	449	2	58.64	3.00	0	0.00	0.00	4.00	4.3	-	-	4.09	-		0	0
Milepost	449	to	450	2	54.88	1.00	0	0.00	0.00	4.06	4.7	-	-	4.24	-		0	0
Milepost	450	to	451	2	55.97	4.00	0	0.00	0.00	4.04	4.1	-	-	4.07	-		0	0
			Total	34			0											4
			Weighted Average							3.76	3.54	-	-	3.45	-			
			Factor							1.00		1.00						
			Indicator Score							**3.76**		**-**						**11.8%**

	Direction 1 (Eastbound)			Direction 2 (Westbound)			Direction 1 (Eastbound)		Direction 2 (Westbound)		Composite		Pavement Index	% Pavement Failure	
	# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	Dir 1 (EB)	Dir 2 (WB)		Dir 1 (EB)	Dir 2 (WB)
Pavement Index													**3.45**		
Segment 11 ***Interstate?***	**No**														
Milepost 451 to 452	2	51.06	7.00	0	0.00	0.00	4.12	3.8	-	-	3.86	-		0	0
Milepost 452 to 453	2	57.51	15.00	0	0.00	0.00	4.02	2.9	-	-	3.26	-		0	0
Milepost 453 to 454	2	89.62	0.00	0	0.00	0.00	3.56	5.0	-	-	3.99	-		0	0
Milepost 454 to 455	2	93.77	1.00	0	0.00	0.00	3.50	4.7	-	-	3.85	-		0	0
Milepost 455 to 456	2	98.35	0.00	0	0.00	0.00	3.44	5.0	-	-	3.91	-		0	0
Milepost 456 to 457	2	98.08	0.00	0	0.00	0.00	3.44	5.0	-	-	3.91	-		0	0
Milepost 457 to 458	2	64.73	0.00	0	0.00	0.00	3.91	5.0	-	-	4.24	-		0	0
Milepost 458 to 459	2	69.31	0.00	0	0.00	0.00	3.84	5.0	-	-	4.19	-		0	0
Milepost 459 to 460	2	69.79	0.00	0	0.00	0.00	3.84	5.0	-	-	4.18	-		0	0
Milepost 460 to 461	2	77.01	0.00	0	0.00	0.00	3.73	5.0	-	-	4.11	-		0	0
Milepost 461 to 462	2	77.67	1.00	0	0.00	0.00	3.72	4.7	-	-	4.00	-		0	0
Milepost 462 to 463	2	46.53	0.00	0	0.00	0.00	4.19	5.0	-	-	4.43	-		0	0
Total	24			0											0
Weighted Average							3.78	4.67	-	-	4.00	-			
Factor							1.00		1.00						
Indicator Score							**3.78**		**-**						**0.0%**
Pavement Index													**4.00**		
Segment 12 ***Interstate?***	**No**														
Milepost 463 to 464	2	42.93	2.00	0	0.00	0.00	4.25	4.5	-	-	4.31	-		0	0
Milepost 464 to 465	2	43.95	0.00	0	0.00	0.00	4.23	5.0	-	-	4.46	-		0	0
Milepost 465 to 466	2	51.11	2.00	0	0.00	0.00	4.12	4.5	-	-	4.22	-		0	0
Milepost 466 to 467	2	52.78	1.00	0	0.00	0.00	4.09	4.7	-	-	4.26	-		0	0
Milepost 467 to 468	2	73.17	3.00	0	0.00	0.00	3.79	4.3	-	-	3.94	-		0	0
Milepost 468 to 469	2	67.20	6.00	0	0.00	0.00	3.87	3.9	-	-	3.87	-		0	0
Milepost 469 to 470	2	69.63	6.00	0	0.00	0.00	3.84	3.9	-	-	3.85	-		0	0
Total	14			0											0
Weighted Average							4.03	4.37	-	-	4.13	-			
Factor							1.00		1.00						
Indicator Score							**4.03**		**-**						**0.0%**
Pavement Index													**4.13**		

Bridge Performance Area Data

Structure Name (A209)	Structure # (N8)	Milepost (A232)	Area (A225)	Bridge Sufficiency Sufficiency Rating	Bridge Index Deck (N58)	Sub (N59)	Super (N60)	Eval (N67)	Lowest	Functionally Obsolete Bridges Deck Area on Func Obsolete	Bridge Rating	Hot Spots on Bridge Index map
Segment 1												
Hamblin Wash Br	531	312.20	886	71.80	6.00	6.00	6.00	5.00	5.0	0		
Total			886									
Weighted Average				71.80					5.00	0.00%		
Factor				1.00					1.00	1.00		
Indicator Score				**71.80**						**0.00%**	**5**	
Bridge Index									**5.00**			
Segment 2												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			
Segment 3												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			
Segment 4												
Begashbito Wash Br	1011	349.90	307	64.30	6.00	6.00	6.00	6.00	6.0	307		
Total			307									
Weighted Average				64.30					6.00	100.00%		
Factor				1.00					1.00	1.00		
Indicator Score				**64.30**						**100.00%**	**6**	
Bridge Index									**6.00**			
Segment 5												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			

Structure Name (A209)	Structure # (N8)	Milepost (A232)	Area (A225)	Bridge Sufficiency	Bridge Index					Functionally Obsolete Bridges	Bridge Rating	Hot Spots on Bridge Index map
				Sufficiency Rating	Deck (N58)	Sub (N59)	Super (N60)	Eval (N67)	Lowest	Deck Area on Func Obsolete		
Segment 6												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			
Segment 7												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			
Segment 8												
Church Rock Wash Br	747	400.53	431	83.70	6.00	6.00	7.00	6.00	6.0	0		
Total			431									
Weighted Average				83.70					6.00	0.00%		
Factor				1.00					1.00	1.00		
Indicator Score				**83.70**						**0.00%**	**6**	
Bridge Index									**6.00**			
Segment 9												
Laguna Creek Bridge	20001	420.10	634	89.90	8.00	8.00	8.00	8.00	8.0	0		
Chinle Wash Bridge	746	429.06	702	64.20	5.00	6.00	6.00	6.00	5.0	702		
Total			1,336									
Weighted Average				76.40					6.42	52.52%		
Factor				1.00					1.00	1.00		
Indicator Score				**76.40**						**52.52%**	**5**	
Bridge Index									**6.42**			
Segment 10												
Walker Creek Bridge	748	435.33	755	62.70	5.00	7.00	6.00	6.00	5.0	755		
Total			755									
Weighted Average				62.70					5.00	100.00%		
Factor				1.00					1.00	1.00		
Indicator Score				**62.70**						**100.00%**	**5**	
Bridge Index									**5.00**			

Structure Name (A209)	Structure # (N8)	Milepost (A232)	Area (A225)	Bridge Sufficiency	Bridge Index					Functionally Obsolete Bridges	Bridge Rating	Hot Spots on Bridge Index map
				Sufficiency Rating	Deck (N58)	Sub (N59)	Super (N60)	Eval (N67)	Lowest	Deck Area on Func Obsolete		
Segment 11												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			
Segment 12												
No Bridges in Segment		-	-	-	-	-	-	-	-	-		
Total			-									
Weighted Average				-					-	-		
Factor				1.00					1.00	1.00		
Indicator Score				**-**						**-**	**-**	
Bridge Index									**-**			

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)	Weighted Average Posted Speed Limit (mph)	Divided or Undivided	Access Points (per mile)	% No-Passing Zone	Street Parking
1	311	319	8	Rural	Interrupted	Rolling	2	Rural Two-Lane, Non-Signalized	12.00	63	Undivided	1.5	32%	N/A
2	319	323	4	Rural	Interrupted	Rolling	2.375	Urban/Rural Single or Multilane Signalized	12.00	49	Undivided	N/A	42%	N/A
3	323	344	21	Rural	Uninterrupted	Level	2	Rural Two-Lane, Non-Signalized	12.00	64	Undivided	1.7	12%	N/A
4	344	362	18	Rural	Uninterrupted	Level	2	Rural Two-Lane, Non-Signalized	12.00	65	Undivided	1.6	33%	N/A
5	362	374	12	Rural	Uninterrupted	Level	2	Rural Two-Lane, Non-Signalized	12.00	65	Undivided	2.3	14%	N/A
6	374	391	17	Rural	Uninterrupted	Rolling	2	Rural Two-Lane, Non-Signalized	12.00	64	Undivided	1.9	24%	N/A
7	391	395	4	Rural	Interrupted	Rolling	2.235	Urban/Rural Single or Multilane Signalized	12.00	60	Undivided	N/A	47%	N/A
8	395	413	18	Rural	Uninterrupted	Level	2	Rural Two-Lane, Non-Signalized	12.00	65	Undivided	0.4	9%	N/A
9	413	434	21	Rural	Uninterrupted	Level	2	Rural Two-Lane, Non-Signalized	12.00	65	Undivided	1.5	20%	N/A
10	434	451	17	Rural	Uninterrupted	Rolling	2	Rural Two-Lane, Non-Signalized	12.00	64	Undivided	1.3	25%	N/A
11	451	463	12	Rural	Uninterrupted	Rolling	2	Rural Two-Lane, Non-Signalized	12.00	65	Undivided	1.7	21%	N/A
12	463	470	7	Rural	Interrupted	Rolling	2	Rural Two-Lane, Non-Signalized	12.00	60	Undivided	3.6	31%	N/A

TTI and PTI Eastbound

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
1	115P06556	1 AM Peak	Weekday	US-160	NB	60.6	50.4	42.3	28.0	65	65	1.07	1.29	1.54	2.32	1.10	1.29	1.69	2.32	1.07	1.20	1.48	1.84
	115P06556	2 Mid Day	Weekday	US-160	NB	60.0	51.3	42.4	28.2	65	65	1.08	1.27	1.53	2.30								
	115P06556	3 PM Peak	Weekday	US-160	NB	60.8	51.2	42.9	28.0	65	65	1.07	1.27	1.51	2.32								
	115P06556	4 Evening	Weekday	US-160	NB	59.0	50.9	38.5	28.6	65	65	1.10	1.28	1.69	2.27								
	115P06557	1 AM Peak	Weekday	US-160	NB	64.3	60.0	54.2	51.0	65	65	1.01	1.08	1.20	1.27	1.04	1.10	1.27	1.36				
	115P06557	2 Mid Day	Weekday	US-160	NB	62.7	59.7	51.0	50.8	65	65	1.04	1.09	1.27	1.28								
	115P06557	3 PM Peak	Weekday	US-160	NB	63.2	59.8	52.1	49.7	65	65	1.03	1.09	1.25	1.31								
	115P06557	4 Evening	Weekday	US-160	NB	62.7	59.0	51.0	47.8	65	65	1.04	1.10	1.27	1.36								
2	115P06557	1 AM Peak	Weekday	US-160	NB	64.3	60.0	54.2	51.0	65	65	1.01	1.08	1.20	1.27	1.04	1.10	1.27	1.36	1.12	1.17	3.75	2.43
	115P06557	2 Mid Day	Weekday	US-160	NB	62.7	59.7	51.0	50.8	65	65	1.04	1.09	1.27	1.28								
	115P06557	3 PM Peak	Weekday	US-160	NB	63.2	59.8	52.1	49.7	65	65	1.03	1.09	1.25	1.31								
	115P06557	4 Evening	Weekday	US-160	NB	62.7	59.0	51.0	47.8	65	65	1.04	1.10	1.27	1.36								
	115P06558	1 AM Peak	Weekday	US-160	NB	32.8	32.7	11.8	15.6	40	40	1.22	1.22	3.39	2.57	1.26	1.22	5.37	2.67				

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
	115P06558	2 Mid Day	Weekday	US-160	NB	32.0	33.6	9.3	15.0	40	40	1.25	1.19	4.29	2.67								
	115P06558	3 PM Peak	Weekday	US-160	NB	32.1	34.3	7.5	16.8	40	40	1.25	1.16	5.37	2.38								
	115P06558	4 Evening	Weekday	US-160	NB	31.9	33.7	9.9	15.0	40	40	1.26	1.19	4.02	2.67								
	115P06559	1 AM Peak	Weekday	US-160	NB	53.3	50.0	29.9	31.6	60	60	1.12	1.20	2.01	1.90	1.16	1.20	2.32	1.96				
	115P06559	2 Mid Day	Weekday	US-160	NB	51.9	50.3	25.9	30.5	60	60	1.16	1.19	2.32	1.96								
	115P06559	3 PM Peak	Weekday	US-160	NB	53.7	52.3	37.8	40.4	60	60	1.12	1.15	1.59	1.48								
	115P06559	4 Evening	Weekday	US-160	NB	53.3	49.9	35.4	36.8	60	60	1.13	1.20	1.69	1.63								
	115P05878	1 AM Peak	Weekday	US-160	NB	45.3	38.6	10.0	12.1	45	45	1.00	1.16	4.52	3.71	1.04	1.16	6.03	3.71				
	115P05878	2 Mid Day	Weekday	US-160	NB	43.3	39.2	7.5	12.4	45	45	1.04	1.15	6.03	3.62								
	115P05878	3 PM Peak	Weekday	US-160	NB	44.2	39.9	8.7	21.8	45	45	1.02	1.13	5.18	2.07								
	115P05878	4 Evening	Weekday	US-160	NB	43.5	38.8	12.4	18.6	45	45	1.03	1.16	3.62	2.41								
3	115P06560	1 AM Peak	Weekday	US-160	NB	66.4	59.8	56.0	51.2	65	65	1.00	1.09	1.16	1.27	1.00	1.09	1.21	1.27	1.01	1.07	1.30	1.48
	115P06560	2 Mid Day	Weekday	US-160	NB	66.3	60.1	57.2	52.2	65	65	1.00	1.08	1.14	1.25								
	115P06560	3 PM Peak	Weekday	US-160	NB	66.6	60.5	57.8	53.2	65	65	1.00	1.07	1.13	1.22								
	115P06560	4 Evening	Weekday	US-160	NB	65.9	60.1	53.9	51.2	65	65	1.00	1.08	1.21	1.27								
	115P06561	1 AM Peak	Weekday	US-160	NB	64.7	58.8	48.1	43.5	65	65	1.00	1.10	1.35	1.49	1.02	1.11	1.39	1.49				
	115P06561	2 Mid Day	Weekday	US-160	NB	64.5	59.4	49.7	46.1	65	65	1.01	1.09	1.31	1.41								
	115P06561	3 PM Peak	Weekday	US-160	NB	64.0	59.4	47.8	46.3	65	65	1.02	1.09	1.36	1.40								
	115P06561	4 Evening	Weekday	US-160	NB	63.5	58.5	46.7	43.6	65	65	1.02	1.11	1.39	1.49								
	115P06562	1 AM Peak	Weekday	US-160	NB	56.0	47.2	40.1	26.7	45	45	1.00	1.00	1.12	1.68	1.00	1.00	1.31	1.68				
	115P06562	2 Mid Day	Weekday	US-160	NB	54.5	48.0	41.5	30.1	45	45	1.00	1.00	1.09	1.50								
	115P06562	3 PM Peak	Weekday	US-160	NB	54.1	48.9	38.8	40.1	45	45	1.00	1.00	1.16	1.12								
	115P06562	4 Evening	Weekday	US-160	NB	53.3	47.1	34.3	28.6	45	45	1.00	1.00	1.31	1.57								
4	115P05879	1 AM Peak	Weekday	US-160	NB	65.3	61.3	45.6	56.0	65	65	1.00	1.06	1.43	1.16	1.00	1.07	1.43	1.25	1.00	1.07	1.31	1.24
	115P05879	2 Mid Day	Weekday	US-160	NB	65.4	61.2	53.4	56.0	65	65	1.00	1.06	1.22	1.16								
	115P05879	3 PM Peak	Weekday	US-160	NB	65.6	61.4	53.4	55.4	65	65	1.00	1.06	1.22	1.17								
	115P05879	4 Evening	Weekday	US-160	NB	64.9	60.6	50.9	52.0	65	65	1.00	1.07	1.28	1.25								
	115P06563	1 AM Peak	Weekday	US-160	NB	66.4	61.1	55.0	54.7	65	65	1.00	1.06	1.18	1.19	1.00	1.08	1.22	1.26				
	115P06563	2 Mid Day	Weekday	US-160	NB	66.6	61.2	57.2	55.6	65	65	1.00	1.06	1.14	1.17								
	115P06563	3 PM Peak	Weekday	US-160	NB	66.7	61.5	57.2	55.3	65	65	1.00	1.06	1.14	1.18								
	115P06563	4 Evening	Weekday	US-160	NB	65.3	60.3	53.4	51.6	65	65	1.00	1.08	1.22	1.26								
	115P06564	1 AM Peak	Weekday	US-160	NB	66.0	61.1	51.0	55.6	65	65	1.00	1.06	1.28	1.17	1.00	1.07	1.28	1.22				
	115P06564	2 Mid Day	Weekday	US-160	NB	67.0	61.1	57.8	56.4	65	65	1.00	1.06	1.13	1.15								
	115P06564	3 PM Peak	Weekday	US-160	NB	67.2	61.3	58.1	55.1	65	65	1.00	1.06	1.12	1.18								
	115P06564	4 Evening	Weekday	US-160	NB	65.9	60.6	55.3	53.1	65	65	1.00	1.07	1.17	1.22								
5	115P06565	1 AM Peak	Weekday	US-160	NB	64.6	61.5	47.5	56.4	65	65	1.01	1.06	1.37	1.15	1.01	1.07	1.37	1.26	1.01	1.09	1.33	1.36
	115P06565	2 Mid Day	Weekday	US-160	NB	65.5	61.2	54.7	54.7	65	65	1.00	1.06	1.19	1.19								
	115P06565	3 PM Peak	Weekday	US-160	NB	66.0	61.2	55.3	54.1	65	65	1.00	1.06	1.18	1.20								
	115P06565	4 Evening	Weekday	US-160	NB	64.7	60.7	50.8	51.5	65	65	1.00	1.07	1.28	1.26								

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
	115P06566	1 AM Peak	Weekday	US-160	NB	64.8	59.0	51.0	47.0	65	65	1.00	1.10	1.27	1.38	1.01	1.11	1.29	1.45				
	115P06566	2 Mid Day	Weekday	US-160	NB	64.4	59.0	51.8	47.8	65	65	1.01	1.10	1.26	1.36								
	115P06566	3 PM Peak	Weekday	US-160	NB	65.0	59.6	54.6	50.0	65	65	1.00	1.09	1.19	1.30								
	115P06566	4 Evening	Weekday	US-160	NB	64.4	58.8	50.4	44.7	65	65	1.01	1.11	1.29	1.45								
6	115P06567	1 AM Peak	Weekday	US-160	NB	64.7	60.7	49.4	51.2	65	65	1.00	1.07	1.32	1.27	1.00	1.09	1.32	1.36	1.02	1.10	1.51	1.41
	115P06567	2 Mid Day	Weekday	US-160	NB	65.3	60.4	53.2	48.8	65	65	1.00	1.08	1.22	1.33								
	115P06567	3 PM Peak	Weekday	US-160	NB	66.0	60.7	55.3	51.5	65	65	1.00	1.07	1.18	1.26								
	115P06567	4 Evening	Weekday	US-160	NB	64.9	59.8	51.3	47.9	65	65	1.00	1.09	1.27	1.36								
	115P06568	1 AM Peak	Weekday	US-160	NB	62.3	59.0	38.2	44.2	65	65	1.04	1.10	1.70	1.47	1.04	1.11	1.70	1.47				
	115P06568	2 Mid Day	Weekday	US-160	NB	63.9	59.7	50.8	50.3	65	65	1.02	1.09	1.28	1.29								
	115P06568	3 PM Peak	Weekday	US-160	NB	64.1	60.3	50.3	50.8	65	65	1.01	1.08	1.29	1.28								
	115P06568	4 Evening	Weekday	US-160	NB	63.5	58.7	47.2	44.4	65	65	1.02	1.11	1.38	1.46								
7	115P05880	1 AM Peak	Weekday	US-160	NB	56.7	52.2	16.4	18.0	65	65	1.15	1.25	3.97	3.61	1.15	1.25	3.97	3.61	1.12	1.34	3.26	3.98
	115P05880	2 Mid Day	Weekday	US-160	NB	57.1	52.2	20.5	19.9	65	65	1.14	1.25	3.17	3.27								
	115P05880	3 PM Peak	Weekday	US-160	NB	58.6	53.7	26.7	24.4	65	65	1.11	1.21	2.43	2.66								
	115P05880	4 Evening	Weekday	US-160	NB	58.6	53.7	25.5	23.6	65	65	1.11	1.21	2.55	2.75								
	115P06569	1 AM Peak	Weekday	US-160	NB	61.6	46.8	34.2	20.9	65	65	1.06	1.39	1.90	3.11	1.09	1.44	2.55	4.36				
	115P06569	2 Mid Day	Weekday	US-160	NB	59.5	45.6	29.8	16.8	65	65	1.09	1.43	2.18	3.87								
	115P06569	3 PM Peak	Weekday	US-160	NB	61.0	46.3	34.8	17.4	65	65	1.07	1.40	1.87	3.74								
	115P06569	4 Evening	Weekday	US-160	NB	59.9	45.2	25.5	14.9	65	65	1.09	1.44	2.55	4.36								
8	115P06570	1 AM Peak	Weekday	US-160	NB	68.7	62.3	59.7	57.9	65	65	1.00	1.04	1.09	1.12	1.00	1.05	1.16	1.19	1.00	1.05	1.15	1.18
	115P06570	2 Mid Day	Weekday	US-160	NB	67.3	62.1	58.6	57.9	65	65	1.00	1.05	1.11	1.12								
	115P06570	3 PM Peak	Weekday	US-160	NB	67.6	62.6	59.0	58.0	65	65	1.00	1.04	1.10	1.12								
	115P06570	4 Evening	Weekday	US-160	NB	66.6	61.8	55.9	54.7	65	65	1.00	1.05	1.16	1.19								
	115P06571	1 AM Peak	Weekday	US-160	NB	68.7	62.5	59.8	58.0	65	65	1.00	1.04	1.09	1.12	1.00	1.05	1.13	1.16				
	115P06571	2 Mid Day	Weekday	US-160	NB	67.9	62.1	60.3	58.2	65	65	1.00	1.05	1.08	1.12								
	115P06571	3 PM Peak	Weekday	US-160	NB	67.7	62.5	59.6	58.4	65	65	1.00	1.04	1.09	1.11								
	115P06571	4 Evening	Weekday	US-160	NB	66.4	62.1	57.4	55.9	65	65	1.00	1.05	1.13	1.16								
9	115P06571	1 AM Peak	Weekday	US-160	NB	68.7	62.5	59.8	58.0	65	65	1.00	1.04	1.09	1.12	1.00	1.05	1.13	1.16	1.01	1.06	1.37	1.21
	115P06571	2 Mid Day	Weekday	US-160	NB	67.9	62.1	60.3	58.2	65	65	1.00	1.05	1.08	1.12								
	115P06571	3 PM Peak	Weekday	US-160	NB	67.7	62.5	59.6	58.4	65	65	1.00	1.04	1.09	1.11								
	115P06571	4 Evening	Weekday	US-160	NB	66.4	62.1	57.4	55.9	65	65	1.00	1.05	1.13	1.16								
	115P06572	1 AM Peak	Weekday	US-160	NB	65.0	62.1	42.9	57.5	65	65	1.00	1.05	1.51	1.13	1.05	1.05	1.90	1.21				
	115P06572	2 Mid Day	Weekday	US-160	NB	63.7	62.2	40.0	57.8	65	65	1.02	1.05	1.62	1.12								
	115P06572	3 PM Peak	Weekday	US-160	NB	62.6	62.3	34.2	56.9	65	65	1.04	1.04	1.90	1.14								
	115P06572	4 Evening	Weekday	US-160	NB	61.9	61.6	37.3	53.5	65	65	1.05	1.05	1.74	1.21								
	115P06573	1 AM Peak	Weekday	US-160	NB	67.6	61.0	58.5	52.7	65	65	1.00	1.07	1.11	1.23	1.00	1.07	1.23	1.26				
	115P06573	2 Mid Day	Weekday	US-160	NB	66.5	61.2	56.6	53.3	65	65	1.00	1.06	1.15	1.22								
	115P06573	3 PM Peak	Weekday	US-160	NB	66.9	61.6	57.8	54.7	65	65	1.00	1.06	1.12	1.19								

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
	115P06573	4 Evening	Weekday	US-160	NB	65.3	61.0	52.9	51.5	65	65	1.00	1.07	1.23	1.26								
	115P05881	1 AM Peak	Weekday	US-160	NB	67.8	61.2	57.8	55.1	65	65	1.00	1.06	1.13	1.18	1.00	1.06	1.24	1.22				
	115P05881	2 Mid Day	Weekday	US-160	NB	66.1	61.5	52.6	55.7	65	65	1.00	1.06	1.24	1.17								
	115P05881	3 PM Peak	Weekday	US-160	NB	67.0	62.0	57.2	56.6	65	65	1.00	1.05	1.14	1.15								
	115P05881	4 Evening	Weekday	US-160	NB	66.1	61.8	55.1	53.4	65	65	1.00	1.05	1.18	1.22								
10	115P05881	1 AM Peak	Weekday	US-160	NB	67.8	61.2	57.8	55.1	65	65	1.00	1.06	1.13	1.18	1.00	1.06	1.24	1.22	1.05	1.13	1.89	2.25
	115P05881	2 Mid Day	Weekday	US-160	NB	66.1	61.5	52.6	55.7	65	65	1.00	1.06	1.24	1.17								
	115P05881	3 PM Peak	Weekday	US-160	NB	67.0	62.0	57.2	56.6	65	65	1.00	1.05	1.14	1.15								
	115P05881	4 Evening	Weekday	US-160	NB	66.1	61.8	55.1	53.4	65	65	1.00	1.05	1.18	1.22								
	115P05882	1 AM Peak	Weekday	US-160	NB	59.5	48.9	25.5	15.5	65	65	1.09	1.33	2.55	4.19	1.19	1.36	3.32	5.23				
	115P05882	2 Mid Day	Weekday	US-160	NB	57.4	47.7	22.0	5.6	65	65	1.13	1.36	2.96									
	115P05882	3 PM Peak	Weekday	US-160	NB	56.8	52.9	22.0	18.2	65	65	1.15	1.23	2.95	3.58								
	115P05882	4 Evening	Weekday	US-160	NB	54.6	49.7	19.6	12.4	65	65	1.19	1.31	3.32	5.23								
	115P06574	1 AM Peak	Weekday	US-160	NB	67.9	61.0	56.5	50.7	65	65	1.00	1.07	1.15	1.28	1.01	1.08	1.32	1.29				
	115P06574	2 Mid Day	Weekday	US-160	NB	65.9	60.3	52.6	50.5	65	65	1.00	1.08	1.24	1.29								
	115P06574	3 PM Peak	Weekday	US-160	NB	65.7	60.6	52.6	52.8	65	65	1.00	1.07	1.24	1.23								
	115P06574	4 Evening	Weekday	US-160	NB	64.4	60.5	49.1	50.5	65	65	1.01	1.07	1.32	1.29								
	115P06575	1 AM Peak	Weekday	US-160	NB	63.4	60.0	47.8	51.6	62	62	1.00	1.03	1.30	1.20	1.02	1.04	1.69	1.25				
	115P06575	2 Mid Day	Weekday	US-160	NB	61.0	60.4	36.7	52.8	62	62	1.02	1.03	1.69	1.17								
	115P06575	3 PM Peak	Weekday	US-160	NB	61.9	60.3	41.3	53.2	62	62	1.00	1.03	1.50	1.17								
	115P06575	4 Evening	Weekday	US-160	NB	60.9	59.7	45.4	49.5	62	62	1.02	1.04	1.37	1.25								
11	115P06576	1 AM Peak	Weekday	US-160	NB	62.0	61.6	32.3	54.3	65	65	1.05	1.06	2.01	1.20	1.05	1.06	2.01	1.24	1.02	1.15	2.27	1.74
	115P06576	2 Mid Day	Weekday	US-160	NB	63.0	61.7	39.8	54.8	65	65	1.03	1.05	1.63	1.19								
	115P06576	3 PM Peak	Weekday	US-160	NB	65.0	61.5	50.9	55.1	65	65	1.00	1.06	1.28	1.18								
	115P06576	4 Evening	Weekday	US-160	NB	63.8	61.2	48.5	52.2	65	65	1.02	1.06	1.34	1.24								
	115P05883	1 AM Peak	Weekday	US-160	NB	57.0	49.4	30.5	11.8	55	55	1.00	1.11	1.81		1.00	1.24	2.53	2.23				
	115P05883	2 Mid Day	Weekday	US-160	NB	55.4	44.5	21.8	7.1	55	55	1.00	1.24	2.53									
	115P05883	3 PM Peak	Weekday	US-160	NB	57.8	54.5	32.5	28.3	55	55	1.00	1.01	1.69	1.95								
	115P05883	4 Evening	Weekday	US-160	NB	58.6	53.8	36.2	24.7	55	55	1.00	1.02	1.52	2.23								
12	115P05883	1 AM Peak	Weekday	US-160	NB	57.0	49.4	30.5	11.8	55	55	1.00	1.11	1.81		1.00	1.24	2.53	2.23	1.08	1.19	2.95	2.17
	115P05883	2 Mid Day	Weekday	US-160	NB	55.4	44.5	21.8	7.1	55	55	1.00	1.24	2.53									
	115P05883	3 PM Peak	Weekday	US-160	NB	57.8	54.5	32.5	28.3	55	55	1.00	1.01	1.69	1.95								
	115P05883	4 Evening	Weekday	US-160	NB	58.6	53.8	36.2	24.7	55	55	1.00	1.02	1.52	2.23								
	115P06577	1 AM Peak	Weekday	US-160	NB	56.7	58.4	20.5	39.4	65	65	1.15	1.11	3.17	1.65	1.15	1.15	3.37	2.11				
	115P06577	2 Mid Day	Weekday	US-160	NB	56.3	56.7	23.0	30.9	65	65	1.15	1.15	2.83	2.11								
	115P06577	3 PM Peak	Weekday	US-160	NB	56.4	57.0	19.3	31.7	65	65	1.15	1.14	3.37	2.05								
	115P06577	4 Evening	Weekday	US-160	NB	57.8	57.5	26.7	34.8	65	65	1.12	1.13	2.43	1.87								

TTI & PTI Westbound

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
1	115N06556	1 AM Peak	Weekday	US-160	SB	64.4	53.6	52.7	20.5	65	65	1.01	1.21	1.23		1.05	1.21	1.31	1.40	1.02	1.15	1.88	2.39
	115N06556	2 Mid Day	Weekday	US-160	SB	62.4	59.2	51.0	47.8	65	65	1.04	1.10	1.27	1.36								
	115N06556	3 PM Peak	Weekday	US-160	SB	62.0	59.3	51.0	48.8	65	65	1.05	1.10	1.27	1.33								
	115N06556	4 Evening	Weekday	US-160	SB	62.7	58.6	49.7	46.4	65	65	1.04	1.11	1.31	1.40								
	115N05877	1 AM Peak	Weekday	US-160	SB	59.4	52.0	32.3	16.3	55	55	1.00	1.06	1.70	3.37	1.00	1.08	2.46	3.37				
	115N05877	2 Mid Day	Weekday	US-160	SB	56.5	51.4	22.4	19.6	55	55	1.00	1.07	2.46	2.81								
	115N05877	3 PM Peak	Weekday	US-160	SB	56.3	50.8	25.5	11.0	55	55	1.00	1.08	2.16									
	115N05877	4 Evening	Weekday	US-160	SB	57.3	51.3	31.1	25.5	55	55	1.00	1.07	1.77	2.16								
2	115N06556	1 AM Peak	Weekday	US-160	SB	64.4	53.6	52.7	20.5	65	65	1.01	1.21	1.23		1.05	1.21	1.31	1.40	1.17	1.24	3.25	3.49
	115N06556	2 Mid Day	Weekday	US-160	SB	62.4	59.2	51.0	47.8	65	65	1.04	1.10	1.27	1.36								
	115N06556	3 PM Peak	Weekday	US-160	SB	62.0	59.3	51.0	48.8	65	65	1.05	1.10	1.27	1.33								
	115N06556	4 Evening	Weekday	US-160	SB	62.7	58.6	49.7	46.4	65	65	1.04	1.11	1.31	1.40								
	115N06557	1 AM Peak	Weekday	US-160	SB	49.4	38.0	23.0	4.4	45	45	1.00	1.18	1.95		1.00	1.18	2.50	2.90				
	115N06557	2 Mid Day	Weekday	US-160	SB	47.2	42.4	18.9	15.5	45	45	1.00	1.06	2.38	2.90								
	115N06557	3 PM Peak	Weekday	US-160	SB	46.9	44.2	18.0	23.0	45	45	1.00	1.02	2.50	1.95								
	115N06557	4 Evening	Weekday	US-160	SB	47.4	42.0	22.8	18.6	45	45	1.00	1.07	1.97	2.41								
	115N06558	1 AM Peak	Weekday	US-160	SB	54.3	51.6	35.0	39.9	60	60	1.11	1.16	1.71	1.50	1.14	1.17	2.05	1.63				
	115N06558	2 Mid Day	Weekday	US-160	SB	52.7	51.2	29.3	36.8	60	60	1.14	1.17	2.05	1.63								
	115N06558	3 PM Peak	Weekday	US-160	SB	54.0	52.5	35.0	40.4	60	60	1.11	1.14	1.71	1.48								
	115N06558	4 Evening	Weekday	US-160	SB	53.6	51.1	35.4	37.8	60	60	1.12	1.17	1.69	1.59								
	115N05878	1 AM Peak	Weekday	US-160	SB	30.0	30.7	6.2	6.8	40	40	1.33	1.30	6.44	5.85	1.51	1.39	7.16	8.04				
	115N05878	2 Mid Day	Weekday	US-160	SB	27.8	28.7	5.6	5.0	40	40	1.44	1.39	7.16	8.04								
	115N05878	3 PM Peak	Weekday	US-160	SB	26.5	29.4	5.6	7.5	40	40	1.51	1.36	7.16	5.37								
	115N05878	4 Evening	Weekday	US-160	SB	28.0	29.7	6.8	5.6	40	40	1.43	1.35	5.85	7.16								
3	115N06559	1 AM Peak	Weekday	US-160	SB	68.1	62.8	59.6	57.8	65	65	1.00	1.03	1.09	1.13	1.00	1.04	1.14	1.18	1.01	1.11	1.35	1.47
	115N06559	2 Mid Day	Weekday	US-160	SB	66.7	62.3	58.4	56.6	65	65	1.00	1.04	1.11	1.15								
	115N06559	3 PM Peak	Weekday	US-160	SB	66.2	62.7	57.2	57.4	65	65	1.00	1.04	1.14	1.13								
	115N06559	4 Evening	Weekday	US-160	SB	66.6	62.5	57.4	55.0	65	65	1.00	1.04	1.13	1.18								
	115N06560	1 AM Peak	Weekday	US-160	SB	66.0	60.0	50.3	49.2	65	65	1.00	1.08	1.29	1.32	1.03	1.12	1.49	1.65				
	115N06560	2 Mid Day	Weekday	US-160	SB	64.5	59.4	47.8	46.7	65	65	1.01	1.09	1.36	1.39								
	115N06560	3 PM Peak	Weekday	US-160	SB	63.9	59.7	45.9	46.7	65	65	1.02	1.09	1.41	1.39								
	115N06560	4 Evening	Weekday	US-160	SB	63.1	57.8	43.5	39.5	65	65	1.03	1.12	1.49	1.65								
	115N06561	1 AM Peak	Weekday	US-160	SB	56.2	42.3	38.8	30.8	45	45	1.00	1.06	1.16	1.46	1.00	1.15	1.42	1.57				
	115N06561	2 Mid Day	Weekday	US-160	SB	52.9	43.4	36.4	31.6	45	45	1.00	1.04	1.24	1.42								
	115N06561	3 PM Peak	Weekday	US-160	SB	51.2	43.8	33.4	30.8	45	45	1.00	1.03	1.35	1.46								
	115N06561	4 Evening	Weekday	US-160	SB	50.4	39.1	31.6	28.6	45	45	1.00	1.15	1.42	1.57								
4	115N06562	1 AM Peak	Weekday	US-160	SB	68.4	59.6	57.8	39.7	65	65	1.00	1.09	1.12	1.64	1.00	1.10	1.24	1.64	1.00	1.08	1.25	1.40

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
	115N06562	2 Mid Day	Weekday	US-160	SB	67.0	60.4	56.6	49.2	65	65	1.00	1.08	1.15	1.32								
	115N06562	3 PM Peak	Weekday	US-160	SB	66.3	60.8	52.9	51.3	65	65	1.00	1.07	1.23	1.27								
	115N06562	4 Evening	Weekday	US-160	SB	65.3	59.0	52.2	41.3	65	65	1.00	1.10	1.24	1.57								
	115N06563	1 AM Peak	Weekday	US-160	SB	69.1	62.1	60.3	55.9	65	65	1.00	1.05	1.08	1.16	1.00	1.05	1.15	1.20				
	115N06563	2 Mid Day	Weekday	US-160	SB	67.9	61.9	59.1	55.5	65	65	1.00	1.05	1.10	1.17								
	115N06563	3 PM Peak	Weekday	US-160	SB	67.4	62.7	56.8	58.1	65	65	1.00	1.04	1.14	1.12								
	115N06563	4 Evening	Weekday	US-160	SB	66.7	61.9	56.3	54.3	65	65	1.00	1.05	1.15	1.20								
	115N06564	1 AM Peak	Weekday	US-160	SB	68.0	61.1	54.8	53.9	65	65	1.00	1.06	1.19	1.21	1.00	1.08	1.35	1.36				
	115N06564	2 Mid Day	Weekday	US-160	SB	66.6	60.5	54.8	50.7	65	65	1.00	1.07	1.19	1.28								
	115N06564	3 PM Peak	Weekday	US-160	SB	65.3	61.4	48.2	55.4	65	65	1.00	1.06	1.35	1.17								
	115N06564	4 Evening	Weekday	US-160	SB	65.6	60.2	49.7	47.8	65	65	1.00	1.08	1.31	1.36								
5	115N06565	1 AM Peak	Weekday	US-160	SB	67.7	61.2	54.6	53.5	65	65	1.00	1.06	1.19	1.21	1.00	1.08	1.23	1.31	1.00	1.06	1.23	1.25
	115N06565	2 Mid Day	Weekday	US-160	SB	66.6	60.7	56.3	52.2	65	65	1.00	1.07	1.16	1.25								
	115N06565	3 PM Peak	Weekday	US-160	SB	66.1	61.6	54.5	54.4	65	65	1.00	1.06	1.19	1.20								
	115N06565	4 Evening	Weekday	US-160	SB	65.9	60.2	52.8	49.8	65	65	1.00	1.08	1.23	1.31								
	115N05879	1 AM Peak	Weekday	US-160	SB	67.9	62.4	56.6	55.9	65	65	1.00	1.04	1.15	1.16	1.00	1.05	1.23	1.20				
	115N05879	2 Mid Day	Weekday	US-160	SB	66.4	62.4	55.9	56.3	65	65	1.00	1.04	1.16	1.15								
	115N05879	3 PM Peak	Weekday	US-160	SB	65.9	62.6	54.7	56.6	65	65	1.00	1.04	1.19	1.15								
	115N05879	4 Evening	Weekday	US-160	SB	66.0	62.1	52.8	54.3	65	65	1.00	1.05	1.23	1.20								
6	115N06566	1 AM Peak	Weekday	US-160	SB	65.7	59.4	54.9	49.7	65	65	1.00	1.09	1.18	1.31	1.03	1.12	1.31	1.44	1.06	1.13	2.11	1.48
	115N06566	2 Mid Day	Weekday	US-160	SB	64.1	58.9	52.8	48.5	65	65	1.01	1.10	1.23	1.34								
	115N06566	3 PM Peak	Weekday	US-160	SB	63.7	59.7	52.5	50.3	65	65	1.02	1.09	1.24	1.29								
	115N06566	4 Evening	Weekday	US-160	SB	63.2	58.2	49.7	45.2	65	65	1.03	1.12	1.31	1.44								
	115N06567	1 AM Peak	Weekday	US-160	SB	63.6	58.0	47.2	48.6	65	65	1.02	1.12	1.38	1.34	1.10	1.14	2.91	1.52				
	115N06567	2 Mid Day	Weekday	US-160	SB	62.7	58.1	46.5	46.5	65	65	1.04	1.12	1.40	1.40								
	115N06567	3 PM Peak	Weekday	US-160	SB	61.0	58.9	40.6	49.8	65	65	1.06	1.10	1.60	1.30								
	115N06567	4 Evening	Weekday	US-160	SB	59.3	56.9	22.4	42.9	65	65	1.10	1.14	2.91	1.52								
7	115N06568	1 AM Peak	Weekday	US-160	SB	59.0	50.5	24.9	13.7	65	65	1.10	1.29	2.61	4.75	1.18	1.29	3.32	4.75	1.16	1.34	3.07	5.28
	115N06568	2 Mid Day	Weekday	US-160	SB	56.6	51.3	19.9	18.6	65	65	1.15	1.27	3.27	3.49								
	115N06568	3 PM Peak	Weekday	US-160	SB	55.2	52.5	19.6	20.0	65	65	1.18	1.24	3.32	3.24								
	115N06568	4 Evening	Weekday	US-160	SB	56.4	51.0	20.3	15.5	65	65	1.15	1.27	3.20	4.18								
	115N05880	1 AM Peak	Weekday	US-160	SB	59.4	47.6	27.3	14.9	65	65	1.09	1.36	2.38	4.36	1.14	1.39	2.83	5.81				
	115N05880	2 Mid Day	Weekday	US-160	SB	57.2	48.0	23.0	14.9	65	65	1.14	1.35	2.83	4.36								
	115N05880	3 PM Peak	Weekday	US-160	SB	57.3	48.1	24.4	12.4	65	65	1.13	1.35	2.66	5.23								
	115N05880	4 Evening	Weekday	US-160	SB	57.6	46.8	24.2	11.2	65	65	1.13	1.39	2.68	5.81								
8	115N06569	1 AM Peak	Weekday	US-160	SB	66.8	59.7	56.7	52.2	65	65	1.00	1.09	1.15	1.24	1.00	1.10	1.22	1.30	1.00	1.08	1.20	1.26
	115N06569	2 Mid Day	Weekday	US-160	SB	66.0	59.5	55.9	52.0	65	65	1.00	1.09	1.16	1.25								
	115N06569	3 PM Peak	Weekday	US-160	SB	65.7	59.9	54.7	51.4	65	65	1.00	1.08	1.19	1.26								

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
	115N06569	4 Evening	Weekday	US-160	SB	64.9	59.0	53.5	50.0	65	65	1.00	1.10	1.22	1.30								
	115N06570	1 AM Peak	Weekday	US-160	SB	67.2	62.2	59.1	56.8	65	65	1.00	1.05	1.10	1.15	1.00	1.05	1.19	1.22				
	115N06570	2 Mid Day	Weekday	US-160	SB	66.8	62.0	58.7	57.0	65	65	1.00	1.05	1.11	1.14								
	115N06570	3 PM Peak	Weekday	US-160	SB	66.3	62.4	57.8	56.9	65	65	1.00	1.04	1.13	1.14								
	115N06570	4 Evening	Weekday	US-160	SB	65.6	61.9	54.7	53.5	65	65	1.00	1.05	1.19	1.22								
9	115N06570	1 AM Peak	Weekday	US-160	SB	67.2	62.2	59.1	56.8	65	65	1.00	1.05	1.10	1.15	1.00	1.05	1.19	1.22	1.02	1.06	1.37	1.25
	115N06570	2 Mid Day	Weekday	US-160	SB	66.8	62.0	58.7	57.0	65	65	1.00	1.05	1.11	1.14								
	115N06570	3 PM Peak	Weekday	US-160	SB	66.3	62.4	57.8	56.9	65	65	1.00	1.04	1.13	1.14								
	115N06570	4 Evening	Weekday	US-160	SB	65.6	61.9	54.7	53.5	65	65	1.00	1.05	1.19	1.22								
	115N06571	1 AM Peak	Weekday	US-160	SB	62.0	61.2	36.9	54.7	65	65	1.05	1.06	1.76	1.19	1.06	1.07	1.88	1.25				
	115N06571	2 Mid Day	Weekday	US-160	SB	62.5	61.7	39.7	56.0	65	65	1.04	1.05	1.64	1.16								
	115N06571	3 PM Peak	Weekday	US-160	SB	61.9	62.1	34.5	55.8	65	65	1.05	1.05	1.88	1.17								
	115N06571	4 Evening	Weekday	US-160	SB	61.1	60.8	35.4	51.9	65	65	1.06	1.07	1.83	1.25								
	115N06572	1 AM Peak	Weekday	US-160	SB	65.3	60.4	53.7	51.9	65	65	1.00	1.08	1.21	1.25	1.01	1.09	1.24	1.30				
	115N06572	2 Mid Day	Weekday	US-160	SB	65.6	60.4	55.3	52.0	65	65	1.00	1.08	1.17	1.25								
	115N06572	3 PM Peak	Weekday	US-160	SB	66.1	60.8	56.6	52.5	65	65	1.00	1.07	1.15	1.24								
	115N06572	4 Evening	Weekday	US-160	SB	64.3	59.8	52.5	50.0	65	65	1.01	1.09	1.24	1.30								
	115N06573	1 AM Peak	Weekday	US-160	SB	66.2	61.9	54.6	56.2	65	65	1.00	1.05	1.19	1.16	1.00	1.05	1.19	1.22				
	115N06573	2 Mid Day	Weekday	US-160	SB	66.3	61.9	56.6	55.9	65	65	1.00	1.05	1.15	1.16								
	115N06573	3 PM Peak	Weekday	US-160	SB	67.3	62.7	57.8	56.6	65	65	1.00	1.04	1.13	1.15								
	115N06573	4 Evening	Weekday	US-160	SB	66.2	61.9	55.9	53.4	65	65	1.00	1.05	1.16	1.22								
10	115N05881	1 AM Peak	Weekday	US-160	SB	57.9	53.5	19.9	22.7	65	65	1.12	1.22	3.27	2.86	1.14	1.24	3.27	3.73	1.04	1.10	1.85	1.86
	115N05881	2 Mid Day	Weekday	US-160	SB	58.6	52.5	23.6	17.4	65	65	1.11	1.24	2.75	3.73								
	115N05881	3 PM Peak	Weekday	US-160	SB	59.2	54.5	20.5	20.5	65	65	1.10	1.19	3.17	3.17								
	115N05881	4 Evening	Weekday	US-160	SB	56.9	53.0	21.8	20.5	65	65	1.14	1.23	2.99	3.17								
	115N05882	1 AM Peak	Weekday	US-160	SB	65.8	62.0	56.5	54.7	65	65	1.00	1.05	1.15	1.19	1.00	1.05	1.22	1.22				
	115N05882	2 Mid Day	Weekday	US-160	SB	66.5	62.3	57.4	55.9	65	65	1.00	1.04	1.13	1.16								
	115N05882	3 PM Peak	Weekday	US-160	SB	67.0	62.4	57.8	55.3	65	65	1.00	1.04	1.12	1.18								
	115N05882	4 Evening	Weekday	US-160	SB	65.6	62.1	53.4	53.1	65	65	1.00	1.05	1.22	1.22								
	115N06574	1 AM Peak	Weekday	US-160	SB	60.4	59.2	38.5	51.0	62	62	1.03	1.05	1.61	1.22	1.03	1.05	1.72	1.28				
	115N06574	2 Mid Day	Weekday	US-160	SB	60.3	59.3	36.0	49.0	62	62	1.03	1.05	1.72	1.26								
	115N06574	3 PM Peak	Weekday	US-160	SB	61.9	59.3	43.7	51.0	62	62	1.00	1.05	1.42	1.22								
	115N06574	4 Evening	Weekday	US-160	SB	61.5	58.8	43.2	48.5	62	62	1.01	1.05	1.43	1.28								
	115N06573	1 AM Peak	Weekday	US-160	SB	66.2	61.9	54.6	56.2	65	65	1.00	1.05	1.19	1.16	1.00	1.05	1.19	1.22				
	115N06573	2 Mid Day	Weekday	US-160	SB	66.3	61.9	56.6	55.9	65	65	1.00	1.05	1.15	1.16								
	115N06573	3 PM Peak	Weekday	US-160	SB	67.3	62.7	57.8	56.6	65	65	1.00	1.04	1.13	1.15								
	115N06573	4 Evening	Weekday	US-160	SB	66.2	61.9	55.9	53.4	65	65	1.00	1.05	1.16	1.22								
11	115N06575	1 AM Peak	Weekday	US-160	SB	63.6	62.0	44.7	55.5	65	65	1.02	1.05	1.45	1.17	1.03	1.06	1.61	1.23	1.01	1.11	1.83	2.39

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	Trucks TTI	Cars PTI	Trucks PTI	Cars Peak TTI	Trucks Peak TTI	Cars Peak PTI	Trucks Peak PTI	Segment Average Cars TTI	Segment Average Trucks TTI	Segment Average Cars PTI	Segment Average Trucks PTI
	115N06575	2 Mid Day	Weekday	US-160	SB	63.1	62.1	40.4	55.7	65	65	1.03	1.05	1.61	1.17								
	115N06575	3 PM Peak	Weekday	US-160	SB	64.5	62.2	50.8	55.1	65	65	1.01	1.04	1.28	1.18								
	115N06575	4 Evening	Weekday	US-160	SB	63.9	61.6	51.0	52.7	65	65	1.02	1.06	1.28	1.23								
	115N06576	1 AM Peak	Weekday	US-160	SB	55.1	48.1	26.7	15.5	55	55	1.00	1.14	2.06	3.54	1.00	1.16	2.06	3.54				
	115N06576	2 Mid Day	Weekday	US-160	SB	55.8	47.6	29.2	13.7	55	55	1.00	1.16	1.88									
	115N06576	3 PM Peak	Weekday	US-160	SB	57.4	52.9	36.1	30.5	55	55	1.00	1.04	1.52	1.81								
	115N06576	4 Evening	Weekday	US-160	SB	56.3	52.1	34.8	28.0	55	55	1.00	1.06	1.58	1.97								
12	115N05883	1 AM Peak	Weekday	US-160	SB	51.9	47.5	16.2	26.7	55	55	1.06	1.16	3.40	2.06	1.12	1.17	3.40	2.33	1.12	1.17	3.40	2.33
	115N05883	2 Mid Day	Weekday	US-160	SB	50.2	47.6	18.6	25.5	55	55	1.10	1.16	2.95	2.16								
	115N05883	3 PM Peak	Weekday	US-160	SB	49.5	47.3	16.8	24.9	55	55	1.11	1.16	3.28	2.21								
	115N05883	4 Evening	Weekday	US-160	SB	49.1	46.9	20.5	23.6	55	55	1.12	1.17	2.68	2.33								

Closure Data

Segment	Length (miles)	# of closures	# F&I	Total miles of closures		Avg Occurrences/Mile/Year	
				EB	WB	EB	EB
160-1	8	3	2	3.0	0.0	0.08	0.00
160-2	4	2	1	2.0	0.0	0.10	0.00
160-3	21	10	9	25.0	5.0	0.24	0.05
160-4	18	14	4	31.0	63.0	0.34	0.70
160-5	12	3	1	0.0	3.0	0.00	0.05
160-6	17	18	3	10.0	28.5	0.12	0.34
160-7	4	5	1	2.0	3.0	0.10	0.15
160-8	18	4	2	3.0	1.0	0.03	0.01
160-9	21	8	2	4.0	4.0	0.04	0.04
160-10	17	13	6	12.0	1.0	0.14	0.01
160-11	12	4	2	0.0	4.0	0.00	0.07
160-12	7	5	2	3.0	2.0	0.09	0.06

	ITIS Category Description											
	Closures		Incidents/Accidents		Incidents/Crashes		Obstruction Hazards		Winds		Winter Storm Codes	
Segment	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
160-1	0	0	3	0	0	0	0	0	0	0	0	0
160-2	0	0	1	0	0	0	1	0	0	0	0	0
160-3	0	0	4	5	0	0	0	0	0	0	1	0
160-4	0	0	4	8	0	0	0	0	0	0	1	1
160-5	0	0	0	2	0	0	0	1	0	0	0	0
160-6	0	0	9	3	0	0	1	2	0	0	0	3
160-7	0	0	2	3	0	0	0	0	0	0	0	0
160-8	0	0	3	1	0	0	0	0	0	0	0	0
160-9	0	0	4	4	0	0	0	0	0	0	0	0
160-10	0	0	12	1	0	0	0	0	0	0	0	0
160-11	0	0	0	4	0	0	0	0	0	0	0	0
160-12	0	0	3	2	0	0	0	0	0	0	0	0

HPMS Data

Segment	MP From	MP To	Weighted Average NB/WB AADT	Weighted Average SB/EB AADT	Weighted Average AADT	NB/WB AADT	SB/EB AADT	2015 AADT	K Factor	D-Factor	T-Factor
160-1	311	319	2925	2958	5884	3080	3223	6303	10	51	8
160-2	319	323	5560	6154	11714	4722	6220	10942	11	56	9
160-3	323	344	2203	2186	4389	2288	2292	4581	11	50	13
160-4	344	362	1776	1806	3582	1584	1694	3278	9	52	12
160-5	362	374	2235	2253	4488	2138	2241	4379	10	51	11
160-6	374	391	2577	2538	5115	2838	2738	5577	10	51	10
160-7	391	395	2226	2234	4461	2523	2582	5106	10	51	10
160-8	395	413	1452	1471	2924	1553	1628	3181	9	51	11
160-9	413	434	1370	1395	2766	1526	1541	3068	11	50	11
160-10	434	451	1453	1433	2886	1522	1533	3055	8	50	11
160-11	451	463	1458	1440	2898	1513	1533	3046	8	50	11
160-12	463	470	904	898	1802	1147	1153	2299	9	50	11

Segment	Loc ID	BMP	EMP	Length	Pos Dir AADT	Neg Dir AADT	Corrected Pos Dir AADT	Corrected Neg Dir AADT	2015 AADT	K Factor	D-Factor	D-Factor Adjusted	T-Factor
160-1	102171	311.46	318.49	7.03	2933	2946	2933	2946	5880	10	60	50	8
	102172	318.49	319.00	0.51	5099	7035	5099	7035	12134	11	61	58	9
160-2	102172	319.00	321.95	2.95	5099	7035	5099	7035	12134	11	61	58	9
	102173	321.95	322.35	0.40	5877	6569	5877	6569	12446	11	62	53	9
	102174	322.35	323.00	0.65	2303	2304	2303	2304	4608	11	54	50	13
160-3	102174	323.00	343.58	20.58	2303	2304	2303	2304	4608	11	54	50	13
	102175	343.58	344.00	0.42	1572	1682	1572	1682	3254	9	50	52	12
160-4	102175	344.00	361.62	17.62	1572	1682	1572	1682	3254	9	50	52	12
	102176	361.62	362.00	0.38	2138	2241	2138	2241	4379	10	55	51	11
160-5	102176	362.00	374.00	12.00	2138	2241	2138	2241	4379	10	55	51	11
160-6	102176	374.00	374.28	0.28	2138	2241	2138	2241	4379	10	55	51	11
	102177	374.28	382.27	7.99	2865	2689	2865	2689	5554	9	51	52	10
	102178	382.97	391.00	8.03	2835	2804	2835	2804	5641	11	63	50	10
160-7	102178	391.00	393.55	2.55	2835	2804	2835	2804	5641	11	63	50	10
	102286	393.55	395.00	1.45	1975	2191	1975	2191	4166	9	61	53	10
160-8	102179	401.46	413.00	11.54	1317	1313	1317	1313	2630	9	62	50	11
	102286	395.00	401.45	6.45	1975	2191	1975	2191	4166	9	61	53	10
160-9	102287	413.00	434.00	21.00	1526	1541	1526	1541	3068	11	64	50	11
160-10	102287	434.00	434.83	0.83	1526	1541	1526	1541	3068	11	64	50	11
	102180	434.83	437.15	2.32	1575	1528	1575	1528	3103	9	54	51	11
	102181	437.15	451.00	13.85	1513	1533	1513	1533	3046	8	51	50	11
160-11	102181	451.00	463.00	12.00	1513	1533	1513	1533	3046	8	51	50	11
160-12	102181	463.00	465.40	2.40	1513	1533	1513	1533	3046	8	51	50	11
	102182	465.40	470.73	5.33	0	1007	982	982	1963	9	58	50	11

Bicycle Accommodation Data

Segment	BMP	EMP	Divided or Non	EB Right Shoulder Width	WB Right Shoulder Width	EB Left Shoulder Width	WB Left Shoulder Width	EB Effective Length of Shoulder	WB Effective Length of Shoulder	% Bicycle Accommodation
160-1	311	319	Undivided	5.0	5.0	N/A	N/A	0.0	0.0	0%
160-2	319	323	Undivided	5.1	6.1	N/A	N/A	2.9	3.8	84%
160-3	323	344	Undivided	5.0	6.1	N/A	N/A	0.3	7.9	19%
160-4	344	362	Undivided	5.2	5.5	N/A	N/A	1.4	2.0	9%
160-5	362	374	Undivided	5.0	5.0	N/A	N/A	0.0	0.0	0%
160-6	374	391	Undivided	5.0	5.0	N/A	N/A	0.0	0.0	0%
160-7	391	395	Undivided	4.1	4.1	N/A	N/A	0.2	0.2	6%
160-8	395	413	Undivided	5.0	5.0	N/A	N/A	0.1	0.0	0%
160-9	413	434	Undivided	5.0	5.0	N/A	N/A	0.1	0.1	1%
160-10	434	451	Undivided	4.9	5.0	N/A	N/A	0.0	0.2	1%
160-11	451	463	Undivided	5.0	5.0	N/A	N/A	0.0	0.0	0%
160-12	463	470	Undivided	5.0	5.3	N/A	N/A	0.3	0.3	4%

AZTDM Data

SEGMENT	Growth Rate	% Non-SOV
1	2.22%	14.2%
2	2.22%	14.2%
3	2.09%	12.7%
4	2.06%	14.7%
5	1.98%	17.5%
6	2.01%	15.9%
7	3.25%	6.9%
8	1.82%	7.2%
9	1.82%	12.1%
10	1.72%	16.7%
11	1.73%	0.0%
12	1.77%	0.0%

HERS Capacity Calculation Data

Segment	Facility Type	Terrain	Lane Width (Rounded, feet)	EB Rt. Shoulder	WB Rt. Shoulder	F_{lw} or f_w or f_{LS}	EB F_{lc}	WB F_{lc}	Total Ramp Density[1]	PHF	E_T	f_{HV}	f_M	f_A	g/C[2]	f_G	f_{NP}	Nm	f_p	EB FFS	WB FFS	EB Peak-Hour Capacity	WB Peak-Hour Capacity	Major Direction Peak-Hour Capacity	Daily Capacity[3]
1	Rural	Rolling	12.00	5.00	5.00	0.0	N/A	N/A	N/A	0.88	2.1	0.919	N/A	0.38	N/A	0.83	2.35	N/A	N/A	72.63	72.63	N/A	N/A	1309.56	24,944
2	Rural	Rolling	12.00	5.09	6.09	1.0	N/A	N/A	N/A	0.9	2	0.917	N/A	N/A	0.55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1024.63	19,517
3	Rural	Level	12.00	5.04	6.13	0.0	N/A	N/A	N/A	0.88	1.4	0.951	N/A	0.43	N/A	1	1.90	N/A	N/A	73.58	73.58	N/A	N/A	1707.23	32,519
4	Rural	Level	12.00	5.22	5.54	0.0	N/A	N/A	N/A	0.88	1.5	0.943	N/A	0.4	N/A	1	1.65	N/A	N/A	74.60	74.60	N/A	N/A	1762.55	33,572
5	Rural	Level	12.00	5.00	5.00	0.0	N/A	N/A	N/A	0.88	1.5	0.948	N/A	0.58	N/A	1	2.20	N/A	N/A	74.43	74.43	N/A	N/A	1731.93	32,989
6	Rural	Rolling	12.00	5.00	5.00	0.0	N/A	N/A	N/A	0.88	2.1	0.901	N/A	0.48	N/A	0.83	1.90	N/A	N/A	73.53	73.53	N/A	N/A	1340.84	25,540
7	Rural	Rolling	12.00	4.13	4.12	1.0	N/A	N/A	N/A	0.9	2	0.909	N/A	N/A	0.55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	955.46	18,199
8	Rural	Level	12.00	4.99	4.95	0.0	N/A	N/A	N/A	0.88	1.9	0.910	N/A	0.1	N/A	1	1.10	N/A	N/A	74.90	74.90	N/A	N/A	1743.85	33,216
9	Rural	Level	12.00	5.02	5.01	0.0	N/A	N/A	N/A	0.88	1.5	0.948	N/A	0.38	N/A	1	2.20	N/A	N/A	74.63	74.63	N/A	N/A	1742.68	33,194
10	Rural	Rolling	12.00	4.94	4.99	0.0	N/A	N/A	N/A	0.88	2.7	0.842	N/A	0.33	N/A	0.67	1.65	N/A	N/A	73.68	73.68	N/A	N/A	1024.95	19,523
11	Rural	Rolling	12.00	5.00	5.00	0.0	N/A	N/A	N/A	0.88	2.7	0.842	N/A	0.43	N/A	0.67	1.10	N/A	N/A	74.58	74.58	N/A	N/A	1071.36	20,407
12	Rural	Rolling	12.00	5.04	5.26	0.0	N/A	N/A	N/A	0.88	2.7	0.842	N/A	0.9	N/A	0.67	1.65	N/A	N/A	69.10	69.10	N/A	N/A	878.53	16,734

Safety Performance Area Data

Segment	Segment Similar Operating Environment Type	Segment Length (miles)	EB Fatal Crashes 2011-2015	WB Fatal Crashes 2011-2015	EB Incapacitating Injury Crashes 2011-2015	WB Incapacitating Injury Crashes 2011-2015	Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors
160-1	2 or 3 Lane Undivided Highway	8	1	0	0	0	0
160-2	2 or 3 Lane Undivided Highway	4	1	0	0	0	0
160-3	2 or 3 Lane Undivided Highway	21	6	6	2	1	7
160-4	2 or 3 Lane Undivided Highway	18	5	0	2	3	5
160-5	2 or 3 Lane Undivided Highway	12	0	0	0	1	0
160-6	2 or 3 Lane Undivided Highway	17	1	0	0	2	3
160-7	2 or 3 Lane Undivided Highway	4	1	0	0	2	1
160-8	2 or 3 Lane Undivided Highway	18	0	3	0	1	2
160-9	2 or 3 Lane Undivided Highway	21	1	3	0	0	2
160-10	2 or 3 Lane Undivided Highway	17	2	3	3	1	4
160-11	2 or 3 Lane Undivided Highway	12	1	0	1	0	1
160-12	2 or 3 Lane Undivided Highway	7	0	0	2	2	2

Segment	Segment Similar Operating Environment Type	Fatal + Incapacitating Injury Crashes Involving Trucks	Fatal + Incapacitating Injury Crashes Involving Motorcycles	Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers	Weighted 5-Year Average EB AADT	Weighted 5-Year Average WB AADT	Weighted 5-Year Average Total AADT
160-1	2 or 3 Lane Undivided Highway	0	0	0	2925	2958	5883
160-2	2 or 3 Lane Undivided Highway	0	0	1	5560	6154	11714
160-3	2 or 3 Lane Undivided Highway	1	0	1	2203	2186	4388
160-4	2 or 3 Lane Undivided Highway	1	3	0	1776	1806	3582
160-5	2 or 3 Lane Undivided Highway	0	0	0	2235	2253	4488
160-6	2 or 3 Lane Undivided Highway	0	0	1	2577	2538	5115
160-7	2 or 3 Lane Undivided Highway	0	1	0	2226	2234	4460
160-8	2 or 3 Lane Undivided Highway	0	0	0	1452	1471	2924
160-9	2 or 3 Lane Undivided Highway	0	0	1	1370	1395	2765
160-10	2 or 3 Lane Undivided Highway	2	0	1	1453	1433	2886
160-11	2 or 3 Lane Undivided Highway	0	0	0	1458	1440	2899
160-12	2 or 3 Lane Undivided Highway	0	0	0	904	898	1802

Freight Performance Area Data

Segment	Length (miles)	# of closures	# F&I	Total minutes of closures		Avg Mins/Mile/Year	
				EB	WB	EB	WB
160-1	8	3	2	413.0	0.0	10.33	0.00
160-2	4	2	1	241.0	0.0	12.05	0.00
160-3	21	10	9	5919.0	945.0	56.37	9.00
160-4	18	14	4	6742.0	8391.0	74.91	93.23
160-5	12	3	1	0.0	951.0	0.00	15.85
160-6	17	18	3	1935.0	5094.0	22.76	59.93
160-7	4	5	1	377.0	295.0	18.85	14.75
160-8	18	4	2	840.0	473.0	9.33	5.26
160-9	21	8	2	1075.0	880.0	10.24	8.38
160-10	17	13	6	3016.0	395.0	35.48	4.65
160-11	12	4	2	0.0	558.0	0.00	9.30
160-12	7	5	2	696.0	925.0	19.89	26.43

	ITIS Category Description											
	Closures		Incidents/Accidents		Incidents/Crashes		Obstruction Hazards		Winds		Winter Storm Codes	
Segment	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
160-1	0	0	3	0	0	0	0	0	0	0	0	0
160-2	0	0	1	0	0	0	1	0	0	0	0	0
160-3	0	0	4	5	0	0	0	0	0	0	1	0
160-4	0	0	4	8	0	0	0	0	0	0	1	1
160-5	0	0	0	2	0	0	0	1	0	0	0	0
160-6	0	0	9	3	0	0	1	2	0	0	0	3
160-7	0	0	2	3	0	0	0	0	0	0	0	0
160-8	0	0	3	1	0	0	0	0	0	0	0	0
160-9	0	0	4	4	0	0	0	0	0	0	0	0
160-10	0	0	12	1	0	0	0	0	0	0	0	0
160-11	0	0	0	4	0	0	0	0	0	0	0	0
160-12	0	0	3	2	0	0	0	0	0	0	0	0

See the **Mobility Performance Area Data** section for other Freight Performance Area related data

Appendix D: Performance Area Data

Pavement Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Pavement Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for Pavement. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scales" within the Step 1 template.

To develop an aggregate Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Enter the appropriate segment information into the columns titled "Segment", "Segment Length", "Segment Mileposts" and "Facility Type".

Step 1.2

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Existing Performance Analysis into the appropriate "Performance Score" columns. Copy the performance score for each segment to the appropriate "Performance Score" column. Paste only the "values" and do not overwrite the formatting.

Step 1.3

Indicate if Pavement is an Emphasis Area by selecting "Yes" or "No" in the row immediately below the segment information.

Step 1.4

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the segment information and the initial needs from the Step 1 template to the "Initial Need" column of the Step 2 template.

Step 2.2

Note in the "Hot Spots" column any pavement failure hot spots identified as part of the baseline corridor performance. For each entry, include the milepost limits of the hot spot. Hot spots are identified in the Pavement Index spreadsheet by the red cells in the columns titled "% Pavement Failure". These locations are based on the following criteria:

Interstates: IRI > 105 or Cracking > 15

Non-Interstates: IRI > 142 or Cracking > 15

Every segment that has a % Pavement Failure greater than 0% will have at least one hot spot. Hot spot locations should be described as extending over consecutive miles. For example, if there is a pavement failure location that extends 5 consecutive miles, it should be identified as one hot spot, not 5 separate hot spots.

Step 2.3

Identify recently completed or under construction paving projects in the "Previous Projects" column. Include only projects that were completed after the pavement condition data period (check dates in pavement condition data provided by ADOT) that would supersede the results of the performance system.

Step 2.5

Update the "Final Need" column using the following criteria:

- If "None" but have a hot spot (or hot spots), the Final Need = Low, and note the reason for the change in the "Comments" column (column H).

- If a recent project has superseded the performance rating data, change the Final Need to “None” and note the reason for the change in the “Comments” column.

Example Scales for Level of Need

Performance Thresholds		Initial Need	Description
3.75		None	(>3.57)
		Low	Middle 1/3rd of Fair Perf. (3.38 - 3.57)
3.2		Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance (3.02-3.38)
		High	Lower 2/3rd of Poor Performance (<3.02)

Need Scale for Interstates

Measure	None >=	Low >=	> Medium <		High <=
Pavement Index (corridor non-emphasis area)	3.57	3.38	3.38	3.02	3.02
Pavement Index (corridor emphasis area)	3.93	3.57	3.57	3.20	3.20
Pavement Index (segments)	3.57	3.38	3.38	3.02	3.02
Directional PSR	3.57	3.38	3.38	3.02	3.02
%Pavement Failure	10%	15%	15%	25%	25%

Need Scale for Highways (Non-Interstates)

Measure	None >=	Low >=	> Medium <		High <=
Pavement Index (corridor non-emphasis area)	3.30	3.10	3.10	2.70	2.70
Pavement Index (corridor emphasis area)	3.70	3.30	3.30	2.90	2.90
Pavement Index (segments)	3.30	3.10	3.10	2.70	2.70
Directional PSR	3.30	3.10	3.10	2.70	2.70
%Pavement Failure	10%	15%	15%	25%	25%

Step 2.6

Note any programmed projects that could have the potential to mitigate pavement needs in in the “Comments” column. Programmed projects are provided as information and do not impact the need rating. The program information can be found in ADOT’s 5-year construction program. If there are other comments relevant to the needs analysis (such as information from previous reports), they can be entered in the “Comments” column. However, only include information related to needs that have been identified through this process. Do not add or create needs from other sources.

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab. The steps to complete Step 3 include:

Step 3.1

Input the level of historical investment for each segment. This will be determined from the numeric score from the Pavement History Table based on the following thresholds:

- Low = < 4.60
- Medium = 4.60 – 6.60
- High = > 6.60

If the PeCoS data shows a high level of maintenance investment, increase the historical investment rating by one level.

Step 3.2

Note the milepost ranges of pavement failure hot spots into the column titled “Contributing Factors and Comments.”

Step 3.3

Note any other information that may be contributing to the deficiency, or supplemental information, in the “Contributing Factors and Comments” column. This could come from discussions with ADOT District staff, ADOT Materials/Pavement Group, previous reports, or the historical investment data.

Step 3.4

Include any programmed projects from ADOT’s 5-year construction program in the “Contributing Factors and Comments” column.

Bridge Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Bridge Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for Bridge. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scales" within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial level of need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Enter the appropriate segment information into the columns titled "Segment", "Segment Length", "Segment Mileposts" and "Number of Bridges."

Step 1.2

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Existing Performance Analysis into the appropriate "Performance Score" columns. Copy the performance score for each segment to the appropriate "Performance Score" column. Paste only the "values" and do not overwrite the formatting.

Step 1.3

Indicate if Bridge is an Emphasis Area by selecting "Yes" or "No" in the row immediately below the segment information.

Step 1.4

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2 .The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial needs from the Step 1 template to the "Initial Need" column of the Step 2 template.

Step 2.2

Note in the column titled "Hot Spots" any bridge hot spots identified as part of the baseline corridor performance. For each entry, note the specific location. Hot spots are identified as having any bridge rating of 4 or less, or multiple ratings of 5 in the deck, substructure, or superstructure ratings.

Step 2.3

Identify recently completed or under construction bridge projects in the "Previous Projects" column. Include only projects that were completed after the bridge condition data period (check dates in bridge condition data provided by ADOT) that would supersede the results of the performance system.

Step 2.4

Update the Final Need on each segment based on the following criteria:

- If the Initial Need is "None" and there is at least one hot spot located on the segment, change the Final Need to "Low".
- If a recent project has superseded the performance rating data, the performance data should be adjusted to increase the specific ratings and the resulting need should be reduced to account for the project.
- Note the reason for any change in the "Comments" column.

Step 2.5

Historical bridge rating data was tabulated and graphed to find any bridges that had fluctuations in the ratings. Note in the "Historical Review" column any bridge that was identified as having a potential historical rating concern based on the following criteria:

- Ratings increase or decrease (bar chart) more than 2 times
- Sufficiency rating drops more than 20 points

This is for information only and does not affect the level of need.

Step 2.6

Note the number of functionally obsolete bridges in each segment in the column titled "# Functionally Obsolete Bridges". This is for information only and does not affect the level of need.

Step 2.7

Identify each bridge "of concern" in the "Comments" column. Note any programmed projects that could have the potential to mitigate bridge needs. Programmed projects are provided as information and do not impact the need rating. The program information can be found in ADOT's 5-year construction program. If there are other comments relevant to the needs analysis (such as information from previous reports), they can be entered in the "Comments" column. However, only include information related to needs that have been identified through this process. Do not add or create needs from other sources.

Example Scales for Level of Need

Bridge Index Performance Thresholds	Level of Need		Description
	Good	None	All of Good Performance and upper 1/3rd of Fair Performance
	Good		
	Good		
6.5	Fair		
	Fair	Low	Middle 1/3rd of Fair Performance
	Fair	Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance
5.0	Poor		
	Poor	High	Lower 2/3rd of Poor Performance
	Poor		

Need Scale

Measure	None >=	Low >=	> Medium <		High <=
Bridge Index (corridor non-emphasis area)	6.0	5.5	5.5	4.5	4.5
Bridge Index (corridor emphasis area)	7.0	6.0	6.0	5.0	5.0
Bridge Index (segments)	6.0	5.5	5.5	4.5	4.5
Bridge Sufficiency	70	60	60	40	40
Bridge Rating	6.0	5.0	4.0	4.0	3.0
%Functionally Obsolete Bridges	21.0%	31.0%	31.0%	49.0%	49.0%

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab. The steps to compete Step 3 include:

Step 3.1

Input the bridge name, structure number, and milepost information for each bridge "of concern" resulting from Step 2.

Step 3.2

For bridges that have a current rating of 5 or less, enter the specific rating, or state "No current ratings less than 6".

Step 3.3

For bridges that were identified for a historical review (step 2.5), state "Could have a repetitive investment issue". If a bridge was not identified for a historical review, state "This structure was not identified in historical review".

Step 3.4

Input any programmed projects from ADOT's 5-year construction program. Note any other information that may be contributing to the deficiency, or supplemental information. This could come from discussions with ADOT District staff, ADOT Bridge Group, or previous reports.

Mobility Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Mobility Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Refined Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

Step 1: Initial Needs

The input required to populate the Step 1 template includes transferring the existing performance score for each segment to the appropriate "Performance Score" columns from Existing Performance Analysis. This includes the primary and secondary measures for Mobility. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scales" in the Step 1 tab.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scores, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Input the accurate number of segments for your corridor in the column titled 'Segment' and the appropriate segment milepost limits and segment lengths in adjacent columns.

Step 1.2

Select the appropriate 'Environment Type' and 'Facility Operation Type' from the drop down menus as defined in Existing Performance Analysis.

Step 1.3

Select 'Yes' or 'No' form the drop down list to not if the Mobility Performance Area is an Emphasis Area for your corridor.

Step 1.4

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Existing Performance Analysis. Copy the performance score for each segment to the appropriate "Performance Score" column.

Step 1.5

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

Step 2: Final Needs

The Initial Need will be carried over to Step 2 The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial deficiencies from the Step 1 template to the Step 2 template.

Step 2.2

Identify recently completed or under construction projects that would be considered relevant to mobility performance. Include only projects that were constructed after 2015 for which the 2015 HPMS data used for traffic volumes would not include. Any completed or under construction roadway project after 2015 that has the potential to mitigate a mobility issue on a corridor segment should be listed in the template. Such projects should include the construction of new travel lanes or speed limit changes on the main corridor only. Do not include projects involving frontage roads or crossings as they would not impact the corridor level performance.

Step 2.3

Update the Final Need using the following criteria:

- If a recent project has superseded the performance rating data and it is certain the project addressed the deficiency, change the need rating to "None".
- If a recent project has superseded the performance rating data but it is uncertain that a project addressed the need, maintain the current deficiency rating and note the uncertainty as a comment.

Step 2.4

Note any programmed or planned projects that have the potential to mitigate any mobility needy on the segment. Programmed and Planned projects are provided as information and do not impact the deficiency rating. Future projects will be reviewed in the development of solution sets for identified needs and deficiencies. The source of future projects can be found in ADOT's 5-year construction program or other planning documents. Other comments relevant to the needs analysis can be entered.

Example Scales for Level of Need

Performance Thresholds	Initial Need	Description
0.71	None	(<0.77)
	Low	Middle 1/3rd of Fair Perf. (0.77 - 0.83)
0.89	Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance (0.83-0.95)
	High	Lower 2/3rd of Poor Performance (>0.95)

Needs Scale

Measure		None <=	Low >=	> Medium <		High <=
Mobility Index (Corridor Emphasis Area)		Weighted calculation for the segment totals in corridor (urban vs. rural)				
Mobility Index (Corridor Non-Emphasis Area)		Weighted calculation for the segment totals in corridor (urban vs. rural)				
Mobility Index (Segment)	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Future Daily V/C	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Existing Peak hour V/C	Urban	0.77	0.83	0.83	0.95	0.95
	Rural	0.63	0.69	0.69	0.83	0.83
Closure Extent		0.35	0.49	0.49	0.75	0.75
Directional TTI	Uninterrupted	1.21	1.27	1.27	1.39	1.39
	Interrupted	1.53	1.77	1.77	2.23	2.23
Directional PTI	Uninterrupted	1.37	1.43	1.43	1.57	1.57
	Interrupted	4.00	5.00	5.00	7.00	7.00
Bicycle Accommodation		80%	70%	70%	50%	50%

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab. The steps to compete Step 3 include:

Step 3.1

Input data from Mobility Index worksheet and corridor observations in appropriate columns for Roadway Variables.

Step 3.2

Input traffic variable data in appropriate columns as indicated, Buffer Index scores will auto populate.

Step 3.3

Input relevant mobility related infrastructure located within each segment as appropriate

Step 3.4

Input the Closure Extents that have occurred along the study corridor. Road closure information can be detailed out by the reason for the closure as documented in Highway Condition Reporting System (HCRS) data analyzed as part of the baseline corridor performance. Closure reasons include incident/accidents, winter storms, obstruction hazards, and undefined closures. Statewide average percentages for the various closure reasons have been calculated for 2010-2015 on ADOT's designated strategic corridors. Compare these statewide average percentages to the corridor percentages for the various closure reasons to identify higher than average percentages of one or more closure reasons on any given segment. Input the closures as follows and use red text to indicate that the segment percentage exceeds statewide averages:

- Total Number of Closures
- % Incidents/Accidents
- % Obstructions/Hazards
- % Weather Related

Step 3.5

List the non-actionable conditions that are present within each segment by milepost if possible. Non-Actionable conditions are conditions that exist within the environment of each segment that cannot be improved through an engineered solution. For example, the border patrol check point in Segment 3 of I-19 is a non-actionable condition.

Step 3.6

Considering all information input, identify and list the contributing factors to the Final Need score.

Safety Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Safety Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

<u>Step 1: Initial Needs</u>

The input required to populate the Step 1 template includes transferring the corridor characteristics and existing performance score for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for safety. As each performance score is input into the template, the Level of Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Scale" within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted scored, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Populate the Step 1 template with the corridor characteristics information. This includes segment operating environments and segment length. Also specify if the safety performance area is an emphasis area as determined in Goals and Objectives. The "Level of Need" is dependent on the input of the operating environment and "Emphasis Area" as the thresholds dynamically update accordingly.

Input the existing (baseline) performance scores for all primary and secondary performance measures from Existing Performance Analysis. Copy the performance score (paste values only) for each segment to the appropriate "Performance Score" column and conditional formatting should color each cell green, yellow, or red based on the corresponding performance thresholds.

Step 1.2

The thresholds for the corridor safety index are based on the segments' operating environments. To ensure that the correct corridor safety index threshold is applied, input the unique segment operating environments that exist with the corridor. Once the input is complete, the average of the Good/Fair and Fair/Poor thresholds for each of the operating environments is calculated and the "Level of Need" thresholds will be derived and applied to the main Step 1 Table.

Step 1.3

Confirm that the following criteria for "Insufficient Data" have been applied and that the resulting Level of Need has been shown as "N/A" where applicable.

- Crash frequency for a segment is less than 5 crashes over the 5-year crash analysis period.
- The change in +/- 1 crash results in the change of need level of 2 levels (i.e., changes from Good to Poor or changes from Poor to Good).
- The average segment crash frequency for the overall corridor (total fatal plus incapacitating injury crash frequency divided by the number of corridor segments) is less than 2 per segment over the 5-year crash analysis period.

Step 1.4

Confirm that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

<u>Step 2: Final Needs</u>

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial needs from the Step 1 template to the Step 2 template**.**

Step 2.2

Using the crash concentration (hot spot) map developed as part of the baseline corridor performance, note the direction of travel and approximate milepost limits of each hot spot.

Step 2.3

Identify recently completed or under construction projects that would be considered relevant to safety performance. Include only projects that were not taken into account during the crash data analysis period (2011 – 2015). Any completed or under construction roadway project after 2015 that has the potential to mitigate a safety issue on a corridor segment should be listed in the template. Sources of recent or current project activity can include ADOT MPD staff, ADOT public notices, and ADOT District staff.

Step 2.4

Update the Final Need based on the following criteria:

- If there is a crash hot spot concentration on a "None" segment, upgrade the need rating to "Low."

Step 2.5

Note any programmed projects that could have the potential to mitigate any safety need on the segment. Programmed projects are provided as information and do not impact the need rating. Programmed projects will be reviewed in the development of solution sets for identified needs. The source of the programming information can be found in ADOT's 5-year construction program. Any other relevant issues identified in previous reports should also be reported.

Needs Scale

Measure		None <=	Low <=	< Medium >		High >=	Good/Fair Threshold	Fair/Poor Threshold
Corridor Safety Index (Emphasis Area)		Weighted average based on operating environment type						
Corridor Safety Index (Non-Emphasis Area)		# Weighted average based on operating environment type					#DIV/0!	#DIV/0!
Safety Index and Directional Safety Index (Segment)	2 or 3 Lane Undivided Highway	0.98	1.02	1.02	1.10	1.10	0.94	1.06
	2 or 3 or 4 Lane Divided Highway	0.92	1.07	1.07	1.38	1.38	0.77	1.23
	4 or 5 Lane Undivided Highway	0.93	1.06	1.06	1.33	1.33	0.8	1.2
	6 Lane Highway	0.85	1.14	1.14	1.73	1.73	0.56	1.44
	Rural 4 Lane Freeway with Daily Volume < 25,000	0.91	1.09	1.09	1.45	1.45	0.73	1.27
	Rural 4 Lane Freeway with Daily Volume > 25,000	0.89	1.1	1.1	1.53	1.53	0.68	1.32
	Urban 4 Lane Freeway	0.93	1.07	1.07	1.35	1.35	0.79	1.21
	Urban or Rural 6 Lane Freeway	0.94	1.06	1.06	1.3	1.3	0.82	1.18
	Urban > 6 Lane Freeway	0.93	1.06	1.06	1.33	1.33	0.8	1.2
% of Fatal + Incap. Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	2 or 3 Lane Undivided Highway	53%	55%	55%	59%	59%	51%	57%
	2 or 3 or 4 Lane Divided Highway	47%	50%	50%	57%	57%	44%	54%
	4 or 5 Lane Undivided Highway	45%	48%	48%	54%	54%	42%	51%
	6 Lane Highway	39%	43%	43%	50%	50%	35%	46%
	Rural 4 Lane Freeway with Daily Volume < 25,000	46%	49%	49%	56%	56%	43%	53%
	Rural 4 Lane Freeway with Daily Volume > 25,000	46%	51%	51%	62%	62%	41%	57%
	Urban 4 Lane Freeway	52%	55%	55%	62%	62%	49%	59%
	Urban or Rural 6 Lane Freeway	42%	50%	50%	65%	65%	34%	57%
	Urban > 6 Lane Freeway	47%	51%	51%	59%	59%	43%	55%
% of Fatal + Incap. Injury Crashes Involving Trucks	2 or 3 Lane Undivided Highway	6%	7%	7%	8%	8%	5%	7%
	2 or 3 or 4 Lane Divided Highway	5%	6%	6%	8%	8%	4%	7%
	4 or 5 Lane Undivided Highway	7%	8%	8%	11%	11%	6%	10%
	6 Lane Highway	3%	6%	6%	12%	12%	0%	9%
	Rural 4 Lane Freeway with Daily Volume < 25,000	14%	15%	15%	18%	18%	13%	17%
	Rural 4 Lane Freeway with Daily Volume > 25,000	9%	11%	11%	15%	15%	7%	13%
	Urban 4 Lane Freeway	8%	9%	9%	12%	12%	7%	11%
	Urban or Rural 6 Lane Freeway	8%	10%	10%	13%	13%	6%	11%
	Urban > 6 Lane Freeway	4%	5%	5%	7%	7%	3%	6%
% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	2 or 3 Lane Undivided Highway	22%	25%	25%	30%	30%	19%	27%
	2 or 3 or 4 Lane Divided Highway	19%	22%	22%	29%	29%	16%	26%
	4 or 5 Lane Undivided Highway	7%	8%	8%	10%	10%	6%	9%
	6 Lane Highway	7%	14%	14%	27%	27%	0%	20%
	Rural 4 Lane Freeway with Daily Volume < 25,000	6%	7%	7%	9%	9%	5%	8%
	Rural 4 Lane Freeway with Daily Volume > 25,000	11%	14%	14%	20%	20%	8%	17%
	Urban 4 Lane Freeway	10%	11%	11%	13%	13%	9%	12%
	Urban or Rural 6 Lane Freeway	9%	11%	11%	15%	15%	7%	13%
	Urban > 6 Lane Freeway	15%	17%	17%	22%	22%	13%	20%
% of Fatal _ Incapacitating Injury Crashes Involving Non-Motorized Travelers	2 or 3 Lane Undivided Highway	3%	4%	4%	5%	5%	2%	4%
	2 or 3 or 4 Lane Divided Highway	3%	4%	4%	5%	5%	2%	4%
	4 or 5 Lane Undivided Highway	6%	7%	7%	9%	9%	5%	8%
	6 Lane Highway	11%	14%	14%	20%	20%	8%	17%
	Rural 4 Lane Freeway with Daily Volume < 25,000	2%	2%	2%	3%	3%	1.7%	2.5%
	Rural 4 Lane Freeway with Daily Volume > 25,000	0%	0%	0%	0%	0%	0%	0%
	Urban 4 Lane Freeway	7%	9%	9%	12%	12%	5%	10%
	Urban or Rural 6 Lane Freeway	3%	5%	5%	9%	9%	1%	7%
	Urban > 6 Lane Freeway	1%	1%	1%	2%	2%	0.5%	1.5%

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab.

Table 3 - Step 3 Template

A separate *Crash Summary Sheet* file contains summaries for 8 crash attributes for the entire corridor, for each corridor segment, and for statewide roadways with similar operating environments (the database of crashes on roadways with similar operating environments was developed in Existing Performance Analysis (the baseline corridor performance)). The crash attribute summaries are consistent with the annual ADOT Publication, *Crash Facts*. The 8 crash attribute summaries consist of the following:

- First Harmful Event (FHET)
- Crash Type (CT)
- Violation or Behavior (VB)
- Lighting Condition (LC)
- Roadway Surface Type (RST)
- First Unit Event (FUE)
- Driver Physical Condition (Impairment)
- Safety Device Usage (Safety Device)

Non-colored tabs in this spreadsheet auto-populate with filtered crash attributes. Each tab is described below:

- **Step_3_Summary** – This tab contains the filtered summary of crashes that exceed statewide thresholds for crashes on roadways with similar operating environments. Data in this tab are copied into the Step 3 template.
- **Statewide** – This tab contains a summary of statewide crashes from roadways with similar operating environments filtered by the 8 crash type summaries listed above. The crash type summaries calculate statewide crash thresholds (% total for fatal plus incapacitating crashes). The crash thresholds were developed to provide a statewide expected proportion of crash attributes against which the corridor segments' crash attributes can be compared. The crash thresholds were developed using the *Probability of Specific Crash Types Exceeding a Threshold Proportion* as shown in the Highway Safety Manual, Volume 1 (2010). The thresholds are automatically calculated within the spreadsheet. The threshold proportion was calculated as follows:

$$p *_i = \frac{\sum N_{Observed,i}}{\sum N_{Observed,i(total)}}$$

Where:

$p *_i$ = Threshold proportion

$\sum N_{Observed,i}$ = Sum of observed target crash frequency within the population

$\sum N_{Observed,i(total)}$ = Sum of total observed crash frequency within the population

A minimum crash sample size of 5 crashes over the 5-year crash analysis period is required for a threshold exceedance to be displayed in the Step 3 template. The probability of exceeding the crash threshold was not calculated to simplify the process.

- **Corridor** – A summary of corridor-wide crashes filtered by the 8 crash attribute summaries listed above.
- **Segment FHET** – A segment-by-segment summary of crashes filtered by first harmful event attributes.
- **Segment CT** – A segment-by-segment summary of crashes filtered by crash type attributes.
- **Segment VB** - A segment-by-segment summary of crashes filtered by violation or behavior attributes.
- **Segment LC** – A segment-by-segment summary of crashes filtered by lighting condition attributes.
- **Segment RST** – A segment-by-segment summary of crashes filtered by roadway surface attributes.
- **Segment FUE** – A segment-by-segment summary of crashes filtered by first unit event attributes.
- **Segment Impairment** – A segment-by-segment summary of crashes filtered by driver physical condition attributes related to impairment.
- **Segment Safety Device** – A segment-by-segment summary of crashes filtered by safety device usage attributes.

The steps to compete Step 3 include:

Step 3.1

Using the Crash_Summary_Sheet.xlsx, go to the "Step_3_Summary" tab. Input the operating environments for each segment in the table.

Step 3.2

Filter data from the ADOT database for the "CORRIDOR_DATA" tab by inserting the following data in the appropriate columns that are highlighted in gray for the "INPUT_CORRIDOR_DATA" tab:

- Incident ID
- Incident Crossing Feature (MP)
- Segment Number (Non-native ADOT data – must be manually assigned based on the location of the crash)
- Operating Environment (Non-native ADOT data – should already be assigned but if for some reason it isn't, it will need to be manually assigned)
- Incident Injury Severity
- Incident First Harmful Description
- Incident Collision Manner
- Incident Lighting Condition Description
- Unit Body Style
- Surface Condition
- First Unit Event Sequence
- Person Safety Equipment
- Personal Violation or Behavior
- Impairment

Note that columns highlighted in yellow perform a calculated input to aggregate specific crash descriptions. For example, crashes can contain various attributes for animal-involved crashes. The crash attributes that involve an animal were combined into a common attribute, such as "ANIMAL". This will allow the summaries to be consistent with the ADOT *Crash Facts*.

The data in the Impairment category contains blank descriptions if it was found that there was "No Apparent Influence" or if it was "Unknown". Using the crash data fields "PersonPhysicalDescription" 0 - 99, fill in the blank columns to reflect if the physical description is described as "No Apparent Influence" or "Unknown". Note that the native physical description data from the ADOT database may need to be combined to a single column.

Step 3.3

Confirm that the crash database is being properly filtered by comparing crash frequencies from the summary tables with the frequencies developed in Existing Performance Analysis. For example, the lookup function will fail if the filter is for "NO IMPROPER ACTION" if the database has the attribute of "NO_IMPROPER_ACTION".

Step 3.4

Copy and paste the Step_3_Summary into the Safety Needs Assessment spreadsheet in the Step 3 tab. Paste values only and remove the summaries with "0%s" for a clean display. Where duplicate values exist, go to the "Calcs" tab in the Crash_Summary_Sheet file to determine which categories have the same %. If there are more crash types with the same % than there is space in the table, select the crash type with the highest difference between the segment % and the statewide average %

Step 3.5

The Step 3 table in the Safety Needs Assessment spreadsheet should be similar to the Step 3 template. In the Segment Crash Summaries row, the top three crash attributes are displayed. Change the font color of the crash attributes that exceed the statewide crash threshold to red for emphasis. The attributes with a red font in the "Calcs" tab have exceeded statewide crash thresholds. Note that corridor-wide values are not compared to statewide values as corridor-wide values are typically a blend of multiple similar operating environments while the statewide values apply to one specific similar operating environment.

Step 3.6

Provide a summary of any observable patterns found within the crash Hot Spots, if any exist in the segments.

Step 3.7

Input any historic projects (going no further back than 2000) that can be related to improving safety. Projects more than five years old may have exceeded their respective design life and could be contributing factors to safety performance needs.

Step 3.8

Input key points from District interviews or any important information from past discussions with District staff that is consistent with needs and crash patterns identified as part of the performance and needs assessment as this may be useful in identifying contributing causes. This information may be obtained from District Maintenance personnel by requesting the mile post locations that may be considered safety issues.

Step 3.9

For segments with one or more of the following characteristics, review crashes of all severity levels (not just fatal and incapacitating injury crashes). Identify likely contributing factors and compare that to the above statewide average comparison findings already calculated for fatal and incapacitating injury crashes. Refine the contributing factors list accordingly.

- Segments with Medium or High need
- Segments with a crash hot spot concentration (but only review crashes at the concentration areas)

- Segments with no apparent predominant contributing factors based on the comparison of fatal and incapacitating crashes to statewide averages if the segment has a Medium or High need.

Step 3.10

Considering all information in Steps 1-3, list the contributing factors using engineering judgment and the information on contributing factors available in Section 6.2 of the 2010 Highway Safety Manual. Additional sources for determining contributing factors may include aerial, “streetview”, and/or ADOT photologs. Other documents such as Design Concept Reports (DCR) or Road Safety Assessments can provide insight into the study corridor’s contributing factors.

Add comments as needed on additional information related to contributing factors that may have been provided by input from ADOT staff.

Freight Needs Assessment Methodology (Steps 1-3)

This section documents the approach for conducting the first three steps of a 5-step needs assessment process for the Freight Performance Area. After completion of Step 3 for all performance areas (Pavement, Bridge, Mobility, Safety, and Freight), Step 4 will review each corridor segment to quantify a total level of need that combines all performance areas. Corridor needs are then identified in Step 5 of the process. The 5-step process is listed below:

- Step 1: Initial Needs
- Step 2: Final Needs
- Step 3: Contributing Factors
- Step 4: Segment Review
- Step 5: Corridor Needs

<u>Step 1: Initial Needs</u>

The input required to populate the Step 1 template includes transferring the existing performance score and color for each segment to the appropriate "Performance Score" columns. This includes the primary and secondary measures for Freight. As each performance score is input into the template, the Initial Need will populate based on the weighted scoring system for each measure.

The Level of Need for each performance measure has levels of "None" (score = 0), "Low" (score = 1), "Medium" (score = 2), and "High" (score = 3). The assignment of these levels to individual performance measures for segments is determined by the table entitled "Needs Assessment Scale" within the Step 1 template.

To develop an aggregated Initial Need for each segment, the primary and secondary measures are combined by summing the weighted score, with the primary measure having a weight of 1.0 while each secondary measure has a weight of 0.2 (0.1 each direction if directional). The Initial Need for each segment (combining the primary and secondary measures) has levels of "None" (score < 0.01), "Low" (score $\geq$ 0.01 and < 1.5), "Medium" (score $\geq$ 1.5 and < 2.5), and "High" (score $\geq$ 2.5).

The steps include:

Step 1.1

Populate the Step 1 template with the existing (baseline) performance scores for all primary and secondary performance measures from Existing Performance Analysis. Copy the performance score for each segment to the appropriate "Performance Score" column. Select the *Facility Operations* for each segment from the drop-down list and input whether or not the performance area is an emphasis area. The corridor needs assessment scales will be updated automatically.

Step 1.2

Confirm that that the Step 1 template is generating the appropriate "Level of Need" for each primary and secondary measure by reviewing the relationship of baseline performance score to level of need.

<u>Step 2: Final Needs</u>

The Initial Need will be carried over to Step 2. The steps required to complete Step 2 are as follows:

Step 2.1

Confirm that the template has properly populated the initial need from the Step 1 template to the Step 2 template.

Step 2.2

Note any truck height restriction hot spots (clearance < 16.25') identified as part of the baseline corridor performance. For each entry, note the milepost of the height restriction and if the height restriction can be detoured by ramping around the obstruction. If it is not possible for a truck to ramp around the height restriction, note the existing height as well.

Step 2.3

Identify recently completed or under construction projects that would be considered relevant to freight performance. Include only projects that were not taken into account during the freight data analysis period. Any completed or under construction roadway project after the date of the data that has the potential to mitigate a freight issue on a corridor segment should be listed in the template. Such projects can include the construction of climbing lanes or Dynamic Message Signs (DMS) installation. Sources of recent or current project activity can be ADOT MPD staff, ADOT public notices, and ADOT District staff.

Step 2.4

Update the Final Need using the following criteria:

- If there is one or more truck height restriction hot spots where a truck cannot ramp around on a 'None' segment, increase (i.e., worsen) the need rating to 'Low'.
- If a recent project has superseded the performance rating data and it is certain the project addressed the need, change the need rating to "None".
- If a recent project has superseded the performance rating data but it is uncertain that a project addressed the need, maintain the current need rating and note the uncertainty as a comment.

Step 2.5

Note any programmed projects that could have the potential to mitigate any freight need on the segment. Programmed projects are provided as information and do not impact the need rating. Programmed projects will be reviewed in the development of solution sets for identified needs.

The source of the programming information can be found in ADOT's 5-year construction program. If there are other comments relevant to the needs analysis, they can be entered in the right-most column.

Example Scales for Level of Need - Freight Index

Performance Score Thresholds	Performance Level	Initial Performance Level of Need	Description (Non-emphasis Area)
	Good	None	All levels of Good and the top third of Fair (>0.74)
	Good		
0.77	Good		
0.74	Fair		
0.70	Fair	Low	Middle third of Fair (0.70-0.74)
0.67	Fair	Medium	Lower third of Fair and top third of Poor (0.64-0.70)
0.64	Poor		
	Poor	High	Lower two-thirds of Poor (<0.64)
	Poor		

Needs Scale

Measure	None >=	> Low <		> Medium <		High <=
Corridor Freight Index (Emphasis Area)	Dependent on weighted average of interrupted vs. uninterrupted segments					
Corridor Freight Index (Non-Emphasis Area)	Dependent on weighted average of interrupted vs. uninterrupted segments					
Freight Index (Segment)						
Measure	**None >=**	**> Low <**		**> Medium <**		**High <=**
Interrupted	0.28	0.28	0.22	0.22	0.12	0.12
Uninterrupted	0.74	0.74	0.70	0.70	0.64	0.64
Measure	**None <=**	**< Low >**		**< Medium >**		**High >=**
Directional TTI						
Interrupted	1.53	1.53	1.77	1.77	2.23	2.23
Uninterrupted	1.21	1.21	1.27	1.27	1.39	1.39
Directional PTI						
Interrupted	4.00	4.00	5.00	5.00	7.00	7.00
Uninterrupted	1.37	1.367	1.43	1.43	1.57	1.57
Closure Duration						
All Facility Operations	71.07	71.07	97.97	97.97	151.75	151.75
Measure	**None >=**	**> Low <**		**> Medium <**		**High <=**
Bridge Clearance (feet)						
All Bridges	16.33	16.33	16.17	16.17	15.83	15.83

Step 3: Contributing Factors

The Final Need ratings from Step 2 will populate into the Step 3 tab.

The steps to compete Step 3 include:

Step 3.1

Input all roadway variable data that describe each segment into the appropriate columns. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Needs Assessment.

Step 3.2

Input all traffic variables for each segment into the appropriate columns. The Buffer Index will auto populate based on the TPTI and TTTI input in the Step 1 tab. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Needs Assessment.

Step 3.3

Input any freight-related infrastructure that currently exists on the corridor for each segment. The relevant infrastructure can include DMS locations, weigh stations, Ports of Entry (POE), rest areas, parking areas, and climbing lanes. Include the mileposts of the listed infrastructure. This data can be extracted from the most recent Highway Log and the 2015 Climbing and Passing Lane Prioritization Study.

Step 3.4

Input the Closure Extents that have occurred along the study corridor. Road closure information can be detailed out by the reason for the closure as documented in Highway Condition Reporting System (HCRS) data analyzed as part of the baseline corridor performance. Closure reasons include incident/accidents, winter storms, obstruction hazards, and undefined closures. Statewide average percentages for the various closure reasons have been calculated for the analysis period on ADOT's designated strategic corridors. Compare these statewide average percentages to the corridor percentages for the various closure reasons to identify higher than average percentages of one or more closure reasons on any given segment. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Needs Assessment. Input the closures as follows and use red text to indicate that the segment percentage exceeds statewide averages:

- Total Number of Closures
- % Closures (No Reason)
- % Incidents/Accidents
- % Obstructions/Hazards
- % Weather Related

Step 3.5

List the non-actionable conditions that are present within each segment by milepost if possible. Non-Actionable conditions are conditions that exist within the environment of each segment that cannot be improved through an engineered solution. Examples of Non-Actionable conditions can include border patrol check points and other closures/restrictions not controlled by ADOT. Note that this data can be copied from the Mobility Needs Assessment spreadsheet for Needs Assessment.

Step 3.6

Input any programmed and planned projects or issues that have been identified from previous documents or studies that are relevant to the Final Need. Sources for this data include the current Highway Log, the 2015 Climbing and Passing Lane Prioritization Study, and ADOT's 5-year construction program.

Step 3.7

Considering all information in Steps 1-3, identify the contributing factors to the Final Need column. Potential contributing factors to freight performance needs include roadway vertical grade, number of lanes, traffic volume-to-capacity ratios, presence/lack of a climbing lanes, and road closures. Also identify higher than average percentages of one or more closure reasons on any given segment.

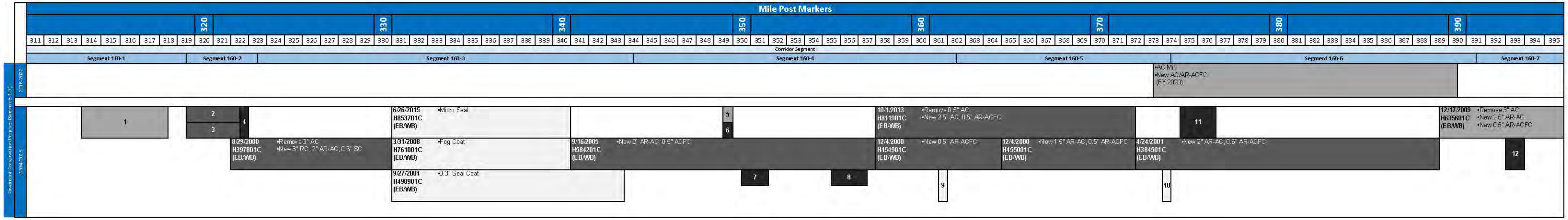
Pavement Performance Area - Needs Analysis Step 1

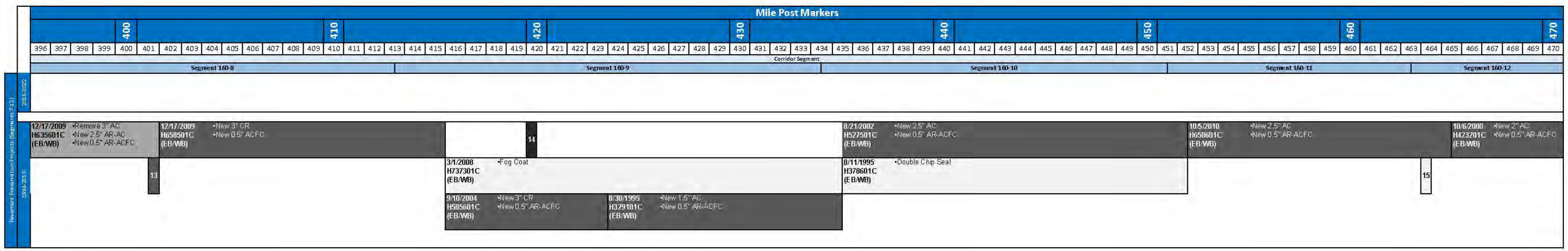
Segment #	Segment Length (miles)	Segment Mileposts (MP)	Facility Type	Pavement Index			Directional PSR					% Area Failure			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score EB	Performance Score WB	Performance Objective	Level of Need EB	Level of Need WB	Performance Score	Performance Objective	Level of Need	
160-1	8	311-319	Highway	4.04	Fair or Better	None	3.76	3.76	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-2	4	319-323	Highway	3.87	Fair or Better	None	3.59	3.59	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-3	21	323-344	Highway	3.66	Fair or Better	None	3.51	3.51	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-4	18	344-362	Highway	4.16	Fair or Better	None	4.04	4.04	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-5	12	362-374	Highway	4.39	Fair or Better	None	4.17	4.17	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-6	17	374-391	Highway	3.60	Fair or Better	None	3.40	3.40	Fair or Better	None	None	12.00%	Fair or Better	Low	Low
160-7	4	391-395	Highway	4.13	Fair or Better	None	4.04	4.04	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-8	18	395-413	Highway	4.03	Fair or Better	None	3.88	3.88	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-9	21	413-434	Highway	3.29	Fair or Better	Low	3.18	3.18	Fair or Better	Low	Low	29.00%	Fair or Better	High	Medium
160-10	17	434-451	Highway	3.45	Fair or Better	None	3.76	3.76	Fair or Better	None	None	12.00%	Fair or Better	Low	Low
160-11	12	451-463	Highway	4.00	Fair or Better	None	3.78	3.78	Fair or Better	None	None	0.00%	Fair or Better	None	None
160-12	7	463-470	Highway	4.13	Fair or Better	None	4.03	4.03	Fair or Better	None	None	0.00%	Fair or Better	None	None
Emphasis Area?	Yes	Weighted Average		3.82	Good	None									

Pavement Performance Area - Needs Analysis Step 2

Segment #	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Need Adjustments: Hot Spots	Need Adjustments: Previous Projects (which supersede condition data)	Final Need	Comments (may include programmed projects or issues from previous reports)
160-1	8	311-319	None		None	None	No Previous Completed or Programmed Projects that supersede condtion data
160-2	4	319-323	None		None	None	No Previous Completed or Programmed Projects that supersede condtion data
160-3	21	323-344	None		None	None	No Previous Completed or Programmed Projects that supersede condtion data
160-4	18	344-362	None		None	None	No Previous Completed or Programmed Projects that supersede condtion data
160-5	12	362-374	None		None	None	**FY20 F014401C**: Long House Valley - Kayenta, Pavement Rehabilitation (MP 373-390)
160-6	17	374-391	Low	MP 379-381	None	Low	**FY20 F014401C**: Long House Valley - Kayenta, Pavement Rehabilitation (MP 373-390), May address pavement hotspot (MP 379-381)
160-7	4	391-395	None		None	None	No Previous Completed or Programmed Projects that supersede condtion data
160-8	18	395-413	None		None	None	No Previous Completed or Programmed Projects that supersede condtion data
160-9	21	413-434	Medium	MP 424-429 MP 433-434	None	Medium	No Previous Completed or Programmed Projects that supersede condtion data
160-10	17	434-451	Low	MP 438-440	None	Low	No Previous Completed or Programmed Projects that supersede condtion data
160-11	12	451-463	None		None	None	
160-12	7	463-470	None		None	None	

Pavement History





Pavement Treatment Reference Numbers

1. 2/23/2012 H798801C (EB/WB): Remove 0.5" AC, New 0.5" ACFC
2. 9/8/2008 H460101C (EB): Remove 0.5" AC, New 6" AB, New 4" AC, New 0.5" AR-ACFC
3. 9/8/2008 H460101C (WB): New 6" AB, New 4" AC, New 2" AC, New 0.5" AR-ACFC
4. 8/29/2000 H397801C (EB/WB): New 4" AB, 9" AC, 0.6" SC
5. 8/19/2011 H709101C (EB): Remove 0.5", New 0.5" AR-ACFC
6. 8/19/2011 H709101C (WB): New 8" AB, 5"AC, 0.5" ACFC
7. 9/16/2005 H584201C (EB): New 6" AB, 2.5"AC, 2" AR, 0.5" AR-ACFC
8. 9/16/2005 H584201C (WB): New 6" AB, 2.5" AC, 2" AR, 0.5" AR-ACFC
9. 7/11/1996 H328901C (EB/WB): New 0.3" Seal Coat, Fog Coat
10. 7/11/1996 H329001C (EB/WB): Fog Coat
11. 6/11/2014 H512001C (EB/WB): Remove 0.5" AC, New 6" AB, 6.5" AC, 0.5" AR-ACFC
12. 6/26/1997 H315501C (EB/WB): New 6" AB, 5" AC, 0.5" AR-ACFC
13. 7/21/1997 H374101C (EB/WB): New 0.5" ACFC
14. 10/13/2013 H757101 (EB/WB): New 8" AB, 4" AC, 0.5" ACFC
15. 4/15/1998 H063104C (EB/WB): New 0.3" Seal Coat

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

Value	Level	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						56%		3%		4%								84%		6%		15%		6%
1							56%														89%				
1							72%																		
1																									
3	L2		50%					3%					11%		100%		33%								
3																									
3																									
3																									
3																									
3																									
4	L3			60%	25%		40%		71%		77%		83%				64%		11%		6%		15%		37%
4				60%			17%		24%		19%						3%		36%		89%		85%		63%
4									24%		58%								48%						
4											15%														
6	L4				10%			3%					11%		20%				2%						
6								8%																	
6								10%																	
6																									
6																									
6																									
Sub-Total		0.0	1.5	4.8	1.6	0.0	4.1	1.4	4.8	0.0	6.8	0.0	4.3	0.0	4.2	0.0	3.7	0.0	4.8	0.0	4.8	0.0	4.2	0.0	4.1
Total		**1.5**		**4.0**		**4.1**		**5.5**		**6.8**		**4.3**		**4.2**		**3.7**		**4.8**		**4.8**		**4.2**		**4.1**	

Pavement Historical Investment

Segment #	Segment Length (miles)	Segment Mileposts (MP)	Bid History Value	Bid History Score	Bid History Investment	Pecos ($/mile/yr)	PeCos Score	PeCos History Investment	Resulting Historical Investment
160-1	8	311-319	1.5	-1.02	Low	$6	-0.90	Low	Low
160-2	4	319-323	4.0	0.06	Low	$32	-0.88	Low	Low
160-3	21	323-344	4.1	0.10	Low	$117	-0.82	Low	Low
160-4	18	344-362	5.5	0.71	Medium	$198	-0.76	Low	Medium
160-5	12	362-374	6.8	1.27	High	$291	-0.70	Low	High
160-6	17	374-391	4.3	0.19	Low	$4,224	2.12	High	Medium
160-7	4	391-395	4.2	0.15	Low	$3,669	1.72	Medium	Low
160-8	18	395-413	3.7	-0.07	Low	$2,875	1.15	Medium	Low
160-9	21	413-434	4.8	0.41	Medium	$2,638	0.98	Medium	Medium
160-10	17	434-451	4.8	0.41	Medium	$1,477	0.15	Medium	Medium
160-11	12	451-463	4.2	0.15	Low	$0	-0.90	Low	Low
160-12	7	463-470	4.1	0.10	Low	$1,165	-0.07	Medium	Low

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
160-1	8	311-319	None	Low	Low	Low	No identified need District Notes: Humps, dips and sinking of pavement (MP 312.7 – 313.5)
160-2	4	319-323	None	Low	Low	Low	No identified need District Notes: Pavement unravelling, depressions and potholes (MP 322.5 - 323)
160-3	21	323-344	None	Low	Low	Low	No identified need District Notes: Pavement unravelling, depressions and potholes (MP 323 - 331) District Notes: Pavement cracking on recent microseal job (MP 331 - 341)
160-4	18	344-362	None	Medium	Low	Medium	No identified need
160-5	12	362-374	None	High	Low	High	No identified need
160-6	17	374-391	Low	Low	High	Medium	Failure hot spots identified MP 379-381. Historical investment increased to 'Medium' based on PeCos investment. Project programmed for FY20 (MP 373-390) should mitigate issues District Notes: Concerned about the current pavement conditions within Kayenta town limits.
160-7	4	391-395	None	Low	Medium	Low	No identified need
160-8	18	395-413	None	Low	Medium	Low	No identified need
160-9	21	413-434	Medium	Medium	Medium	Medium	Failure hot spots identified MP 424-429 and 433-434. Historical investment is 'Low'; no programmed projects have been identified
160-10	17	434-451	Low	Medium	Medium	Medium	Failure hot spots identified MP 438-440. Historical investment is 'Medium"; no programmed projects have bene identified
160-11	12	451-463	None	Low	Low	Low	No identified need
160-12	7	463-470	None	Low	Medium	Low	No identified need

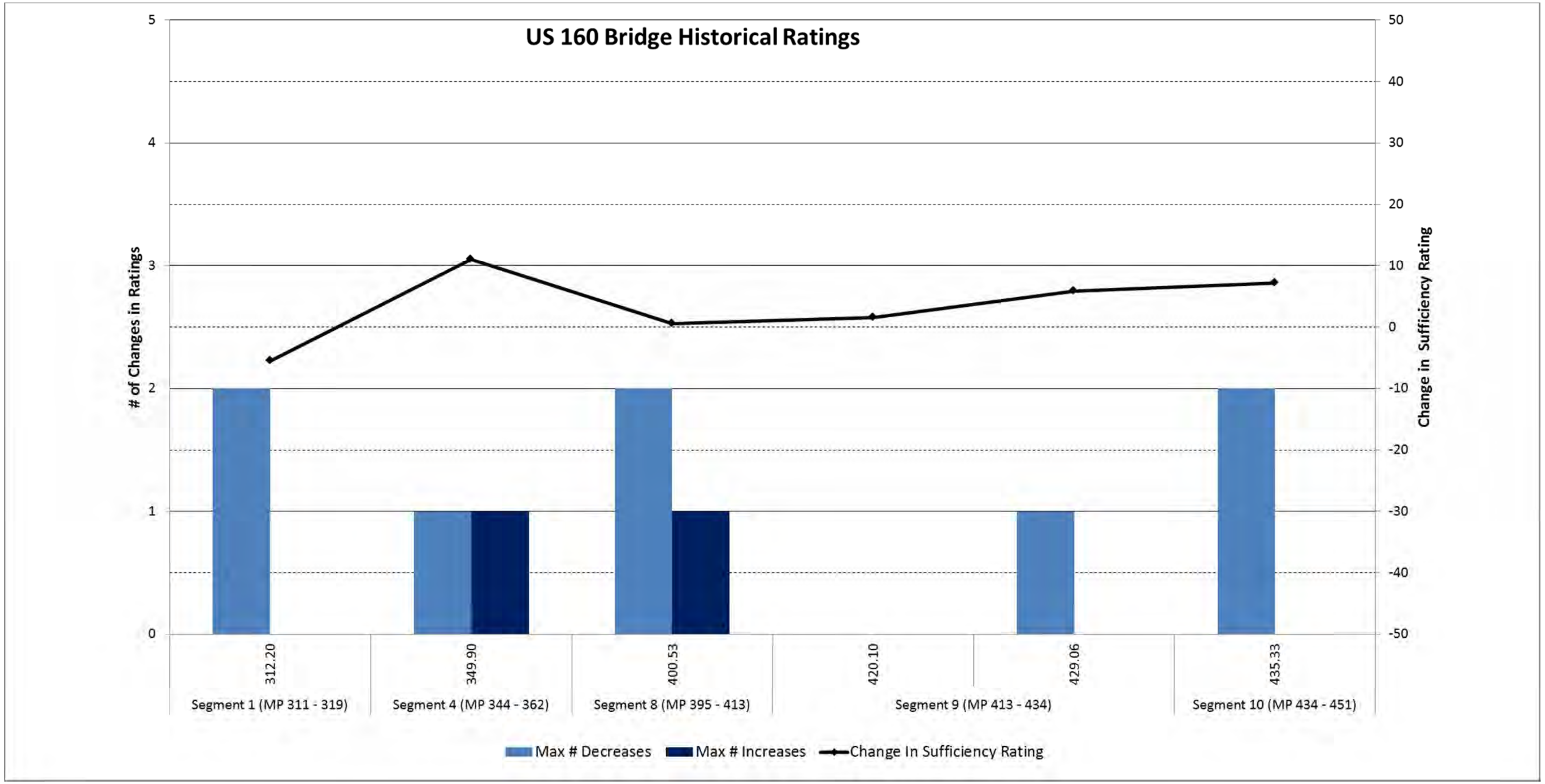
Bridge Performance Area - Needs Analysis Step 1

Segment #	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Bridge Index			Lowest Bridge Rating			Sufficiency Rating			% of Deck Area on 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	
160-1	8	311-319	1	5.00	Fair or Better	Medium	5	Fair or Better	Low	71.80	Fair or Better	None	0.00%	Fair or Better	None	Medium
160-2	4	319-323	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
160-3	21	323-344	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
160-4	18	344-362	1	6.00	Fair or Better	None	6	Fair or Better	None	64.3	Fair or Better	Low	100.0%	Fair or Better	High	Low
160-5	12	362-374	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
160-6	17	374-391	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
160-7	4	391-395	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
160-8	18	395-413	1	6.00	Fair or Better	None	6	Fair or Better	None	83.7	Fair or Better	None	0.0%	Fair or Better	None	None
160-9	21	413-434	2	6.42	Fair or Better	None	5	Fair or Better	Low	76.4	Fair or Better	None	52.5%	Fair or Better	High	Low
160-10	17	434-451	1	5.00	Fair or Better	Medium	5	Fair or Better	Low	62.7	Fair or Better	Low	100.0%	Fair or Better	High	High
160-11	12	451-463	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
160-12	7	463-470	0	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	No Bridges	Fair or Better	N/A	N/A
Emphasis Area?	No	Weighted Average		5.81	Fair or Better	Low										

Bridge Performance Area - Needs Analysis Step 2

Segment #	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Initial Need	Need Adjustments: Hot Spots (Rating of 4 or multiple 5's)	Need Adjustments: Previous Projects (which supersede condition data)	Final Need	Historical Review	# Functionally Obsolete Bridges	Comments
160-1	8	311-319	1	Medium	None		Medium	None	0	Hamblin Wash Bridge Evaluation Rating of 5; no historical issues; no programmed projects
160-2	4	319-323	0	N/A	None		None	None	0	No bridges in segment
160-3	21	323-344	0	N/A	None		None	None	0	No bridges in segment
160-4	18	344-362	1	Low	None		Low	None	1	Begashibito Wash Bridge is the only bridge in the segment and 'Low' need based on % Functionally Obsolete Deck Area; no historical issues; no programmed projects.
160-5	12	362-374	0	N/A	None		None	None	0	No bridges in segment
160-6	17	374-391	0	N/A	None		None	None	0	No bridges in segment
160-7	4	391-395	0	N/A	None		None	None	0	No bridges in segment
160-8	18	395-413	1	None	None		None	None	0	No bridges with current ratings of 4 or 5 and no historical issues
160-9	21	413-434	2	Low	None	FY17 H8913: Laguna Creek Bridge STR #20001, Construct Scour Retrofit (MP 420)	Low	None	1	Chinle Wash Bridge Deck Rating of 5; Bridge Replacement programmed FY18 H849001C: Chinle Wash Bridge Replacement, STR #746 (MP 429-430); no historical issues
160-10	17	434-451	1	High	None		High	None	1	Walker Creek Bridge Deck Rating of 5; no historical issues; no programmed projects. 'High' need based on % Functionally Obsolete Deck Area and only bridge in segment
160-11	12	451-463	0	N/A	None		None	None	0	No bridges in segment
160-12	7	463-470	0	N/A	None		None	None	0	No bridges in segment

Bridge Rating History



identifies the bridge indicated is of concern from a historical ratings perspective

Maximum # of Decreases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating decreased from 1997 to 2014. (Higher number could indicate a more dramatic decline in the performance of the bridge)

Maximum # of Increases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating increased from 1997 to 2014. (Higher number could indicate a higher level of investment

Change in Sufficiency Rating: Cumulative change in Sufficiency Rating from 1997 to 2014. (Bigger negative number could indicate a more dramatic decline in the performance of the bridge)

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	
160-1	8	311-319	1	0	Medium	Hamblin Wash Br (#531)(MP 312.20)	Structural Evaluation Rating of 5	This structure was not identified for historical review	
160-2	4	319-323	0	0	None	No bridges with current ratings less than 6 and no historical issues			
160-3	21	323-344	0	0	None	No bridges with current ratings less than 6 and no historical issues			
160-4	18	344-362	1	1	Low	Begashibito Wash Br (#1011)(MP 349.90)	No bridges with current ratings less than 6 and no historical issues		Percentage of deck area on functionally obsolete bridge in segment cause 'low' need. Only bridge in segment.
160-5	12	362-374	0	0	None	No bridges with current ratings less than 6 and no historical issues			
160-6	17	374-391	0	0	None	No bridges with current ratings less than 6 and no historical issues			
160-7	4	391-395	0	0	None	No bridges with current ratings less than 6 and no historical issues			
160-8	18	395-413	1	0	None	No bridges with current ratings less than 6 and no historical issues			
160-9	21	413-434	2	1	Low	Chinle Wash Bridge (#746)(MP 429.06)	Deck Rating of 5	This structure was not identified for historical review	
160-10	17	434-451	1	1	High	Walker Creek Bridge (#748)(MP 435.33)	Deck Rating of 5	This structure was not identified for historical review	Percentage of deck area on funtionally obsolete bridge and Bridge Index performance score of 5 in segment cause 'high' need. Only bridge in segment.
160-11	12	451-463	0	0	None	No bridges with current ratings less than 6 and no historical issues			
160-12	7	463-470	0	0	None	No bridges with current ratings less than 6 and no historical issues			

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	
											EB	WB		EB	WB	EB	WB		EB	WB
160-1	311-319	8	Rural	Interrupted	0.32	Fair or Better	None	0.39	Fair or Better	None	0.24	0.25	Fair or Better	None	None	0.08	0.00	Fair or Better	None	None
160-2	319-323	4	Rural	Interrupted	0.72	Fair or Better	Medium	0.87	Fair or Better	High	0.51	0.67	Fair or Better	None	Low	0.10	0.00	Fair or Better	None	None
160-3	323-344	21	Rural	Uninterrupted	0.18	Fair or Better	None	0.21	Fair or Better	None	0.15	0.15	Fair or Better	None	None	0.24	0.05	Fair or Better	None	None
160-4	344-362	18	Rural	Uninterrupted	0.12	Fair or Better	None	0.15	Fair or Better	None	0.08	0.09	Fair or Better	None	None	0.34	0.70	Fair or Better	None	Medium
160-5	362-374	12	Rural	Uninterrupted	0.17	Fair or Better	None	0.20	Fair or Better	None	0.12	0.13	Fair or Better	None	None	0.00	0.05	Fair or Better	None	None
160-6	374-391	17	Rural	Uninterrupted	0.27	Fair or Better	None	0.33	Fair or Better	None	0.21	0.20	Fair or Better	None	None	0.12	0.34	Fair or Better	None	None
160-7	391-395	4	Rural	Interrupted	0.41	Fair or Better	None	0.53	Fair or Better	None	0.26	0.27	Fair or Better	None	None	0.10	0.15	Fair or Better	None	None
160-8	395-413	18	Rural	Uninterrupted	0.12	Fair or Better	None	0.14	Fair or Better	None	0.08	0.08	Fair or Better	None	None	0.03	0.01	Fair or Better	None	None
160-9	413-434	21	Rural	Uninterrupted	0.11	Fair or Better	None	0.13	Fair or Better	None	0.10	0.10	Fair or Better	None	None	0.04	0.04	Fair or Better	None	None
160-10	434-451	17	Rural	Uninterrupted	0.19	Fair or Better	None	0.22	Fair or Better	None	0.12	0.12	Fair or Better	None	None	0.14	0.01	Fair or Better	None	None
160-11	451-463	12	Rural	Uninterrupted	0.18	Fair or Better	None	0.21	Fair or Better	None	0.11	0.11	Fair or Better	None	None	0.00	0.07	Fair or Better	None	None
160-12	463-470	7	Rural	Interrupted	0.17	Fair or Better	None	0.20	Fair or Better	None	0.12	0.12	Fair or Better	None	None	0.09	0.06	Fair or Better	None	None
Mobility Emphasis Area		Yes	Weighted Average		0.19	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	
					EB	WB		EB	WB	EB	WB		EB	WB				
160-1	311-319	8	Rural	Interrupted	1.07	1.02	Fair or Better	None	None	1.48	1.88	Fair or Better	None	None	0%	Fair or Better	High	Low
160-2	319-323	4	Rural	Interrupted	1.12	1.17	Fair or Better	None	None	3.75	3.25	Fair or Better	None	None	84%	Fair or Better	None	High
160-3	323-344	21	Rural	Uninterrupted	1.01	1.01	Fair or Better	None	None	1.30	1.35	Fair or Better	None	None	19%	Fair or Better	High	Low
160-4	344-362	18	Rural	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.31	1.25	Fair or Better	None	None	9%	Fair or Better	High	Low
160-5	362-374	12	Rural	Uninterrupted	1.01	1.00	Fair or Better	None	None	1.33	1.23	Fair or Better	None	None	0%	Fair or Better	High	Low
160-6	374-391	17	Rural	Uninterrupted	1.02	1.06	Fair or Better	None	None	1.51	2.11	Fair or Better	Medium	High	0%	Fair or Better	High	Low
160-7	391-395	4	Rural	Interrupted	1.12	1.16	Fair or Better	None	None	3.26	3.07	Fair or Better	None	None	6%	Fair or Better	High	Low
160-8	395-413	18	Rural	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.15	1.20	Fair or Better	None	None	0%	Fair or Better	High	Low
160-9	413-434	21	Rural	Uninterrupted	1.01	1.02	Fair or Better	None	None	1.37	1.37	Fair or Better	Low	Low	1%	Fair or Better	High	Low
160-10	434-451	17	Rural	Uninterrupted	1.05	1.04	Fair or Better	None	None	1.89	1.85	Fair or Better	High	High	1%	Fair or Better	High	Low
160-11	451-463	12	Rural	Uninterrupted	1.02	1.01	Fair or Better	None	None	2.27	1.83	Fair or Better	High	High	0%	Fair or Better	High	Low
160-12	463-470	7	Rural	Interrupted	1.08	1.12	Fair or Better	None	None	2.95	3.40	Fair or Better	None	None	4%	Fair or Better	High	Low

Mobility Performance Area - Needs Analysis Step 2

Segment #	Segment Mileposts (MP)	Segment Length (miles)	Initial Need	Need Adjustments Recently Completed Projects	Final Need	Planned and Programmed Future Projects
160-1	311-319	8	Low	None	Low	Planned: - TI improvements at Junction US 89/US 160 Diamond Interchange (MP 311), US 89 Antelope Hills to Jct. US 160 MP 442 to MP 484 DCR, 2007 - Widen the mainline, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -EB MP 311 - MP 320 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015 -EB MP 312 - MP 314 Climbing Lane, Climbing and Passing Lane Prioritization Study, 2015 -Expand to 4-lane Rural Divided with Median (MP311.5-401.4), US 160, Jct. US to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007 Programmed: FY19 F005901C: IR 6731 - SR 98, Construct Bus Pullouts (MP 318-325)
160-2	319-323	4	High	None	High	Planned: - Widen the mainline, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -EB MP 311 - MP 320 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015 -EB MP 312 - MP 314 Climbing Lane, Climbing and Passing Lane Prioritization Study, 2015 -Expand to 4-lane with Median Flush Median, US 160, Jct. US to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007 Programmed: FY19 F005901C: IR 6731 - SR 98, Construct Bus Pullouts (MP 318-325)
160-3	323-344	21	Low	None	Low	Planned: - Widen the mainline, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -Expand to 4-lane Rural Divided with Median (MP311.5-401.4), US 160, Jct. US to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007 -US 160 EB: MP 335 - MP 341 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015 -US 160 WB: MP 343 - MP 337 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015 -US 160 WB: MP 345 - MP 343 Climbing Lane, Climbing and Passing Lane Prioritization Study, 2015 Programmed: FY19 F005901C: IR 6731 - SR 98, Construct Bus Pullouts (MP 318-325)
160-4	344-362	18	Low	None	Low	Planned: - Widen the mainline, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -Expand to 4-lane Rural Divided with Median (MP311.5-401.4), US 160, Jct. US to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007 -EB MP 361 - MP 367 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015
160-5	362-374	12	Low	None	Low	Planned: - Widen the mainline, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -Expand to 4-lane Rural Divided with Median (MP311.5-401.4), US 160, Jct. US to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007 -EB MP 361 - MP 367 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015 -WB MP 369 - MP 375 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015

Segment #	Segment Mileposts (MP)	Segment Length (miles)	Initial Need	Need Adjustments Recently Completed Projects	Final Need	Planned and Programmed Future Projects
160-6	374-391	17	Low	None	Low	Planned: - Widen the mainline, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -Expand to 4-lane Rural Divided with Median (MP311.5-401.4), US 160, Jct. US to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007 -WB MP 369 - MP 375 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015 -SR 564 Traffic Intersection Improvement, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -EB MP 381 - MP 384 Climbing Lane, Climbing and Passing Lane Prioritization Study, 2015 -EB MP 385 - MP 391 Climbing Lane, Climbing and Passing Lane Prioritization Study, 2015 -MP 386 EB DMS Sign, Arizona Dynamic Message Sign Master Plan, 2011 (ADOT)
160-7	391-395	4	Low	None	Low	Planned: - Widen the mainline, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -Expand to 4-lane Rural Divided with Median (MP311.5-401.4), US 160, Jct. US to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007 -Improve Access and Circulation US 163 and US 160 Intersection and Right-Turn Deceleration Lanes (MP 393.5), Kayenta Township Multimodal Transportation Study, 2012
160-8	395-413	18	Low	None	Low	Planned: - Widen the mainline, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -Expand to 4-lane Rural Divided with Median (MP311.5-401.4), US 160, Jct. US to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007 -Climbing and passing lane (MP 401.4-MP 434.8), US 160, Jct. US 89 to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007
160-9	413-434	21	Low	None	Low	Planned: - Widen the mainline, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -Climbing and passing lane (MP 401.4-MP 434.8), US 160, Jct. US 89 to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007 -MP 430 EB DMS Sign, Arizona Dynamic Message Sign Master Plan, 2011 (ADOT)
160-10	434-451	17	Low	None	Low	Planned: - Widen the mainline, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -Expand to 4-lane Rural Divided with Median (MP434.8-465.8), US 160, Jct. US to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007
160-11	451-463	12	Low	None	Low	Planned: - Widen the mainline, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -Expand to 4-lane Rural Divided with Median (MP434.8-465.8), US 160, Jct. US to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007 -WB MP 462 - MP 4460 Climbing Lane, Climbing and Passing Lane Prioritization Study, 2015 -MP 460 EB DMS Sign, Arizona Dynamic Message Sign Master Plan, 2011 (ADOT) -WB MP 458 - MP 463 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015
160-12	463-470	7	Low	None	Low	Planned: - Widen the mainline, Building a Quality Arizona (bqAZ) Transportation Planning Framework Study, 2010 (ADOT) -Expand to 4-lane Rural Divided with Median (MP434.8-465.8), US 160, Jct. US to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007

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	EB Buffer Index (PTI-TTI)	WB Buffer Index (PTI-TTI)	
160-1	311-319	8	Low	State Highway	Rural	Rolling	2	63	No	Undivided	32%	A/B	A/B	8%	0.41	0.86	
160-2	319-323	4	High	State Highway	Rural	Rolling	2.375	49	No	Undivided	42%	C	D-F	9%	2.63	2.08	Passing/Climbing Lane: EB MP 320-322.5
160-3	323-344	21	Low	State Highway	Rural	Level	2	64	No	Undivided	12%	A/B	A/B	13%	0.30	0.34	
160-4	344-362	18	Low	State Highway	Rural	Level	2	65	No	Undivided	33%	A/B	A/B	12%	0.31	0.25	Passing/Climbing Lane: EB MP 349.5-352, WB MP 356.5-357.5
160-5	362-374	12	Low	State Highway	Rural	Level	2	65	No	Undivided	14%	A/B	A/B	11%	0.32	0.23	
160-6	374-391	17	Low	State Highway	Rural	Rolling	2	64	No	Undivided	24%	A/B	A/B	10%	0.48	1.05	Passing/Climbing Lane: EB MP 376.5-377
160-7	391-395	4	Low	State Highway	Rural	Rolling	2.235	60	No	Undivided	47%	A/B	A/B	10%	2.14	1.92	
160-8	395-413	18	Low	State Highway	Rural	Level	2	65	No	Undivided	9%	A/B	A/B	11%	0.15	0.20	
160-9	413-434	21	Low	State Highway	Rural	Level	2	65	No	Undivided	20%	A/B	A/B	11%	0.36	0.36	
160-10	434-451	17	Low	State Highway	Rural	Rolling	2	64	No	Undivided	25%	A/B	A/B	11%	0.84	0.81	
160-11	451-463	12	Low	State Highway	Rural	Rolling	2	65	No	Undivided	21%	A/B	A/B	11%	1.25	0.82	
160-12	463-470	7	Low	State Highway	Rural	Rolling	2	60	No	Undivided	31%	A/B	A/B	11%	1.87	2.28	

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		
160-1	311-319	8	Low	3	3	100%	0	0%	0	0%		• Limited bicycle accommodation on shoulders • Percentage of closures related to Incidents/Accidents is higher than statewide average (100% to 96%)
160-2	319-323	4	High	2	1	50%	1	50%	0	0%		• Percentage of closures related to Obstructions/Hazards is higher than statewide average (50% to 2.8%) • Projected future travel demand is anticipated to exceed current capacity.
160-3	323-344	21	Low	10	9	90%	0	0%	1	10%		• Limited bicycle accommodation on shoulders • Percentage of closures related to weather is higher than statewide average (10% to 1.3%)

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		
160-4	344-362	18	Low	14	12	86%	0	0%	2	14%		• Limited bicycle accommodation on shoulders • Closures are higher in the westbound direction. Percentage of closures related to weather is higher than statewide average (14% to 1.3%)
160-5	362-374	12	Low	3	2	67%	1	33%	0	0%		• Limited bicycle accommodation on shoulders • Percentage of closures related to Obstructions/Hazards is higher than statewide average (33% to 2.8%)
160-6	374-391	17	Low	18	12	67%	3	17%	3	17%		• Limited bicycle accommodation on shoulders • Percentage of closures related to Obstructions/Hazards is higher than statewide average (17% to 2.8%) • Percentage of closures related to weather is higher than statewide average (17% to 1.3%) • Issues with PTI and Reliability are likely related to No Passing Lanes
160-7	391-395	4	Low	5	5	100%	0	0%	0	0%		• Limited bicycle accommodation on shoulders • Percentage of closures related to Incidents/Accidents is higher than statewide average (100% to 96%)
160-8	395-413	18	Low	4	4	100%	0	0%	0	0%		• Limited bicycle accommodation on shoulders • Percentage of closures related to Incidents/Accidents is higher than statewide average (100% to 96%)
160-9	413-434	21	Low	8	8	100%	0	0%	0	0%		• Limited bicycle accommodation on shoulders • Percentage of closures related to Incidents/Accidents is higher than statewide average (100% to 96%)
160-10	434-451	17	Low	13	13	100%	0	0%	0	0%		• Limited bicycle accommodation on shoulders • Percentage of closures related to Incidents/Accidents is higher than statewide average (100% to 96%) • Issues with PTI and Reliability are likely related to No Passing Lanes
160-11	451-463	12	Low	4	4	100%	0	0%	0	0%		• Limited bicycle accommodation on shoulders • Percentage of closures related to Incidents/Accidents is higher than statewide average (100% to 96%) • Issues with PTI and Reliability are likely related to No Passing Lanes
160-12	463-470	7	Low	5	5	100%	0	0%	0	0%		• Limited bicycle accommodation on shoulders • Percentage of closures related to Incidents/Accidents is higher than statewide average (100% to 96%)

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	EB Performance Score	WB Performance Score	Performance Objective	EB Level of Need	WB Level of Need	Performance Score	Performance Objective	Level of Need
160-1	2 or 3 Lane Undivided Highway	8	311-319	0.70	Average or Better	None	1.40	0.00	Average or Better	High	None	*Insufficient Data*	Average or Better	N/A
160-2	2 or 3 Lane Undivided Highway	4	319-323	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	*Insufficient Data*	Average or Better	N/A	N/A	*Insufficient Data*	Average or Better	N/A
160-3	2 or 3 Lane Undivided Highway	21	323-344	3.59	Average or Better	High	3.61	3.57	Average or Better	High	High	47%	Average or Better	None
160-4	2 or 3 Lane Undivided Highway	18	344-362	1.99	Average or Better	High	3.83	0.15	Average or Better	High	None	*Insufficient Data*	Average or Better	N/A
160-5	2 or 3 Lane Undivided Highway	12	362-374	0.04	Average or Better	None	0.00	0.07	Average or Better	None	None	*Insufficient Data*	Average or Better	N/A
160-6	2 or 3 Lane Undivided Highway	17	374-391	0.39	Average or Better	None	0.69	0.10	Average or Better	None	None	*Insufficient Data*	Average or Better	N/A
160-7	2 or 3 Lane Undivided Highway	4	391-395	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	*Insufficient Data*	Average or Better	N/A	N/A	*Insufficient Data*	Average or Better	N/A
160-8	2 or 3 Lane Undivided Highway	18	395-413	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	*Insufficient Data*	Average or Better	N/A	N/A	*Insufficient Data*	Average or Better	N/A
160-9	2 or 3 Lane Undivided Highway	21	413-434	1.43	Average or Better	High	0.72	2.14	Average or Better	None	High	*Insufficient Data*	Average or Better	N/A
160-10	2 or 3 Lane Undivided Highway	17	434-451	2.28	Average or Better	High	1.90	2.66	Average or Better	High	High	44%	Average or Better	None
160-11	2 or 3 Lane Undivided Highway	12	451-463	0.65	Average or Better	None	1.30	0.00	Average or Better	High	None	*Insufficient Data*	Average or Better	N/A
160-12	2 or 3 Lane Undivided Highway	7	463-470	0.37	Average or Better	None	0.37	0.37	Average or Better	None	None	*Insufficient Data*	Average or Better	N/A
Safety Emphasis Area?		Yes	Weighted Average	1.53	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	
160-1	2 or 3 Lane Undivided Highway	8	311-319	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	Low
160-2	2 or 3 Lane Undivided Highway	4	319-323	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	None
160-3	2 or 3 Lane Undivided Highway	21	323-344	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	High
160-4	2 or 3 Lane Undivided Highway	18	344-362	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	High
160-5	2 or 3 Lane Undivided Highway	12	362-374	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	None
160-6	2 or 3 Lane Undivided Highway	17	374-391	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	None
160-7	2 or 3 Lane Undivided Highway	4	391-395	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	None
160-8	2 or 3 Lane Undivided Highway	18	395-413	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	None
160-9	2 or 3 Lane Undivided Highway	21	413-434	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	High
160-10	2 or 3 Lane Undivided Highway	17	434-451	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	High
160-11	2 or 3 Lane Undivided Highway	12	451-463	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	Low
160-12	2 or 3 Lane Undivided Highway	7	463-470	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	None

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)
160-1	8	311-319	Low	None	None	Low	FY19 F005901C: IR 6731 - SR 98, Construct Bus Pullouts (MP 318-325)
160-2	4	319-323	None	None	None	None	FY19 F005901C: IR 6731 - SR 98, Construct Bus Pullouts (MP 318-325)
160-3	21	323-344	High	None	FY15 H803701C: US 160 at N21, US 160/ N21 Intersection Lighting (MP 343/343.7) FY14 H8037: Tonalea, Install Intersection Lighting (MP 343.4)	High	FY19 F005901C: IR 6731 - SR 98, Construct Bus Pullouts (MP 318-325)
160-4	18	344-362	High	None	None	High	No Previous Completed or Programmed Projects that supersede condition data
160-5	12	362-374	None	None	None	None	No Previous Completed or Programmed Projects that supersede condition data
160-6	17	374-391	None	None	None	None	No Previous Completed or Programmed Projects that supersede condition data
160-7	4	391-395	None	None	None	None	No Previous Completed or Programmed Projects that supersede condition data
160-8	18	395-413	None	None	None	None	No Previous Completed or Programmed Projects that supersede condition data
160-9	21	413-434	High	None	None	High	No Previous Completed or Programmed Projects that supersede condition data
160-10	17	434-451	High	None	None	High	No Previous Completed or Programmed Projects that supersede condition data
160-11	12	451-463	Low	None	None	Low	No Previous Completed or Programmed Projects that supersede condition data
160-12	7	463-470	None	None	None	None	No Previous Completed or Programmed Projects that supersede condition data

Safety Performance Area - Needs Analysis Step 3

Segment Number	160-1	160-2	160-3	160-4	160-5	160-6	160-7	160-8	160-9	160-10	160-11	160-12	Corridor-Wide Crash Characteristics
Segment Length (miles)	8	4	21	18	12	17	4	18	21	17	12	7	
Segment Milepost (MP)	311-319	319-323	323-344	344-362	362-374	374-391	391-395	395-413	413-434	434-451	451-463	463-470	
Final Need	Low	None	High	High	None	None	None	None	High	High	Low	None	
Segment Crash Overview	1 Crashes were fatal 0 Crashes had incapacitating injuries 0 Crashes involve trucks 0 Crashes involve Motorcycles	1 Crashes were fatal 0 Crashes had incapacitating injuries 0 Crashes involve trucks 0 Crashes involve Motorcycles	12 Crashes were fatal 3 Crashes had incapacitating injuries 1 Crashes involve trucks 0 Crashes involve Motorcycles	5 Crashes were fatal 5 Crashes had incapacitating injuries 1 Crashes involve trucks 3 Crashes involve Motorcycles	0 Crashes were fatal 1 Crashes had incapacitating injuries 0 Crashes involve trucks 0 Crashes involve Motorcycles	1 Crashes were fatal 2 Crashes had incapacitating injuries 0 Crashes involve trucks 0 Crashes involve Motorcycles	1 Crashes were fatal 2 Crashes had incapacitating injuries 0 Crashes involve trucks 1 Crashes involve Motorcycles	3 Crashes were fatal 1 Crashes had incapacitating injuries 0 Crashes involve trucks 0 Crashes involve Motorcycles	4 Crashes were fatal 0 Crashes had incapacitating injuries 0 Crashes involve trucks 0 Crashes involve Motorcycles	5 Crashes were fatal 4 Crashes had incapacitating injuries 2 Crashes involve trucks 0 Crashes involve Motorcycles	1 Crashes were fatal 1 Crashes had incapacitating injuries 0 Crashes involve trucks 0 Crashes involve Motorcycles	0 Crashes were fatal 4 Crashes had incapacitating injuries 1 Crashes involve trucks 0 Crashes involve Motorcycles	34 Crashes were fatal 23 Crashes had incapacitating injuries 5 Crashes involve trucks 4 Crashes involve Motorcycles
Segment Crash Summaries (Fatal and Serious Injury Crashes) – First Harmful Event Type	N/A - Sample size too small	N/A - Sample size too small	33% Involve Collision with Motor Vehicle 33% Involve Overturning 27% Involve Collision with Pedestrian	70% Involve Collision with Motor Vehicle 10% Involve Overturning 10% Involve Other Non-Collision	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	56% Involve Collision with Motor Vehicle 33% Involve Overturning 11% Involve Collision with Pedestrian	N/A - Sample size too small	N/A - Sample size too small	51% Involve Collision with Motor Vehicle 21% Involve Overturning 12% Involve Collision with Pedestrian
Collision Type	N/A - Sample size too small	N/A - Sample size too small	33% Involve Single Vehicle 33% Involve Other 20% Involve Head On	30% Involve Single Vehicle 30% Involve Head On 10% Involve Angle	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	33% Involve Single Vehicle 22% Involve Other 22% Involve Rear End	N/A - Sample size too small	N/A - Sample size too small	33% Involve Single Vehicle 21% Involve Other 19% Involve Head On
Violation or Behavior	N/A - Sample size too small	N/A - Sample size too small	27% Involve No Improper Action 13% Involve Drove in Opposing Lane 13% Involve Failure to Keep in Proper Lane	20% Involve Inattention/Distraction 10% Involve Speed too Fast for Conditions 10% Involve Exceeded Lawful Speed	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	22% Involve Unknown 11% Involve Speed too Fast for Conditions 11% Involve No Improper Action	N/A - Sample size too small	N/A - Sample size too small	18% Involve Drove in Opposing Lane 16% Involve Unknown 11% Involve Speed too Fast for Conditions
Lighting Conditions	N/A - Sample size too small	N/A - Sample size too small	47% Occur in Dark-Unlighted Conditions	60% Occur in Daylight Conditions	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	56% Occur in Dark-Unlighted Conditions	N/A - Sample size too small	N/A - Sample size too small	46% Occur in Daylight Conditions

Segment Number	160-1	160-2	160-3	160-4	160-5	160-6	160-7	160-8	160-9	160-10	160-11	160-12	Corridor-Wide Crash Characteristics
Segment Length (miles)	8	4	21	18	12	17	4	18	21	17	12	7	
Segment Milepost (MP)	311-319	319-323	323-344	344-362	362-374	374-391	391-395	395-413	413-434	434-451	451-463	463-470	
Final Need	Low	None	High	High	None	None	None	None	High	High	Low	None	
			33% Occur in Daylight Conditions 13% Occur in Dark-Unknown Lighting Conditions	30% Occur in Dark-Unlighted Conditions 10% Occur in Dark-Unknown Lighting Conditions						22% Occur in Daylight Conditions 11% Occur in Dawn Conditions			37% Occur in Dark-Unlighted Conditions 9% Occur in Dark-Unknown Lighting Conditions
Surface Conditions	N/A - Sample size too small	N/A - Sample size too small	80% Involve Dry Conditions 13% Involve Wet Conditions 7% Involve Unknown Conditions	80% Involve Dry Conditions 10% Involve Mud, Dirt, Gravel Conditions 10% Involve Unknown Conditions	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	78% Involve Dry Conditions 22% Involve Unknown Conditions	N/A - Sample size too small	N/A - Sample size too small	81% Involve Dry Conditions 11% Involve Unknown Conditions 5% Involve Wet Conditions
First Unit Event	N/A - Sample size too small	N/A - Sample size too small	40% Involve a first unit event of Ran Off the Road (Right) 27% Involve a first unit event of Collision with Pedestrian 27% Involve a first unit event of Motor Vehicle in Transport	40% Involve a first unit event of Motor Vehicle in Transport 30% Involve a first unit event of Crossed Centerline 10% Involve a first unit event of Ran Off the Road (Right)	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	67% Involve a first unit event of Motor Vehicle in Transport 11% Involve a first unit event of Ran Off the Road (Right) 11% Involve a first unit event of Ran Off the Road (Left)	N/A - Sample size too small	N/A - Sample size too small	33% Involve a first unit event of Motor Vehicle in Transport 23% Involve a first unit event of Ran Off the Road (Right) 23% Involve a first unit event of Ran Off the Road (Right)
Driver Physical Condition	N/A - Sample size too small	N/A - Sample size too small	40% No Apparent Influence 33% Under the Influence of Drugs or Alcohol 27% Unknown	50% No Apparent Influence 40% Under the Influence of Drugs or Alcohol 10% Unknown	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	33% Under the Influence of Drugs or Alcohol 33% No Apparent Influence 22% Unknown	N/A - Sample size too small	N/A - Sample size too small	37% No Apparent Influence 33% Under the Influence of Drugs or Alcohol 26% Unknown
Safety Device Usage	N/A - Sample size too small	N/A - Sample size too small	33% None Used 27% Shoulder And Lap Belt Used 13% Air Bag Deployed	30% Unknown 20% Shoulder And Lap Belt Used 20% None Used	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	N/A - Sample size too small	33% Shoulder And Lap Belt Used 33% None Used 22% Unknown	N/A - Sample size too small	N/A - Sample size too small	32% Shoulder And Lap Belt Used 21% None Used 18% Unknown

Segment Number	160-1	160-2	160-3	160-4	160-5	160-6	160-7	160-8	160-9	160-10	160-11	160-12	Corridor-Wide Crash Characteristics
Segment Length (miles)	8	4	21	18	12	17	4	18	21	17	12	7	
Segment Milepost (MP)	311-319	319-323	323-344	344-362	362-374	374-391	391-395	395-413	413-434	434-451	451-463	463-470	
Final Need	Low	None	High	High	None	None	None	None	High	High	Low	None	
Hot Spot Crash Summaries	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Previously Completed Safety-Related Projects	None	None	FY15 H803701C: US 160 at N21, US 160/ N21 Intersection Lighting (MP 343/343.7) FY14 H8037: Tonalea, Install Intersection Lighting (MP 343.4)	None	None	None	None	None	None	None	None	None	
District Interviews/Discussions			• Lack of passing lanes • Informal right-turn lanes leading to unpaved/dirt roads • Small towns located along US 160 use it as a local road for daily commuting • Speed differences during right/left turns • Accidents related to elderly drivers have been noted							• Driving under influence of alcohol has been noted • Red Mesa High School and Four Corners Health Center is located within the segment			
Contributing Factors			• Roadside design • Lack of crossing opportunity • Inadequate roadway geometry • Poor nighttime visibility or lighting • Improper lane changes • Inadequate roadway shoulders	• Inadequate roadway geometry • Driver inattention/distraction • Poor nighttime visibility or lighting • Inadequate pavement markings • Inadequate roadway shoulders						• Roadside design • Inadequate roadway geometry • Lack of crossing opportunity • Poor nighttime visibility or lighting • Inadequate gaps in traffic • Inadequate roadway shoulders			

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)				
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
							EB	WB		EB	WB	EB	WB		EB	WB
160-1	Interrupted	311-319	8	0.47	Fair or Better	None	1.20	1.15	Fair or Better	None	None	1.84	2.39	Fair or Better	None	None
160-2	Interrupted	319-323	4	0.34	Fair or Better	None	1.17	1.24	Fair or Better	None	None	2.43	3.49	Fair or Better	None	None
160-3	Uninterrupted	323-344	21	0.68	Fair or Better	Medium	1.07	1.11	Fair or Better	None	None	1.48	1.47	Fair or Better	Medium	Medium
160-4	Uninterrupted	344-362	18	0.76	Fair or Better	None	1.07	1.08	Fair or Better	None	None	1.24	1.40	Fair or Better	None	Low
160-5	Uninterrupted	362-374	12	0.77	Fair or Better	None	1.09	1.06	Fair or Better	None	None	1.36	1.25	Fair or Better	None	None
160-6	Uninterrupted	374-391	17	0.69	Fair or Better	Medium	1.10	1.13	Fair or Better	None	None	1.41	1.48	Fair or Better	Low	Medium
160-7	Interrupted	391-395	4	0.22	Fair or Better	Medium	1.34	1.34	Fair or Better	None	None	3.98	5.28	Fair or Better	None	Medium
160-8	Uninterrupted	395-413	18	0.82	Fair or Better	None	1.05	1.08	Fair or Better	None	None	1.18	1.26	Fair or Better	None	None
160-9	Uninterrupted	413-434	21	0.81	Fair or Better	None	1.06	1.06	Fair or Better	None	None	1.21	1.25	Fair or Better	None	None
160-10	Uninterrupted	434-451	17	0.49	Fair or Better	High	1.13	1.10	Fair or Better	None	None	2.25	1.86	Fair or Better	High	High
160-11	Uninterrupted	451-463	12	0.48	Fair or Better	High	1.15	1.11	Fair or Better	None	None	1.74	2.39	Fair or Better	High	High
160-12	Interrupted	463-470	7	0.44	Fair or Better	None	1.19	1.17	Fair or Better	None	None	2.17	2.33	Fair or Better	None	None
Emphasis Area?	No	Weighted Average		0.65	Fair or Better	Low										

Segment	Facility Operations	Segment Mileposts (MP)	Segment Length (miles)	Closure Duration (minutes/mile/year)					Bridge Clearance (feet)			Initial Need
				Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
				EB	WB		EB	WB				
160-1	Interrupted	311-319	8	10.33	0.00	Fair or Better	None	None	No UP	Fair or Better	None	None
160-2	Interrupted	319-323	4	12.05	0.00	Fair or Better	None	None	No UP	Fair or Better	None	None
160-3	Uninterrupted	323-344	21	56.37	9.00	Fair or Better	None	None	No UP	Fair or Better	None	Medium
160-4	Uninterrupted	344-362	18	74.91	93.23	Fair or Better	Low	Low	No UP	Fair or Better	None	Low
160-5	Uninterrupted	362-374	12	0.00	15.85	Fair or Better	None	None	No UP	Fair or Better	None	None
160-6	Uninterrupted	374-391	17	22.76	59.93	Fair or Better	None	None	No UP	Fair or Better	None	Medium
160-7	Interrupted	391-395	4	18.85	14.75	Fair or Better	None	None	No UP	Fair or Better	None	Medium
160-8	Uninterrupted	395-413	18	9.33	5.26	Fair or Better	None	None	No UP	Fair or Better	None	None
160-9	Uninterrupted	413-434	21	10.24	8.38	Fair or Better	None	None	No UP	Fair or Better	None	None
160-10	Uninterrupted	434-451	17	35.48	4.65	Fair or Better	None	None	No UP	Fair or Better	None	High
160-11	Uninterrupted	451-463	12	0.00	9.30	Fair or Better	None	None	No UP	Fair or Better	None	High
160-12	Interrupted	463-470	7	19.89	26.43	Fair or Better	None	None	No UP	Fair or Better	None	None

Freight Performance Area - Needs Analysis Step 2

Segment #	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Vertical Clearance Hot Spots (Vertical Clearance < 16.25' and No Ramps)	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)
160-1	8	311-319	None	None	None	None	No Previous Completed or Programmed Projects that supersede condition data
160-2	4	319-323	None	None	None	None	No Previous Completed or Programmed Projects that supersede condition data
160-3	21	323-344	Medium	None	None	Medium	No Previous Completed or Programmed Projects that supersede condition data
160-4	18	344-362	Low	None	None	Low	No Previous Completed or Programmed Projects that supersede condition data
160-5	12	362-374	None	None	None	None	No Previous Completed or Programmed Projects that supersede condition data
160-6	17	374-391	Medium	None	None	Medium	No Previous Completed or Programmed Projects that supersede condition data
160-7	4	391-395	Medium	None	None	Medium	No Previous Completed or Programmed Projects that supersede condition data
160-8	18	395-413	None	None	None	None	No Previous Completed or Programmed Projects that supersede condition data
160-9	21	413-434	None	None	None	None	No Previous Completed or Programmed Projects that supersede condition data
160-10	17	434-451	High	None	None	High	No Previous Completed or Programmed Projects that supersede condition data
160-11	12	451-463	High	None	None	High	No Previous Completed or Programmed Projects that supersede condition data
160-12	7	463-470	None	None	None	None	No Previous Completed or Programmed Projects that supersede condition data

Freight Performance Area - Needs Analysis Step 3

Segment #	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Roadway Variables								Traffic Variables					Relevant Freight 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	EB Buffer Index (TPTI-TTTI)	WB Buffer Index (TPTI-TTTI)	
160-1	311-319	8	None	State Highway	Rural	Level	2	63	No	Undivided	32%	A-C	A-C	8%	0.65	1.24	
160-2	319-323	4	None	State Highway	Rural	Level	2.375	49	No	Undivided	42%	D	E/F	9%	1.25	2.25	Passing/Climbing Lane: EB MP 320-322.5 (within limits of Tuba City)
160-3	323-344	21	Medium	State Highway	Rural	Level	2	64	No	Undivided	12%	A-C	A-C	13%	0.42	0.36	
160-4	344-362	18	Low	State Highway	Rural	Level	2	65	No	Undivided	33%	A-C	A-C	12%	0.17	0.32	Passing/Climbing Lane: EB MP 349.5-352, WB MP 356.5-357.5
160-5	362-374	12	None	State Highway	Rural	Level	2	65	No	Undivided	14%	A-C	A-C	11%	0.27	0.19	
160-6	374-391	17	Medium	State Highway	Rural	Level	2	64	No	Undivided	24%	A-C	A-C	10%	0.32	0.35	Passing/Climbing Lane: EB MP 376.5-377
160-7	391-395	4	Medium	State Highway	Rural	Level	2.235	60	No	Undivided	47%	A-C	A-C	10%	2.64	3.94	Kayenta limits
160-8	395-413	18	None	State Highway	Rural	Level	2	65	No	Undivided	9%	A-C	A-C	11%	0.13	0.18	
160-9	413-434	21	None	State Highway	Rural	Level	2	65	No	Undivided	20%	A-C	A-C	11%	0.16	0.18	
160-10	434-451	17	High	State Highway	Rural	Level	2	64	No	Undivided	25%	A-C	A-C	11%	1.11	0.77	
160-11	451-463	12	High	State Highway	Rural	Level	2	65	No	Undivided	21%	A-C	A-C	11%	0.59	1.28	
160-12	463-470	7	None	State Highway	Rural	Level	2	60	No	Undivided	31%	A-C	A-C	11%	0.98	1.16	Teec Nos Pos Port of Entry (MP 465.2)

Segment #	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Programmed and Planned Projects or Issues from Previous Documents Relevant to Final Need	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related			
160-1	311-319	8	None	3	3	100%	0	0%	0	0%		Planned: -EB MP 311 - MP 320 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015 -EB MP 312 - MP 314 Climbing Lane, Climbing and Passing Lane Prioritization Study, 2015	• No identified performance deficiencies
160-2	319-323	4	None	2	1	50%	1	50%	0	0%		Planned: -EB MP 311 - MP 320 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015 -EB MP 312 - MP 314 Climbing Lane, Climbing and Passing Lane Prioritization Study, 2015	• No identified performance deficiencies
160-3	323-344	21	Medium	10	9	90%	0	0%	1	10%		Planned: -US 160 EB: MP 335 - MP 341 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015 -US 160 WB: MP 343 - MP 337 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015 -US 160 WB: MP 345 - MP 343 Climbing Lane, Climbing and Passing Lane Prioritization Study, 2015	• Percentage of closures related to weather is higher than statewide average (10% to 1%)
160-4	344-362	18	Low	14	12	86%	0	0%	2	14%		Planned: -EB MP 361 - MP 367 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015	• Percentage of closures related to weather is higher than statewide average (14% to 1%)
160-5	362-374	12	None	3	2	67%	1	33%	0	0%		Planned: -EB MP 361 - MP 367 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015 -WB MP 369 - MP 375 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015	• No identified performance deficiencies
160-6	374-391	17	Medium	18	12	67%	3	17%	3	17%		Planned: -WB MP 369 - MP 375 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015 -EB MP 381 - MP 384 Climbing Lane, Climbing and Passing Lane Prioritization Study, 2015 -EB MP 385 - MP 391 Climbing Lane, Climbing and Passing Lane Prioritization Study, 2015 -MP 386 EB DMS Sign, Arizona Dynamic Message Sign Master Plan, 2011 (ADOT)	• Percentage of closures related to Obstructions/Hazards is higher than statewide average (17% to 3%) • Percentage of closures related to weather is higher than statewide average (17% to 1%)
160-7	391-395	4	Medium	5	5	100%	0	0%	0	0%			• WB Buffer Index is 3.94 which is highest on the corridor indicating that it is less reliable • EB Buffer Index is 2.64 which is second highest on the corridor indicating that it is less reliable • Percentage of closures related to Incidents/Accidents is higher than statewide average (100% to 96%)
160-8	395-413	18	None	4	4	100%	0	0%	0	0%		Planned: -Climbing and passing lane (MP 401.4-MP 434.8), US 160, Jct. US 89 to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007	• No identified performance deficiencies

Segment #	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Programmed and Planned Projects or Issues from Previous Documents Relevant to Final Need	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related			
160-9	413-434	21	None	8	8	100%	0	0%	0	0%		Planned: -Climbing and passing lane (MP 401.4-MP 434.8), US 160, Jct. US 89 to Four Corners Final Feasibility Report & Corridor Improvement Plan, 2007 -MP 430 EB DMS Sign, Arizona Dynamic Message Sign Master Plan, 2011 (ADOT)	• No identified performance deficiencies
160-10	434-451	17	High	13	13	100%	0	0%	0	0%			• Deficiencies primarily related to PTI • Percentage of closures related to Incidents/Accidents is higher than statewide average (100% to 96%) • Issues with PTI and Reliability are likely related to No Passing Lanes and location of Mexican Water gas station within the segment
160-11	451-463	12	High	4	4	100%	0	0%	0	0%		Planned: -WB MP 462 - MP 4460 Climbing Lane, Climbing and Passing Lane Prioritization Study, 2015 -MP 460 EB DMS Sign, Arizona Dynamic Message Sign Master Plan, 2011 (ADOT) Programmed: -WB MP 458 - MP 463 Passing Lane, Climbing and Passing Lane Prioritization Study, 2015	• Deficiencies primarily related to PTI Percentage of closures related to Incidents/Accidents is higher than statewide average (100% to 96%) Issues with PTI and Reliability are likely related to No Passing Lanes
160-12	463-470	7	None	5	5	100%	0	0%	0	0%		Planned: Teec Nos Pos Mainline Screening (weight and credential screening, cameras, signage and signals on the mainline), Arizona Port of Entry Study, 2014 (ADOT)	• No identified performance deficiencies

Needs Summary Table

Performance Area	Segment Number and Mileposts (MP)											
	160-1	160-2	160-3	160-4	160-5	160-6	160-7	160-8	160-9	160-10	160-11	160-12
	MP 311-319	MP 319-323	MP 323-344	MP 344-362	MP 362-374	MP 374-391	MP 391-395	MP 395-413	MP 413-434	MP 434-451	MP 451-463	MP 463-470
Pavement+	None*	None*	None*	None*	None*	Low	None*	None*	Medium	Low	None*	None*
Bridge	Medium	None*	None*	Low	None*	None*	None*	None*	Low	High	None*	None*
Mobility+	Low	High	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Safety+	Low	N/A#	High	High	None*	None*	N/A#	N/A#	High	High	Low	None*
Freight	None*	None*	Medium	Low	None*	Medium	Medium	None*	None*	High	High	None*
Average Need (0-3)	**0.77**	**0.90**	**1.23**	**1.23**	**0.23**	**0.77**	**0.70**	**0.30**	**1.54**	**2.08**	**0.92**	**0.23**

+ Identified as an emphasis area for the US 160 Corridor.

 # N/A indicates insufficient or no data available to determine level of need.

**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.*

Level of Need	Average Need Range
None*	< 0.1
Low	0.1 - 1.0
Medium	1.0 - 2.0
High	> 2.0

Appendix E: Life-Cycle Cost Analysis

*Based on the candidate solutions presented in **Table 19**, LCCA was not conducted for any bridges and pavement on the US 160 Corridor.*

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

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
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
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.

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
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
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

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
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
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

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
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	$154,000	Includes conduit, conductors, and controllers for 2 intersections that span a total of approximately 1 mile	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.)
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

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
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.)

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
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							
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

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
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
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

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
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
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

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF FOR CORRIDOR PROFILE STUDIES	CMF NOTES
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
OTHER IMPROVEMENTS							
Install Curb and Gutter	$211,200	Mile	2.20	$465,000	In both directions; curb and gutter	0.89	From CMF Clearinghouse
Install Sidewalks, Curb, and Gutter	$475,200	Mile	2.20	$1,045,000	In both directions; 5' sidewalks, curb, and gutter	0.89 installing sidewalk 0.24 (pedestrian crashes only)	From CMF Clearinghouse Average of 6 values from FHWA Desktop Reference
Install Sidewalks	$264,000	Mile	2.20	$581,000	In both directions; 5' sidewalks	0.24 (pedestrian crashes only)	Average of 6 values from FHWA Desktop Reference
Install Advanced Warning Signal System	$108,000	each	2.20	$238,000	Overhead static sign with flashing beacons, detectors, and radar system. Signs for each mainline approach of the intersection (2)	0.61	FHWA Desktop Reference for CRF
Install Indirect Left Turn Intersection	$1,140,000	each	2.20	$2,500,000	Raised concrete median improvements; intersection improvements; turn lanes	0.80	CMF Clearinghouse
Convert Standard Diamond Interchange to Diverging Diamond Interchange	$2,272,700	each	2.20	$5,000,000	Convert traditional diamond interchange into diverging diamond interchange; assumes re-use of existing bridges	0.67	CMF Clearinghouse
Install Adaptive Signal Control and Signal Coordination	$181,750	mile	2.20	$400,000	Controller upgrades, advanced detection, software configuration, cameras; includes conduit, conductors, and controllers for 2 intersections that span a total of approximately 1 miles for coordination	0.81 (adaptive control) 0.90 (signal coordination)	CMF Clearinghouse
Left-in Only Center Raised Median Improvements	$84,100	each	2.20	$185,000	Left-in only center raised median improvements	0.87	CMF Clearinghouse

^ 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	<6,000
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 Scale

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

Risk Priority

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
160.1	10,942.23	2.6		4,700				1,012	y	2.25	2.63	2.4	y	4	y
160.2-1	10,942.23	0.6		4,800				1,012	y	2.25	2.63	3	y	4	y
160.2-2	4,580.92	2		5,000				590	y	0.42	0.34	3	n	4	y
160.3	4,580.92	10		5,600				590	y	0.42	0.34	2.1	n	4	y
160.4	4,580.92	1.5		5,600				590	y	0.42	0.34	1.7	n	4	y
160.5	4,580.92	2		5,600				590	y	0.42	0.34	1.9	n	4	y
160.6	3,277.75	16		6,200				389	y	0.32	0.31	2.5	n	4	y
160.7	5,576.68	2		6,000				572	y	0.35	1.05	2.7	n	4	y
160.8-1	3,068.00	2		4,900				337	y	0.18	0.36	2.3	n	5	y
160.8-2	3,054.85	4		5,100				339	y	1.11	0.84	2.3	n	5	y
160.9	3,054.85	2.4		5,100				339	y	1.11	0.84	2.3	n	5	y

Solution Number	Bridge	Pavement	Mobility	Safety	Freight	Risk Score (0 to 10)				
						Bridge	Pavement	Mobility	Safety	Freight
160.1	n	y	y	y	y	0.00	2.36	6.83	4.97	6.43
160.2-1	n	y	y	y	y	0.00	2.43	6.23	5.01	6.43
160.2-2	n	y	y	y	y	0.00	1.67	7.00	2.72	7.44
160.3	n	n	y	y	y	0.00	0.00	7.88	2.96	7.44
160.4	n	n	y	y	y	0.00	0.00	6.93	2.96	7.44
160.5	n	n	y	y	y	0.00	0.00	7.00	2.96	7.44
160.6	n	n	y	y	y	0.00	0.00	7.84	3.12	6.83
160.7	n	n	y	y	y	0.00	0.00	7.86	3.19	7.08
160.8-1	n	n	y	y	y	0.00	0.00	7.00	2.58	6.10
160.8-2	n	n	y	y	y	0.00	0.00	7.89	2.66	7.70
160.9	n	n	y	y	y	0.00	0.00	7.74	2.66	7.70

Appendix H: Candidate Solution Cost Estimates

SOLUTION		QUANTITY	UNIT	UNIT COST	TOTAL CONSTRUCTION COST	NOTES
CS160.1	**West Tuba City Widening (MP 319 - 321.6)**					
	Convert a 2-Lane undivided highway to a 5-Lane highway	2.6	Mile	$3,467,200	$9,014,700	
				CONSTRUCTION SUBTOTAL	**$9,014,700**	
			3%	Preliminary Eng	**$270,400**	
			10%	Design	**$901,500**	
				TOTAL	**$10,186,600**	
CS160.2	**East Tuba City Widening (MP 322.4 - 325)**					
	Convert a 2-Lane undivided highway to a 5-Lane highway	2.6	Mile	$3,467,200	$9,014,700	
	Install lighting (connecting to existing power) (eastbound)	2.6	Mile	$594,000	$1,544,400	
	Install lighting (connecting to existing power) (westbound)	2.6	Mile	$594,000	$1,544,400	
				CONSTRUCTION SUBTOTAL	**$12,103,500**	
			3%	Preliminary Eng	**$363,100**	
			10%	Design	**$1,210,400**	
				TOTAL	**$13,677,000**	
CS160.3	**Tonalea Safety Improvement (MP 331-341)**					
	Widen shoulder (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips)	10	Mile	$693,000	$6,930,000	Assumes 10' of existing shoulder (combined left and right), includes widening shoulder by a total of 6'
	Install Curve Warning Signs (eastbound)	1	Each	$5,500	$5,500	Will be installed at curve (MP 336 to MP 336.5)
	Install Curve Warning Signs (westbound)	1	Each	$5,500	$5,500	
	Install Chevrons (MP 336 to MP 336.5)	0.5	Mile	$40,500	$20,300	
				CONSTRUCTION SUBTOTAL	**$6,961,300**	
			3%	Preliminary Eng	**$208,800**	
			10%	Design	**$696,100**	
				TOTAL	**$7,866,200**	

CS160.4	**Tuba City – Tonalea: Eastbound Passing Lane (MP 335-336.5 EB)**					
	Construct EB passing lane (MP 335 - 336.5)	1.5	Mile	$3,300,000	$4,950,000	
				CONSTRUCTION SUBTOTAL	**$4,950,000**	
			3%	Preliminary Eng	**$148,500**	
			10%	Design	**$495,000**	
				TOTAL	**$5,593,500**	
CS160.5	**Tonalea – Tuba City: Westbound Passing Lane (MP 340-343 WB)**					
	Construct WB passing lane (MP 340 - 341)	1	Mile	$3,300,000	$3,300,000	Divided the project length in two pieces, however, it is expected to construct both the passing lanes at the same time.
	Construct WB passing lane (MP 342 - 343)	1	Mile	$3,300,000	$3,300,000	
				CONSTRUCTION SUBTOTAL	**$6,600,000**	
			3%	Preliminary Eng	**$198,000**	
			10%	Design	**$660,000**	
				TOTAL	**$7,458,000**	
CS160.6	**Shonto Safety Improvement (MP 346-362)**					
	Widen shoulder (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips)	16	Mile	$794,200	$12,707,200	Assumes 8' of existing shoulder (combined left and right), includes widening shoulder by a total of 8'
	Install lighting (solar powered LED) at SR 98 intersection (MP 361.6)	6	Each	$22,000	$132,000	
	Install Curve Warning Signs (eastbound)	1	Each	$5,500	$5,500	
	Install Curve Warning Signs (westbound)	1	Each	$5,500	$5,500	
	Install Chevrons (MP 358 to MP 359)	1	Mile	$40,500	$40,500	
				CONSTRUCTION SUBTOTAL	**$12,890,700**	
			3%	Preliminary Eng	**$386,700**	
			10%	Design	**$1,289,100**	
				TOTAL	**$14,566,500**	

CS160.7	**Tsegi Canyon Passing Lanes (MP 389-391)**					
	Construct WB passing lane (MP 389 – MP 390)	1	Mile	$3,300,000	$3,300,000	
	Construct EB passing lane (MP 390 – MP 391)	1	Mile	$3,300,000	$3,300,000	
				CONSTRUCTION SUBTOTAL	**$6,600,000**	
			3%	Preliminary Eng	**$198,000**	
			10%	Design	**$660,000**	
				TOTAL	**$7,458,000**	
CS160.8	**Mexican Water Safety Improvement (MP 432-438)**					
	Widen shoulder (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips)	6	Mile	$594,000	$3,564,000	Assumes 12' of existing shoulder (combined left and right), includes widening shoulder by a total of 4'
	Install Curve Warning Signs (eastbound)	2	Each	$5,500	$11,000	Will be installed at 2 curves (MP 432.5 to MP 433.5 and MP 434.5 to MP 435.5)
	Install Curve Warning Signs (westbound)	2	Each	$5,500	$11,000	
	Install Chevrons (MP 432.5 to MP 433.5 and MP 434.5 to MP 435.5)	2	Mile	$40,500	$81,000	
				CONSTRUCTION SUBTOTAL	**$3,667,000**	
			3%	Preliminary Eng	**$110,000**	
			10%	Design	**$366,700**	
				TOTAL	**$4,143,700**	
CS160.9	**US 160/US 191 Intersection Improvement (MP 435-437)**					
	Install acceleration lane (eastbound) (MP 434.8)	1	Each	$280,500	$280,500	Intersection has a deceleration lane in westbound direction
	Install acceleration lane (westbound) (MP 437.2)	1	Each	$280,500	$280,500	
	Install deceleration lane (eastbound) (MP 434.8)	1	Each	$280,500	$280,500	
	Install lighting (solar powered LED) at US 191 intersection (MP 434.8)	6	Each	$22,000	$132,000	
	Install lighting (solar powered LED) at US 191 intersection (MP 437.2)	6	Each	$22,000	$132,000	
				CONSTRUCTION SUBTOTAL	**$1,105,500**	
			3%	Preliminary Eng	**$33,200**	
			10%	Design	**$110,600**	
				TOTAL	**$1,249,300**	

Appendix I: Performance Effectiveness Scores

Need Reduction

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 #	CS160.1	CS160.2-1	CS160.2-2	CS160.3	CS160.4	CS160.5	CS160.6	CS160.7	CS160.8-1	CS160.8-2	CS160.9
Description	West Tuba City Widening	East Tuba City Widening	East Tuba City Widening	Tonalea Safety Improvement	Tuba City – Tonalea: Eastbound Passing Lane	Tonalea – Tuba City: Westbound Passing Lane	Shonto Safety Improvement	Tsegi Canyon Passing Lanes	Mexican Water Safety Improvement	Mexican Water Safety Improvement	US 160/US 191 Intersection Improvement
Project Beg MP	319	322.4	323	331	335	340	346	389	432	434	435
Project End MP	321.6	323	325	341	336.5	343	362	391	434	438	437
Project Length (miles)	2.6	0.6	2	10	1.5	2	16	2	2	4	2.4
Segment Beg MP	319	319	323	323	323	323	344	374	413	434	434
Segment End MP	323	323	344	344	344	344	362	391	434	451	451
Segment Length (miles)	4	4	21	21	21	21	18	17	21	17	17
Segment #	2	2	3	3	3	3	4	6	9	10	10
Current # of Lanes (both directions)	2.375	2.375	2	2	2	2	2	2	2	2	2
Project Type (one-way or two-way)	two-way	two-way	two-way	two-way	one-way	one-way	two-way	one-way	two-way	two-way	two-way
Additional Lanes (one-way)	1	1	1	0	1	1	0	1	0	0	0
Pro-Rated # of Lanes	3.68	2.68	2.19	2.00	2.07	2.10	2.00	2.12	2.00	2.00	2.00

SAFETY — DIRECTIONAL SAFETY

Notes and Directions	Description	CS160.1	CS160.2-1	CS160.2-2	CS160.3	CS160.4	CS160.5	CS160.6	CS160.7	CS160.8-1	CS160.8-2	CS160.9
Input current value from performance system (direction 1)	Orig Segment Directional Safety Index (EB)	2.400	2.400	3.610	3.610	3.610	3.610	3.830	0.690	0.720	1.900	1.900
Input current value from performance system (direction 1)	Orig Segment Directional Fatal Crashes (EB)	1	1	6	6	6	6	5	1	1	2	2
Input current value from performance system (direction 1)	Orig Segment Directional Incap Crashes (EB)	0	0	2	2	2	2	2	0	0	3	3
Input current value from performance system (direction 1)	Original Fatal Crashes in project limits (EB)	0	0	3	3	1	1	5	1	1	1	1
Input current value from performance system (direction 1)	Original Incap Crashes in project limits (EB)	0	0	0	1	0	0	2	0	0	3	2
Input CMF value (direction 1) - If no CMF enter 1.0	CMF 1 (EB)(lowest CMF)	0.6	0.6	0.6	0.64	0.63	0.63	0.64	0.63	0.64	0.64	0.75
Input CMF value (direction 1) - If no CMF enter 1.0	CMF 2 (EB)	1	0.75	0.75	0.79	1	1	0.75	1	0.79	0.79	0.85
Input CMF value (direction 1) - If no CMF enter 1.0	CMF 3 (EB)	1	1	1	1	1	1	0.79	1	1	1	1
Input CMF value (direction 1) - If no CMF enter 1.0	CMF 4 (EB)	1	1	1	1	1	1	1	1	1	1	1
Input CMF value (direction 1) - If no CMF enter 1.0	CMF 5 (EB)	1	1	1	1	1	1	1	1	1	1	1
Calculated Value (direction 1)	Total CMF (EB)	0.600	N/A	N/A	N/A	0.630	0.630	N/A	0.630	0.573	N/A	N/A
Calculated Value (direction 1)	Fatal Crash reduction (EB)	0.000	0.000	1.275	1.147	0.370	0.370	1.880	0.370	0.427	0.360	0.250
Calculated Value (direction 1)	Incap Crash reduction (EB)	0.000	0.000	0.000	0.360	0.000	0.000	0.787	0.000	0.000	1.214	0.556
Enter in Safety Index spreadsheet to calculate new Safety Index (direction 1)	Post-Project Segment Directional Fatal Crashes (EB)	1.000	1.000	4.725	4.853	5.630	5.630	3.120	0.630	0.573	1.640	1.750
Enter in Safety Index spreadsheet to calculate new Safety Index (direction 1)	Post-Project Segment Directional Incap Crashes (EB)	0.000	0.000	2.000	1.640	2.000	2.000	1.213	0.000	0.000	1.786	2.444
Input value from updated Safety Index spreadsheet (direction 1)	Post-Project Segment Directional Safety Index (EB)	2.400	2.400	2.860	2.920	3.390	3.390	2.390	0.430	0.410	1.520	1.660
Enter in Safety Needs spreadsheet to calculate new segment level Safety Need (direction 1)	Post-Project Segment Directional Safety Index (EB)	2.400	2.400	2.860	2.920	3.390	3.390	2.390	0.430	0.410	1.520	1.660
Input current value from performance system (direction 2)	Orig Segment Directional Safety Index (WB)	0.000	0.000	3.570	3.570	3.570	3.570	0.150	0.100	2.140	2.660	2.660
Input current value from performance system (direction 2)	Orig Segment Directional Fatal Crashes (WB)	0	0	6	6	6	6	0	0	3	3	3

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		Solution #	CS160.1	CS160.2-1	CS160.2-2	CS160.3	CS160.4	CS160.5	CS160.6	CS160.7	CS160.8-1	CS160.8-2	CS160.9
		Description	West Tuba City Widening	East Tuba City Widening	East Tuba City Widening	Tonalea Safety Improvement	Tuba City – Tonalea: Eastbound Passing Lane	Tonalea – Tuba City: Westbound Passing Lane	Shonto Safety Improvement	Tsegi Canyon Passing Lanes	Mexican Water Safety Improvement	Mexican Water Safety Improvement	US 160/US 191 Intersection Improvement
		Project Beg MP	319	322.4	323	331	335	340	346	389	432	434	435
		Project End MP	321.6	323	325	341	336.5	343	362	391	434	438	437
		Project Length (miles)	2.6	0.6	2	10	1.5	2	16	2	2	4	2.4
		Segment Beg MP	319	319	323	323	323	323	344	374	413	434	434
		Segment End MP	323	323	344	344	344	344	362	391	434	451	451
		Segment Length (miles)	4	4	21	21	21	21	18	17	21	17	17
		Segment #	2	2	3	3	3	3	4	6	9	10	10
	Input current value from performance system (direction 2)	Orig Segment Directional Incap Crashes (WB)	0	0	1	1	1	1	3	2	0	1	1
	Input current value from performance system (direction 2)	Original Fatal Crashes in project limits (WB)	0	0	2	3	1	3	0	0	1	2	2
	Input current value from performance system (direction 2)	Original Incap Crashes in project limits (WB)	0	0	1	0	0	0	3	1	0	0	0
	Input CMF value (direction 2) - If no CMF enter 1.0	CMF 1 (WB)(lowest CMF)	0.6	0.6	0.6	0.64	0.63	0.63	0.64	0.63	0.64	0.64	0.75
	Input CMF value (direction 2) - If no CMF enter 1.0	CMF 2 (WB)	1	0.75	0.75	0.79	1	1	0.75	1	0.79	0.79	0.85
	Input CMF value (direction 2) - If no CMF enter 1.0	CMF 3 (WB)	1	1	1	1	1	1	0.79	1	1	1	1
	Input CMF value (direction 2) - If no CMF enter 1.0	CMF 4 (WB)	1	1	1	1	1	1	1	1	1	1	1
	Input CMF value (direction 2) - If no CMF enter 1.0	CMF 5 (WB)	1	1	1	1	1	1	1	1	1	1	1
	Calculated Value (direction 2)	Total CMF (WB)	0.600	N/A	N/A	N/A	0.630	0.630	N/A	0.630	0.573	N/A	N/A
	Calculated Value (direction 2)	Fatal Crash reduction (WB)	0.000	0.000	0.950	1.080	0.370	1.110	0.000	0.000	0.427	0.787	0.400
	Calculated Value (direction 2)	Incap Crash reduction (WB)	0.000	0.000	0.475	0.000	0.000	0.000	1.147	0.370	0.000	0.000	0.000
	Enter in Safety Index spreadsheet to calculate new Safety Index (direction 2)	Post-Project Segment Directional Fatal Crashes (WB)	0.000	0.000	5.050	4.920	5.630	4.890	0.000	0.000	2.573	2.213	2.600
	Enter in Safety Index spreadsheet to calculate new Safety Index (direction 2)	Post-Project Segment Directional Incap Crashes (WB)	0.000	0.000	0.525	1.000	1.000	1.000	1.853	1.630	0.000	1.000	1.000
	Input value from updated Safety Index spreadsheet (direction 2)	Post-Project Segment Directional Safety Index (WB)	0.000	0.000	3.000	2.940	3.360	2.920	0.090	0.080	1.830	1.980	2.320
	Enter in Safety Needs spreadsheet to calculate new segment level Safety Need (direction 2)	Post-Project Segment Directional Safety Index (WB)	0.000	0.000	3.000	2.940	3.360	2.920	0.090	0.080	1.830	1.980	2.320
SAFETY INDEX	Calculated Value - verify that it matches current performance system	Current Safety Index	1.200	1.200	3.590	3.590	3.590	3.590	1.990	0.395	1.430	2.280	2.280
SAFETY INDEX	Enter in Safety Needs spreadsheet to calculate new segment level Safety Need	Post-Project Safety Index	1.20000	1.200000	2.930	2.930	3.375	3.155	1.240	0.255	1.120	1.750	1.990
Needs	User entered value from Safety Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Safety Need	**3.481**	**3.481**	**12.502**	**12.502**	**12.502**	**12.502**	**6.456**	**0.239**	**4.13**	**7.503**	**7.503**
Needs	User entered value from Safety Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Safety Need	**3.481**	**3.481**	**9.984**	**9.984**	**11.682**	**10.842**	**3.610**	**0.156**	**3.067**	**5.481**	**6.396**

LEGEND:

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- assumed values (do not modify)

			Solution #	CS160.1	CS160.2-1	CS160.2-2	CS160.3	CS160.4	CS160.5	CS160.6	CS160.7	CS160.8-1	CS160.8-2	CS160.9
			Description	West Tuba City Widening	East Tuba City Widening	East Tuba City Widening	Tonalea Safety Improvement	Tuba City – Tonalea: Eastbound Passing Lane	Tonalea – Tuba City: Westbound Passing Lane	Shonto Safety Improvement	Tsegi Canyon Passing Lanes	Mexican Water Safety Improvement	Mexican Water Safety Improvement	US 160/US 191 Intersection Improvement
			Project Beg MP	319	322.4	323	331	335	340	346	389	432	434	435
			Project End MP	321.6	323	325	341	336.5	343	362	391	434	438	437
			Project Length (miles)	2.6	0.6	2	10	1.5	2	16	2	2	4	2.4
			Segment Beg MP	319	319	323	323	323	323	344	374	413	434	434
			Segment End MP	323	323	344	344	344	344	362	391	434	451	451
			Segment Length (miles)	4	4	21	21	21	21	18	17	21	17	17
			Segment #	2	2	3	3	3	3	4	6	9	10	10
MOBILITY	MOBILITY INDEX	Input current value from performance system	Original Segment Mobility Index	0.720	0.720	0.180	0.180	0.180	0.180	0.120	0.270	0.110	0.190	0.190
		Enter in Mobility Index Spreadsheet to determine new segment level Mobility Index	Post-Project # of Lanes (both directions)	3.68	2.68	2.19	2.00	2.07	2.10	2.00	2.12	2.00	2.00	2.00
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Mobility Index	0.46	0.63	0.16	0.18	0.17	0.17	0.12	0.26	0.11	0.19	0.19
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Mobility Index	0.460	0.630	0.160	0.180	0.170	0.170	0.120	0.260	0.110	0.190	0.190
	FUT V/C	Input current value from performance system	Original Segment Future V/C	0.870	0.870	0.210	0.210	0.210	0.210	0.150	0.330	0.130	0.220	0.220
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Future V/C	0.560	0.770	0.190	0.210	0.210	0.200	0.150	0.310	0.130	0.220	0.220
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Future V/C	0.560	0.770	0.190	0.210	0.210	0.200	0.150	0.310	0.130	0.220	0.220
	PEAK HOUR V/C	Input current value from performance system (direction 1)	Original Segment Peak Hour V/C (EB)	0.510	0.510	0.150	0.150	0.150	0.150	0.080	0.210	0.100	0.120	0.120
		Input current value from performance system (direction 2)	Original Segment Peak Hour V/C (WB)	0.670	0.670	0.150	0.150	0.150	0.150	0.090	0.200	0.100	0.120	0.120
		***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	N/A	N/A	N/A	N/A	2.14	2.19	N/A	2.24	N/A	N/A	N/A
		Input value from updated Mobility Index spreadsheet (direction 1)	Post-Project Segement Peak Hr V/C (EB)	0.330	0.450	0.13	0.15	0.14	0.13	0.08	0.19	0.10	0.12	0.12
		Input value from updated Mobility Index spreadsheet (direction 2)	Post-Project Segement Peak Hr V/C (WB)	0.430	0.590	0.13	0.15	0.14	0.13	0.09	0.18	0.10	0.12	0.12
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Peak Hr V/C (EB)	0.330	0.450	0.130	0.150	0.140	0.130	0.080	0.190	0.100	0.120	0.120
		Enter in Mobility Needs spreadsheet to update segment level Mobility Need	Post-Project Segment Peak Hr V/C (WB)	0.430	0.590	0.130	0.150	0.140	0.130	0.090	0.180	0.100	0.120	0.120
	TTI AND PTI	Calculated Value (both directions)	Safety Reduction Factor	1.000	1.000	0.816	0.816	0.940	0.879	0.623	0.646	0.783	0.768	0.873
		Calculated Value (both directions)	Safety Reduction	0.000	0.000	0.184	0.184	0.060	0.121	0.377	0.354	0.217	0.232	0.127
		Calculated Value (both directions)	Mobility Reduction Factor	0.639	0.875	0.889	1.000	0.944	0.944	1.000	0.963	1.000	1.000	1.000
		Calculated Value (both directions)	Mobility Reduction	0.361	0.125	0.111	0.000	0.056	0.056	0.000	0.037	0.000	0.000	0.000

LEGEND:
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			CS160.1	CS160.2-1	CS160.2-2	CS160.3	CS160.4	CS160.5	CS160.6	CS160.7	CS160.8-1	CS160.8-2	CS160.9
		Solution #	CS160.1	CS160.2-1	CS160.2-2	CS160.3	CS160.4	CS160.5	CS160.6	CS160.7	CS160.8-1	CS160.8-2	CS160.9
		Description	West Tuba City Widening	East Tuba City Widening	East Tuba City Widening	Tonalea Safety Improvement	Tuba City – Tonalea: Eastbound Passing Lane	Tonalea – Tuba City: Westbound Passing Lane	Shonto Safety Improvement	Tsegi Canyon Passing Lanes	Mexican Water Safety Improvement	Mexican Water Safety Improvement	US 160/US 191 Intersection Improvement
		Project Beg MP	319	322.4	323	331	335	340	346	389	432	434	435
		Project End MP	321.6	323	325	341	336.5	343	362	391	434	438	437
		Project Length (miles)	2.6	0.6	2	10	1.5	2	16	2	2	4	2.4
		Segment Beg MP	319	319	323	323	323	323	344	374	413	434	434
		Segment End MP	323	323	344	344	344	344	362	391	434	451	451
		Segment Length (miles)	4	4	21	21	21	21	18	17	21	17	17
		Segment #	2	2	3	3	3	3	4	6	9	10	10
	Assumed effect on TTI (% of mobility reduction)	Mobility effect on TTI	0.30	0.30	0.30	0.30	0.60	0.60	0.30	0.60	0.30	0.30	0.30
	Assumed effect on PTI (% of mobility reduction)	Mobility effect on PTI	0.20	0.20	0.20	0.20	0.50	0.50	0.20	0.50	0.20	0.20	0.20
	Assumed effect on TTI (% of safety reduction)	Safety effect on TTI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Assumed effect on PTI (% of safety reduction)	Safety effect on PTI	0.30	0.30	0.30	0.30	0.60	0.60	0.30	0.60	0.30	0.30	0.30
	Input current value from performance system (direction 1)	Original Directional Segment TTI (EB)	1.120	1.120	1.010	1.010	1.010	1.010	1.000	1.020	1.010	1.050	1.050
	Input current value from performance system (direction 1)	Original Directional Segment PTI (EB)	3.750	3.750	1.300	1.300	1.300	1.300	1.310	1.510	1.370	1.890	1.890
	Input current value from performance system (direction 2)	Original Directional Segment TTI (WB)	1.170	1.170	1.010	1.010	1.010	1.010	1.000	1.060	1.020	1.040	1.040
	Input current value from performance system (direction 2)	Original Directional Segment PTI (WB)	3.250	3.250	1.350	1.350	1.350	1.350	1.250	2.110	1.370	1.850	1.850
	Calculated Value (both directions)	Reduction Factor for Segment TTI	0.108	0.038	0.033	0.000	0.033	0.033	0.000	0.022	0.000	0.000	0.000
	Calculated Value (both directions)	Reduction Factor for Segment PTI	0.072	0.025	0.077	0.055	0.064	0.100	0.113	0.231	0.065	0.070	0.038
	Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Directional Segment TTI (EB)	1.060	1.078	1.005	1.010	1.005	1.005	1.000	1.010	1.010	1.050	1.050
	Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Directional Segment PTI (EB)	3.479	3.656	1.199	1.228	1.217	1.169	1.162	1.161	1.281	1.758	1.818
	Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Directional Segment TTI (WB)	1.043	1.126	1.005	1.010	1.010	1.010	1.000	1.060	1.020	1.040	1.040
	Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Directional Segment PTI (WB)	3.015	3.169	1.246	1.276	1.350	1.350	1.109	2.110	1.28	1.72	1.779
CLOSURE EXTENT	Input current value from performance system (direction 1)	Orig Segment Directional Closure Extent (EB)	0.100	0.100	0.240	0.240	0.240	0.240	0.340	0.120	0.040	0.140	0.140
CLOSURE EXTENT	Input current value from performance system (direction 2)	Orig Segment Directional Closure Extent (WB)	0.000	0.000	0.050	0.050	0.050	0.050	0.700	0.340	0.040	0.010	0.010
CLOSURE EXTENT	Input value from HCRS	Segment Closures with fatalities/injuries	1	1	9	9	9	9	4	3	2	6	6
CLOSURE EXTENT	Input value from HCRS	Total Segment Closures	2	2	10	10	10	10	14	18	8	13	13
CLOSURE EXTENT	Calculated Value (both directions)	% Closures with Fatality/Injury	0.50	0.50	0.90	0.90	0.90	0.90	0.29	0.17	0.25	0.46	0.46
CLOSURE EXTENT	Calculated Value (both directions)	Closure Reduction	0.000	0.000	0.165	0.165	0.054	0.109	0.108	0.059	0.054	0.107	0.059
CLOSURE EXTENT	Calculated Value (both directions)	Closure Reduction Factor	1.000	1.000	0.835	0.835	0.946	0.891	0.892	0.941	0.946	0.893	0.941
CLOSURE EXTENT	Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 1)	Post-Project Segment Directional Closure Extent (EB)	0.100	0.10000	0.200	0.200	0.227	0.214	0.303	0.113	0.038	0.125	0.132
CLOSURE EXTENT	Enter in Mobility Needs spreadsheet to update segment level Mobility Need (direction 2)	Post-Project Segment Directional Closure Extent (WB)	0.000	0.000	0.042	0.042	0.050	0.050	0.625	0.340	0.038	0.009	0.009

ADOT

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			Description	West Tuba City Widening	East Tuba City Widening	East Tuba City Widening	Tonalea Safety Improvement	Tuba City – Tonalea: Eastbound Passing Lane	Tonalea – Tuba City: Westbound Passing Lane	Shonto Safety Improvement	Tsegi Canyon Passing Lanes	Mexican Water Safety Improvement	Mexican Water Safety Improvement	US 160/US 191 Intersection Improvement
			Project Beg MP	319	322.4	323	331	335	340	346	389	432	434	435
			Project End MP	321.6	323	325	341	336.5	343	362	391	434	438	437
			Project Length (miles)	2.6	0.6	2	10	1.5	2	16	2	2	4	2.4
			Segment Beg MP	319	319	323	323	323	323	344	374	413	434	434
			Segment End MP	323	323	344	344	344	344	362	391	434	451	451
			Segment Length (miles)	4	4	21	21	21	21	18	17	21	17	17
			Segment #	2	2	3	3	3	3	4	6	9	10	10
FREIGHT	BICYCLE ACCOM	Input current value from performance system	Orig Segment Bicycle Accomodation %	83.78%	83.78%	19.49%	19.5%	19.5%	19.5%	9.4%	0.0%	0.5%	0.7%	0.7%
		Input current value from performance system	Orig Segment Outside Shoulder width	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Outside Shoulder width	7.4	5.9	5.8	7.6	5.0	5.0	8.1	5.0	5.4	5.8	5.0
		Input value from updated Mobility Index spreadsheet	Post-Project Segment Bicycle Accomodation (%)	89.39%	94.39%	26.6%	85.8%	19.5%	19.5%	100.0%	0.0%	12.5%	25.8%	0.7%
		Enter in Mobiity Needs spreadsheet to calculate new segment level Mobility Need	Post-Project Segment Bicycle Accomodation (%)	89.39%	94.39%	26.6%	85.8%	19.5%	19.5%	100.0%	0.0%	12.5%	25.8%	0.7%
	Needs	User entered value from Mobility Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Mobility Need	**2.677**	**2.677**	**1.046**	**1.046**	**1.046**	**1.046**	**1.252**	**2.014**	**1.028**	**1.966**	**1.966**
		User entered value from Mobility Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Mobility Need	**0.734**	**1.247**	**0.979**	**0.481**	**1.030**	**1.023**	**0.544**	**1.836**	**0.963**	**1.667**	**1.856**
	TTTI AND TPTI	Assumed effect on TTTI (% of mobility reduction)	Mobility effect on TTTI	0.15	0.15	0.15	0.15	0.30	0.30	0.15	0.30	0.15	0.15	0.15
		Assumed effect on TPTI (% of mobility reduction)	Mobility effect on TPTI	0.10	0.10	0.10	0.10	0.25	0.25	0.10	0.25	0.10	0.10	0.10
		Assumed effect on TTTI (% of safety reduction)	Safety effect on TTTI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Assumed effect on TPTI (% of safety reduction)	Safety effect on TPTI	0.15	0.15	0.15	0.15	0.30	0.30	0.15	0.30	0.15	0.15	0.15
		Input current value from performance system (direction 1)	Original Directional Segment TTTI (EB)	1.170	1.170	1.070	1.070	1.070	1.070	1.070	1.100	1.060	1.130	1.130
		Input current value from performance system (direction 1)	Original Directional Segment TPTI (EB)	2.430	2.430	1.480	1.480	1.480	1.480	1.240	1.410	1.210	2.250	2.250
		Input current value from performance system (direction 2)	Original Directional Segment TTTI (WB)	1.240	1.240	1.110	1.110	1.110	1.110	1.080	1.130	1.060	1.100	1.100
		Input current value from performance system (direction 2)	Original Directional Segment TPTI (WB)	3.490	3.490	1.470	1.470	1.470	1.470	1.400	1.480	1.250	1.860	1.860
		Calculated Value (both directions)	Reduction Factor for Segment TTTI (both directions)	0.054	0.019	0.017	0.000	0.017	0.017	0.000	0.011	0.000	0.000	0.000
		Calculated Value (both directions)	Reduction Factor for Segment TPTI (both directions)	0.036	0.013	0.039	0.028	0.032	0.050	0.057	0.116	0.033	0.035	0.019
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Directional Segment TTTI (EB)	1.107	1.14806	1.052	1.070	1.052	1.052	1.070	1.088	1.060	1.130	1.130
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Directional Segment TPTI (EB)	2.342	2.39963	1.423	1.439	1.433	1.406	1.170	1.247	1.171	2.172	2.207
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Directional Segment TTTI (WB)	1.173	1.21675	1.092	1.110	1.110	1.110	1.080	1.130	1.060	1.100	1.100
		Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Directional Segment TPTI (WB)	3.364	3.44638	1.413	1.429	1.470	1.470	1.321	1.480	1.209	1.795	1.825

LEGEND:

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- assumed values (do not modify)

		Solution #	CS160.1	CS160.2-1	CS160.2-2	CS160.3	CS160.4	CS160.5	CS160.6	CS160.7	CS160.8-1	CS160.8-2	CS160.9
		Description	West Tuba City Widening	East Tuba City Widening	East Tuba City Widening	Tonalea Safety Improvement	Tuba City – Tonalea: Eastbound Passing Lane	Tonalea – Tuba City: Westbound Passing Lane	Shonto Safety Improvement	Tsegi Canyon Passing Lanes	Mexican Water Safety Improvement	Mexican Water Safety Improvement	US 160/US 191 Intersection Improvement
		Project Beg MP	319	322.4	323	331	335	340	346	389	432	434	435
		Project End MP	321.6	323	325	341	336.5	343	362	391	434	438	437
		Project Length (miles)	2.6	0.6	2	10	1.5	2	16	2	2	4	2.4
		Segment Beg MP	319	319	323	323	323	323	344	374	413	434	434
		Segment End MP	323	323	344	344	344	344	362	391	434	451	451
		Segment Length (miles)	4	4	21	21	21	21	18	17	21	17	17
		Segment #	2	2	3	3	3	3	4	6	9	10	10
FREIGHT INDEX	Value from above	Original Segment TPTI (EB)	2.430	2.430	1.480	1.480	1.480	1.480	1.240	1.410	1.210	2.250	2.250
	Value from above	Original Segment TPTI (WB)	3.490	3.490	1.470	1.470	1.470	1.470	1.400	1.480	1.250	1.860	1.860
	Calculated Value	Original Segment Freight Index	0.3378	0.3378	0.678	0.678	0.678	0.678	0.758	0.692	0.813	0.487	0.487
	Calculated Value	Post-Project Segment TPTI (EB)	2.342	2.400	1.423	1.439	1.433	1.406	1.170	1.247	1.171	2.172	2.207
	Calculated Value	Post-Project Segment TPTI (WB)	3.364	3.446	1.413	1.429	1.470	1.470	1.321	1.480	1.209	1.795	1.825
	Enter in Freight Needs spreadsheet to update segment level Freight Need	Post-Project Segment Freight Index	0.350495	0.34211	0.705	0.697	0.689	0.695	0.803	0.733	0.840	0.504	0.496
CLOSURE DURATION	Input current value from performance system (direction 1)	Orig Segment Directional Closure Duration (dir 1)	12.050	12.050	56.370	56.370	56.370	56.370	74.910	22.760	10.240	35.480	35.480
	Input current value from performance system (direction 2)	Orig Segment Directional Closure Duration (dir 2)	0.000	0.000	9.000	9.000	9.000	9.000	93.230	59.930	8.380	4.650	4.650
	Calculated Value	Segment Closures with fatalities	1	1	9	9	9	9	4	3	2	6	6
	Calculated Value	Total Segment Closures	2	2	10	10	10	10	14	18	8	13	13
	Calculated Value	% Closures with Fatality	0.50	0.50	0.90	0.90	0.90	0.90	0.29	0.17	0.25	0.46	0.46
	Calculated Value	Closure Reduction	0.000	0.000	0.165	0.165	0.054	0.109	0.108	0.059	0.054	0.107	0.059
	Calculated Value	Closure Reduction Factor	1.000	1.000	0.835	0.835	0.946	0.891	0.892	0.941	0.946	0.893	0.941
	Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 1)	Post-Project Segment Directional Closure Duration (EB)	12.050	12.050	47.043	47.043	53.332	50.223	66.844	21.416	9.685	31.673	33.397
	Enter in Freight Needs spreadsheet to update segment level Freight Need (direction 2)	Post-Project Segment Directional Closure Duration (WB)	0.000	0.000	7.511	7.511	9.000	9.000	83.191	59.930	7.926	4.151	4.377
VERT CLR	Input current value from performance system	Original Segment Vertical Clearance	No change	No change	No change	No change	No change	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	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	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	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	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change

LEGEND:

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- for input into Performance Effectiveness Score spreadsheet
- assumed values (do not modify)

			Solution #	CS160.1	CS160.2-1	CS160.2-2	CS160.3	CS160.4	CS160.5	CS160.6	CS160.7	CS160.8-1	CS160.8-2	CS160.9
			Description	West Tuba City Widening	East Tuba City Widening	East Tuba City Widening	Tonalea Safety Improvement	Tuba City – Tonalea: Eastbound Passing Lane	Tonalea – Tuba City: Westbound Passing Lane	Shonto Safety Improvement	Tsegi Canyon Passing Lanes	Mexican Water Safety Improvement	Mexican Water Safety Improvement	US 160/US 191 Intersection Improvement
			Project Beg MP	319	322.4	323	331	335	340	346	389	432	434	435
			Project End MP	321.6	323	325	341	336.5	343	362	391	434	438	437
			Project Length (miles)	2.6	0.6	2	10	1.5	2	16	2	2	4	2.4
			Segment Beg MP	319	319	323	323	323	323	344	374	413	434	434
			Segment End MP	323	323	344	344	344	344	362	391	434	451	451
			Segment Length (miles)	4	4	21	21	21	21	18	17	21	17	17
			Segment #	2	2	3	3	3	3	4	6	9	10	10
BRIDGE	Needs	User entered value from Freight Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Freight Need	**0.374**	**0.374**	**2.378**	**2.378**	**2.378**	**2.378**	**0.777**	**2.131**	**0.191**	**4.093**	**4.093**
BRIDGE	Needs	User entered value from Freight Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Freight Need	**0.308**	**0.352**	**2.060**	**2.021**	**2.175**	**2.043**	**0.325**	**0.990**	**0.187**	**3.955**	**4.018**
BRIDGE	BRIDGE INDEX	Input current value from performance system	Original Segment Bridge Index	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change
BRIDGE	BRIDGE INDEX	Input current value from performance system	Original lowest rating for specific bridge	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change
BRIDGE	BRIDGE INDEX	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	No change	No change	No change	No change	No change	No change
BRIDGE	BRIDGE INDEX	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	No change	No change	No change	No change	No change	No change
BRIDGE	BRIDGE INDEX	Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Bridge Index	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change
BRIDGE	BRIDGE INDEX	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	No change	No change	No change	No change	No change	No change
BRIDGE	SUFF RATING	Input current value from performance system	Original Segment Sufficiency Rating	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change
BRIDGE	SUFF RATING	Input current value from performance system	Original Sufficiency Rating for specific bridge	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change
BRIDGE	SUFF RATING	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	No change	No change	No change	No change	No change	No change
BRIDGE	SUFF RATING	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	No change	No change	No change	No change	No change	No change
BRIDGE	SUFF RATING	Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Sufficiency Rating	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change
BRIDGE	SUFF RATING	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	No change	No change	No change	No change	No change	No change
BRIDGE	BR RTNG	Input current value from performance system	Original Segment Bridge Rating	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change
BRIDGE	BR RTNG	Input updated segment value from updated Bridge Index spreadsheet	Post-Project Segment Bridge Rating	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change
BRIDGE	BR RTNG	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	No change	No change	No change	No change	No change	No change

LEGEND:

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			Solution #	CS160.1	CS160.2-1	CS160.2-2	CS160.3	CS160.4	CS160.5	CS160.6	CS160.7	CS160.8-1	CS160.8-2	CS160.9
			Description	West Tuba City Widening	East Tuba City Widening	East Tuba City Widening	Tonalea Safety Improvement	Tuba City – Tonalea: Eastbound Passing Lane	Tonalea – Tuba City: Westbound Passing Lane	Shonto Safety Improvement	Tsegi Canyon Passing Lanes	Mexican Water Safety Improvement	Mexican Water Safety Improvement	US 160/US 191 Intersection Improvement
			Project Beg MP	319	322.4	323	331	335	340	346	389	432	434	435
			Project End MP	321.6	323	325	341	336.5	343	362	391	434	438	437
			Project Length (miles)	2.6	0.6	2	10	1.5	2	16	2	2	4	2.4
			Segment Beg MP	319	319	323	323	323	323	344	374	413	434	434
			Segment End MP	323	323	344	344	344	344	362	391	434	451	451
			Segment Length (miles)	4	4	21	21	21	21	18	17	21	17	17
			Segment #	2	2	3	3	3	3	4	6	9	10	10
	% FUN OB	Input current value from performance system	Original Segment % Functionally Obsolete	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change	No change
	% FUN OB	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	No change	No change	No change	No change	No change	No change
	% FUN OB	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	No change	No change	No change	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	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**1.2470**	**0.0000**	**0.4850**	**2.8790**	**2.8790**
	Needs	User entered value from Bridge Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Bridge Need	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**1.2470**	**0.0000**	**0.4850**	**2.8790**	**2.8790**
PAVEMENT	PAVEMENT INDEX	Input current value from performance system	Original Segment Pavement Index	3.87	3.87	3.66	No change	No change	No change	No change	No change	No change	No change	No change
PAVEMENT	PAVEMENT INDEX	Input current value from performance system	Original Segment IRI in project limits	96.93	82.36	105.52	No change	No change	No change	No change	No change	No change	No change	No change
PAVEMENT	PAVEMENT INDEX	Input current value from performance system	Original Segment Cracking in project limits	1.00	4.00	2.00	No change	No change	No change	No change	No change	No change	No change	No change
PAVEMENT	PAVEMENT INDEX	Input post-project value (For rehab, increase to 45; for replace increase to 30)	Post-Project IRI in project limits	45	45	45	No change	No change	No change	No change	No change	No change	No change	No change
PAVEMENT	PAVEMENT INDEX	Enter in Pavement Index spreadsheet to calculate new Pavement Index	Post-Project IRI in project limits	45	45	45	No change	No change	No change	No change	No change	No change	No change	No change
PAVEMENT	PAVEMENT INDEX	Input post-project value (Lower to 0 for rehab or replace)	Post-Project Cracking in project limits	0	0	0	No change	No change	No change	No change	No change	No change	No change	No change
PAVEMENT	PAVEMENT INDEX	Enter in Pavement Index spreadsheet to calculate new Pavement Index	Post-Project Cracking in project limits	0	0	0	No change	No change	No change	No change	No change	No change	No change	No change
PAVEMENT	PAVEMENT INDEX	Input updated segment value from updated Pavement Index spreadsheet	Post-Project Segment Pavement Index	4.45	4.45	3.74	No change	No change	No change	No change	No change	No change	No change	No change
PAVEMENT	PAVEMENT INDEX	Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Pavement Index	4.45	4.45	3.74	No change	No change	No change	No change	No change	No change	No change	No change
PAVEMENT	DIRECTION PSR	Input current value from performance system (direction 1)	Original Segment Directional PSR (EB)	3.59	3.59	3.51	No change	No change	No change	No change	No change	No change	No change	No change
PAVEMENT	DIRECTION PSR	Input current value from performance system (direction 2)	Original Segment Directional PSR (WB)	3.59	3.59	3.51	No change	No change	No change	No change	No change	No change	No change	No change

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		Description	West Tuba City Widening	East Tuba City Widening	East Tuba City Widening	Tonalea Safety Improvement	Tuba City – Tonalea: Eastbound Passing Lane	Tonalea – Tuba City: Westbound Passing Lane	Shonto Safety Improvement	Tsegi Canyon Passing Lanes	Mexican Water Safety Improvement	Mexican Water Safety Improvement	US 160/US 191 Intersection Improvement
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		Project Length (miles)	2.6	0.6	2	10	1.5	2	16	2	2	4	2.4
		Segment Beg MP	319	319	323	323	323	323	344	374	413	434	434
		Segment End MP	323	323	344	344	344	344	362	391	434	451	451
		Segment Length (miles)	4	4	21	21	21	21	18	17	21	17	17
		Segment #	2	2	3	3	3	3	4	6	9	10	10
	Value from above	Original Segment IRI in project limits	96.93	82.36	105.52	No change	No change	No change	No change	No change	No change	No change	No change
	Value from above	Post-Project directional IRI in project limits	45	45	45	No change	No change	No change	No change	No change	No change	No change	No change
	Input updated segment value from updated Pavement Index spreadsheet (direction 1)	Post-Project Segment Directional PSR (EB)	4.21	4.21	3.58	No change	No change	No change	No change	No change	No change	No change	No change
	Input updated segment value from updated Pavement Index spreadsheet (direction 2)	Post-Project Segment Directional PSR (WB)	4.21	4.21	3.58	No change	No change	No change	No change	No change	No change	No change	No change
	Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Directional PSR (EB)	4.21	4.21	3.58	No change	No change	No change	No change	No change	No change	No change	No change
	Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment Directional PSR (WB)	4.21	4.21	3.58	No change	No change	No change	No change	No change	No change	No change	No change
% FAIL	Input current value from performance system	Original Segment % Failure	0.0%	0.0%	0.0%	No change	No change	No change	No change	No change	No change	No change	No change
% FAIL	Input value from updated Pavement Index spreadsheet	Post-Project Segment % Failure	0.0%	0.0%	0.0%	No change	No change	No change	No change	No change	No change	No change	No change
% FAIL	Enter in Pavement Needs spreadsheet to update segment level Pavement Need	Post-Project Segment % Failure	0.0%	0.0%	0.0%	No change	No change	No change	No change	No change	No change	No change	No change
Needs	User entered value from Pavement Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Original Segment Pavement Need	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.230**	**1.350**	**0.305**	**0.305**
Needs	User entered value from Pavement Needs spreadsheet and for use in Performance Effectiveness spreadsheet	Post-Project Segment Pavement Need	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.230**	**1.350**	**0.305**	**0.305**

Application of Multiple Crash Modification Factors

CS160.2-1 (Eastbound)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Current Fatal	Current Incap	Post-Project Fatal	Post-Project Incap	Reduction Fatal	Reduction Incap		Length
322.4	323	0.6	0.75	1	1	EB	0.525	0	0	0.000	0.000	0.000	0.000	Segment 2 EB - night	0.6
322.4	323	0.6	1	1	1	EB	0.600	0	0	0.000	0.000	0.000	0.000	Segment 2 EB - day	0.6
								0	0			**0.000**	**0.000**	Segment 2 EB	

CS160.2-1 (Westbound)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Current Fatal	Current Incap	Post-Project Fatal	Post-Project Incap	Reduction Fatal	Reduction Incap		Length
322.4	323	0.6	0.75	1	1	WB	0.525	0	0	0.000	0.000	0.000	0.000	Segment 2 WB - night	0.6
322.4	323	0.6	1	1	1	WB	0.600	0	0	0.000	0.000	0.000	0.000	Segment 2 WB - day	0.6
								0	0			**0.000**	**0.000**	Segment 2 WB	

CS160.2-2 (Eastbound)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Current Fatal	Current Incap	Post-Project Fatal	Post-Project Incap	Reduction Fatal	Reduction Incap		Length
323	325	0.6	0.75	1	1	EB	0.525	1	0	0.525	0.000	0.475	0.000	Segment 3 EB - night	2
323	325	0.6	1	1	1	EB	0.600	2	0	1.200	0.000	0.800	0.000	Segment 3 EB - day	2
								3	0			**1.275**	**0.000**	Segment 3 EB	

CS160.2-2 (Westbound)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Current Fatal	Current Incap	Post-Project Fatal	Post-Project Incap	Reduction Fatal	Reduction Incap		Length
323	325	0.6	0.75	1	1	WB	0.525	2	1	1.050	0.525	0.950	0.475	Segment 3 WB - night	2
323	325	0.6	1	1	1	WB	0.600	0	0	0.000	0.000	0.000	0.000	Segment 3 WB - day	2
								2	1			**0.950**	**0.475**	Segment 3 WB	

CS160.3 (Eastbound)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Current Fatal	Current Incap	Post-Project Fatal	Post-Project Incap	Reduction Fatal	Reduction Incap		Length
331	336	0.64	1	1	1	EB	0.640	1	1	0.640	0.640	0.360	0.360	Segment 3 EB	5
336	336.5	0.64	0.79	1	1	EB	0.573	1	0	0.573	0.000	0.427	0.000	Segment 3 EB - chevrons	0.5
336.5	338	0.64	1	1	1	EB	0.640	0	0	0.000	0.000	0.000	0.000	Segment 3 EB	1.5
338	341	0.64	1	1	1	EB	0.640	1	0	0.640	0.000	0.360	0.000	Segment 3 EB	3
								3	1			**1.147**	**0.360**	Segment 3 EB	

CS160.3 (Westbound)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Current Fatal	Current Incap	Post-Project Fatal	Post-Project Incap	Reduction Fatal	Reduction Incap		Length
331	336	0.64	1	1	1	WB	0.640	1	0	0.640	0.000	0.360	0.000	Segment 3 WB	5
336	336.5	0.64	0.79	1	1	WB	0.573	0	0	0.000	0.000	0.000	0.000	Segment 3 EB - chevrons	0.5
336.5	338	0.64	1	1	1	WB	0.640	0	0	0.000	0.000	0.000	0.000	Segment 3 WB	1.5
338	341	0.64	1	1	1	WB	0.640	2	0	1.280	0.000	0.720	0.000	Segment 3 WB	3
								3	0			**1.080**	**0.000**	Segment 3 WB	

CS160.6 (Eastbound)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Current Fatal	Current Incap	Post-Project Fatal	Post-Project Incap	Reduction Fatal	Reduction Incap		Length
346	358	0.64	1	1	1	EB	0.640	4	1	2.560	0.640	1.440	0.360	Segment 4 EB	12
358	359	0.64	0.79	1	1	EB	0.573	0	1	0.000	0.573	0.000	0.427	Segment 4 EB - chevrons	1
359	361	0.64	1	1	1	EB	0.640	0	0	0.000	0.000	0.000	0.000	Segment 4 EB	2
361	362	0.64	1	1	1	EB	0.640	0	0	0.000	0.000	0.000	0.000	Segment 4 EB	1
361	362	0.64	0.75	1	1	EB	0.560	1	0	0.560	0.000	0.440	0.000	Segment 4 EB - night	1
								5	2			**1.880**	**0.787**	Segment 4 EB	

CS160.6 (Westbound)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Current Fatal	Current Incap	Post-Project Fatal	Post-Project Incap	Reduction Fatal	Reduction Incap		Length
358	359	0.64	0.79	1	1	WB	0.573	0	1	0.000	0.573	0.000	0.427	Segment 4 WB - chevrons	1
359	361	0.64	1	1	1	WB	0.640	0	1	0.000	0.640	0.000	0.360	Segment 4 WB	2
361	362	0.64	1	1	1	WB	0.640	0	1	0.000	0.640	0.000	0.360	Segment 4 WB	1
361	362	0.64	0.75	1	1	WB	0.560	0	0	0.000	0.000	0.000	0.000	Segment 4 WB - night	1
								0	3			**0.000**	**1.147**	Segment 4 WB	

CS160.8-2 (Eastbound)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Current Fatal	Current Incap	Post-Project Fatal	Post-Project Incap	Reduction Fatal	Reduction Incap		Length
434	434.5	0.64	1	1	1	EB	0.640	0	0	0.000	0.000	0.000	0.000	Segment 10 EB	0.5
434.5	435.5	0.64	0.79	1	1	EB	0.573	0	2	0.000	1.146	0.000	0.854	Segment 10 EB - chevrons	1
435.5	438	0.64	1	1	1	EB	0.640	1	1	0.640	0.640	0.360	0.360	Segment 10 EB	2.5
								1	3			**0.360**	**1.214**	Segment 10 EB	

CS160.8-2 (Westbound)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Current Fatal	Current Incap	Post-Project Fatal	Post-Project Incap	Reduction Fatal	Reduction Incap		Length
434	434.5	0.64	1	1	1	WB	0.640	0	0	0.000	0.000	0.000	0.000	Segment 10 WB	0.5
434.5	435.5	0.64	0.79	1	1	WB	0.573	1	0	0.573	0.000	0.427	0.000	Segment 4 WB - chevrons	1
435.5	438	0.64	1	1	1	WB	0.640	1	0	0.640	0.000	0.360	0.000	Segment 10 WB	2.5
								2	0			**0.787**	**0.000**	Segment 10 WB	

CS160.9 (Eastbound)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Current Fatal	Current Incap	Post-Project Fatal	Post-Project Incap	Reduction Fatal	Reduction Incap		Length
434.6	435	0.75	0.85	1	1	EB	0.694	0	1	0.000	0.694	0.000	0.306	Segment 10 EB - acce/dec, night	0.4
435	438	0.75	1	1	1	EB	0.750	1	1	0.750	0.750	0.250	0.250	Segment 10 EB - night	3
								1	2			**0.250**	**0.556**	Segment 10 EB	

CS160.9 (Westbound)

BMP	EMP	CMF1	CMF2	CMF3	CMF4	Dir	Effective CMF	Current Fatal	Current Incap	Post-Project Fatal	Post-Project Incap	Reduction Fatal	Reduction Incap		Length
434.6	437	0.75	1	1	1	WB	0.750	1	0	0.750	0.000	0.250	0.000	Segment 10 WB - acce/dec, night	2.4
434.6	437	0.85	1	1	1	WB	0.850	1	0	0.850	0.000	0.150	0.000	Segment 10 WB - night	2.4
								2	0			**0.400**	**0.000**	Segment 10 WB	

Performance Area Scoring

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Pavement					Bridge					Safety					Mobility					Freight					Total Risk Factored Performance Area Benefit
				Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	
CS160.1	West Tuba City Widening	319 to 321.6	10.19	0.000	0.000	0.000	2.36	0.000	0.000	0.000	0.000	0.00	0.000	3.481	3.481	0.000	4.97	0.000	2.677	0.734	1.943	6.83	13.271	0.374	0.308	0.066	6.43	0.424	13.695
CS160.2	East Tuba City Widening	322.4 to 325	13.68	0.000	0.000	0.000		0.000	0.000	0.000	0.000		0.000	15.983	13.465	2.518		6.849	3.723	2.226	1.497		9.378	2.752	2.412	0.340		2.507	18.734
CS160.2-1	*East Tuba City Widening*	*322.4 to 323*	*3.16*	*0.000*	*0.000*	*0.000*	*2.43*	*0.000*	*0.000*	*0.000*	*0.000*	*0.00*	*0.000*	*3.481*	*3.481*	*0.000*	*5.01*	*0.000*	*2.677*	*1.247*	*1.430*	*6.23*	*8.909*	*0.374*	*0.352*	*0.022*	*6.43*	*0.141*	*9.050*
CS160.2-2	*East Tuba City Widening*	*323 to 325*	*10.52*	*0.000*	*0.000*	*0.000*	*1.67*	*0.000*	*0.000*	*0.000*	*0.000*	*0.00*	*0.000*	*12.502*	*9.984*	*2.518*	*2.72*	*6.849*	*1.046*	*0.979*	*0.067*	*7.00*	*0.469*	*2.378*	*2.060*	*0.318*	*7.44*	*2.366*	*9.684*
CS160.3	Tonalea Safety Improvement	331 to 341	7.87	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.00	0.000	12.502	9.984	2.518	2.96	7.453	1.046	0.481	0.565	7.88	4.452	2.378	2.021	0.357	7.44	2.656	14.562
CS160.4	Tuba City – Tonalea: Eastbound Passing Lane	335 to 336.5	5.59	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.00	0.000	12.502	11.682	0.820	2.96	2.427	1.046	1.030	0.016	6.93	0.111	2.378	2.175	0.203	7.44	1.510	4.048
CS160.5	Tonalea – Tuba City: Westbound Passing Lane	340 to 343	7.46	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.00	0.000	12.502	10.842	1.660	2.96	4.914	1.046	1.023	0.023	7.00	0.161	2.378	2.043	0.335	7.44	2.492	7.567
CS160.6	Shonto Safety Improvement	346 to 362	14.57	0.000	0.000	0.000	0.00	0.000	1.247	1.247	0.000	0.00	0.000	6.456	3.610	2.846	3.12	8.880	1.252	0.544	0.708	7.84	5.551	0.777	0.325	0.452	6.83	3.087	17.517
CS160.7	Tsegi Canyon Passing Lanes	389 to 391	7.46	0.230	0.230	0.000	0.00	0.000	0.000	0.000	0.000	0.00	0.000	0.239	0.156	0.083	3.19	0.265	2.014	1.836	0.178	7.86	1.399	2.131	0.990	1.141	7.08	8.078	9.742
CS160.8	Mexican Water Safety Improvement	432 to 438	4.14	1.655	1.655	0.000		0.000	3.364	3.364	0.000		0.000	11.633	8.548	3.085		8.121	2.994	2.630	0.364		2.814	4.284	4.142	0.142		1.087	12.022
CS160.8-1	*Mexican Water Safety Improvement*	*432 to 434*	*1.38*	*1.350*	*1.350*	*0.000*	*0.00*	*0.000*	*0.485*	*0.485*	*0.000*	*0.00*	*0.000*	*4.130*	*3.067*	*1.063*	*2.58*	*2.743*	*1.028*	*0.963*	*0.065*	*7.00*	*0.455*	*0.191*	*0.187*	*0.004*	*6.10*	*0.024*	*3.222*
CS160.8-2	*Mexican Water Safety Improvement*	*434 to 438*	*2.76*	*0.305*	*0.305*	*0.000*	*0.00*	*0.000*	*2.879*	*2.879*	*0.000*	*0.00*	*0.000*	*7.503*	*5.481*	*2.022*	*2.66*	*5.379*	*1.966*	*1.667*	*0.299*	*7.89*	*2.359*	*4.093*	*3.955*	*0.138*	*7.70*	*1.063*	*8.800*
CS160.9	US 160/US 191 Intersection Improvement	435 to 437	1.25	0.305	0.305	0.000	0.00	0.000	2.879	2.879	0.000	0.00	0.000	7.503	6.396	1.107	2.66	2.945	1.966	1.856	0.110	7.74	0.851	4.093	4.018	0.075	7.70	0.578	4.374

Emphasis Area Scoring

				Safety Emphasis Area						Mobility Emphasis Area						Pavement Emphasis Area						
Candidate Solution #	**Candidate Solution Name**	**Milepost Location**	**Estimated Cost ($ millions)**	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	Existing Corridor Need	Post-Solution Corridor Need	Raw Score	Risk Factor	Emphasis Factor	Factored Score	**Total Factored Benefit**
CS160.1	West Tuba City Widening	319 to 321.6	10.19	3.984	3.984	0.000	4.97	1.50	0.000	0.196	0.189	0.007	6.83	1.50	0.072	0.635	0.635	0.000	2.36	1.50	0.000	13.767
CS160.2	East Tuba City Widening	322.4 to 325	13.68	7.968	7.637	0.331			1.352	0.392	0.386	0.006			0.059	1.270	1.270	0.000			0.000	20.146
CS160.2-1	*East Tuba City Widening*	*322.4 to 323*	*3.16*	*3.984*	*3.984*	*0.000*	*5.01*	*1.50*	*0.000*	*0.196*	*0.193*	*0.003*	*6.23*	*1.50*	*0.028*	*0.635*	*0.635*	*0.000*	*2.43*	*1.50*	*0.000*	*9.078*
CS160.2-2	*East Tuba City Widening*	*323 to 325*	*10.52*	*3.984*	*3.653*	*0.331*	*2.72*	*1.50*	*1.352*	*0.196*	*0.193*	*0.003*	*7.00*	*1.50*	*0.031*	*0.635*	*0.635*	*0.000*	*1.67*	*1.50*	*0.000*	*11.067*
CS160.3	Tonalea Safety Improvement	331 to 341	7.87	3.984	3.653	0.331	2.96	1.50	1.472	0.196	0.196	0.000	7.88	1.50	0.000	0.635	0.635	0.000	0.00	1.50	0.000	16.033
CS160.4	Tuba City – Tonalea: Eastbound Passing Lane	335 to 336.5	5.59	3.984	3.876	0.108	2.96	1.50	0.479	0.196	0.194	0.002	6.93	1.50	0.017	0.635	0.635	0.000	0.00	1.50	0.000	4.545
CS160.5	Tonalea – Tuba City: Westbound Passing Lane	340 to 343	7.46	3.984	3.766	0.218	2.96	1.50	0.970	0.196	0.194	0.002	7.00	1.50	0.017	0.635	0.635	0.000	0.00	1.50	0.000	8.554
CS160.6	Shonto Safety Improvement	346 to 362	14.57	3.984	3.661	0.323	3.12	1.50	1.512	0.196	0.196	0.000	6.97	1.50	0.003	0.635	0.635	0.000	0.00	1.50	0.000	19.032
CS160.7	Tsegi Canyon Passing Lanes	389 to 391	7.46	3.984	3.929	0.055	3.19	1.50	0.263	0.196	0.195	0.001	7.86	1.50	0.016	0.635	0.635	0.000	0.00	1.50	0.000	10.021
CS160.8	Mexican Water Safety Improvement	432 to 438	4.14	7.968	7.597	0.371			1.239	0.392	0.392	0.000			0.000	1.270	1.270	0.000			0.000	13.262
CS160.8-1	*Mexican Water Safety Improvement*	*432 to 434*	*1.38*	*3.984*	*3.828*	*0.156*	*2.18*	*1.50*	*0.509*	*0.196*	*0.196*	*0.000*	*6.50*	*1.50*	*0.000*	*0.635*	*0.635*	*0.000*	*0.00*	*1.50*	*0.000*	*3.731*
CS160.8-2	*Mexican Water Safety Improvement*	*434 to 438*	*2.76*	*3.984*	*3.769*	*0.215*	*2.26*	*1.50*	*0.730*	*0.196*	*0.196*	*0.000*	*7.39*	*1.50*	*0.000*	*0.635*	*0.635*	*0.000*	*0.00*	*1.50*	*0.000*	*9.531*
CS160.9	US 160/US 191 Intersection Improvement	435 to 437	1.25	3.984	3.866	0.118	2.26	1.50	0.400	0.196	0.196	0.000	7.39	1.50	0.000	0.635	0.635	0.000	0.00	1.50	0.000	4.774

Performance Effectiveness Scoring

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Risk Factored Benefit Score					Risk Factored Emphasis Area Scores			Total Factored Benefit	F_{VMT}	F_{NPV}	Performance Effectiveness Score	miles	2014 ADT	1-way or 2-way	VMT
				Pavement	Bridge	Safety	Mobility	Freight	Safety	Mobility	Pavement								
CS160.1	West Tuba City Widening	319 to 321.6	10.19	0.000	0.000	0.000	13.271	0.424	0.000	0.072	0.000	13.767	1.63	20.2	44.6	2.60	10942	2	28449.2
CS160.2	East Tuba City Widening	322.4 to 325	13.68	0.000	0.000	6.849	9.378	2.507	1.352	0.059	0.000	20.146	0.98	20.2	29.2				15727.2
CS160.2-1	*East Tuba City Widening*	*322.4 to 323*	*3.16*	*0.000*	*0.000*	*0.000*	*8.909*	*0.141*	*0.000*	*0.028*	*0.000*	*9.078*	*0.44*	*20.2*	*25.3*	*0.60*	*10942*	*2*	*6565.2*
CS160.2-2	*East Tuba City Widening*	*323 to 325*	*10.52*	*0.000*	*0.000*	*6.849*	*0.469*	*2.366*	*1.352*	*0.031*	*0.000*	*11.067*	*0.60*	*20.2*	*12.7*	*2.00*	*4581*	*2*	*9162*
CS160.3	Tonalea Safety Improvement	331 to 341	7.87	0.000	0.000	7.453	4.452	2.656	1.472	0.000	0.000	16.033	2.35	15.3	73.4	10.00	4581	2	45810
CS160.4	Tuba City – Tonalea: Eastbound Passing Lane	335 to 336.5	5.59	0.000	0.000	2.427	0.111	1.510	0.479	0.017	0.000	4.545	0.23	20.2	3.8	1.50	4581	1	3435.75
CS160.5	Tonalea – Tuba City: Westbound Passing Lane	340 to 343	7.46	0.000	0.000	4.914	0.161	2.492	0.970	0.017	0.000	8.554	0.31	20.2	7.1	2.00	4581	1	4581
CS160.6	Shonto Safety Improvement	346 to 362	14.57	0.000	0.000	8.880	5.551	3.087	1.512	0.003	0.000	19.032	2.59	15.3	51.7	16.00	3278	2	52448
CS160.7	Tsegi Canyon Passing Lanes	389 to 391	7.46	0.000	0.000	0.265	1.399	8.078	0.263	0.016	0.000	10.021	0.37	20.2	10.1	2.00	5577	1	5577
CS160.8	Mexican Water Safety Improvement	432 to 438	4.14	0.000	0.000	8.121	2.814	1.087	1.239	0.000	0.000	13.262	1.13	15.3	55.1				18356
CS160.8-1	*Mexican Water Safety Improvement*	*432 to 434*	*1.38*	*0.000*	*0.000*	*2.743*	*0.455*	*0.024*	*0.509*	*0.000*	*0.000*	*3.731*	*0.41*	*15.3*	*16.9*	*2.00*	*3068*	*2*	*6136*
CS160.8-2	*Mexican Water Safety Improvement*	*434 to 438*	*2.76*	*0.000*	*0.000*	*5.379*	*2.359*	*1.063*	*0.730*	*0.000*	*0.000*	*9.531*	*0.78*	*15.3*	*41.2*	*4.00*	*3055*	*2*	*12220*
CS160.9	US 160/US 191 Intersection Improvement	435 to 437	1.25	0.000	0.000	2.945	0.851	0.578	0.400	0.000	0.000	4.774	0.48	20.2	37.4	2.40	3055	2	7332

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	Segment Need	Prioritization Score
				Score	%	Score	%	Score	%	Score	%	Score	%		Pavement	Bridge	Safety	Mobility	Freight			
CS160.1	West Tuba City Widening	319 to 321.6	10.19	0.000	0.0%	0.000	0.0%	0.000	0.0%	13.342	96.9%	0.424	3.1%	13.767	1.14	1.51	1.78	1.36	1.36	1.360	0.90	55
CS160.2	East Tuba City Widening	322.4 to 325	13.68	0.000	0.0%	0.000	0.0%	8.201	40.7%	9.437	46.8%	2.507	12.4%	20.146	1.14	1.51	1.78	1.36	1.36	1.531	1.15	52
CS160.2-1	*East Tuba City Widening*	*322.4 to 323*	*3.16*	*0.000*	*0.0%*	*0.000*	*0.0%*	*0.000*	*0.0%*	*8.937*	*98.4%*	*0.141*	*1.6%*	*9.078*	*1.14*	*1.51*	*1.78*	*1.36*	*1.36*	*1.360*	*0.90*	
CS160.2-2	*East Tuba City Widening*	*323 to 325*	*10.52*	*0.000*	*0.0%*	*0.000*	*0.0%*	*8.201*	*74.1%*	*0.500*	*4.5%*	*2.366*	*21.4%*	*11.067*	*1.14*	*1.51*	*1.78*	*1.36*	*1.36*	*1.671*	*1.23*	
CS160.3	Tonalea Safety Improvement	331 to 341	7.87	0.000	0.0%	0.000	0.0%	8.925	55.7%	4.452	27.8%	2.656	16.6%	16.033	1.14	1.51	1.78	1.36	1.36	1.594	1.23	144
CS160.4	Tuba City – Tonalea: Eastbound Passing Lane	335 to 336.5	5.59	0.000	0.0%	0.000	0.0%	2.907	64.0%	0.128	2.8%	1.510	33.2%	4.545	1.14	1.51	1.78	1.36	1.36	1.629	1.23	8
CS160.5	Tonalea – Tuba City: Westbound Passing Lane	340 to 343	7.46	0.000	0.0%	0.000	0.0%	5.884	68.8%	0.178	2.1%	2.492	29.1%	8.554	1.14	1.51	1.78	1.36	1.36	1.649	1.23	14
CS160.6	Shonto Safety Improvement	346 to 362	14.57	0.000	0.0%	0.000	0.0%	10.391	54.6%	5.554	29.2%	3.087	16.2%	19.032	1.14	1.51	1.78	1.36	1.36	1.589	1.23	101
CS160.7	Tsegi Canyon Passing Lanes	389 to 391	7.46	0.000	0.0%	0.000	0.0%	0.527	5.3%	1.415	14.1%	8.078	80.6%	10.021	1.14	1.51	1.78	1.36	1.36	1.382	0.77	11
CS160.8	Mexican Water Safety Improvement	432 to 438	4.14	0.000	0.0%	0.000	0.0%	9.361	70.6%	2.814	21.2%	1.087	8.2%	13.262	1.14	1.51	1.78	1.36	1.36	1.656	1.90	174
CS160.8-1	*Mexican Water Safety Improvement*	*432 to 434*	*1.38*	*0.000*	*0.0%*	*0.000*	*0.0%*	*3.252*	*87.2%*	*0.455*	*12.2%*	*0.024*	*0.7%*	*3.731*	*1.14*	*1.51*	*1.78*	*1.36*	*1.36*	*1.726*	*1.54*	
CS160.8-2	*Mexican Water Safety Improvement*	*434 to 438*	*2.76*	*0.000*	*0.0%*	*0.000*	*0.0%*	*6.109*	*64.1%*	*2.359*	*24.8%*	*1.063*	*11.1%*	*9.531*	*1.14*	*1.51*	*1.78*	*1.36*	*1.36*	*1.629*	*2.08*	
CS160.9	US 160/US 191 Intersection Improvement	435 to 437	1.25	0.000	0.0%	0.000	0.0%	3.345	70.1%	0.851	17.8%	0.578	12.1%	4.774	1.14	1.51	1.78	1.36	1.36	1.654	2.08	129

Appendix K: Preliminary Scoping Reports for Prioritized Solutions

ADOT **PRELIMINARY SCOPING REPORT**

GENERAL PROJECT INFORMATION	
Date: January 15, 2018	**ADOT Project Manager:**
Project Name: West Tuba City Widening	
City/Town: Tuba City	**County:** Coconino
COG/MPO: Northern Arizona Council of Governments	**ADOT District:** Northcentral District
Primary Route/Street: US 160	
Beginning Limit: MP 319	
End Limit: MP 321.6	
Project Length: 2.6 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: *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

Mobility needs were identified primarily associated with elevated Future V/C and Westbound existing V/C levels. Projected future travel demand is anticipated to exceed current capacity.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☐	Expansion ☒

This section of US 160 has experienced elevated existing and future V/C levels. The purpose of this project will be to increase capacity between MP 319 and MP 321.6 by creating a 5-Lane *highway that is consistent with the rest of the corridor section through Tuba City.*

ADOT **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 US 160 due to the traffic volumes. Potential Stakeholder issues due to coordination with Local Tribal Government.

POTENTIAL FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STBG	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Tribal	☐ Other:

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$270,400	$901,500	$0	$9,014,700	$10,186,600

RECOMMENDED PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

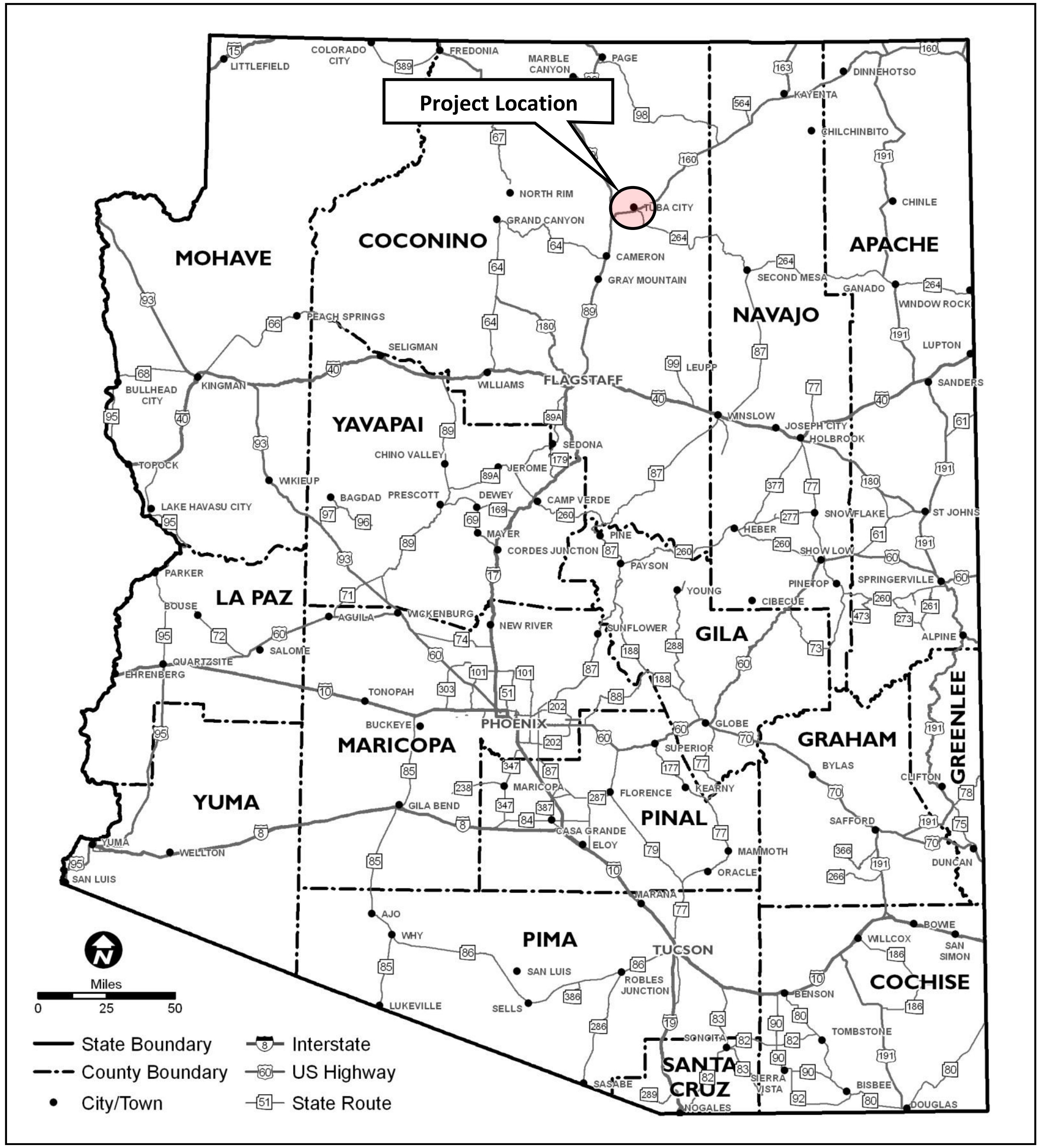
Design Program Year: FY

Construction Program Year: FY

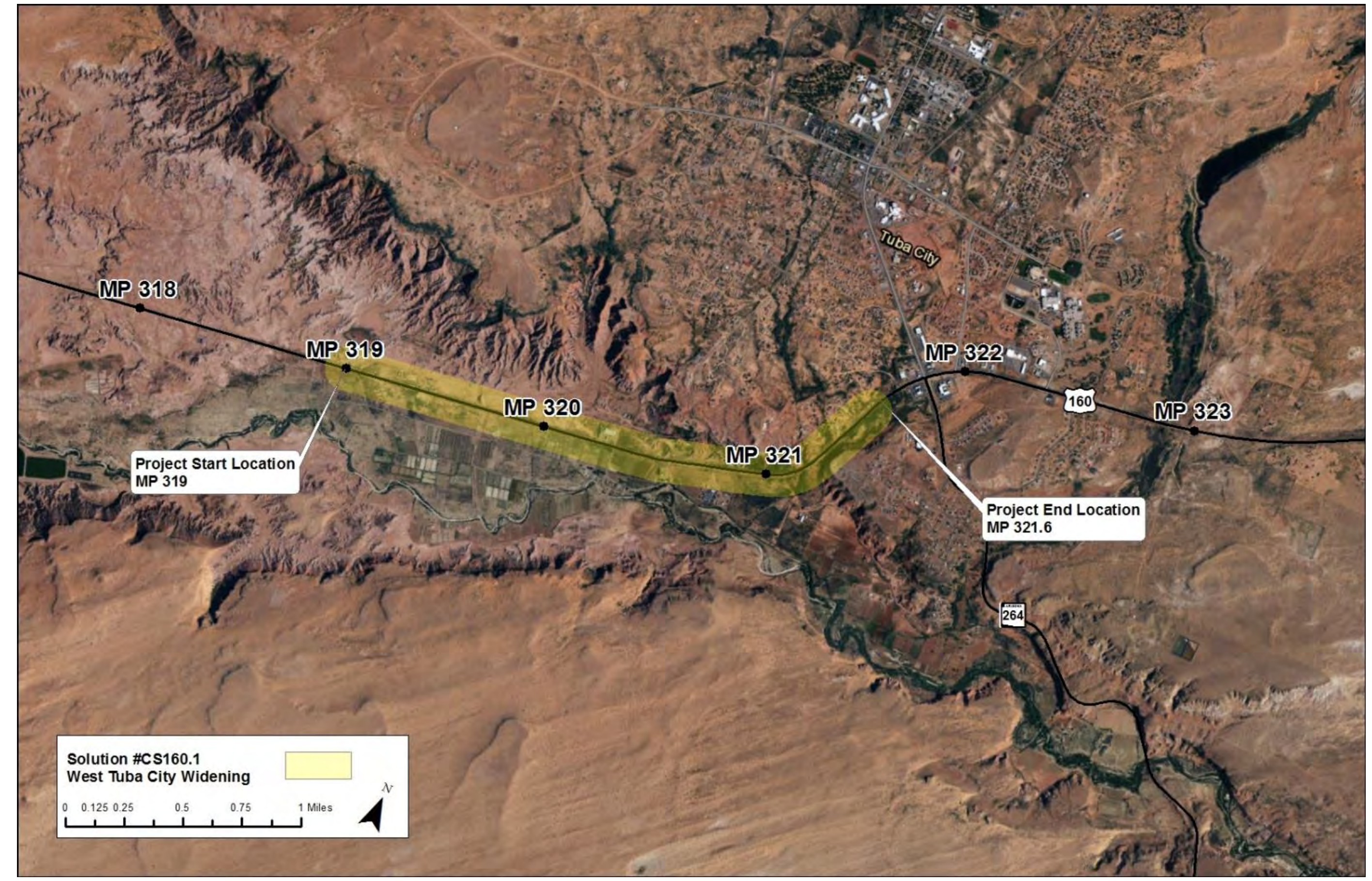
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Convert 2-Lane undivided highway to a 5-Lane highway

SCOPE ITEMS CONSIDERED, BUT NOT INCLUDED
• N/A

The below 23 USC 409 disclaimer is to be included in the Final Pre-Scoping Report and Field Review Report:

Pursuant to 23 USC 409: Notwithstanding any other provision of law, reports, surveys, schedules, lists, or data compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential accident sites, hazardous roadway conditions, or rail-way-highway crossings, pursuant to sections 130, 144, and 148 [152] of this title or for the purpose of developing any highway safety construction improvement project which may be implemented utilizing Federal-aid highway funds shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data

ADOT

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: January 15, 2018	**ADOT Project Manager:**
Project Name: East Tuba City Widening	
City/Town: Tuba City	**County:** Coconino
COG/MPO: Northern Arizona Council of Governments	**ADOT District:** Northcentral District
Primary Route/Street: US 160	
Beginning Limit: MP 322.4	
End Limit: MP 325	
Project Length: 2.6 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:
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

Mobility needs were identified primarily associated with elevated Future V/C and Westbound existing V/C levels. Projected future travel demand is anticipated to exceed current capacity.
High Safety needs were identified throughout the section of US 160 near MP 322 to MP 325.Crash trends show collision with a pedestrian and road conditions show crash occurrences in dark or unlighted conditions.
Freight needs are primarily associated with non-recurring congestion.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☐	Expansion ☒

This section of US 160 has experienced elevated existing and future V/C levels. The purpose of this solution will be to increase capacity between MP 322.4 and MP 325 by creating a 5-Lane highway that is consistent with the preceding corridor section through Tuba City. Also, the solution aims to improve the lighting conditions, due to fatal and incapacitating injury accidents in dark conditions.

ADOT

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 US 160 due to the traffic volumes and lack of alternate route.
Potential Stakeholder issues due to coordination with Local Tribal Government.

POTENTIAL FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STBG	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Tribal	☐ Other:

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$363,100	$1,210,400	$0	$12,103,500	$13,677,000

RECOMMENDED PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

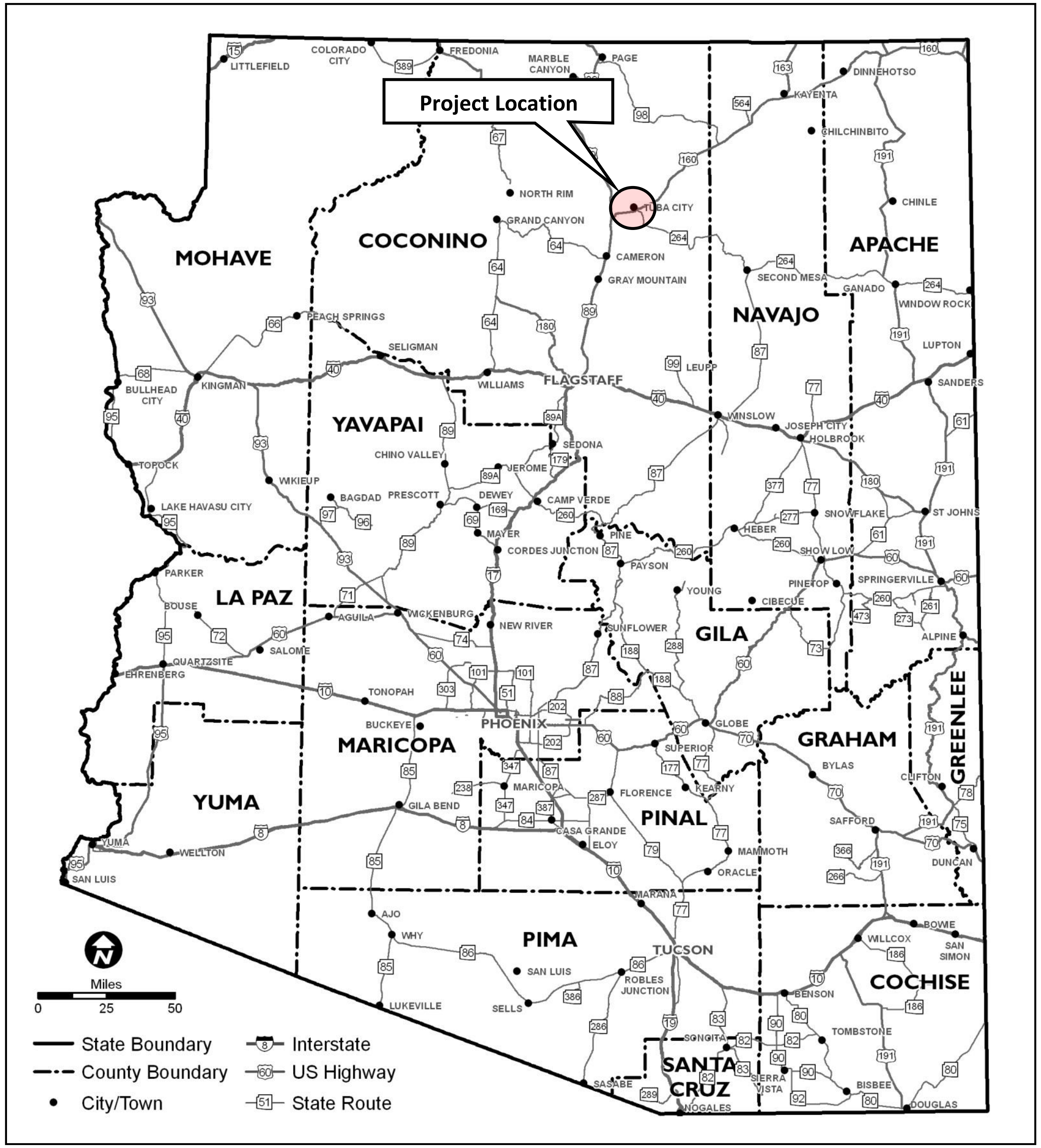
Design Program Year: FY

Construction Program Year: FY

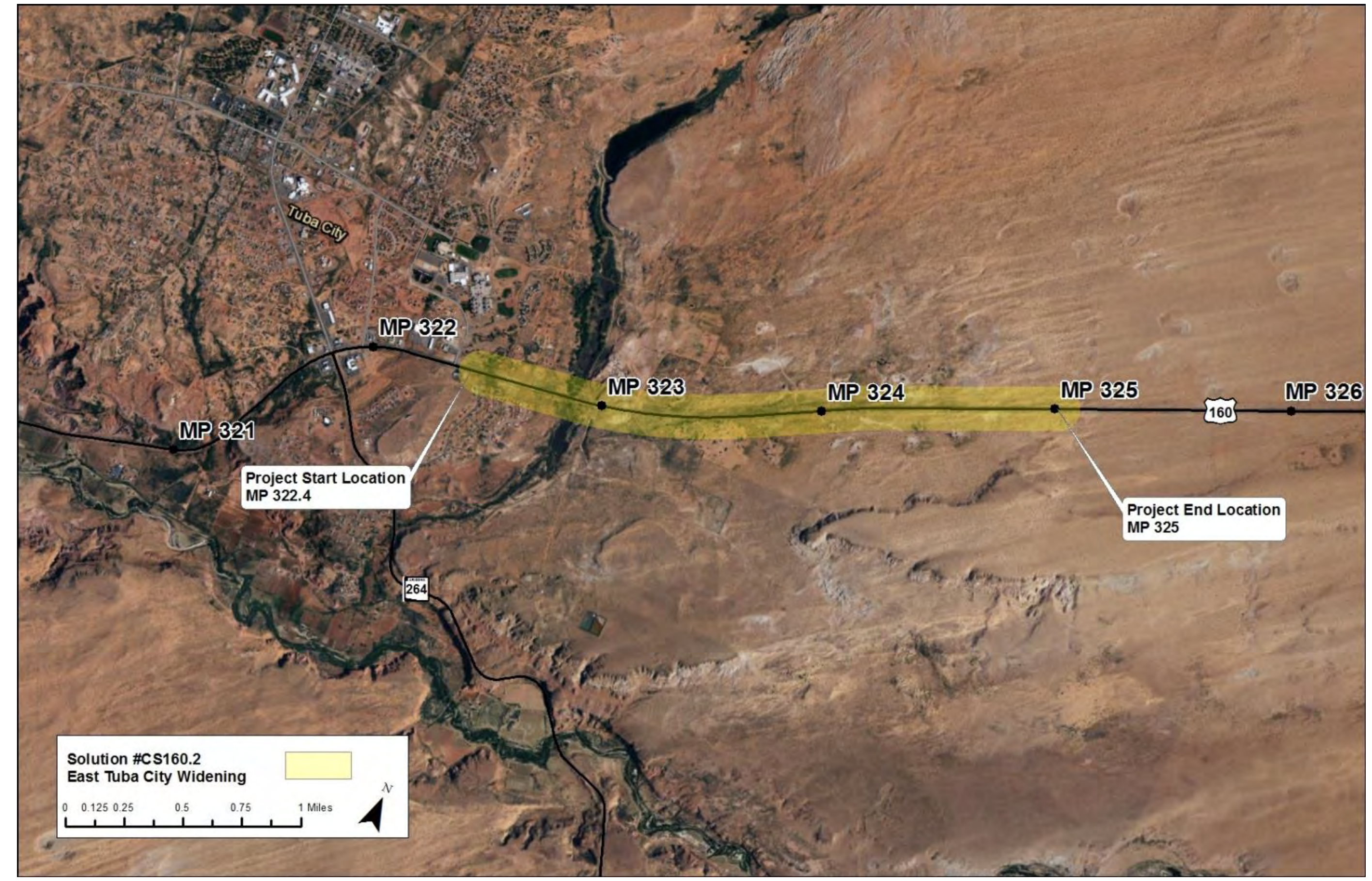
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Convert 2-Lane undivided highway to a 5-Lane highway • Install lighting (connecting to existing power) in both directions

SCOPE ITEMS CONSIDERED, BUT NOT INCLUDED
• N/A

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ADOT

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: January 15, 2018	**ADOT Project Manager:**
Project Name: Tonalea Safety Improvement	
City/Town: Tonalea	**County:** Coconino
COG/MPO: Northern Arizona Council of Governments	**ADOT District:** Northcentral District
Primary Route/Street: US 160	
Beginning Limit: MP 331	
End Limit: MP 341	
Project Length: 10 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:
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

High Safety needs were identified throughout the section of US 160 near MP 331 to MP 341. Crash trends show overturning and head on crashes. Road conditions show crash occurrences in dark or unlighted conditions and wet conditions.

Freight needs are primarily associated with non-recurring congestion.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

This section of US 160 has experienced an elevated number of fatal and incapacitating injury accidents. The purpose of this solution will be to widen the shoulder in order to provide more room for corrective action if vehicles drive off the road and warn drivers of the curve locations.

ADOT

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 US 160 due to the traffic volumes and lack of alternate route.
Potential Stakeholder issues due to coordination with Local Tribal Government.

POTENTIAL FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STBG	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Tribal	☐ Other:

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$208,800	$696,100	$0	$6,961,300	$7,866,200

RECOMMENDED PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

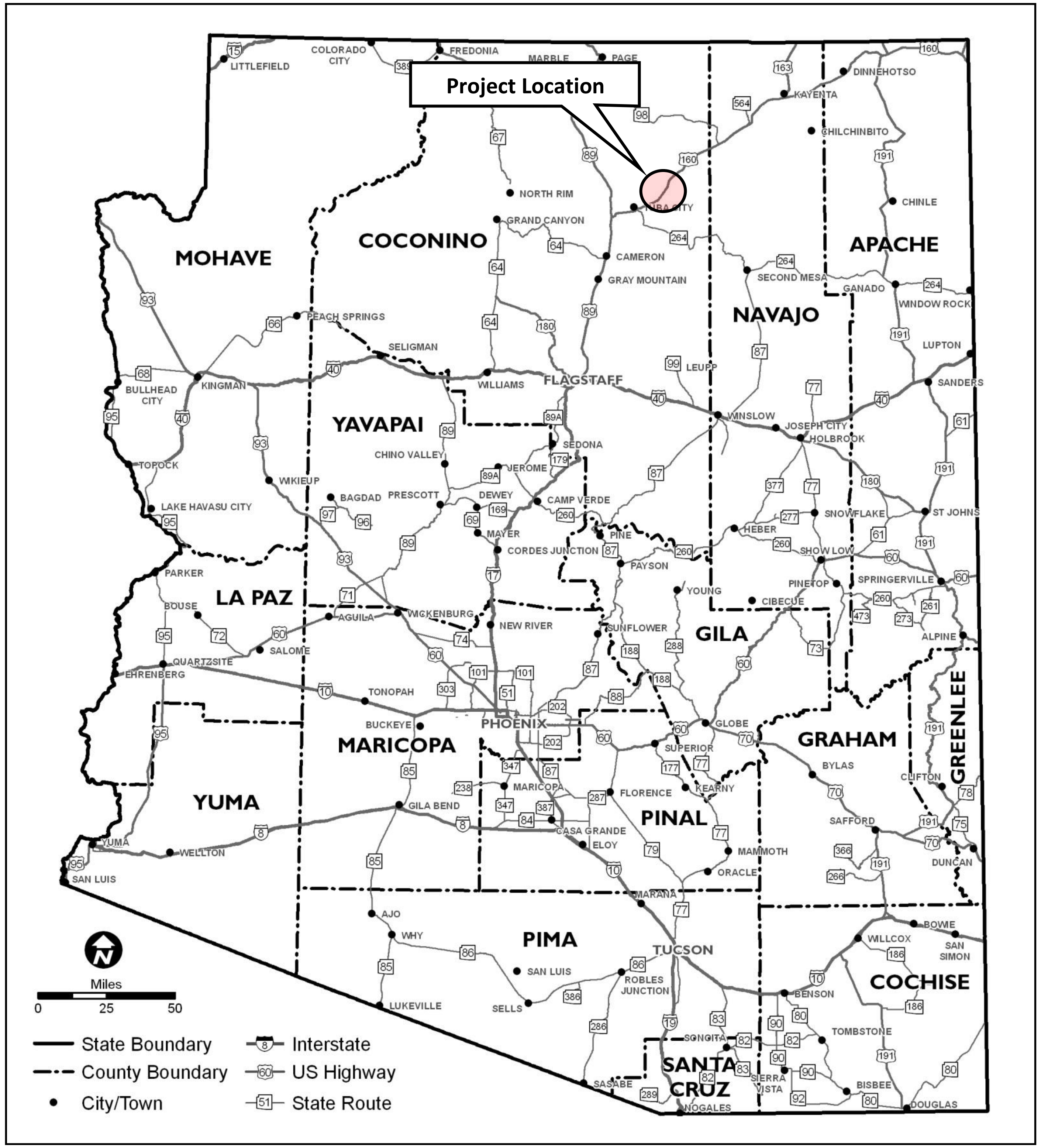
Design Program Year: FY

Construction Program Year: FY

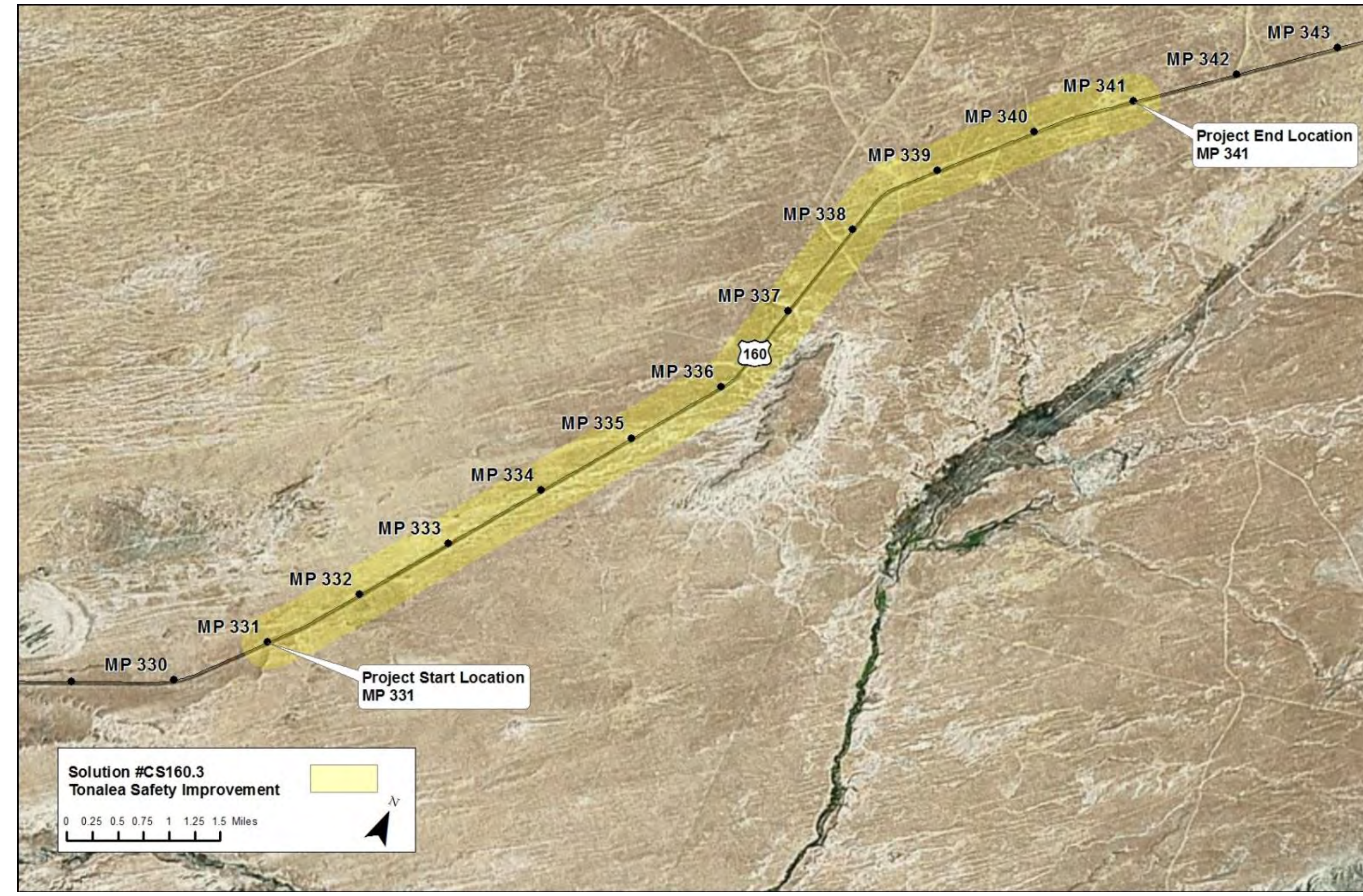
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Widen shoulder in both directions (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips) • Install curve warning signs in both directions • Install chevrons on curves (MP 336 to MP 336.5)

SCOPE ITEMS CONSIDERED, BUT NOT INCLUDED
• N/A

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ADOT

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: January 15, 2018	**ADOT Project Manager:**
Project Name: Tuba City – Tonalea: Eastbound Passing Lane	
City/Town:	**County:** Coconino
COG/MPO: Northern Arizona Council of Governments	**ADOT District:** Northcentral District
Primary Route/Street: US 160	
Beginning Limit: MP 335	
End Limit: MP 336.5	
Project Length: 1.5 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:
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

Freight needs are primarily associated with non-recurring congestion.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

This section of US 160 is subjected to congestion due to lack of passing lanes. The purpose of this solution will be to enhance mobility by constructing passing lane in eastbound direction.

ADOT

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 US 160 due to the traffic volumes and lack of alternate route.
Potential Stakeholder issues due to coordination with Local Tribal Government.

POTENTIAL FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STBG	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Tribal	☐ Other:

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$148,500	$495,000	$0	$4,950,000	$5,593,500

RECOMMENDED PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

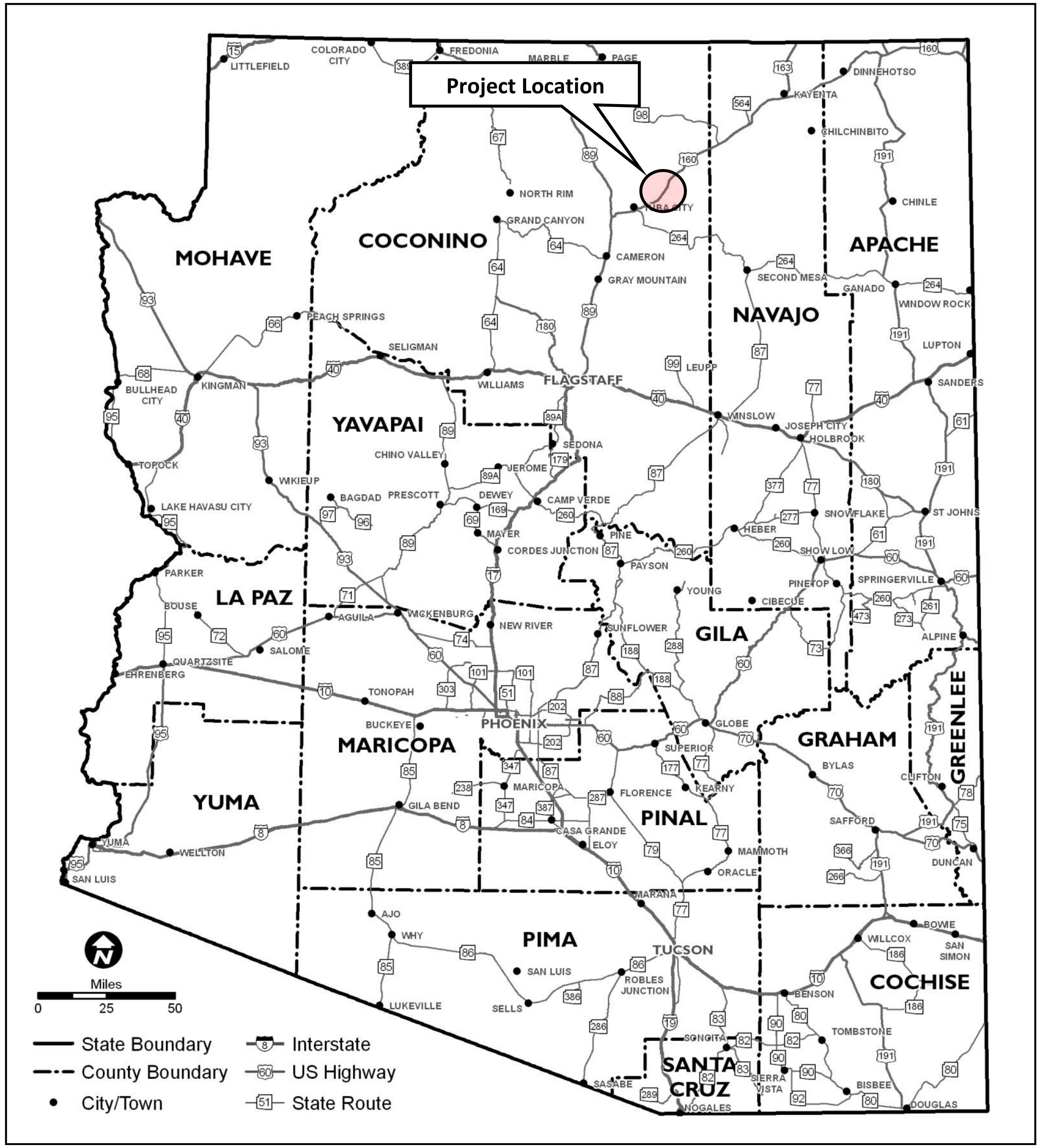
Design Program Year: FY

Construction Program Year: FY

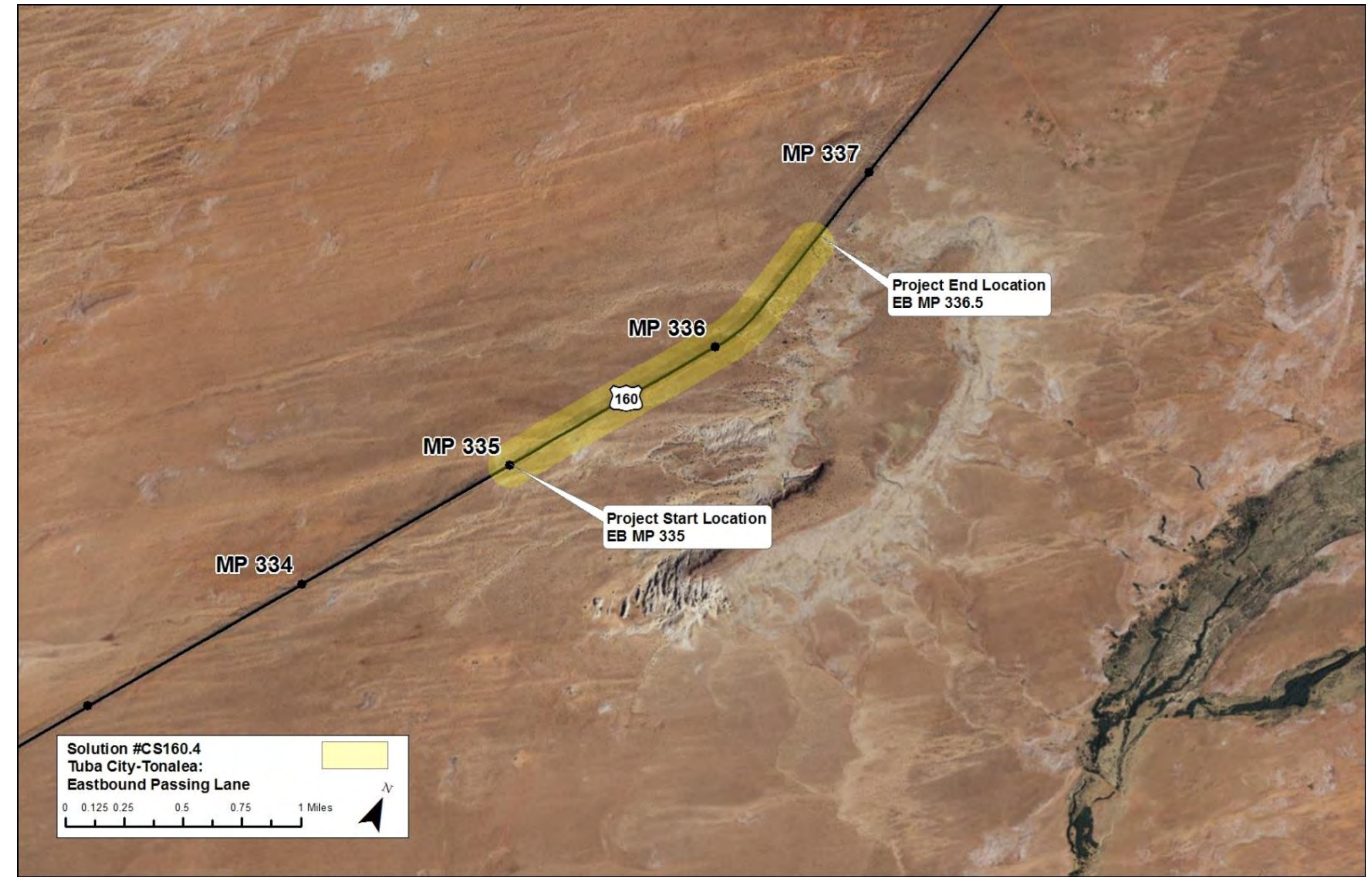
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Construct eastbound passing lane from MP 335 – MP 336.5

SCOPE ITEMS CONSIDERED, BUT <u>NOT</u> INCLUDED
• N/A

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ADOT

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION	
Date: January 15, 2018	**ADOT Project Manager:**
Project Name: Tonalea – Tuba City: Westbound Passing Lane	
City/Town:	**County:** Coconino
COG/MPO: Northern Arizona Council of Governments	**ADOT District:** Northcentral District
Primary Route/Street: US 160	
Beginning Limit: MP 340	
End Limit: MP 343	
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: *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

Freight needs are primarily associated with non-recurring congestion.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

This section of US 160 is subjected to congestion due to lack of passing lanes. The purpose of this solution will be to enhance mobility by constructing passing lanes in westbound direction.

ADOT

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 US 160 due to the traffic volumes and lack of alternate route.
Potential Stakeholder issues due to coordination with Local Tribal Government.

POTENTIAL FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STBG	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Tribal	☐ Other:

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$198,000	$660,000	$0	$6,600,000	$$7,458,000

RECOMMENDED PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

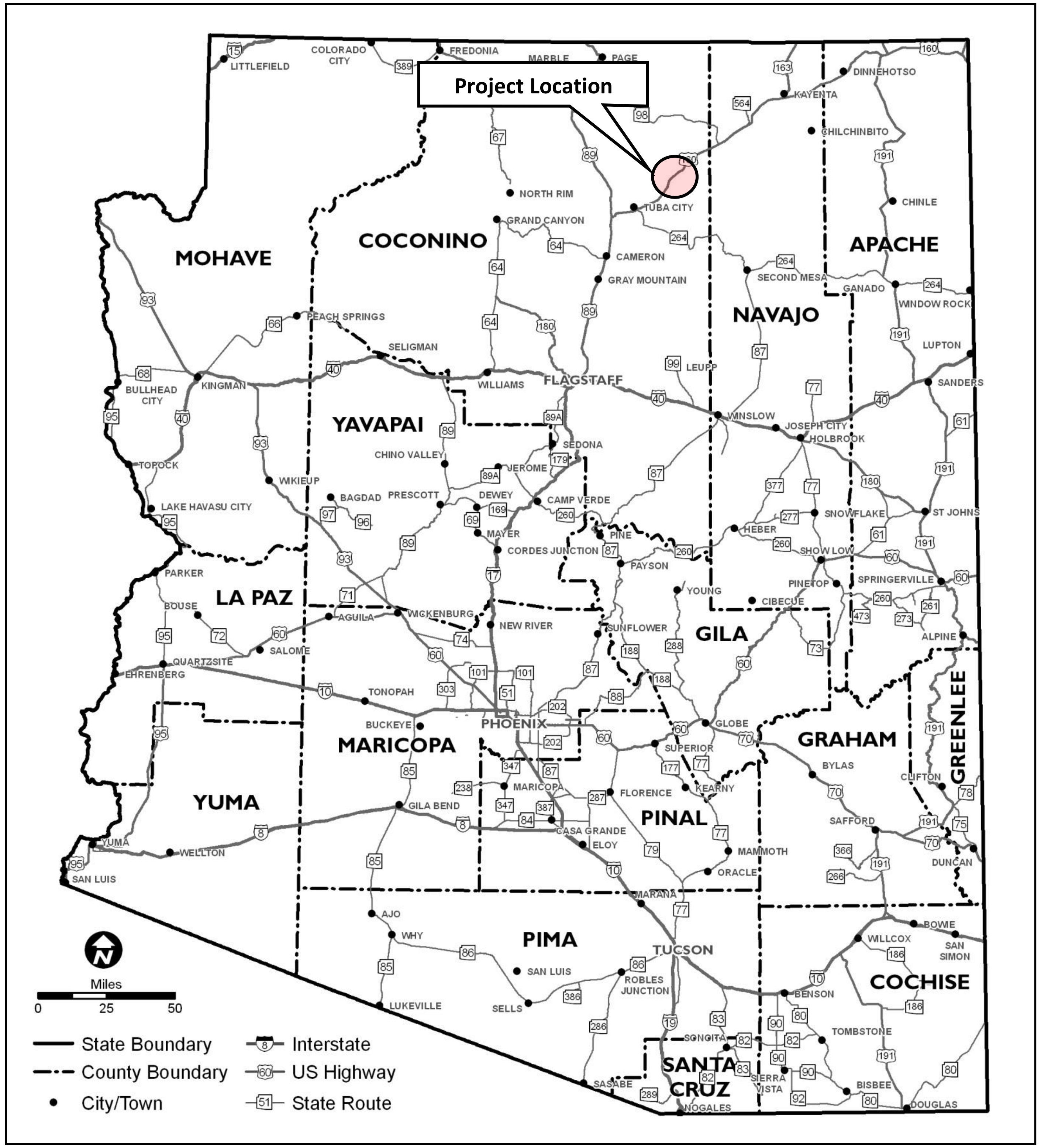
Design Program Year: FY

Construction Program Year: FY

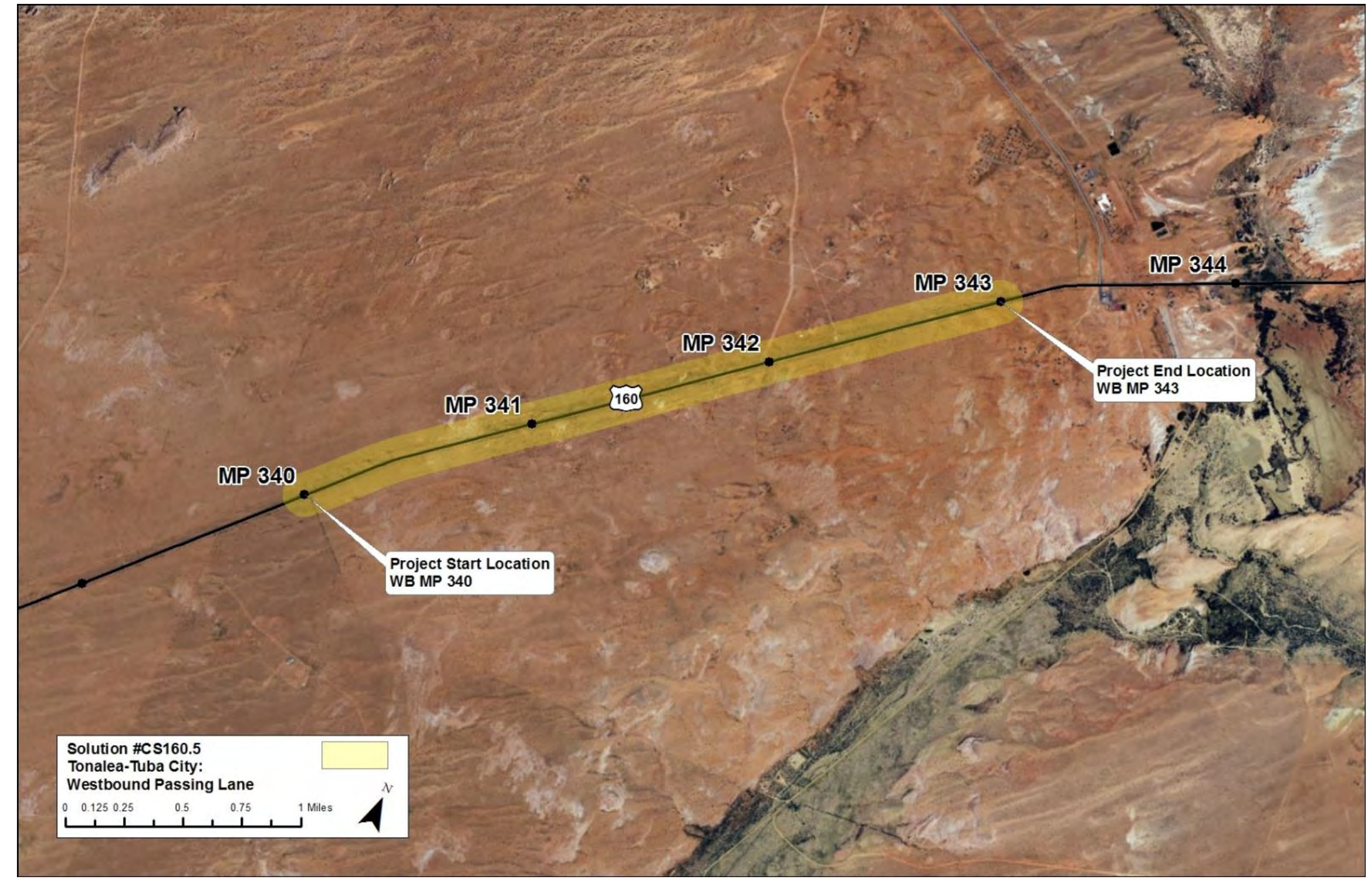
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Construct westbound passing lane from MP 340 – MP 341 • Construct westbound passing lane from MP 342 – MP 343

SCOPE ITEMS CONSIDERED, BUT <u>NOT</u> INCLUDED
• N/A

The below 23 USC 409 disclaimer is to be included in the Final Pre-Scoping Report and Field Review Report:

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ADOT PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION	
Date: January 15, 2018	**ADOT Project Manager:**
Project Name: Shonto Safety Improvement	
City/Town: Shonto	**County:** Coconino/Navajo
COG/MPO: Northern Arizona Council of Governments	**ADOT District:** Northcentral District
Primary Route/Street: US 160	
Beginning Limit: MP 346	
End Limit: MP 362	
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: *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

High Safety needs were identified throughout the section of US 160 near MP 346 to MP 362. Crash trends show collision with motor vehicle, and head on crashes. Road conditions show crash occurrences in dark or unlighted conditions and gravel conditions.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

This section of US 160 has experienced an elevated number of fatal and incapacitating injury accidents. The purpose of this solution will be to widen the shoulder in order to provide more room for corrective action if vehicles drive off the road and warn drivers of the curve locations and upcoming intersections. Also, the solution aims to improve the lighting conditions, due to fatal and incapacitating injury accidents in dark conditions.

ADOT 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 US 160 due to the traffic volumes and lack of alternate route.
Potential Stakeholder issues due to coordination with Local Tribal Government.

POTENTIAL FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STBG	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Tribal	☐ Other:

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$386,700	$1,289,100	$0	$12,890,700	$14,566,500

RECOMMENDED PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

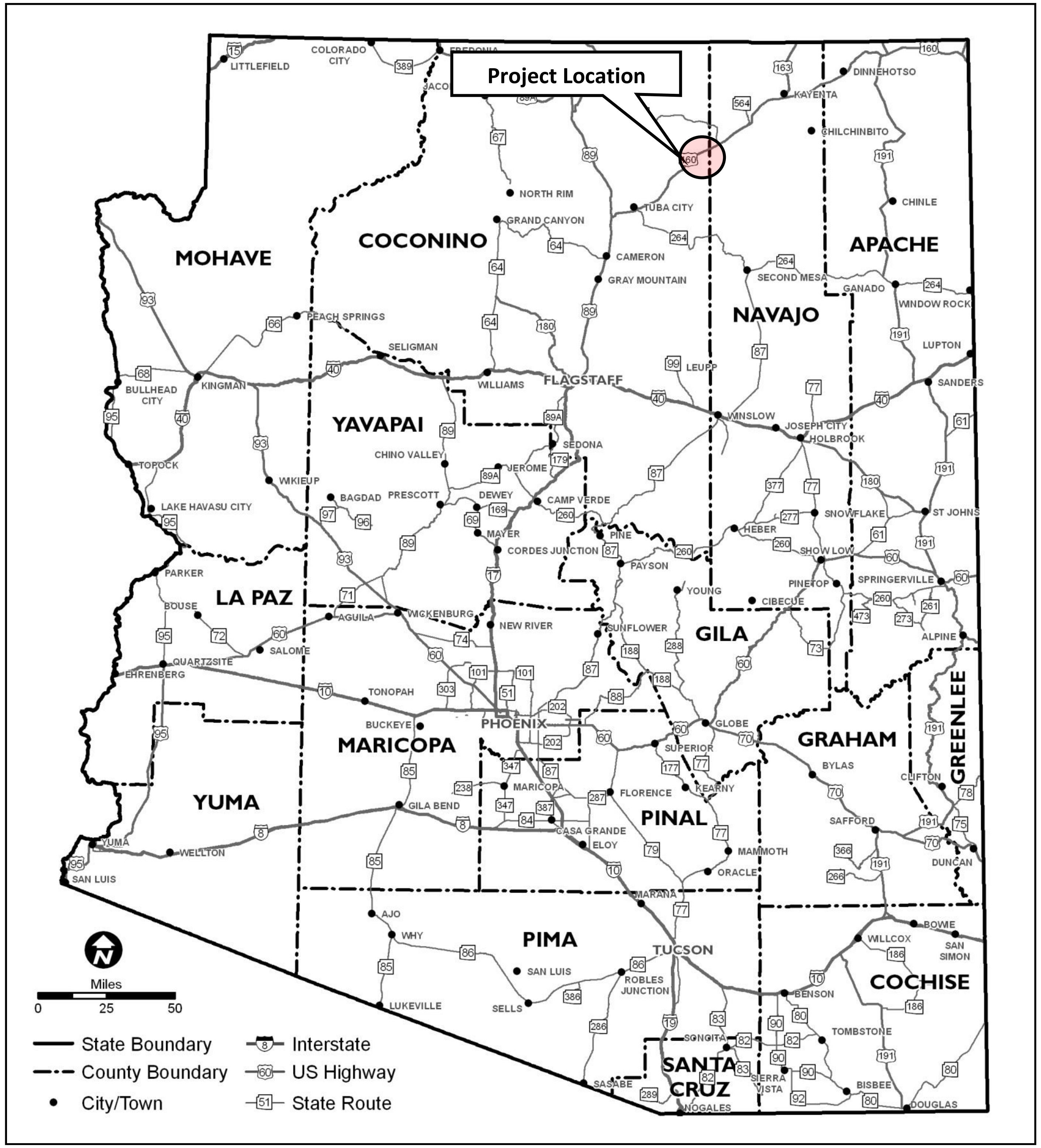
Design Program Year: FY

Construction Program Year: FY

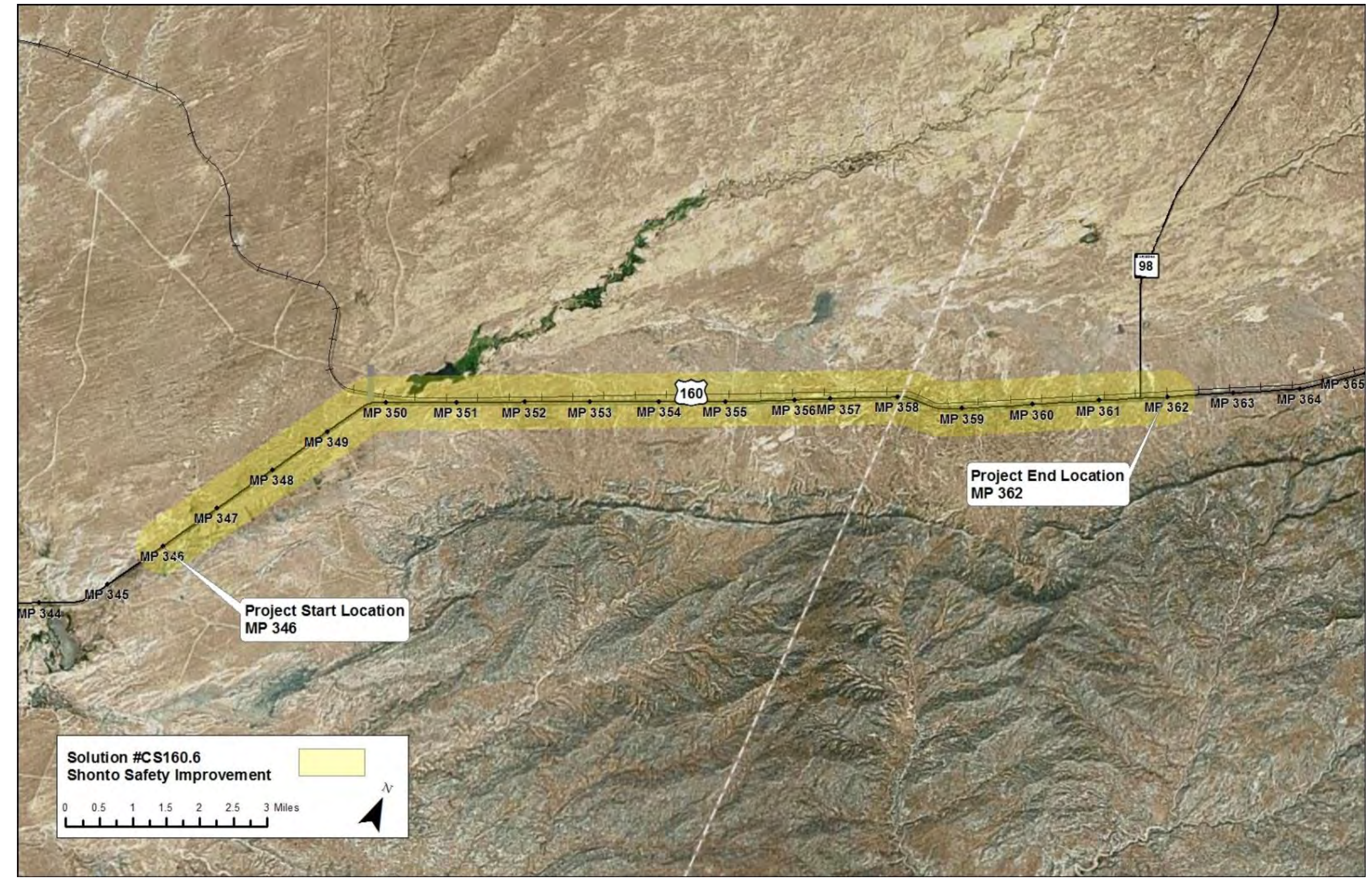
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Widen shoulder in both directions (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips) • Install lighting (solar powered LED) at SR 98 intersection (MP 361.6) • Install curve warning signs in both directions • Install chevrons on curves (MP 358 to MP 359)

SCOPE ITEMS CONSIDERED, BUT <u>NOT</u> INCLUDED
• N/A

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ADOT **PRELIMINARY SCOPING REPORT**

GENERAL PROJECT INFORMATION	
Date: January 15, 2018	**ADOT Project Manager:**
Project Name: Tsegi Canyon Passing Lanes	
City/Town: Tsegi and Kayenta	**County:** Navajo
COG/MPO: Northern Arizona Council of Governments	**ADOT District:** Northeast District
Primary Route/Street: US 160	
Beginning Limit: MP 389	
End Limit: MP 391	
Project Length: 2 miles	
Right-of-Way Ownership(s) (where proposed project construction would occur): *(Check all that apply)* [ ] City/Town; [ ] County; [x] ADOT ; [ ] Private ; [ ] Federal; [ ] Tribal; [ ] Other:	
Adjacent Land Ownership(s): *(Check all that apply)* [ ] City/Town; [ ] County; [ ] ADOT; [ ] Private; [ ] Federal; [x] Tribal; [ ] Other: *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
Freight needs are primarily associated with non-recurring congestion.

PROJECT PURPOSE			
What is the Primary Purpose of the Project?	Preservation [ ]	Modernization [x]	Expansion [ ]
This section of US 160 is subjected to congestion due to lack of passing lanes. The purpose of this solution will be to enhance mobility by constructing alternate passing lanes in eastbound and westbound directions.			

ADOT **PRELIMINARY SCOPING REPORT**

PROJECT RISKS	
Check any risks identified that may impact the project's scope, schedule, or budget:	
[x] Access / Traffic Control / Detour Issues	[ ] Right-of-Way
[x] Constructability / Construction Window Issues	[ ] Environmental
[x] 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 US 160 due to the traffic volumes and lack of alternate route.* *Potential Stakeholder issues due to coordination with Local Tribal Government.*	

POTENTIAL FUNDING SOURCE(S)				
Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	[ ] STBG	[ ] TAP	[ ] HSIP	[ ] State
	[ ] Local	[ ] Private	[ ] Tribal	[ ] Other:

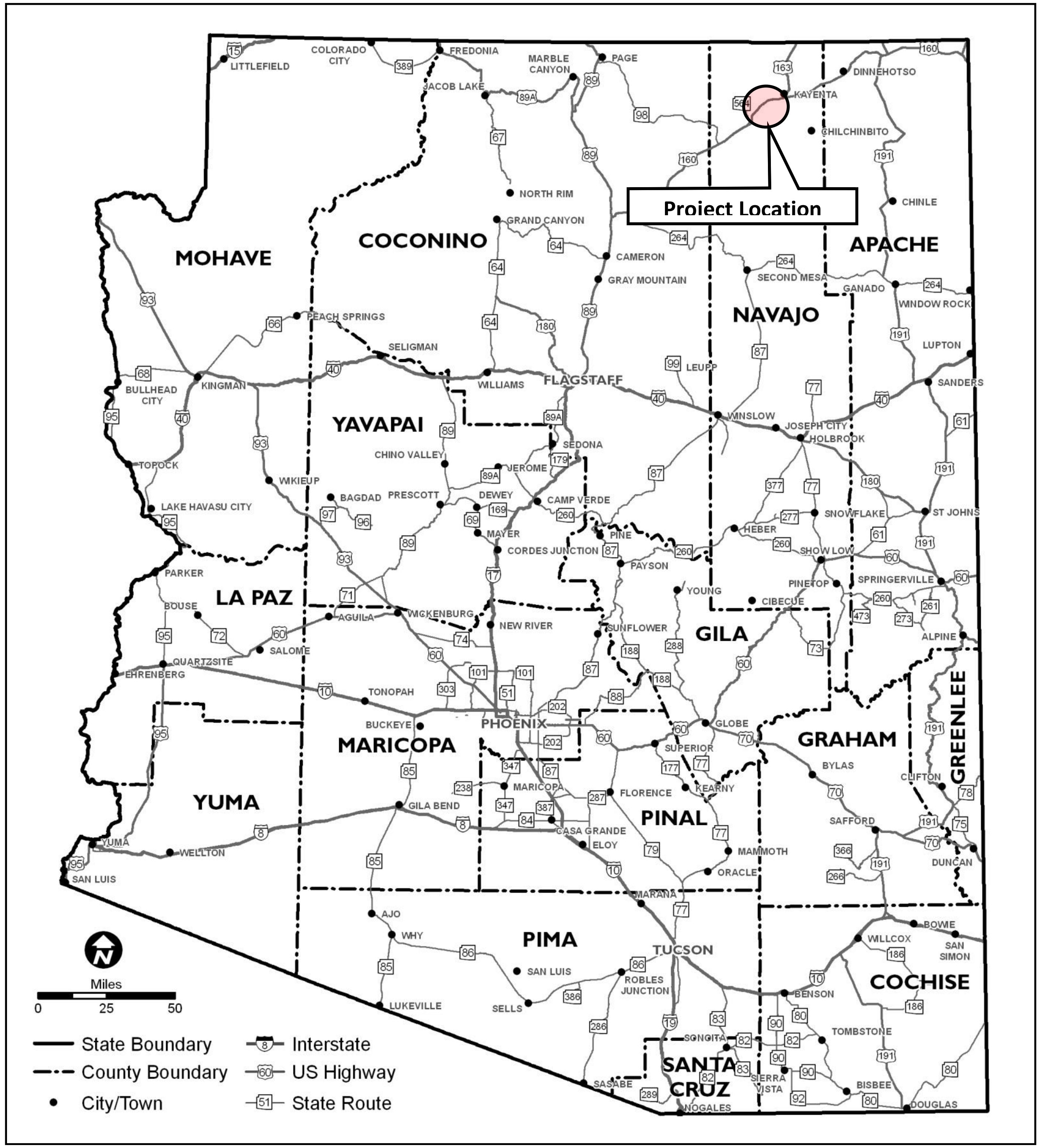
COST ESTIMATE				
Preliminary Engineering $198,000	Design $660,000	Right-of-Way $0	Construction $6,600,000	Total $7,458,000

RECOMMENDED PROJECT DELIVERY
Delivery: [ ] Design-Bid-Build [ ] Design-Build [ ] Other:
Design Program Year: FY
Construction Program Year: FY

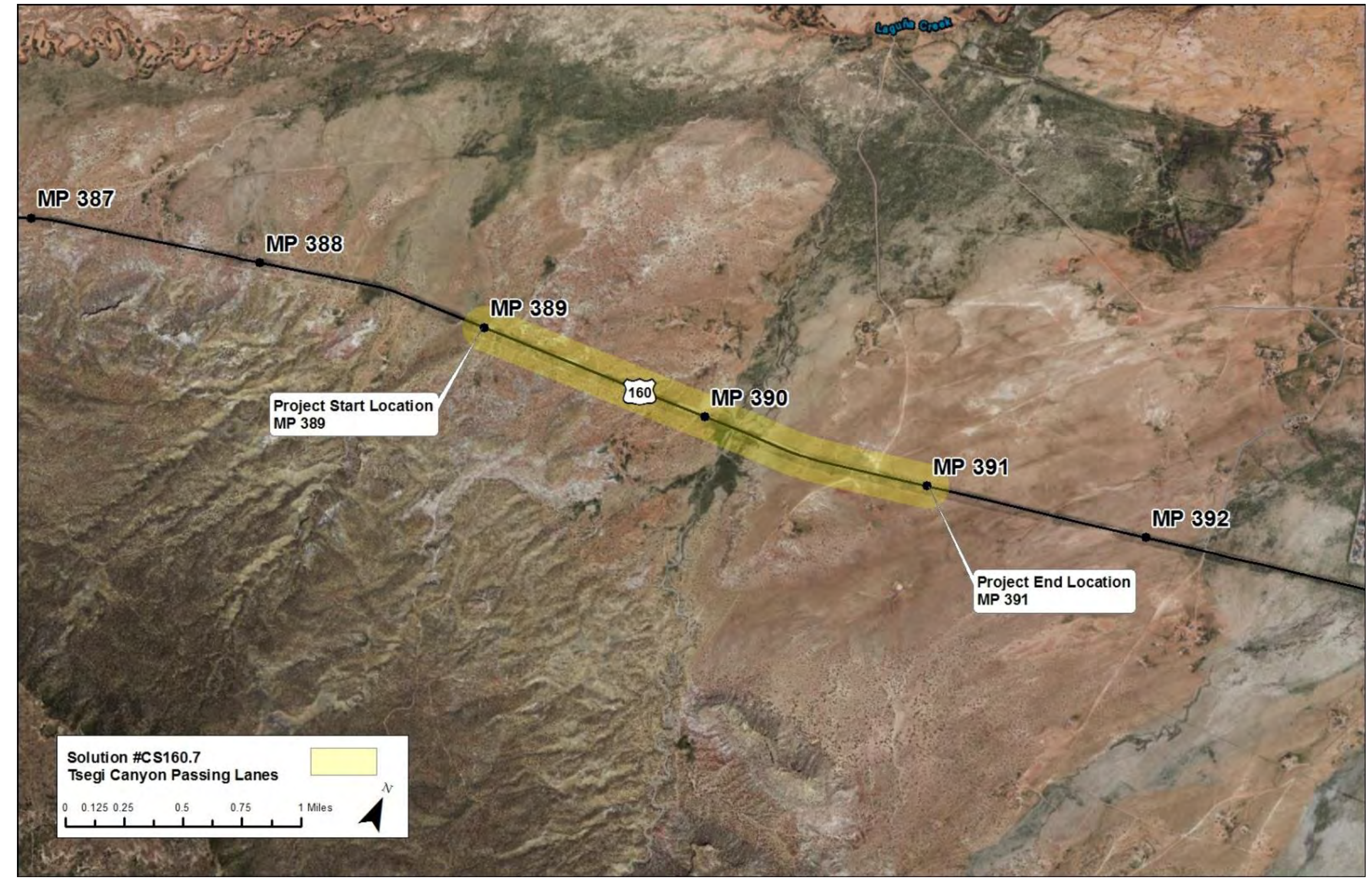
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Construct westbound passing lane from MP 389 – MP 390 • Construct eastbound passing lane from MP 390 – MP 391

SCOPE ITEMS CONSIDERED, BUT <u>NOT</u> INCLUDED
• N/A

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ADOT

PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION

Date: January 15, 2018	**ADOT Project Manager:**
Project Name: Mexican Water Safety Improvement	
City/Town: Mexican Water	**County:** Apache
COG/MPO: Northern Arizona Council of Governments	**ADOT District:** Northeast District
Primary Route/Street: US 160	
Beginning Limit: MP 432	
End Limit: MP 438	
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:
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

High Safety needs were identified throughout the section of US 160 near MP 432 to MP 438. Crash trends show overturn, rear end and ran off road crashes, and collisions involving speed too fast for conditions. Road conditions show crash occurrences in dark or unlighted conditions.

PROJECT PURPOSE

What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐

This section of US 160 has experienced an elevated number of fatal and incapacitating injury accidents. The purpose of this solution will be to widen the shoulder in order to provide more room for corrective action if vehicles drive off the road and warn drivers of the curve locations.

ADOT

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 US 160 due to the traffic volumes and lack of alternate route.
Potential Stakeholder issues due to coordination with Local Tribal Government.

POTENTIAL FUNDING SOURCE(S)

Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STBG	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Tribal	☐ Other:

COST ESTIMATE

Preliminary Engineering	Design	Right-of-Way	Construction	Total
$110,000	$366,700	$0	$3,667,000	$4,143,700

RECOMMENDED PROJECT DELIVERY

Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:

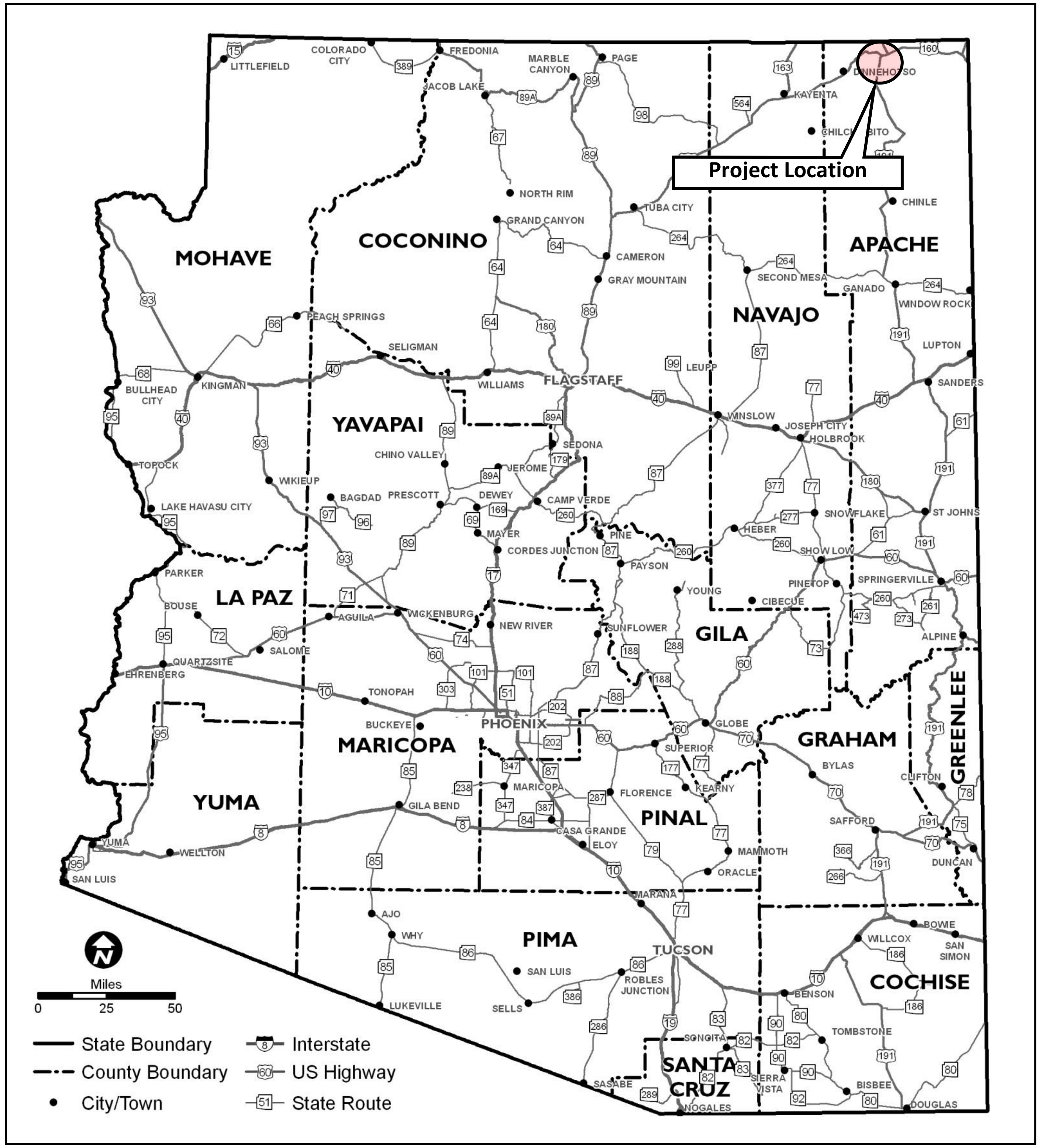
Design Program Year: FY

Construction Program Year: FY

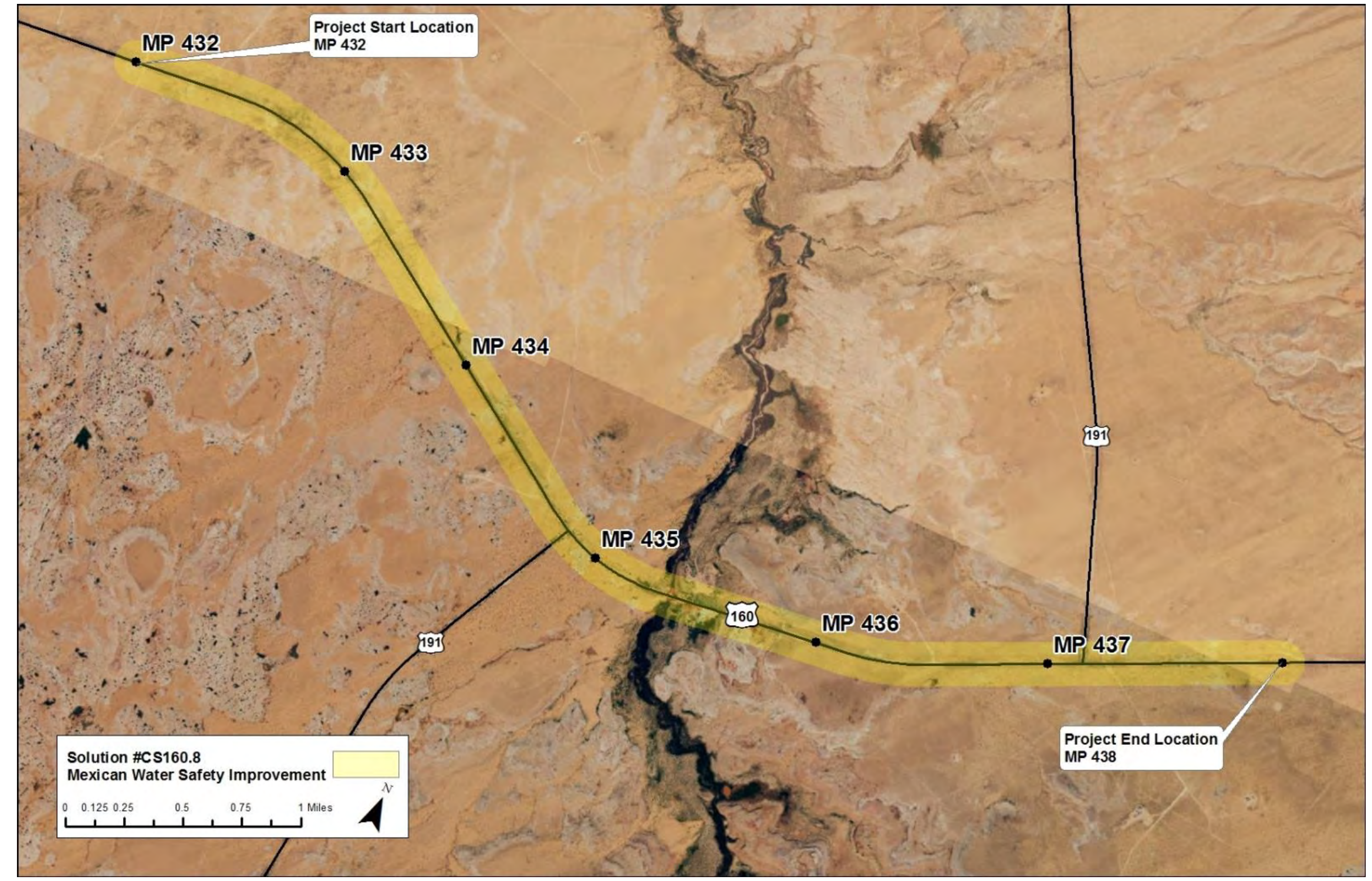
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Widen shoulder in both directions (includes pavement, minor earthwork, striping edge lines, RPMs, high visibility delineators, safety edge, and rumble strips) • Install curve warning signs in both directions • Install chevrons on curves (MP 432 to MP 433 and MP 434.5 to MP 435.5)

SCOPE ITEMS CONSIDERED, BUT NOT INCLUDED
• N/A

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ADOT PRELIMINARY SCOPING REPORT

GENERAL PROJECT INFORMATION	
Date: January 15, 2018	**ADOT Project Manager:**
Project Name: US 160/US 191 Intersection Improvement	
City/Town: Mexican Water	**County:** Apache
COG/MPO: Northern Arizona Council of Governments	**ADOT District:** Northeast District
Primary Route/Street: US 160	
Beginning Limit: MP 435	
End Limit: MP 437	
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: *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
High Safety needs were identified throughout the section of US 160 near MP 432 to MP 438. Crash trends show overturn, rear end and ran off road crashes, and collisions involving speed too fast for conditions. Road conditions show crash occurrences in dark or unlighted conditions.

PROJECT PURPOSE			
What is the Primary Purpose of the Project?	Preservation ☐	Modernization ☒	Expansion ☐
This section of US 160 has experienced an elevated number of fatal and incapacitating injury accidents. The purpose of this solution will be to improve US 191 intersections to allow safer merge movement between US 160 and US 191.			

ADOT 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 US 160 due to the traffic volumes and lack of alternate route.* *Potential Stakeholder issues due to coordination with Local Tribal Government.*	

POTENTIAL FUNDING SOURCE(S)				
Anticipated Project Design/Construction Funding Type: *(Check all that apply)*	☐ STBG	☐ TAP	☐ HSIP	☐ State
	☐ Local	☐ Private	☐ Tribal	☐ Other:

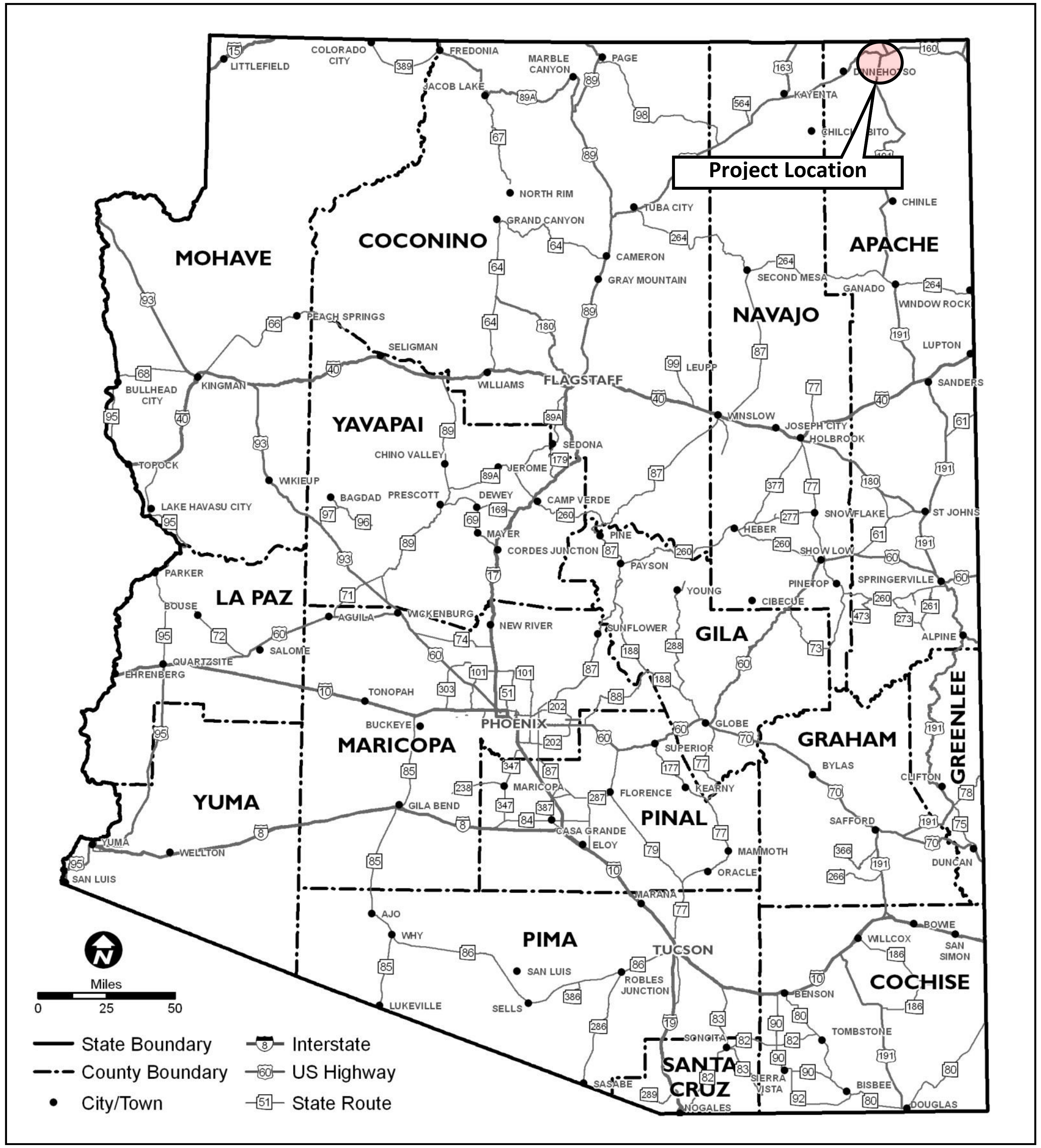
COST ESTIMATE				
Preliminary Engineering $33,200	Design $110,600	Right-of-Way $0	Construction $1,105,500	Total $1,249,300

RECOMMENDED PROJECT DELIVERY
Delivery: ☐ Design-Bid-Build ☐ Design-Build ☐ Other:
Design Program Year: FY
Construction Program Year: FY

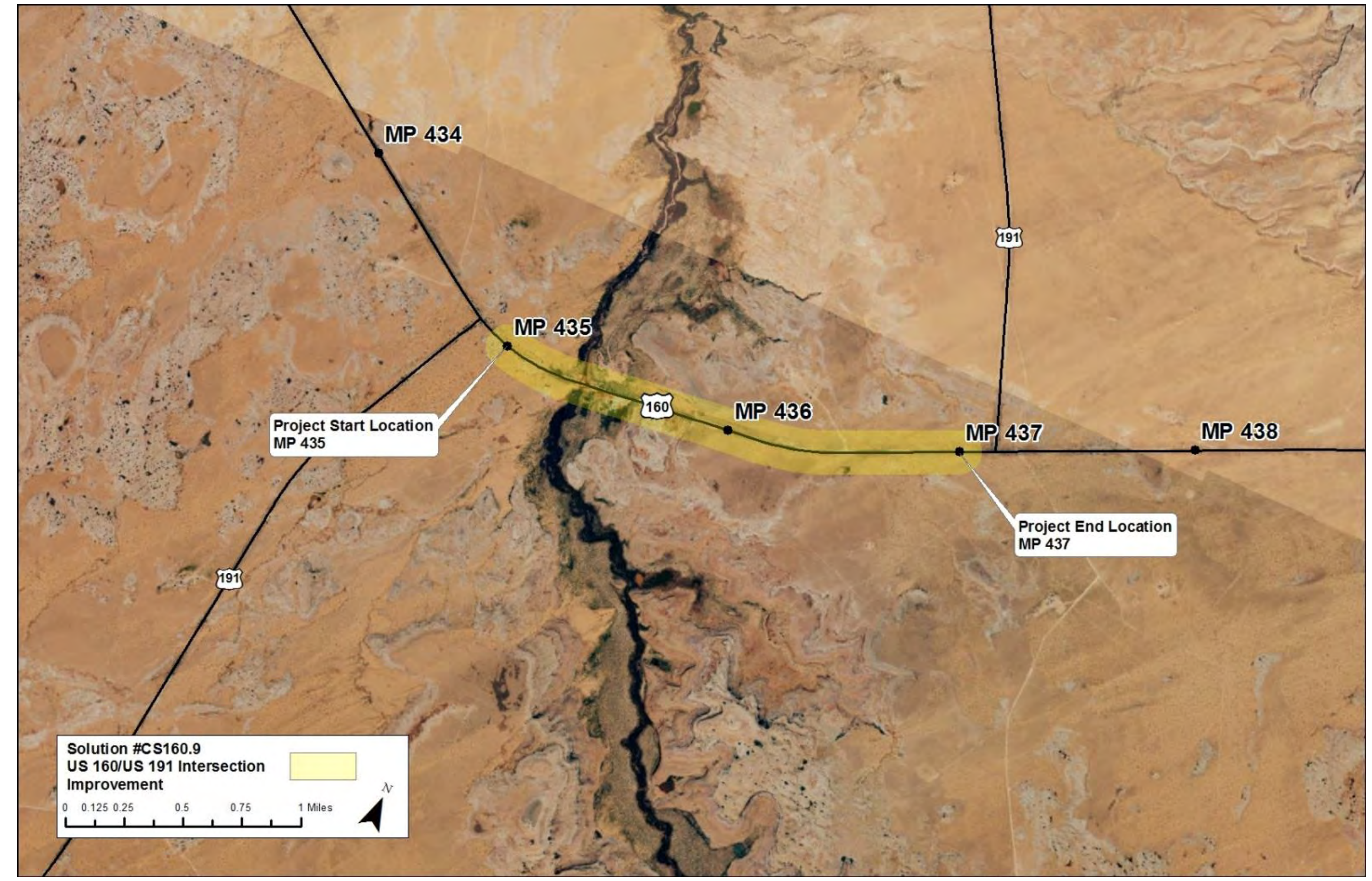
ATTACHMENTS

1) **State Location Map**
2) **Project Vicinity Map**
3) **Project Scope of Work**

ATTACHMENT 1 – STATE LOCATION MAP



ATTACHMENT 2 – PROJECT VICINITY MAP



ATTACHMENT 3 – SCOPE OF WORK

SCOPE OF WORK
• Install eastbound acceleration lane at US 191 intersection (MP 434.8) • Install eastbound deceleration lane at US 191 intersection (MP 434.8) • Install eastbound acceleration lane at US 191 intersection (MP 437.2) • Install lighting (solar powered LED) at US 191 intersections (MP 434.8 and MP 437.2)

SCOPE ITEMS CONSIDERED, BUT NOT INCLUDED
• N/A

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