US 93/US 60 CORRIDOR PROFILE STUDY

NEVADA STATE LINE TO SR 303L

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TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 Corridor Study Purpose ... 2
1.2 Corridor Study Goals and Objectives ... 2
1.3 Working Paper 4 Overview ... 2
1.4 Corridor Overview ... 2
1.5 Study Location and Corridor Segments ... 2

2.0 NEEDS ASSESSMENT PROCESS 5

2.1 Step 1: Initial Need Identification ... 5
2.2 Step 2: Need Refinement ... 5
2.3 Step 3: Contributing Factors ... 5
2.4 Step 4: Segment Review ... 6
2.5 Step 5: Corridor Needs ... 6

3.0 PAVEMENT PERFORMANCE AREA NEEDS (STEPS 1-3) 7

3.1 Step 1: Initial Pavement Needs ... 7
3.2 Step 2: Final Pavement Needs ... 7
3.3 Step 3: Pavement Contributing Factors ... 7

4.0 BRIDGE PERFORMANCE AREA NEEDS (STEPS 1-3) 13

4.1 Step 1: Initial Bridge Needs ... 13
4.2 Step 2: Final Bridge Needs ... 13
4.3 Step 3: Bridge Contributing Factors ... 13

5.0 MOBILITY PERFORMANCE AREA NEEDS (STEPS 1-3) 20

5.1 Step 1: Initial Mobility Needs ... 20
5.2 Step 2: Final Mobility Needs ... 20
5.3 Step 3: Mobility Contributing Factors ... 25

6.0 SAFETY PERFORMANCE NEEDS (STEPS 1-3) 29

6.1 Step 1: Initial Safety Needs ... 29
6.2 Step 2: Final Safety Needs ... 29
6.3 Step 3: Safety Contributing Factors ... 33

7.0 FREIGHT PERFORMANCE NEEDS (STEPS 1-3) 39

7.1 Step 1: Initial Freight Needs ... 39
7.2 Step 2: Final Freight Needs ... 39
7.3 Step 3: Freight Contributing Factors ... 45

8.0 SEGMENT REVIEW (STEP 4) 49

9.0 CORRIDOR NEEDS (STEP 5) 51

9.1 Description of Needs by Performance Area ... 51
9.2 Overlapping Needs ... 54

10.0 NEXT STEPS 57

LIST OF TABLES

Table 1: US 93/US 60 Corridor Segmentation ... 3
Table 2: Initial Pavement Needs (Step 1) ... 8
Table 3: Final Pavement Needs (Step 2) ... 9
Table 4: Pavement Needs Contributing Factors (Step 3) ... 12
Table 5: Initial Bridge Needs (Step 1) ... 14
Table 6: Final Bridge Needs (Step 2) ... 15
Table 7: Bridge Needs Contributing Factors (Step 3) ... 19
Table 8: Initial Mobility Needs (Step 1) ... 21
Table 9: Final Mobility Needs (Step 2) ... 23
Table 10: Mobility Needs Contributing Factors (Step 3) ... 26
Table 11: Initial Safety Needs – Part 1 (Step 1) ... 30
Table 12: Final Safety Needs (Step 2) ... 32
Table 13: Safety Needs Contributing Factors (Step 3) ... 35
Table 14: Initial Freight Needs (Step 1) ... 40
Table 15: Final Freight Needs (Step 2) ... 42
Table 16: Freight Needs Contributing Factors (Step 3) ... 46
Table 17: Segment Needs Summary ... 49

LIST OF FIGURES

Figure 1: Study Area ... 1
Figure 2: Segmentation Map ... 4
Figure 3: Needs Assessment Process ... 5
Figure 4: Initial Need Ratings in Relation to Baseline Performance (Bridge Example) ... 5
Figure 5: Pavement History ... 10
Figure 6: Bridge History ... 16
Figure 7: Needs Summary ... 50
Figure 8: Summary of Needs and Programmed Projects ... 56
Figure 9: Corridor Profile Study Process ... 57

APPENDICES

Appendix A: Methodologies for Determining Performance Area Needs (Steps 1-3)

LIST OF ABBREVIATIONS

ABBREVIATION	NAME
AADT	Average Annual Daily Traffic
ADOT	Arizona Department of Transportation
ARZC	Arizona & California Railroad
ASLD	Arizona State Land Department
AZTDM	Arizona Travel Demand Model
BCA	Benefit Cost Analysis
BI	Bridge Index
BLM	Bureau of Land Management
bqAZ	Building a Quality Arizona
BNSF	BNSF Railway
CANAMEX	Canada to Mexico
CR	Cracking Rating
EB	Eastbound
FAST	Fixing America's Surface Transportation
FHWA	Federal Highway Administration
FI	Freight Index
GA	General Aviation
I	Interstate
IRI	International Roughness Index
KART	Kingman Area Regional Transit
LCCA	Life-Cycle Cost Analysis
LOS	Level of Service
LRTP	Long-Range Transportation Plan
MAG	Maricopa Association of Governments
MAP-21	Moving Ahead for Progress in the 21st Century
MI	Mobility Index
MP	Milepost
MPD	Multimodal Planning Division
NACOG	Northern Arizona Council of Governments
O-D	Origin-Destination
P2P Link	Planning to Programming Link
PI	Pavement Index
POE	Port of Entry
PUD	Planned Development Unit
PSR	Pavement Serviceability Rating
PTI	Planning Time Index
SI	Safety Index
SOV	Single Occupancy Vehicle
SR	State Route
SHSP	Strategic Highway Safety Plan
SWAP	Arizona State Wildlife Action Plan
TAC	Technical Advisory Committee
TI	Traffic Interchange
TTI	Travel Time Index
TPTI	Truck Planning Time Index
TTTI	Truck Travel Time Index
US	United States Route
V/C	Volume-to-Capacity
WB	Westbound
WACOG	Western Arizona Council of Governments

1.0 INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study of United States (US) 93/US 60 between the Nevada State Line and State Route 303 Loop (SR 303L). This study will look at key performance measures relative to the US 93/US 60 corridor, and the results of this performance evaluation will be used to identify potential strategic improvements.

The intent of the corridor profile program, and of the Planning to Programming (P2P) Link process, is to conduct performance-based planning to identify areas of need and make the most efficient use of available funding to provide an efficient transportation network. ADOT is conducting eleven corridor profile studies. The eleven corridors are being evaluated within three separate groupings.

The first three studies (Round 1) began in spring 2014, and encompass:

- I-17: SR 101L to I-40
- I-19: Mexico International Border to I-10
- I-40: California State Line to I-17

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

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

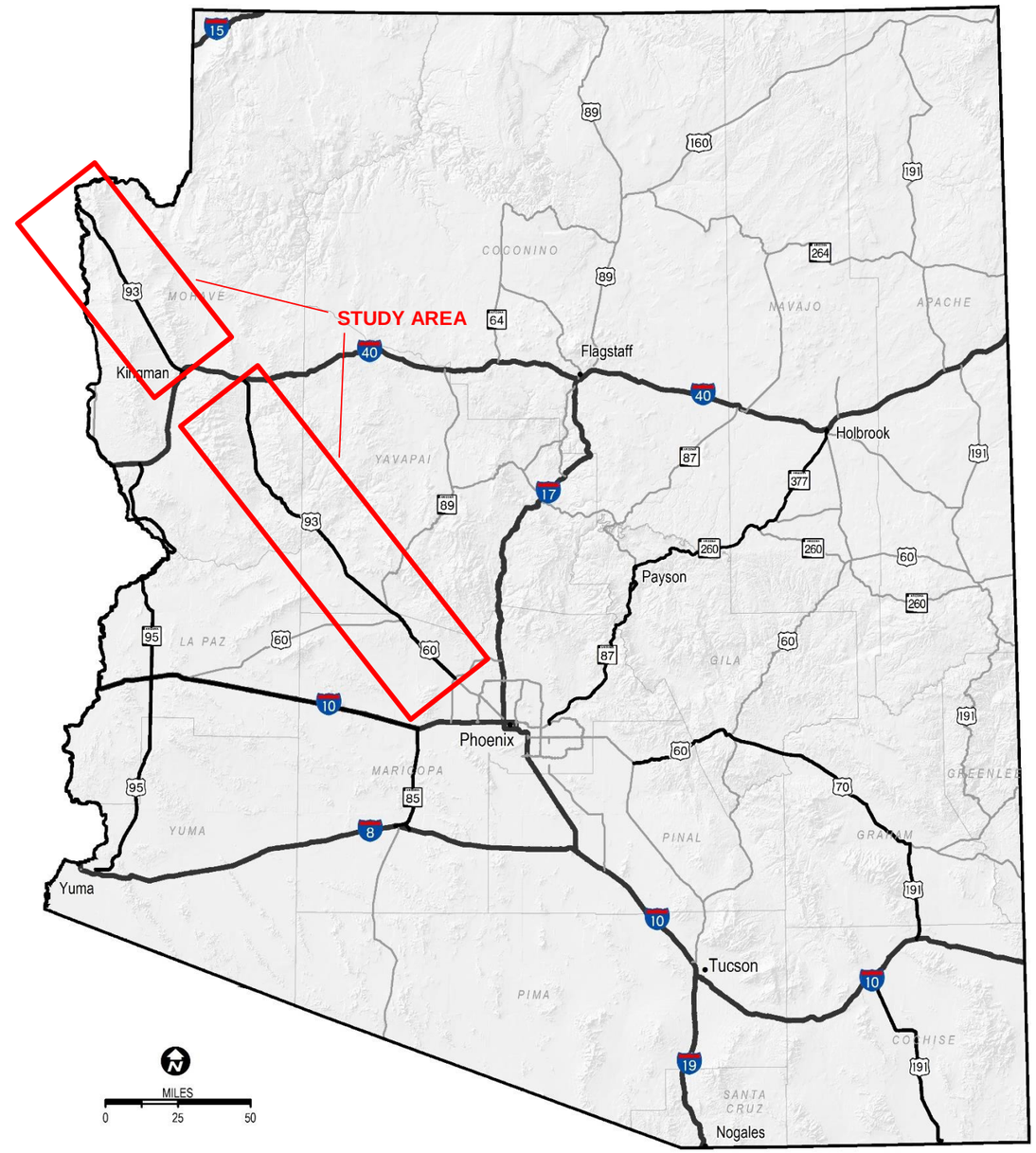
The third round (Round 3) of studies, initiated in fall 2015, includes:

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

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

US 93/US 60 between the Nevada State Line and SR 303L (with the exception of I-40), depicted in **Figure 1**, is one of the strategic statewide corridors identified and is the subject of this Corridor Profile Study.

Figure 1: Study Area



1.1 Corridor Study Purpose

The purpose of the US 93/US 60 Corridor Profile Study 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 established by the previous Round 1 corridor profile studies to:

- 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 projects that can provide quantifiable benefits relative to the performance measures.
- Prioritize projects for future implementation.

1.2 Corridor 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 93/US 60 Corridor Profile Study will define solutions and improvements for the corridor that can be evaluated and ranked to determine which investments offer the greatest benefit to the corridor in terms of enhancing performance.
The following goals have been 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 Working Paper 4 Overview

The purpose of Working Paper 4 is to document the performance-based needs for the US 93/US 60 corridor within the study limits. Corridor needs are defined through a review of the difference in baseline corridor performance (Task 2) and the performance objectives (Task 3) for each of the five performance areas used to characterize the health of the US 93/US 60 corridor: pavement, bridge, mobility, safety, and freight. The product of Working Paper 4 is actionable performance needs that can be addressed through strategic investments in corridor preservation, modernization, and expansion.

1.4 Corridor Overview

The US 93/US 60 corridor provides a critical surface transportation link to Las Vegas from the Phoenix metropolitan area and the broader Central Arizona area. As a north-south US highway, US 93 continues through Nevada, Idaho, and Montana into Canada. Significant upgrades to both US 93 and US 60 have been accomplished in the past decade. US 93 has been upgraded to a four-lane divided highway from Nevada to I-40 in Kingman and through most of its length from I-40 south to Wickenburg.

1.5 Study Location and Corridor Segments

The US 93/US 60 Corridor Profile Study limits extend from the Mike O'Callaghan–Pat Tillman Memorial Bridge at the Colorado River, which is the Arizona/Nevada State Line, to SR 303L in Surprise, Arizona, northwest of Phoenix. US 93 extends 200 miles south from the State Line to its junction with US 60 in Wickenburg, Arizona, at a roundabout on the west bank of the Hassayampa River.

The US 60 portion of the corridor extends from the roundabout over a new, four-lane bridge across the Hassayampa River a distance of approximately 28 miles south to SR 303L.

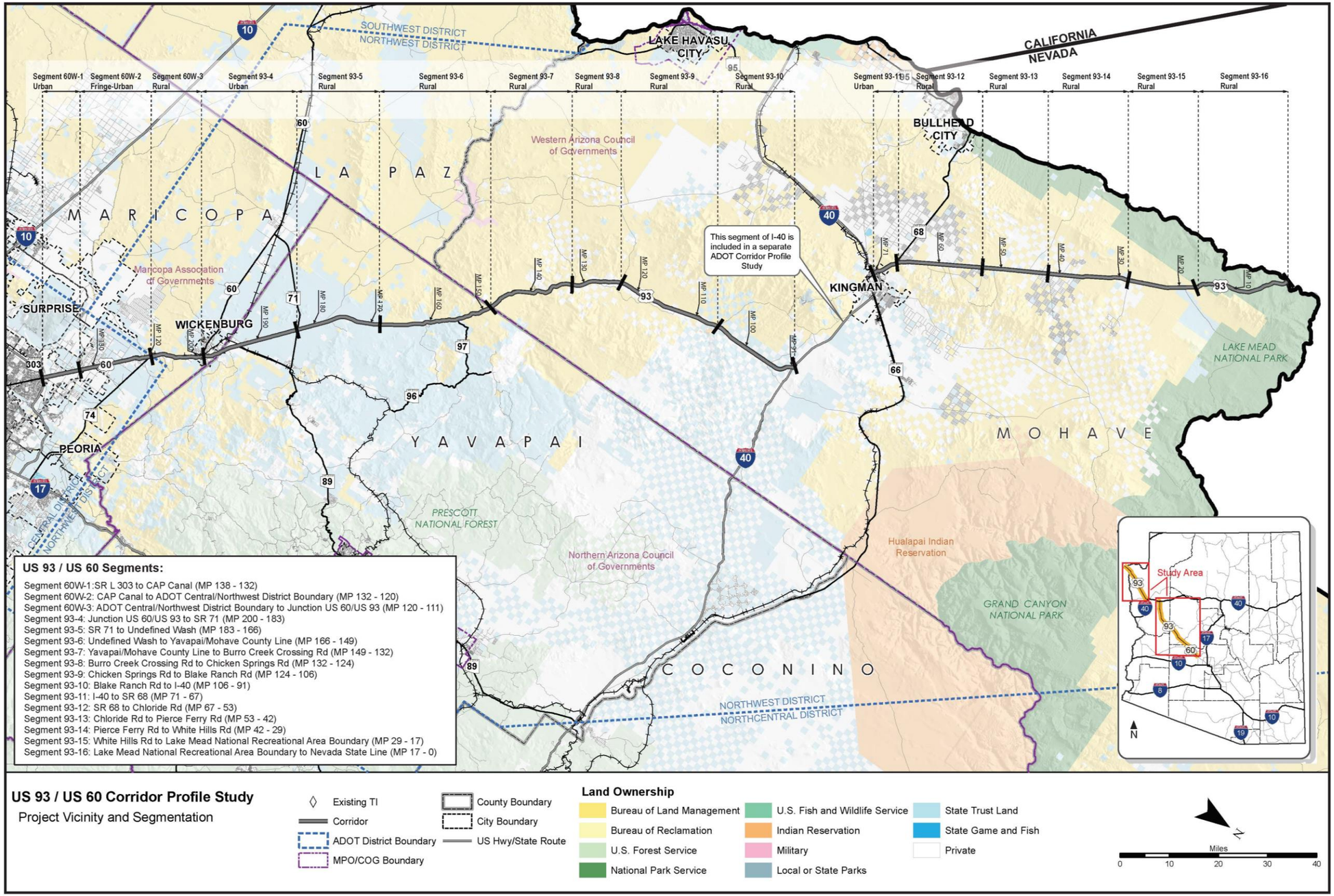
The 2015 Fixing America's Surface Transportation Act, or FAST Act, formally designated Interstate 11 (I-11) throughout Arizona. As part of that designation, a portion of I-11 will follow US 93 from Wickenburg to the Nevada state line. Identification of highway segments for study consideration was based on roadway, traffic, and jurisdictional characteristics to allow for the appropriate level of analysis for similar operating environments.

The US 93/US 60 study corridor has been divided into 16 segments to allow for an appropriate level of detailed needs analysis, performance evaluation, and comparison between different segments of the corridor. These corridor segments are described in **Table 1** and shown in **Figure 2**.

Table 1: US 93/US 60 Corridor Segmentation

Segment	Route	Begin	End	Approximate Begin Milepost	Approximate End Milepost	Approximate Length (miles)	Through Lanes (NB, SB)	2014 Average Annual Daily Traffic volume (VPD)	Character Description
60W-1	US 60	SR 303L	CAP Canal	138	132	6	2, 2	18,400	This 6-mile segment of US 60 is a four-lane, divided highway running west of and parallel to the BNSF Railway (BNSF) line.
60W-2	US 60	CAP Canal	ADOT Central/Northwest District Boundary	132	120	12	2, 2	8,325	This 12-mile segment of US 60 is primarily on an alluvial fan at the base of the Hieroglyphic Mountains. US 60 passes through Wittmann, Circle City and the city of Morristown at the junction with SR 74.
60W-3	US 60	ADOT Central/Northwest District Boundary	Jct US 60 /US 93 (Wickenburg)	120	111	9	2, 2	12,833	This 9-mile segment of US 60 parallels the east side of the Hassayampa River and there are no major developments for roughly seven miles.
93-4	US 93	Jct US 60/US 93 (Wickenburg)	SR 71	200	183	17	1, 1	8,975	This 17-mile segment of US 93 is a two-lane roadway with paved shoulders extending through Wickenburg and junctions with SR 71.
93-5	US 93	SR 71	Undefined Wash	183	166	17	2, 1 & 1, 1	5,700	This 17-mile segment of US 93 is a three-lane roadway with an auxiliary lane to accommodate WB-NB SR 71 traffic, then becomes a two-lane roadway with paved shoulders and passing lanes.
93-6	US 93	Undefined Wash	Yavapai/Mohave County Line	166	149	17	2, 2	5,700	This 17-mile segment of US 93 crosses the Santa Maria River at MP 161 and becomes a four-lane divided roadway at MP 168.
93-7	US 93	Yavapai/Mohave County Line	Burro Creek Crossing Road	149	132	17	2, 2	4,600	This 17-mile segment of US 93 is a four-lane, divided roadway with topography in this segment and includes the Yavapai – Mohave County Line.
93-8	US 93	Burro Creek Crossing Road	Chicken Springs Road	132	124	8	2, 2 & 1, 1	4,600	This 8-mile segment of US 93 transitions from a 4-lane divided highway to a two-lane road south of Chicken Springs Road, and transitions back to a 4-lane roadway with center left-turn lane.
93-9	US 93	Chicken Springs Road	Blake Ranch Road	124	106	18	2, 2 & 1, 1	4,600	This 18-mile segment of US 93 is a four-lane roadway with center left-turn lane and transitions back and forth from a two-lane roadway with paved shoulders to a four-lane, divided roadway.
93-10	US 93	Blake Ranch Road	I-40	106	91	15	2, 2	4,600	This 15-mile segment of US 93 junctions with SR 141 and SR 193 (Blake Ranch Road) approximately 4.5 miles south of I-40 and is a four-lane, divided highway, with a transition at the north end to a two-lane roadway with paved shoulders.
93-11	US 93	I-40	SR 68	71	67	4	2, 2	31,500	This 4-mile segment of US 93 is a four-lane roadway that becomes a divided highway approximately 2.6 miles I-40. Golden Valley is a large rural subdivision about 10 miles west of SR 68.
93-12	US 93	SR 68	Chloride Road	67	53	14	2, 2	8,850	This 14-mile segment of US 93 is a four-lane divided highway. The highway runs through the alluvial fan of the Cerbat Mountains to the east.
93-13	US 93	Chloride Road	Pierce Ferry Road	53	42	11	2, 2	8,000	This 11-mile segment of US 93 is a four-lane divided highway, entering the upper reaches of the valley formed by Detrital Wash.
93-14	US 93	Pierce Ferry Road	White Hills Road	42	29	13	2, 2	8,900	This 13-mile segment of US 93 is a four-lane divided highway with little to no development.
93-15	US 93	White Hills Road	Lake Mead National Recreation Area Boundary	29	17	12	2, 2	8,900	This 12-mile segment of US 93 continues as a four-lane divided highway to the Lake Mead National Recreation Area Boundary.
93-16	US 93	Lake Mead National Recreation Area Boundary	Nevada State Line	17	0	17	2, 2	8,900	This 17-mile segment of US 93 is a four-lane divided highway, with 2.3 miles of the roadway constructed as a four-lane roadway. The road was recently realigned near the border and connects with the Mike O'Callaghan–Pat Tillman Memorial Bridge.

Figure 2: Segmentation Map



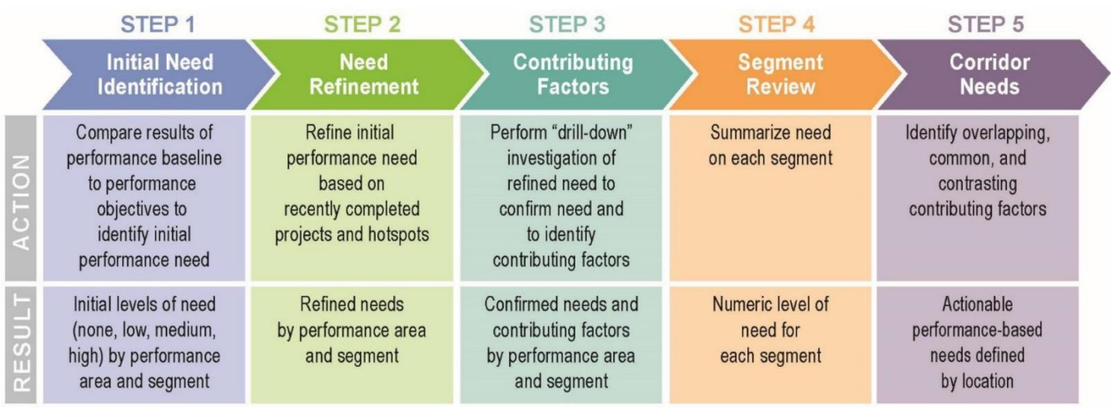
2.0 NEEDS ASSESSMENT PROCESS

A collaborative process involving ADOT Multimodal Planning Department (MPD) staff and the corridor profile study teams was used to develop a framework for the performance-based needs assessment process. The following guiding principles were developed as an initial step in process development:

- Corridor needs are defined as the difference between corridor performance and the performance objectives.
- The needs assessment process should be systematic, progressive, and repeatable, but also include engineering judgment.
- 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 milepost 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 3** and described in the following sections of this working paper.

Figure 3: Needs Assessment Process



2.1 Step 1: Initial Need Identification

The first step in the needs assessment process links baseline (existing) corridor performance documented in Working Paper 2 with performance objectives documented in Working Paper 3. In this step, the baseline corridor performance is compared to the performance objectives to provide a starting point for the identification of initial 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 for the pavement performance measure is shown in **Figure 4**.

Figure 4: Initial Need Ratings in Relation to Baseline Performance (Bridge Example)

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

Initial levels of needs for each performance measure are combined to produce a weighted initial 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. The secondary performance measure needs are added to the need from the Primary Index to create a cumulative measure of need. The resulting weighted initial level of need is assigned a level of None, Low, Medium, or High. With this approach, the resulting segment level of need is always equal to or higher than the Primary Index need.

2.2 Step 2: Need Refinement

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

- If an initial need is not identified, the existence of hot spots in the segment is justification for increasing the level of need from None to Low
- Recently completed projects or projects under construction may be justification for lowering or eliminating a need
- Programmed projects should not be used to lower the initial need because the project 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 need (potential increase, decrease, or no change from initial need) is carried forward for further evaluation in Step 3.

2.3 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 that are

used to develop the baseline performance serve as the principal sources for the more detailed analysis. The databases used for diagnostic analysis are listed below.

Pavement Performance Area

- Pavement Rating Database

Bridge Performance Area

- Bridge Information and Storage System

Mobility Performance Area

- Highway Performance Monitoring System (HPMS) Database
- Arizona Travel Demand Model (AZTDM)
- HERE Travel Time Database
- Highway Condition Reporting System (HCRS) Closure Database

Safety Performance Area

- Crash Database

Freight Performance Area

- HERE Database
- HCRS Database

In addition, other sources are considered to help identify the contributing factors, such as:

- Maintenance history (from ADOT PeCoS, Performance Controlled System for pavement), the level of past investments, or trends in historical data are 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 could be used to provide additional information regarding contributing factors to a need that has been identified

Step 3 results in the identification of contributing factors to needs by segment (and milepost locations, if appropriate) that can be addressed through investments in preservation, modernization, and expansion projects to improve corridor performance.

2.4 Step 4: Segment Review

In this step, the needs from Step 2 are quantified for each segment to numerically estimate the level of need for each segment. Values of 0, 1, 2, and 3 are assigned to the final need levels (from Step 2) of None, Low, Medium, and High, respectively. A weight factor of 1.5 is applied to the performance areas that are identified as Emphasis Areas in Working Paper 3 and a weighted average need is calculated for each segment. The resulting average need value can be used to compare needs across corridors and to determine the location of the highest needs.

2.5 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 solutions that address multiple performance areas and contributing factors. The intent of this process is to identify overlapping, common, and contrasting needs to help develop strategic solutions. This step results in the identification of corridor needs by specific location.

3.0 PAVEMENT PERFORMANCE AREA NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the US 93/US 60 corridor for the Pavement Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

3.1 Step 1: Initial Pavement Needs

Baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the US 93/US 60 corridor were used to determine the initial pavement needs, as described in Section 2.1. The pavement condition data used to calculate baseline performance was provided by ADOT for 2014 and 2015.

Step 1 uses the scores for the Pavement Index primary performance measure and two secondary performance measures to determine the initial need by segment for each performance measure individually as well as for all performance measures combined. The two secondary performance measures are Directional Present Serviceability Rating (PSR) and Percent Pavement Failure.

The performance scores, performance objectives, and initial levels of need for each pavement performance measure and for all pavement performance measures combined are shown in **Table 2**.

For the Pavement Index, no segments have a medium or high level of need. For the directional PSR, no segments have a medium or high level of need. For Percent Pavement Failure, three segments have a low level of need. There are three segments with an initial need for all pavement performance measures combined.

3.2 Step 2: Final Pavement Needs

Once the initial pavement needs by segment for the US 93/US 60 corridor were established, they were then refined in Step 2 (as described in Section 2.2) to more accurately reflect existing needs. An evaluation of pavement hot spots, as well as relevant recently completed and under-construction projects, was performed to determine if segment need levels required adjustment. The initial needs were then refined, based on this assessment, to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 3**.

Pavement Hot Spots

There are six segments containing pavement failure hot spots. The locations of pavement hot spots are listed in **Table 3**. Three hot spots are within segments already identified as having an initial need; so, no adjustments were made to the need level of any segments to account for hot spots.

Recently Completed and Under-Construction Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2015 that have the potential to mitigate a pavement need on a corridor segment.

Only one segment contains recently completed or under-construction projects, which would supersede the pavement condition data, as shown in **Table 3**. This information did not affect the Initial Need determined for the segment.

Planned or Programmed Projects

Information was noted in **Table 3** on pavement-related planned and programmed projects and other issues identified in previous reports cited in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

3.3 Step 3: Pavement Contributing Factors

The final needs for the US 93/US 60 corridor were further investigated, as described in Section 2.3. ADOT provided pavement rehabilitation project data for the last 20 years. These data were used to estimate the level of historical investment in each segment, which is summarized in **Figure 5**.

In addition, data available from ADOT project improvement bids and ADOT's Performance Controlled System (PeCoS) were collected for each segment to estimate the historical level of pavement maintenance activity. If the PeCOS data showed a high level of maintenance investment, the overall historical investment was elevated by one need level (e.g., "Medium" to "High"). Contributing Factors and Comments were recorded to identify specific locations of needs, the level of historical investment, and any additional supporting information available from the ADOT Districts. A summary of the results of the Step 3 process is shown in **Table 4**.

Table 4 shows there are eight segments with a high level of overall historical investment. Additional information regarding the determination of the level of historical investment is contained in **Appendix A**.

Table 2: Initial Pavement Needs (Step 1)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Facility Type	Pavement Index			Directional PSR					% Pavement Failure			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
							NB/WB	SB/EB		NB/WB	SB/EB				
60W-1	6	138-132	Highway	4.01	Fair or Better	None	3.97	3.83	Fair or Better	None	None	0.00%	Fair or Better	None	None
60W-2	12	132-120	Highway	3.98	Fair or Better	None	4.08	4.03	Fair or Better	None	None	0.00%	Fair or Better	None	None
60W-3	9	120-111	Highway	4.40	Fair or Better	None	4.21	4.21	Fair or Better	None	None	0.00%	Fair or Better	None	None
93-4	17	200-183	Highway	3.82	Fair or Better	None	3.63	3.68	Fair or Better	None	None	0.00%	Fair or Better	None	None
93-5	17	183-166	Highway	3.81	Fair or Better	None	3.63	3.81	Fair or Better	None	None	0.00%	Fair or Better	None	None
93-6	17	166-149	Highway	3.71	Fair or Better	None	3.58	3.84	Fair or Better	None	None	13.33%	Fair or Better	Low	Low
93-7	17	149-132	Highway	3.86	Fair or Better	None	3.81	3.79	Fair or Better	None	None	3.03%	Fair or Better	None	None
93-8	8	132-124	Highway	3.87	Fair or Better	None	4.10	3.56	Fair or Better	None	None	13.33%	Fair or Better	Low	Low
93-9	18	124-106	Highway	4.19	Fair or Better	None	4.06	3.99	Fair or Better	None	None	0.00%	Fair or Better	None	None
93-10	15	106-91	Highway	4.19	Fair or Better	None	4.03	3.95	Fair or Better	None	None	0.00%	Fair or Better	None	None
93-11	4	71-67	Highway	4.20	Fair or Better	None	3.69	4.07	Fair or Better	None	None	12.50%	Fair or Better	Low	Low
93-12	14	67-53	Highway	4.12	Fair or Better	None	4.10	4.04	Fair or Better	None	None	3.57%	Fair or Better	None	None
93-13	11	53-42	Highway	3.88	Fair or Better	None	3.78	3.78	Fair or Better	None	None	0.00%	Fair or Better	None	None
93-14	13	42-29	Highway	3.43	Fair or Better	None	3.59	3.49	Fair or Better	None	None	7.69%	Fair or Better	None	None
93-15	12	29-17	Highway	3.80	Fair or Better	None	3.62	4.00	Fair or Better	None	None	0.00%	Fair or Better	None	None
93-16	17	17-0	Highway	4.53	Fair or Better	None	4.38	4.39	Fair or Better	None	None	0.00%	Fair or Better	None	None
Emphasis Area?	No	Weighted Average		3.98	Fair or Better	None									

PSR: Present Serviceability Rating.

Table 3: Final Pavement Needs (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)		
60W-1	6	138-132	None			None	
60W-2	12	132-120	None			None	
60W-3	9	120-111	None			None	
93-4	17	200-183	None		Pavement Preservation Project (H8583) completed in 2015	None	Pavement Preservation project (H8691) programmed in FY17.
93-5	17	183-166	None			None	
93-6	17	166-149	Low	NB MP 153-149		Low	
93-7	17	149-132	None	SB MP 133-132		Low	
93-8	8	132-124	Low	SB MP132-130		Low	
93-9	18	124-106	None			None	
93-10	15	106-91	None			None	
93-11	4	71-67	Low	NB MP 71-70		Low	
93-12	14	67-53	None	NB MP 61-60		Low	
93-13	11	53-42	None			None	
93-14	13	42-29	None	SB MP 35-34, SB MP33-32		Low	
93-15	12	29-17	None			None	
93-16	17	17-0	None			None	Pavement Preservation project (H8408) programmed in FY17.

Figure 5: Pavement History

Pavement Treatment Reference numbers are provided in the legend on the following page.

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

Figure 5: Pavement History (continued)

Pavement Treatment Reference Numbers		
1 **2011 (WB)** : 6- Aggregate Base, 8-AC, 0.50- ACFC With Asphaltic Rubber	38 **2003 (NB)** : 6- Aggregate Base, 5-AC, 0.50- ACFC With Asphaltic Rubber	75 **2006 (SB)** : 0.50-Remove Existing Material, 2- AC with Asphaltic Rubber, 0.50- ACFC With Asphaltic Rubber
2 **2003 (EB)** : 6- Aggregate Base, 8-AC, 0.50- ACFC With Asphaltic Rubber	39 **2000 (NB)** : 6- Aggregate Base, 5-AC, 0.50- ACFC Asphaltic Concrete Friction Course	76 **1996 (NB/SB)** : 1.50- AC with Asphaltic Rubber, 0.50- ACFC With Asphaltic Rubber
3 **2011 (WB)** : 2- Remove Existing Material, 2- AC with Asphaltic Rubber, 0.50- ACFC With Asphaltic Rubber	40 **2008 (SB)** : 7.5- Aggregate Base, 6-AC, 0.50- ACFC With Asphaltic Rubber	77 **1998 (NB)** : 8-Aggregate Base, 4-Asphaltic Concrete, 0.50-ACFC With Asphaltic Rubber
4 **2003 (WB/EB)** : 1- Remove Existing Material, 4- AC, 0.50- ACFC With Asphaltic Rubber	41 **2003 (SB)** : 6- Aggregate Base, 5-AC, 0.50- ACFC With Asphaltic Rubber	78 **1998 (SB)** : 8-Aggregate Base, 4-Asphaltic Concrete, 0.50-ACFC With Asphaltic Rubber
5 **2003 (EB)** : 6- Aggregate Base, 8-AC, 0.50- ACFC With Asphaltic Rubber	42 **2003 (SB)** : 2- Removal of Existing Material, 5-AC, 0.50- ACFC With Asphaltic Rubber	79 **1996 (NB/SB)** : 1.50- AC with Asphaltic Rubber, 0.50- ACFC With Asphaltic Rubber
6 **1998 (WB/SB)** : 0.30- Seal Coat - Cover Material With Emulsified Asphalt, 0- Flush Coat Or Fog Seal Or Fog Coat	43 **2000 (SB)** : 6- Aggregate Base, 5-AC, 0.50- ACFC Asphaltic Concrete Friction Course	80 **2012 (NB)** : 0.50- Remove Existing Material, 0.50- ACFC With Asphaltic Rubber
7 **2011 (WB/EB)** : 0.75- Remove Existing Material, 0.50-ACFC With Asphaltic Rubber	44 **2003 (SB)** : 4- Aggregate Base, 7-AC, 0.50- ACFC With Asphaltic Rubber	81 **2010 (SB)** : 8-Aggregate Base, 6-Asphaltic Concrete, 0.50-ACFC With Asphaltic Rubber
8 **2011 (WB/EB)** : 4- Remove Existing Material, 3.5- AC, 0.50- ACFC With Asphaltic Rubber	45 **2003 (NB)** : 4- Aggregate Base, 7-AC, 0.50- ACFC With Asphaltic Rubber	82 **2007 (NB)** : 3.50- Removal of Existing Material, 3-AC, 0.50-ACFC with Asphaltic Rubber
9 **2003 (WB)** : 1- Remove Existing Material, 4-AC, 0.50-ACFC With Asphaltic Rubber	46 **2003 (NB)** : 2- AC, 0.50- ACFC With Asphaltic Rubber	83 **2008 (SB)** : 9-Aggregate Base, 6-Asphaltic Concrete, 0.50-ACFC With Asphaltic Rubber
10 **2003 (EB)** : 10- Aggregate Base, 8-AC, 0.50- ACFC With Asphaltic Rubber	47 **2004 (NB/SB)** : 6- Aggregate Base, 5-AC, 0.50- ACFC Asphaltic Concrete Friction Course	84 **2007 (SB)** : 6- Aggregate Base, 6-AC, 0.50-ACFC with Asphaltic Rubber
11 **1998 (WB/EB)** : 2- AC, 0.30- Seal Coat - Cover Material With Emulsified Asphalt	48 **2003 (SB)** : 6- Aggregate Base, 5-AC, 0.50- ACFC With Asphaltic Rubber	85 **2007 (NB/SB)** : 3.50- Removalof Existing Material, 3-AC, 0.50-ACFC Asphaltic Concrete Friction Course
12 **1998 (EB)** : 2.5- Remove Existing Material, 2.5- AC, 0.30- Seal Coat - Cover Material With Emulsified Asphalt	49 **1999 (SB)** : 8- Aggregate Base, 5-AC, 0.50- ACFC Asphaltic Concrete Friction Course	86 **1996 (NB/SB)** : 0-Geogrid Base Reinforcement, 1.50- AC with Asphaltic Rubber, 0.50- ACFC With Asphaltic Rubber
13 **1999 (WB)** : 4- Remove Existing Material, 4- AC, 0.30- Seal Coat - Cover Material With Emulsified Asphalt	50 **2006 (NB)** : 6.5- Aggregate Base, 6-AC, 0.50- ACFC With Asphaltic Rubber	87 **2012 (NB/SB)** : 3.5- Removal of Existing Material, 3- AC, 0.50- ACFC With Asphaltic Rubber
14 **1997 (WB/EB)** : 4- Remove Existing Material, 4- AC, 0.50- ACFC With Asphaltic Rubber	51 **1999 (NB)** : 8- Aggregate Base, 5-AC, 0.50- ACFC Asphaltic Concrete Friction Course	88 **2012 (NB/SB)** : 4.5- Removal of Existing Material, 4- AC, 0.50- ACFC With Asphaltic Rubber
15 **2011 (WB/EB)** : 3- Remove Existing Material, 2.5- AC, 0.50- ACFC Asphaltic Concrete Friction Course	52 **2006 (SB)** : 6.5- Aggregate Base, 6-AC, 0.50- ACFC With Asphaltic Rubber	89 **1999 (SB)** : 7-Aggregate Base, 5.5-Asphaltic Concrete, 0.50-ACFC Asphaltic Concrete Friction Course
16 **2010 (WB/EB)** : 3- Remove Existing Material, 3- AC, 0.50- ACFC With Asphaltic Rubber	53 **1995 (SB)** : 4- Aggregate Base, 5.5-AC, 0.50- ACFC Asphaltic Concrete Friction Course	90 **1999 (NB)** : 7-Aggregate Base, 5.5-Asphaltic Concrete, 0.50-ACFC Asphaltic Concrete Friction Course
17 **2010 (NB/SB)** : 8- Aggregate Base, 7-AC, 0.50- ACFC With Asphaltic Rubber	54 **1995 (NB)** : 4- Aggregate Base, 5.5-AC, 0.50- ACFC Asphaltic Concrete Friction Course	91 **1998 (NB/SB)** : 6.89- Aggregate Base, 5.5- AC, 0.60- ACFC Asphaltic Concrete Friction Course
18 **2009 (NB/SB)** : 3- Removal of Existing Material, 3- AC, 0.50- ACFC With Asphaltic Rubber	55 **1995 (NB)** : 10- Aggregate Base, 7-AC, 0.50- ACFC With Asphaltic Rubber	92 **1999 (NB/SB)** : 7- Aggregate Base, 5.5- AC, 0.50- ACFC Asphaltic Concrete Friction Course
19 **2014 (NB)** : 0.50- Removal of Existing Material, 0.50- ACFC With Asphaltic Rubber	56 **2004 (NB)** : 3.5- Removal of Existing Material, 3- AC, 0.50- ACFC With Asphaltic Rubber	93 **2006 (SB)** : 0.50- Removal of Existing Material, 0.50 ACFC With Asphaltic Rubber
20 **2004 (NB/SB)** : 0.50- Removal of Existing Material, 0.50- ACFC With Asphaltic Rubber	57 **2004 (NB)** : 6- Aggregate Base, 6-AC, 0.50- ACFC With Asphaltic Rubber	94 **2006 (SB)** : 3.50- Removal of Existing Material, 3- AC, 0.50 ACFC With Asphaltic Rubber
21 **2014 (SB)** : 11- Aggregate Base, 4-AC, 0.50- ACFC With Asphaltic Rubber	58 **2004 (SB)** : 6- Aggregate Base, 6-AC, 0.30- ACFC With Asphaltic Rubber	95 **2006 (SB)** : 3.50- Removal of Existing Material, 3- AC, 0.50 ACFC With Asphaltic Rubber
22 **2003 (NB/SB)** : 3.50- Removal of Existing Material, 5- AC, 0.50- ACFC With Asphaltic Rubber	59 **2004 (SB)** : 3.5- Removal of Material , 3-AC, 0.50- ACFC With Asphaltic Rubber	96 **2001 (NB/SB)** : 0.50- ACFC Asphaltic Concrete Friction Course
23 **2008 (NB)** : 0- Flush Coat Or Fog Seal Or Fog Coat	60 **1995 (NB/SB)** : 0.30- Seal Coat - Cover Material With Emulsified Asphalt	97 **1999 (SB)** : 2.5- AC, 0.50-ACFC With Asphaltic Rubber
24 **2000 (SB)** : 12- Aggregate Base, 3- AC, 0- Flush Coat Or Fog Seal Or Fog Coat	61 **2002 (NB)** : 2.5- AC, 0.50- ACFC With Asphaltic Rubber	98 **1999 (NB)** : 2- Removal of Existing Material, 4.50- AC, 0.50 ACFC With Asphaltic Rubber
25 **2000 (NB)** : 12- Aggregate Base, 3- AC, 0- Flush Coat Or Fog Seal Or Fog Coat	62 **2005 (NB/SB)** : 2.5- Removal of Existing Material, 2-AC, 0.50- ACFC With Asphaltic Rubber	99 **1999 (NB)** : 2- Removal of Existing Material, 4.50- AC, 0.50 ACFC With Asphaltic Rubber
26 **2000 (NB/SB)** : 0.5- Removal of Existing Material, 3.5- AC, 0.50- ACFC With Asphaltic Rubber	63 **2012 (NB/SB)** : 0.50-Remove Existing Material, 0.50- ACFC With Asphaltic Rubber	100 **1999 (SB)** : 36- Mix And Compacted Existing Materials, 5- AC, 0.50- ACFC With Asphaltic Rubber
27 **2003 (SB)** : 3.50- Removal of Existing Material, 5- AC, 0.50- ACFC With Asphaltic Rubber	64 **2012 (NB/SB)** : 8-Aggregate Base, 7-Asphaltic Concrete, 0.50-ACFC With Asphaltic Rubber	101 **1999 (SB)** : 2.50- Removal of Existing Material, 5- AC, 0.50 AC with Asphaltic Rubber
28 **1999 (NB/SB)** : 2- Removal of Material , 2-AC, 0.50- ACFC With Asphaltic Rubber	65 **2012 (NB/SB)** : 8-Aggregate Base, 6-Asphaltic Concrete, 0.50-ACFC With Asphaltic Rubber	102 **2000 (NB)** : 0.50 Removal of Existing Material, 0.50 ACFC With Asphaltic Rubber
29 **2003 (NB)** : 2- AC, 0.50- ACFC With Asphaltic Rubber	66 **2005 (NB/SB)** : 10- Aggregate Base, 8-AC, 0.50- ACFC With Asphaltic Rubber	103 **2010 (NB)** : 1- Removal of Existing Material, 3-AC, 0.50-ACFC with Asphaltic Rubber
30 **2000 (NB/SB)** : 0.50- Removal of Existing Material, 3.5- AC, 0.50- ACFC With Asphaltic Rubber	67 **2012 (NB)** : 0.50-Remove Existing Material, 0.50- ACFC With Asphaltic Rubber	104 **2010 (SB)** : 1- Removal of Existing Material, 3-AC, 0.50-ACFC with Asphaltic Rubber
31 **1999 (SB)** : 2- Removal of Material , 2-AC, 0.50- ACFC With Asphaltic Rubber	68 **2012 (SB)** : 8-Aggregate Base, 7-Asphaltic Concrete, 0.50-ACFC With Asphaltic Rubber	105 **2010 (SB)** : 10 Aggregate Base, 5- AC, 0.50- ACFC With Asphaltic Rubber
32 **1999 (NB)** : 2- Removal of Material , 2-AC, 0.50- ACFC With Asphaltic Rubber	69 **2008 (NB/SB)** : 8-Aggregate Base, 6-Asphaltic Concrete, 0.50-ACFC With Asphaltic Rubber	106 **2010 (NB)** : 2.5- Removal of Existing Material, 3-AC, 0.50-ACFC with Asphaltic Rubber
33 **2000 (NB/SB)** : 3-AC, 0.50- ACFC With Asphaltic Rubber	70 **2006 (NB/SB)** : 1.50- AC with Asphaltic Rubber, 0.50- ACFC With Asphaltic Rubber	107 **2010 (SB)** : 2.5- Removal of Existing Material, 3-AC, 0.50-ACFC with Asphaltic Rubber
34 **1998 (NB/SB)** : 0.30- Seal Coat - Cover Material With Emulsified Asphalt	71 **2006 (NB/SB)** : 0.50-Remove Existing Material, 2- AC with Asphaltic Rubber, 0.50- ACFC With Asphaltic Rubber	108 **2010 (NB)** : 1- Removal of Existing Material, 3-AC, 0.50-ACFC with Asphaltic Rubber
35 **1998 (NB/SB)** : 6- Aggregate Base, 3-AC, 0.30- Seal Coat - Cover Material With Emulsified Asphalt	72 **2006 (NB/SB)** : 0.50- Remove Existing Material, 2- AC with Asphaltic Rubber, 0.50- ACFC With Asphaltic Rubber	109 **2010 (NB)** : 10 Aggregate Base, 5- AC, 0.5- ACFC with Asphaltic Rubber
36 **2011 (NB/SB)** : 0.50- Removal of Existing Material, 0.50- ACFC With Asphaltic Rubber	73 **2006 (NB)** : 0.50-Remove Existing Material, 2- AC with Asphaltic Rubber, 0.50- ACFC With Asphaltic Rubber	110 **2010 (NB)** : 2.50- Removal of Existing Material, 3-AC, 0.50-ACFC with Asphaltic Rubber
37 **2008 (NB)** : 7.5- Aggregate Base, 6-AC, 0.50- ACFC With Asphaltic Rubber	74 **1999 (SB)** : 8- Aggregate Base, 4- AC, 0.50 - ASFC Asphaltic Concrete Friction Course	

Table 4: Pavement Needs Contributing Factors (Step 3)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Final Need	Bid History Investment	PeCoS* History Investment	Resulting Historical Investment	Contributing Factors and Comments
60W-1	6	138-132	None	High	Medium	High	
60W-2	12	132-120	None	High	Medium	High	
60W-3	9	120-111	None	Low	Low	Low	
93-4	17	200-183	None	Low	Low	Low	
93-5	17	183-166	None	Medium	Medium	Medium	
93-6	17	166-149	Low	Low	Low	Low	Failure hotspot NB MP 153-149
93-7	17	149-132	Low	Low	Medium	Low	Failure hotspot SB MP 133-132
93-8	8	132-124	Low	Medium	Low	Medium	Failure hotspot SB MP 132-130
93-9	18	124-106	None	High	Medium	High	
93-10	15	106-91	None	Medium	High	High	
93-11	4	71-67	Low	High	Low	High	Failure hotspot NB MP 71-70
93-12	14	67-53	Low	High	Low	High	Failure hotspot SB MP 61-60
93-13	11	53-42	None	Medium	Medium	Medium	
93-14	13	42-29	Low	Medium	Low	Medium	Failure hotspots SB MP 35-34, and SB MP 33-32
93-15	12	29-17	None	High	Low	High	
93-16	17	17-0	None	High	Low	High	

PeCoS: **Pe**rformance **Co**ntrolled **S**ystem is a PC-based highway maintenance management system adopted by ADOT to model the costs associated with the State's highway network.

4.0 BRIDGE PERFORMANCE AREA NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the US 93/US 60 corridor for the Bridge Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

4.1 Step 1: Initial Bridge Needs

Baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the US 93/US 60 corridor were used to determine the initial bridge needs, as described in Section 2.1. The bridge condition data used to calculate baseline performance were provided by ADOT for the timeframe from 2011 to 2014.

Step 1 uses scores for the Bridge Index primary performance measure and three secondary performance measures to determine the initial level of need by segment for each performance measure individually as well as for all performance measures combined. The three secondary performance measures are Bridge Rating, Bridge Sufficiency, and Percent Functionally Obsolete Bridges.

The performance scores, performance objectives, and initial levels of need for each bridge performance measure and for all bridge performance measures combined are shown in **Table 5**.

For the Bridge Index, one segment has a low level of need, and one segment has a medium level of need. Nine segments have a low level of need with respect to Bridge Rating. Relative to Bridge Sufficiency and Percent Functionally Obsolete Bridges, no segments were determined to be in need. For all bridge performance measures combined, eight segments were determined to have a low level of initial need, and one segment was determined to have a medium level of initial need.

4.2 Step 2: Final Bridge Needs

Once the initial bridge needs by segment for the US 93/US 60 corridor were established, they were then refined in Step 2 (as described in Section 2.2) to more accurately reflect existing needs. An evaluation of bridge Hot Spots, as well as relevant recently completed and under-construction projects, was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 6**.

Bridge Hot Spots

Only one segment was determined to have a Hot Spot, which is a bridge with a single rating of 4 or less, or multiple ratings of 5 between the deck, superstructure, and substructure. The location of the bridge Hot Spot is identified in **Table 6**. The single Hot Spot identified already is within a segment determined to have a low level of need. Therefore, no adjustments were made to the need level of this segment.

Recently Completed and Under-Construction Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2014 that have the potential to mitigate a bridge need on a corridor segment.

One segment was determined to contain recently completed or under-construction projects, which would supersede bridge condition data, as shown in **Table 6**. The single project identified already is within a segment determined to have a low level of need. Therefore, no adjustments were made to the need level of this segment. The resulting final need is consistent with findings reported in **Table 5**: eight segments have a low level of need, and one segment has a medium level of need. There are no functionally obsolete bridges in the US 93/US 60 corridor.

Planned or Programmed Projects

Information is presented in **Table 6** regarding bridge-related planned and programmed projects and other issues identified in previous reports cited in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

4.3 Step 3: Bridge Contributing Factors

The final needs for the US 93/US 60 corridor were further investigated, as described in Section 2.3. ADOT provided historical bridge rating data for the last 17 years, which was used to investigate historical trends for each bridge. This information is summarized in **Figure 6** for the US 60 segments and US 93 segments.

There are three segments containing bridges identified as having potential historical concerns. The locations of bridges with possible historical concerns are listed in **Table 6**. There are no bridges identified as being functionally obsolete. While historical concerns and functional obsolescence were not used to adjust the level of need, information relating to these two matters are listed in **Table 7** as input to the identification of contributing factors.

The current bridge ratings were reviewed to determine which rating (or ratings) were less than 6 (deck, superstructure, substructure, or structural evaluation rating). **Table 7** provides a summary of this information, identifies the bridges with potential historical concerns, and provides any additional information related to the contributing factors. Overall, there are seven segments with low final need, and one with medium final need. The bridges in these segments have been identified in **Table 7** along with the current rating.

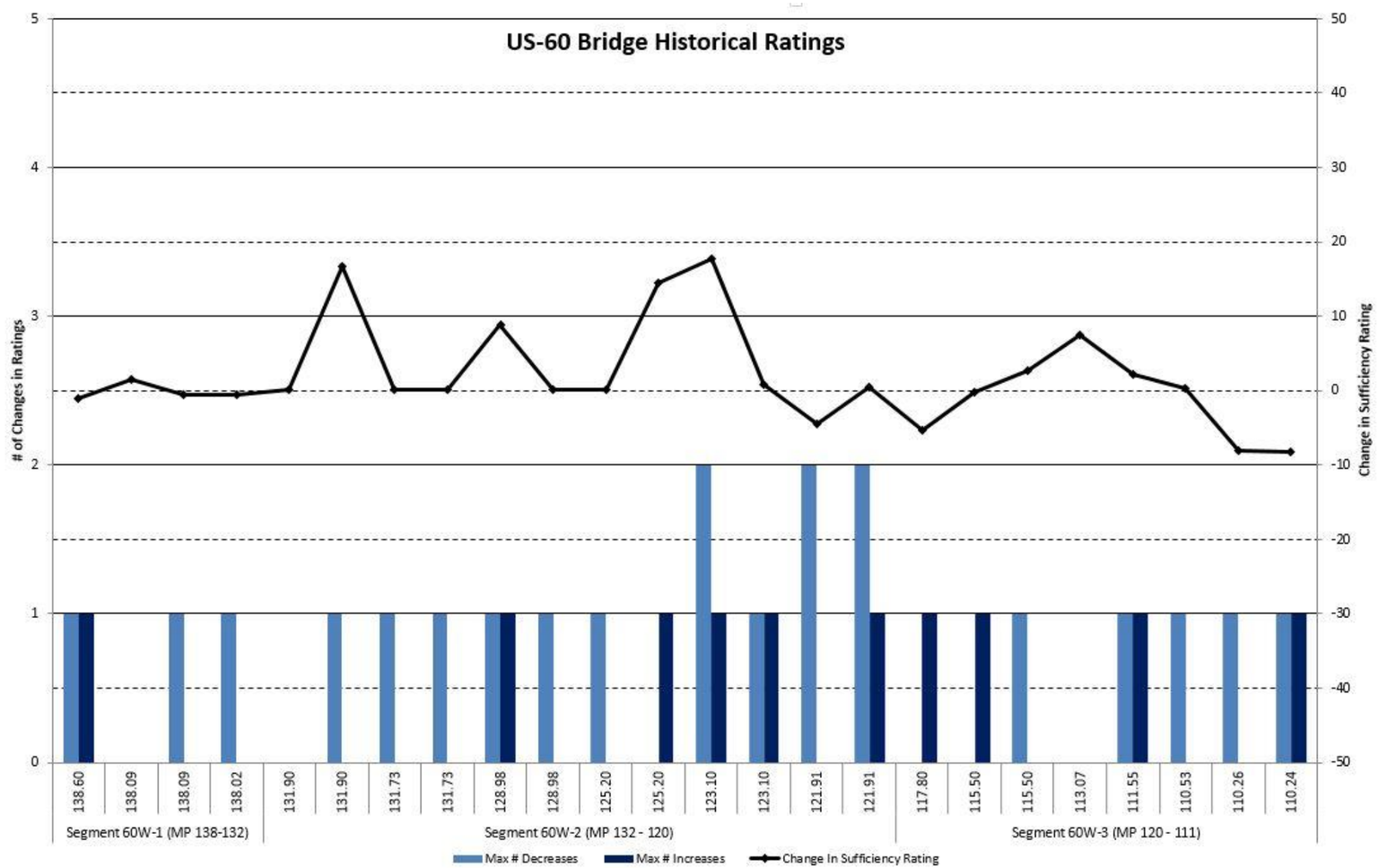
Table 5: Initial Bridge Needs (Step 1)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Bridge Index			Bridge Rating			Bridge Sufficiency			% Functionally Obsolete Bridges			Initial Need
				Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	
60W-1	6	138-132	4	6.81	Fair or Better	None	5	Fair or Better	Low	97.17	Fair or Better	None	0.0%	Fair or Better	None	Low
60W-2	12	132-120	12	6.26	Fair or Better	None	5	Fair or Better	Low	93.9	Fair or Better	None	0.0%	Fair or Better	None	Low
60W-3	9	120-111	6	6.67	Fair or Better	None	6	Fair or Better	None	91.6	Fair or Better	None	0.0%	Fair or Better	None	None
93-4	17	200-183	2	6.76	Fair or Better	None	6	Fair or Better	None	83.1	Fair or Better	None	0.0%	Fair or Better	None	None
93-5	17	183-166	2	5.39	Fair or Better	Medium	5	Fair or Better	Low	86.2	Fair or Better	None	0.0%	Fair or Better	None	Medium
93-6	17	166-149	7	6.37	Fair or Better	None	5	Fair or Better	Low	96.3	Fair or Better	None	0.0%	Fair or Better	None	Low
93-7	17	149-132	4	6.05	Fair or Better	None	5	Fair or Better	Low	94.5	Fair or Better	None	0.0%	Fair or Better	None	Low
93-8	8	132-124	11	6.32	Fair or Better	None	5	Fair or Better	Low	96.7	Fair or Better	None	0.0%	Fair or Better	None	Low
93-9	18	124-106	8	6.48	Fair or Better	None	5	Fair or Better	Low	87.5	Fair or Better	None	0.0%	Fair or Better	None	Low
93-10	15	106-91	3	6.29	Fair or Better	None	5	Fair or Better	Low	93.4	Fair or Better	None	0.0%	Fair or Better	None	Low
93-11	4	71-67	3	6.36	Fair or Better	None	6	Fair or Better	None	94.9	Fair or Better	None	0.0%	Fair or Better	None	None
93-12	14	67-53	6	5.90	Fair or Better	Low	5	Fair or Better	Low	96.1	Fair or Better	None	0.0%	Fair or Better	None	Low
93-13	11	53-42	2	6.00	Fair or Better	None	6	Fair or Better	None	97.2	Fair or Better	None	0.0%	Fair or Better	None	None
93-14	13	42-29	2	6.00	Fair or Better	None	6	Fair or Better	None	97.7	Fair or Better	None	0.0%	Fair or Better	None	None
93-15	12	29-17	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	None	N/A
93-16	17	17-0	10	7.31	Fair or Better	None	6	Fair or Better	None	91.0	Fair or Better	None	0.0%	Fair or Better	None	None
Emphasis Area?	No	Weighted Average		6.32	Fair or Better	None										

Table 6: Final Bridge Needs (Step 2)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Number of Bridges in Segment	Initial Need	Need Adjustments		Final Need	Historical Review	# Functionally Obsolete Bridges	Comments
					Hot Spots (Rating of 4 or multiple 5's)	Previous Projects (which supersede condition data)				
60W-1	6	138-132	4	Low	None	None	Low		0	
60W-2	12	132-120	12	Low	None	None	Low		0	
60W-3	9	120-111	6	None	None	Scour retrofit project Monarch Wash Bridge Str #204 & #759 (H8418) completed in 3/2015	None		0	
93-4	17	200-183	2	None	None	None	None		0	
93-5	17	183-166	2	Medium	None	None	Medium		0	
93-6	17	166-149	7	Low	None	None	Low		0	Big Jim Wash Bridge, Str #548 scour retrofit project programmed in FY18.
93-7	17	149-132	4	Low	None	None	Low		0	Burro Creek SB, Str 846 bridge rehabilitation programmed in FY17.
93-8	8	132-124	11	Low	None	None	Low		0	
93-9	18	124-106	8	Low	None	None	Low		0	
93-10	15	106-91	3	Low	Kabba Wash Br NB (MP97.5)	None	Low		0	
93-11	4	71-67	3	None	None	None	None		0	
93-12	14	67-53	6	Low	None	None	Low		0	
93-13	11	53-42	2	None	None	None	None		0	
93-14	13	42-29	2	None	None	None	None		0	
93-15	12	29-17	0	N/A	None	None	N/A		0	
93-16	17	17-0	10	None	None	None	None		0	

Figure 6: Bridge History



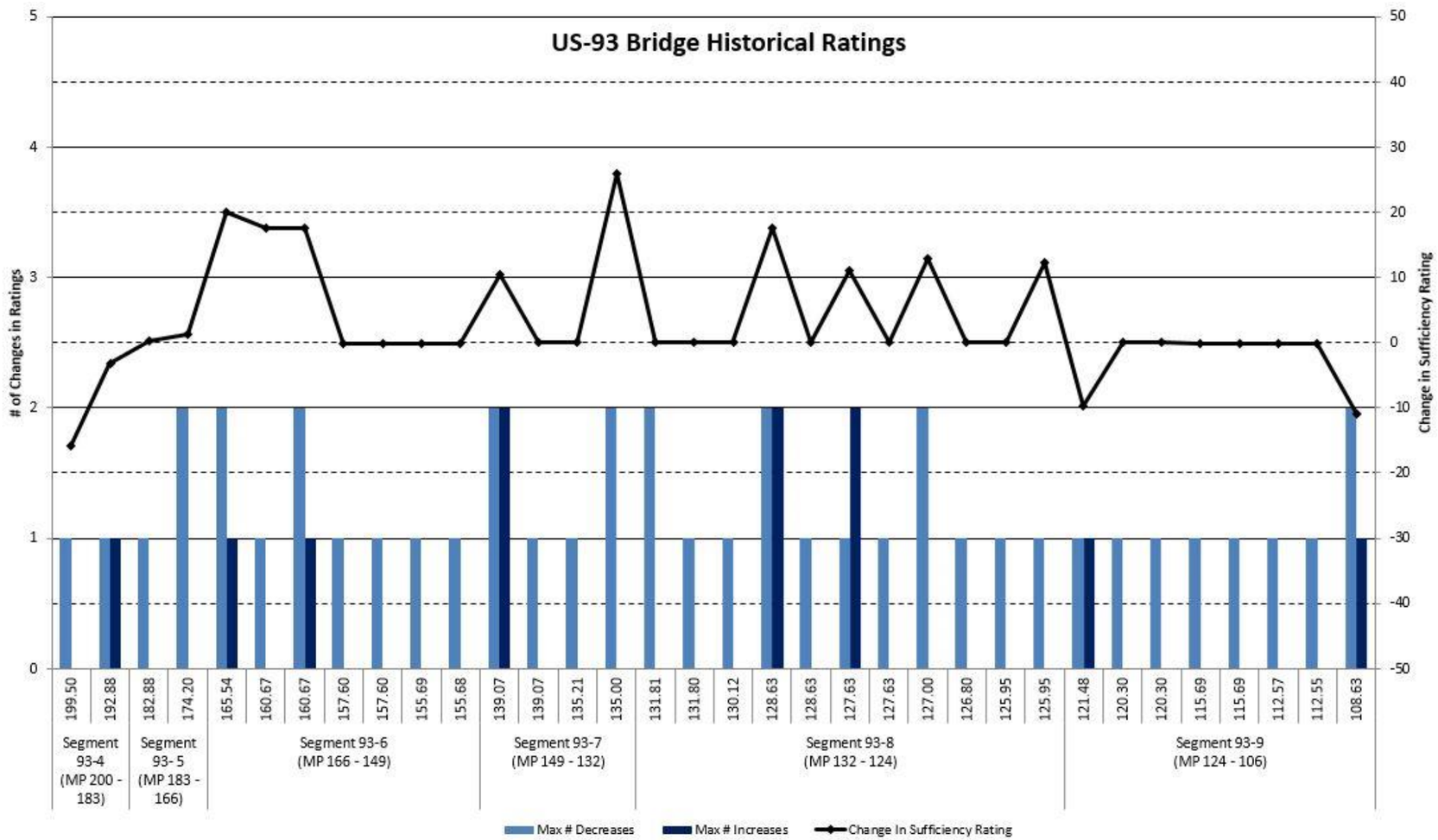
O identifies the bridge indicated is of concern from a historical ratings perspective

Max # 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)

Max # 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)

Figure 6: Bridge History (continued)



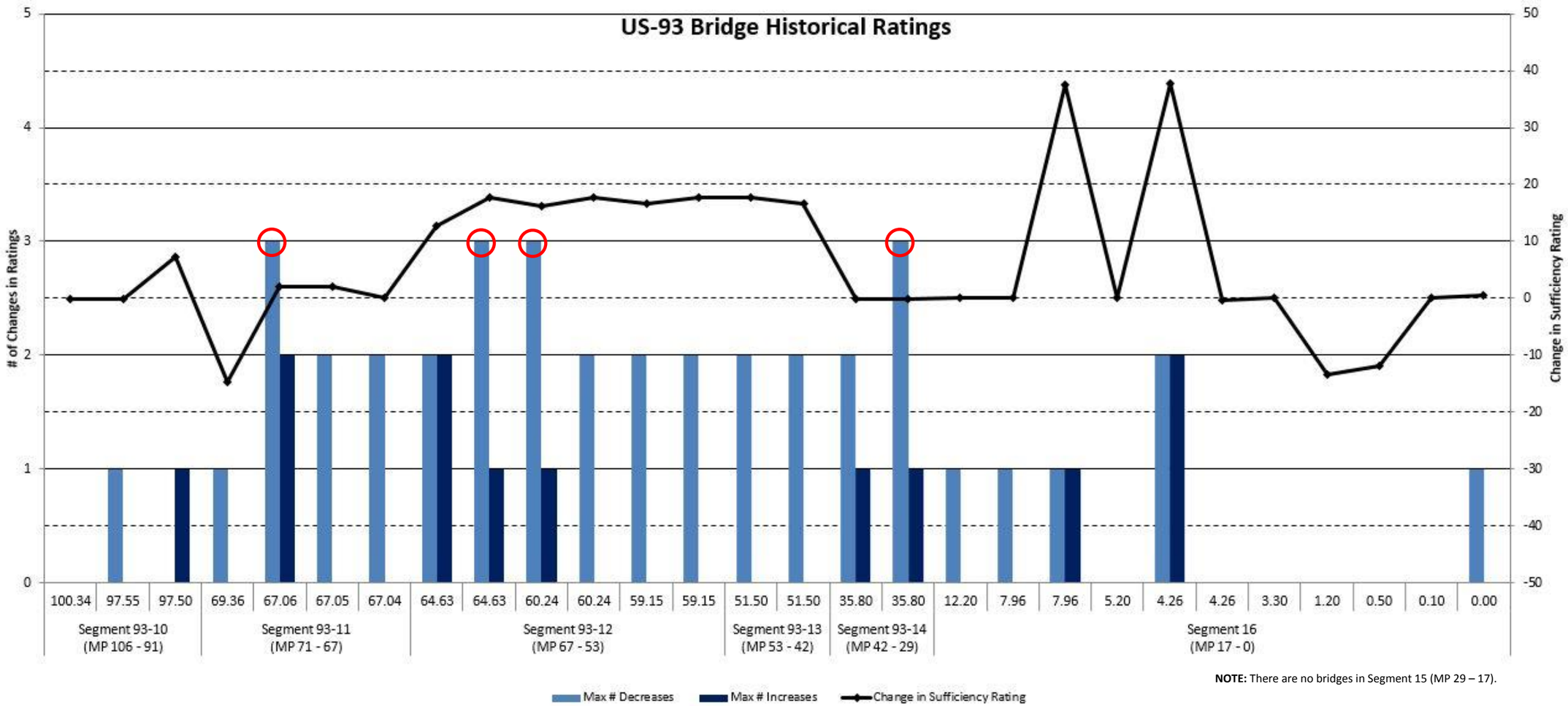
O identifies the bridge indicated is of concern from a historical ratings perspective

Max # 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)

Max # 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)

Figure 6: Bridge History (continued)



NOTE: There are no bridges in Segment 15 (MP 29 – 17).

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

Max # 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)

Max # 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)

Table 7: Bridge Needs Contributing Factors (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	
60W-1	6	138-132	4	0	Low	McMicken Dam Fldwy Bridge WB (#472) (MP138.09)	Current Structural Evaluation Rating of 5	Not identified in historical review	
60W-2	12	132-120	12	0	Low	Morristown RR OP WB (#894) (MP 121.91)	Current Deck Rating of 5	Not identified in historical review	
60W-3	9	120-111	6	0	None	No bridges with current ratings less than 6.			
93-4	17	200-183	2	0	None	No bridges with current ratings less than 6.			
93-5	17	183-166	2	0	Medium	Date Creek Bridge (#2366) (MP 174.2)	Current Deck Rating of 5	Not identified in historical review	
93-6	17	166-149	7	0	Low	Big Jim Wash Bridge (#548) (MP 165.54)	Current Deck & Structural Evaluation Rating of 5	Not identified in historical review	
93-7	17	149-132	4	0	Low	Burro Creek Bridge SB (#846) (MP 139.07)	Current Deck Rating of 5	Not identified in historical review	
93-8	8	132-124	11	0	Low	Big Sandy River Bridge NB(#2355) (MP 127)	Current Deck Rating of 5	Not identified in historical review	
93-9	18	124-106	8	0	Low	Cane Springs Bridge (#637) (MP 108.63)	Current Superstructure and Structural Evaluation Rating of 5	Not identified in historical review	
						Natural Corral Bridge (#639) (MP 121.48)	Current Structural Evaluation Rating of 5	Not identified in historical review	
93-10	15	106-91	3	0	Low	Kabba Wash Bridge NB (#492) (MP 97.5)	2014 Deck, Superstructure and Structural Evaluation Ratings of 5	Not identified in historical review	
93-11	4	71-67	3	0	None	SR 68 TI Overpass NB (#2498) (MP 67.06)	No bridges with current ratings less than 6.	Identified in historical review	
93-12	14	67-53	6	0	Low	Wash Bridge NB (#2365) (MP 64.63)	Current Structural Evaluation Rating of 5	Identified in historical review	
						Cerbat Wash Bridge SB (#1576) (MP 60.24)	No bridges with current ratings less than 6.	Identified in historical review	
93-13	11	53-42	2	0	None	No bridges with current ratings less than 6.			
93-14	13	42-29	2	0	None	Detrital Wash Bridge NB (#1916) (MP 35.8)	No bridges with current ratings less than 6.	Identified in historical review	
93-15	0	29-17	0	0	N/A	No bridges within segment			
93-16	17	17-0	10	0	None	No bridges with current ratings less than 6.			

5.0 MOBILITY PERFORMANCE AREA NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the US 93/US 60 corridor for the Mobility Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

5.1 Step 1: Initial Mobility Needs

Baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the US 93/US 60 corridor were used to determine the initial mobility needs, as described in Section 2.1. Mobility condition data used to calculate baseline performance were provided by ADOT: existing traffic volumes – 2013, travel time data – 2014, bicycle accommodation data – 2014, future traffic volumes – 2035, and closure data – 2010-2014.

Step 1 uses the scores for the Mobility Index primary performance measure and six secondary performance measures to determine the level of need for each performance measure by segment. The six secondary performance measures are: Future Daily Volume-to-Capacity (V/C), Directional Existing Peak Hour V/C, Directional Closure Extent, Directional Travel Time Index (TTI), Directional Planning Time Index (PTI), and Bicycle Accommodation. Then an Initial Need was determined for the corridor as a whole.

Performance scores, performance objectives, and initial levels of need for each mobility performance measure and for all mobility performance measures combined are shown in **Table 8**. Findings reported in **Table 8** are summarized below:

- Mobility Index – No segments were determined to have a need.
- Future Daily V/C – One segment has a low level of need; one segment has a medium level of need; and two segments have a high level of need.
- Directional Existing Peak Hour V/C – No segments were determined to have a need.
- Directional Closure Extent – One segment has a low level of need in the eastbound/southbound (EB/SB) direction; one segment has a medium level of need, also in the EB/SB direction.
- Directional TTI – One segment has a medium level of need in the northbound/westbound (NB/WB) direction; one segment has a high level of need in the EB/SB direction.
- Directional PTI – In the NB/WB direction, one segment has a low level of need, two segments have a medium level of need, and four segments have a high level of need; in the EB/SB direction, one segment has a low level of need, one segment has a medium level of need, and two segments have a high level of need.
- Bicycle Accommodation – Two segments have a low level of need; five segments have a medium level of need; and four segments have a high level of need

5.2 Step 2: Final Mobility Needs

Once the initial mobility needs by segment for the US 93/US 60 corridor were established, they were then refined in Step 2 (as described in Section 2.2) to more accurately reflect existing needs. An evaluation of relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below and summarized in **Table 9**.

Recently Completed and Under-Construction Mobility Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2013 that have the potential to mitigate a mobility need within a corridor segment.

There is one segment containing a recently completed project which would supersede the initial need determined from mobility condition data, as shown in **Table 9**. This recently completed project addressed the identified mobility need for the segment. As such, the final need was adjusted to reflect no needs. No other adjustments to account for recently completed or under-construction projects were made to the initial need level of the remaining segments.

Planned or Programmed Projects

Information is presented in **Table 9** regarding mobility-related planned and programmed projects and other issues identified in previous reports cited in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

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Table 8: Initial Mobility Needs (Step 1)

Segment	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Mobility Index			Future Daily V/C*			Directional Existing Peak Hour V/C					Directional Closure Extent (occurrences/year/mile)				
					Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
											NB/WB	EB/SB		NB/WB	EB/SB	NB/WB	SB/EB		NB/WB	SB/EB
60W-1	138-132	6	Urban	Interrupted	0.77	Fair or Better	None	1.04	Fair or Better	High	0.44	0.42	Fair or Better	None	None	0.10	0.20	Fair or Better	None	None
60W-2	132-120	12	Urban	Interrupted	0.68	Fair or Better	None	1.01	Fair or Better	High	0.27	0.28	Fair or Better	None	None	0.00	0.10	Fair or Better	None	None
60W-3	120-111	9	Rural	Uninterrupted	0.48	Fair or Better	None	0.75	Fair or Better	Medium	0.20	0.20	Fair or Better	None	None	0.09	0.27	Fair or Better	None	None
93-4	200-183	17	Urban	Interrupted	0.61	Fair or Better	None	0.73	Fair or Better	None	0.39	0.38	Fair or Better	None	None	0.06	0.51	Fair or Better	None	Medium
93-5	183-166	17	Rural	Uninterrupted	0.30	Fair or Better	None	0.36	Fair or Better	None	0.17	0.17	Fair or Better	None	None	0.18	0.06	Fair or Better	None	None
93-6	166-149	17	Rural	Uninterrupted	0.28	Fair or Better	None	0.33	Fair or Better	None	0.19	0.19	Fair or Better	None	None	0.05	0.15	Fair or Better	None	None
93-7	149-132	17	Rural	Uninterrupted	0.13	Fair or Better	None	0.15	Fair or Better	None	0.10	0.10	Fair or Better	None	None	0.11	0.02	Fair or Better	None	None
93-8	132-124	8	Rural	Uninterrupted	0.13	Fair or Better	None	0.15	Fair or Better	None	0.10	0.10	Fair or Better	None	None	0.00	0.10	Fair or Better	None	None
93-9	124-106	18	Rural	Uninterrupted	0.26	Fair or Better	None	0.31	Fair or Better	None	0.25	0.25	Fair or Better	None	None	0.24	0.06	Fair or Better	None	None
93-10	106-91	15	Rural	Uninterrupted	0.16	Fair or Better	None	0.18	Fair or Better	None	0.17	0.17	Fair or Better	None	None	0.00	0.24	Fair or Better	None	None
93-11	71-67	4	Urban	Interrupted	0.66	Fair or Better	None	0.78	Fair or Better	Low	0.58	0.61	Fair or Better	None	None	0.15	0.46	Fair or Better	None	Low
93-12	67-53	14	Rural	Uninterrupted	0.22	Fair or Better	None	0.25	Fair or Better	None	0.26	0.26	Fair or Better	None	None	0.03	0.06	Fair or Better	None	None
93-13	53-42	11	Rural	Uninterrupted	0.21	Fair or Better	None	0.23	Fair or Better	None	0.26	0.26	Fair or Better	None	None	0.11	0.02	Fair or Better	None	None
93-14	42-29	13	Rural	Uninterrupted	0.23	Fair or Better	None	0.27	Fair or Better	None	0.24	0.24	Fair or Better	None	None	0.02	0.09	Fair or Better	None	None
93-15	29-17	12	Rural	Uninterrupted	0.23	Fair or Better	None	0.27	Fair or Better	None	0.23	0.23	Fair or Better	None	None	0.00	0.12	Fair or Better	None	None
93-16	17-0	17	Rural	Uninterrupted	0.23	Fair or Better	None	0.27	Fair or Better	None	0.24	0.23	Fair or Better	None	None	0.06	0.12	Fair or Better	None	None
Emphasis Area?		Yes	Weighted Average		0.32	Good	None													

* V/C: Volume-to-Capacity Ratio.

Table 8: Initial Mobility Needs (Step 1) (continued)

Segment	Segment Mileposts	Segment Length (miles)	Environment Type	Facility Operation	Directional Travel Time Index - TTI (all vehicles)					Directional Planning Time Index - PTI (all vehicles)					Bicycle Accommodation			Initial Need
					Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
					NB/WB	SB/EB		NB/WB	SB/EB	NB/WB	SB/EB		NB/WB	SB/EB				
60W-1	138-132	6	Urban	Interrupted	1.10	1.02	Fair or Better	None	None	1.50	1.36	Fair or Better	None	None	0%	Fair or Better		Low
60W-2	132-120	12	Urban	Interrupted	1.04	1.12	Fair or Better	None	None	1.32	1.73	Fair or Better	None	None	16%	Fair or Better	High	Low
60W-3	120-111	9	Rural	Uninterrupted	1.00	2.38	Fair or Better	None	High	2.43	9.65	Fair or Better	High	High	72%	Fair or Better	Low	Medium
93-4	200-183	17	Urban	Interrupted	1.35	1.25	Fair or Better	None	None	5.93	2.13	Fair or Better	Medium	None	51%	Fair or Better	Medium	Low
93-5	183-166	17	Rural	Uninterrupted	*No Data*	*No Data*	Fair or Better	N/A	N/A	*No Data*	*No Data*	Fair or Better	N/A	N/A	15%	Fair or Better	High	Low
93-6	166-149	17	Rural	Uninterrupted	1.03	1.04	Fair or Better	None	None	1.41	1.42	Fair or Better	Low	Low	80%	Fair or Better	None	Low
93-7	149-132	17	Rural	Uninterrupted	1.06	1.11	Fair or Better	None	None	1.61	1.63	Fair or Better	High	High	63%	Fair or Better	Medium	Low
93-8	132-124	8	Rural	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.84	1.15	Fair or Better	High	None	58%	Fair or Better	Medium	Low
93-9	124-106	18	Rural	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.00	1.03	Fair or Better	None	None	48%	Fair or Better	High	Low
93-10	106-91	15	Rural	Uninterrupted	1.03	1.00	Fair or Better	None	None	1.45	1.50	Fair or Better	Medium	Medium	47%	Fair or Better	High	Low
93-11	71-67	4	Urban	Interrupted	1.81	1.00	Fair or Better	Medium	None	11.65	2.85	Fair or Better	High	None	100%	Fair or Better	None	Low
93-12	67-53	14	Rural	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.10	1.16	Fair or Better	None	None	77%	Fair or Better	Low	Low
93-13	53-42	11	Rural	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.06	1.18	Fair or Better	None	None	87%	Fair or Better	None	None
93-14	42-29	13	Rural	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.06	1.18	Fair or Better	None	None	54%	Fair or Better	Medium	Low
93-15	29-17	12	Rural	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.06	1.18	Fair or Better	None	None	54%	Fair or Better	Medium	Low
93-16	17-0	17	Rural	Uninterrupted	1.00	1.00	Fair or Better	None	None	1.06	1.18	Fair or Better	None	None	84%	Fair or Better	None	None

Table 9: Final Mobility Needs (Step 2)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Initial Need	Need Adjustments Recent Projects Since 2013	Final Need	Planned and Programmed Future Projects
60W-1	138-132	6	Low	None	Low	Planned: -Proposed New System US 60 and SR 303L TI (MP 138) - BQAZ
60W-2	132-120	12	Low	None	Low	Planned: -Addition of WB DMS (MP 122) - AZ Statewide Dynamic Message Master Plan -US 60 and SR 74 TI Improvement (MP 120.80) - Hassayampa Framework Study for Wickenburg
60W-3	120-111	9	Medium	None	Medium	Planned: -Addition of EB DMS (MP 118) - AZ Statewide Dynamic Message Master Plan
93-4	200-183	17	Low	Wickenburg Ranch Roundabout (2015)	Low	Planned: -New Separate SB 2 Lane roadway (MP 197.90 to 193.10) - ADOT US 93: SR 89 to Wickenburg Interim Bypass Final Environmental Assessment -Construction of 4-lane divided highway (MP 193.50 to 181.30) - ADOT US 93 Projects -US 93 and SR 89 TI: Proposed Roundabout (MP196.10) - US 93: SR 89 to Wickenburg Interim Bypass Final EA, BQAZ -US 93 and Scenic Loop Rd TI Redesign (MP 194.90) - ADOT US 93: SR 89 to Wickenburg Interim Bypass Final Environmental Assessment -System Interchange at US 93 / I-11 (Planned) and SR 89 Intersection (MP 188) - Hassayampa Framework Study for Wickenburg -Service Interchange at proposed Twin Peaks Rd (MP 186) - Hassayampa Framework Study for Wickenburg -Parkway Interchange at proposed Black Mountain Pkwy (MP 184) - Hassayampa Framework Study for Wickenburg -Parkway Interchange at SR 71 Interchange (MP 183) - Hassayampa Framework Study for Wickenburg
93-5	183-166	17	Low	None	Low	Planned: -Construction of 4-lane divided highway (MP 181.30-173.50) - ADOT US 93 Projects -Addition of SB Passing Lane (MP 172-165 & MP 167-165) - ADOT Climbing and Passing lane Prioritization Study
93-6	166-149	17	Low	None	Low	Planned: -Construction of 4-lane divided highway (MP 166-161.70) - ADOT US 93 Projects -Addition of SB passing lane (MP 163-161) - ADOT Climbing and Passing lane Prioritization Study
93-7	149-132	17	Low	None	Low	None
93-8	132-124	8	Low	MP 124 Median Crossover, intersection improvements (2015)	Low	None
93-9	124-106	18	Low	None	Low	Programmed: -Construction of 4-lane divided highway, H859501C (MP 119.70-116.30) -ADOT 5 Year Program FY 2020 -Construction of 4-lane divided highway, D (MP 108.90-106) - ADOT 5 Year Program FY 2021 Planned: -Cyprus Bagdad Copper Rd proposed TI (MP118.60) - US 93, Right-of-Way and Access Control Addendum DCR -Diamond Jow Rd proposed TI (MP 116.60) - US 93, Right-of-Way and Access Control Addendum DCR -Hofriders Crossing proposed TI (MP113.60) - US 93, Right-of-Way and Access Control Addendum DCR -Proposed TI (MP 111.50) - US 93, Right-of-Way and Access Control Addendum DCR -Upper Trout Creek proposed TI (MP 107.40) - US 93, Right-of-Way and Access Control Addendum DCR

Segment	Segment Mileposts (MP)	Segment Length (miles)	Initial Need	Need Adjustments Recent Projects Since 2013	Final Need	Planned and Programmed Future Projects
93-10	106-91	15	Low	H7388 Antelope Wash construct 4-lane divided highway (2015)	None	Planned: -Proposed TI (MP 102.60) - US 93, Right-of-Way and Access Control Addendum DCR -Proposed TI (MP 99.10) - US 93, Right-of-Way and Access Control Addendum DCR -Old US 93 proposed TI (MP 95.60) - US 93, Right-of-Way and Access Control Addendum DCR -Addition of NB DMS (MP 95) - AZ Statewide Dynamic Message Master Plan -Proposed TI (MP 93.10) - US 93, Right-of-Way and Access Control Addendum DCR -US 93 and I-40 TI Improvement (MP 92.50) - ADOT US 93 Corridor Projects, AZ Key Commerce Corridors, BQAZ
93-11	71-67	4	Low	H8744 US 93 and I-40 Interim Interchange (2016)	Low	Planned: -US 93 and I-40 TI Improvement (MP 71) - AZ Key Commerce Corridors, I-40 / US 93 System Traffic Interchange DCR and EA, BQAZ
93-12	67-53	14	Low	None	Low	Programmed: -Shoulder widening, Mineral Park Rd to Windy Point Rd, H8659 (MP 58-48) - ADOT 5 Year Program FY 2018
93-13	53-42	11	None	None	None	Programmed: -Shoulder widening, Mineral Park Rd to Windy Point Rd, H8659 (MP 58-48) - ADOT 5 Year Program FY 2018 -Shoulder widening design, Windy Point Rd to 11th St, H8658 (MP 48-38) - ADOT 5 Year Program FY 2017
93-14	42-29	13	Low	None	Low	Programmed: -Shoulder widening design, Windy Point Rd to 11th St, H8658 (MP 48-38) - ADOT 5 Year Program FY 2017 -Shoulder widening 11th St to White Hills Rd, H8657 (MP 38-28) - ADOT 5 Year Program FY 2018
93-15	29-17	12	Low	None	Low	Programmed: -Shoulder widening 11th St to White Hills Rd, H8657 (MP 38-28) - ADOT 5 Year Program FY 2018 -Construct shoulder widening White Hills Rd to Willow Beach, H8408 (MP 28-17) - ADOT 5 Year Program FY 2017
93-16	17-0	17	None	H8500 Kingman Wash TI Cattle Guards 2015	None	

5.3 Step 3: Mobility Contributing Factors

As described in Section 2.3, Step 3 identifies potential contributing factors to the performance needs calculated in Step 2. These contributing factors provide information on what types of improvements may help improve performance. Contributing factors listed and reported in **Table 10** include:

- Roadway variables
- Traffic variables
- Relevant mobility-related existing infrastructure
- Closure Extent
- Non-actionable conditions.

Roadway Variables

Roadway variables include functional classification, environmental type (i.e., urban or rural), terrain, number of lanes by direction, speed limit, presence of auxiliary (or Aux) lanes, if a roadway is divided or non-divided, and the percentage of the segment controlled by No Passing zones. These variables are described in more detail below:

- Functional classification indicates if a roadway is an interstate, state highway, or arterial. Capacity equations and parameters differ depending on a roadway's functional classification. In the case of the US 93/US 60 corridor, the entire corridor is on the State Highway System (SHS); therefore, all segments are functionally classified as State Highway.
- Environmental type refers to how developed the land is adjacent to the roadway. Environmental types include: urban, fringe urban, and rural. Capacity thresholds differ for each environmental type, as higher congestion levels are more acceptable in urbanized areas than in rural areas.
- Terrain (described as level, rolling, or mountainous) indicates the general roadway grade, which influences how quickly vehicles can accelerate or decelerate or maintain a constant speed.
- Number of lanes in each direction indicates how many general purpose (GP) through lanes exist.
- Speed limit indicates the posted speed limit.
- Auxiliary (or AUX) lanes accounts for the presence of additional lanes (other than GP lanes) for turning, weaving, or passing that can improve mobility performance by maintaining more consistent speeds in GP lanes.
- Divided/non-divided recognizes roadway segments is considered divided, i.e., there is a raised or depressed median separating the directions of traffic flow that cannot easily be traversed. A roadway with a painted paved median is considered a non-divided roadway. Dividing a roadway generally increases the roadway capacity.
- Percent (%) no passing accounts for the presence of No Passing zones that are establish to control the movement of traffic around slower-moving vehicles.

Traffic Variables

Traffic variables include: existing and future (Year 2035) level of service (LOS), % trucks, and a buffer index (defined as the difference between PTI and TTI). These three variables can indicate how well a corridor is performing in terms of overall mobility and why certain segments of a corridor may be performing worse than others.

- Existing and Future LOS – These two variables provide a letter "grade" between "A" and "F" for mobility that generally is reflective of Existing and Future V/C calculations (refer to **Table 8**). LOS values of "A", "B", and "C" generally are considered highly acceptable. A LOS value of "D" generally is considered moderately acceptable. LOS values of "E" and "F" generally are considered unacceptable.
- Truck Traffic – The amount of truck traffic in a given segment of the corridor can be represented as a percentage of the overall total traffic volume for that specific segment. Truck volume in a corridor can impact overall mobility, based on truck travel speed, corridor grades, required inspection points, and number of lanes.
- Buffer Index – This index is calculated by subtracting the segment level TTI value (i.e., ratio of peak-hour speed to free-flow speed) from the segment level PTI value (i.e., 95th percentile speed). The TTI and PTI values are reported in Working Paper 2. The Buffer Index expresses the amount of extra time necessary to be on-time 95 percent of the time for any given trip. This calculation provides information on the reliability of travel in the corridor.

Mobility-Related Infrastructure

Mobility-related infrastructure refers to devices or features at specific locations that influence mobility performance. Examples include: dynamic message signs (DMS), passing lanes, climbing lanes, ports of entry (POE), rest areas, and parking areas.

Closure Type

The relative frequency of types of closures within each segment helps indicate potential causes of mobility-related needs. Closure types consist of closures due to an incident/crash, obstruction, or weather condition. The number of each type of closure and the corresponding percentage of all closures that are of each type are noted.

Non-Actionable Conditions

Non-actionable conditions are features or characteristics that result in poor mobility performance that cannot be addressed through an engineered solution. An example of this condition is the presence and operation of border patrol checkpoints that require all vehicles to slow down or stop for inspection.

Contributing Factors

Potential contributing factors to mobility needs identify other situations, conditions, and actions that may influence mobility in the US 93/US 60 corridor.

Table 10: Mobility Needs Contributing Factors (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	Auxiliary Lanes	Divided/ Non-Divided	% No Passing	Existing Level of Service (LOS)	Future 2035 LOS	% Trucks	NB Buffer Index (PTI-TTI)*	SB Buffer Index (PTI-TTI)	
60W-1	138-132	6	Low	State Highway	Urban	Level	2	63	No	Divided	0%	A-C	E/F	7.97	0.40	0.34	
60W-2	132-120	12	Low	State Highway	Fringe Urban	Level	2	63	No	Divided	0%	A-C	E/F	7.61	0.28	0.61	
60W-3	120-111	9	Medium	State Highway	Rural	Level	2	57	No	Divided	0%	A-C	C	6.91	1.43	7.27	DMS MP119 (EB) 113.5 (EB), Rest Area MP116 (EB)
93-4	200-183	17	Low	State Highway	Fringe Urban	Level	1	61	No	Non-Divided	65%	A-C	C	10.67	4.58	0.87	
93-5	183-166	17	Low	State Highway	Rural	Level	1	65	No	Non-Divided	56%	A-C	A/B	9.86	No Data	No Data	
93-6	166-149	17	Low	State Highway	Rural	Level	2	65	No	Divided	0%	A-C	A/B	8.64	0.37	0.39	Passing Lane MP176-175.5 (SB) MP173.5-172.5 (NB)
93-7	149-132	17	Low	State Highway	Rural	Level	2	65	No	Divided	0%	A-C	A/B	7.88	0.55	0.53	
93-8	132-124	8	Low	State Highway	Rural	Level	2	65	No	Both	0%	A-C	A/B	7.88	0.84	0.15	
93-9	124-106	18	Low	State Highway	Rural	Level	1	65	No	Both	14%	A-C	A/B	5.67	0.00	0.03	Rest Area MP122.5 (NB), Passing Lane MP117-116 (NB)
93-10	106-91	15	None	State Highway	Rural	Level	2	65	No	Both	0%	A-C	A/B	3.99	0.42	0.50	
93-11	71-67	4	Low	State Highway	Urban	Level	2	56	No	Divided	0%	A-C	D	9.27	9.84	1.85	DMS MP70 (NB)
93-12	67-53	14	Low	State Highway	Rural	Level	2	65	No	Divided	0%	A-C	A/B	8.71	0.10	0.16	DMS MP66 (SB)
93-13	53-42	11	None	State Highway	Rural	Level	2	65	No	Divided	0%	A-C	A/B	7.84	0.06	0.18	
93-14	42-29	13	Low	State Highway	Rural	Level	2	65	No	Divided	0%	A-C	A/B	7.61	0.06	0.18	
93-15	29-17	12	Low	State Highway	Rural	Level	2	65	No	Divided	0%	A-C	A/B	7.53	0.06	0.18	DMS MP27 (NB)
93-16	17-0	17	None	State Highway	Rural	Level	2	61	No	Divided	0%	A-C	A/B	7.53	0.06	0.18	

* PTI-TTI: Planning Time Index minus Travel Time Index.

Table 10: Mobility Needs Contributing Factors (Step 3) (continued)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Type							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			
60W-1	138-132	6	Low	9	9	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Anticipated future growth proximate to Phoenix urban area results in over capacity conditions. 4' shoulder widths minimize bicycle accommodation.
60W-2	132-120	12	Low	6	6	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Anticipated future growth proximate to Phoenix urban area results in over capacity conditions. 4' shoulder widths minimize bicycle accommodation.
60W-3	120-111	9	Medium	16	16	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Anticipated future growth in Wickenburg results in near capacity conditions. High SB TTI and NB/SB PTI, perhaps attributable to counter location within the roundabout and/or density of driveways just south of the roundabouts.
93-4	200-183	17	Low	15	15	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. SB closures dominate. Limited bicycle accommodation on shoulders. Shoulders range from 4-8 feet, except from MP 200-199 where there are no shoulders.
93-5	183-166	17	Low	20	20	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Limited bicycle accommodation on shoulders.
93-6	166-149	17	Low	15	15	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Need stems from Low level NB/SB direction PTI.
93-7	149-132	17	Low	11	11	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Need stems from High level NB/SB direction PTI. Limited bicycle accommodation on shoulders.
93-8	132-124	8	Low	4	4	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Need stems from High level NB direction PTI, potentially attributable to a NB pullout near Nothing , AZ. Limited bicycle accommodation on shoulders.

Table 10: Mobility Needs Contributing Factors (Step 3) (continued)

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			
93-9	124-106	18	Low	27	27	100%	0	0%	0	0%	None	Cane Springs Design (MP 109), construct 4-lane divided highway; programmed in FY 21 H8232 Carrow to Stephens (MP 116), construct 4-lane divided highway; programmed in FY 20	Percent of closures due to incidents/accidents above statewide average. Limited bicycle accommodation on shoulders.
93-10	106-91	15	None	16	15	94%	1	6%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Need stems from Medium level NB/SB direction PTI. Limited bicycle accommodation on shoulders.
93-11	71-67	4	Low	12	12	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Anticipated future growth in Kingman results in near capacity conditions. Low SB closure extent. NB PTI/TTI Medium/High.
93-12	67-53	14	Low	6	6	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Limited bicycle accommodation on shoulders.
93-13	53-42	11	None	7	7	100%	0	0%	0	0%	None	H8659 Windy Point Road - Mineral Park Road (MP 48), shoulder widening (HSIP); programmed in FY18	Percent of closures due to incidents/accidents above statewide average.
93-14	42-29	13	Low	7	7	100%	0	0%	0	0%	None	H8658 11th Street - Windy Point Road (MP 38), shoulder widening (HSIP); programmed in FY17	Percent of closures due to incidents/accidents above statewide average. Limited bicycle accommodation on shoulders.
93-15	29-17	12	Low	7	7	100%	0	0%	0	0%	None	H8657 White Hills Road - 11th Street (MP 28), shoulder widening; programmed in FY18	Percent of closures due to incidents/accidents above statewide average. Limited bicycle accommodation on shoulders.
93-16	17-0	17	None	16	16	100%	0	0%	0	0%	None	H8408 Willow Beach - White Road (MP 17), construct shoulder widening (HSIP); programmed in FY17	Percent of closures due to incidents/accidents above statewide average.
Statewide HCRS Database Closure Type Average %:						96%		2.8%		1.3%			

* Red text indicates segment % exceeds statewide average %.
HSIP: Highway Safety Improvement Program.

6.0 SAFETY PERFORMANCE NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the US 93/US 60 corridor for the Safety Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

6.1 Step 1: Initial Safety Needs

Baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the US 93/US 60 corridor were used to determine initial safety needs, as described in Section 2.1. The safety data used to calculate baseline performance were provided by ADOT for the timeframe from 2010 through 2014.

Step 1 uses the scores for the Safety Index primary performance measure and two of the five secondary safety performance measures to determine the initial level of need by segment for each performance measure individually as well as for all performance measures combined. The two secondary performance measures used are the Directional Safety Index and the Strategic Highway Safety Plan (SHSP) Top 5 Emphasis Area Behaviors. The three other secondary safety performance measures (Truck-Involved Crashes, Motorcycle-Involved Crashes, and Non-Motorized Crashes) exhibited small crash sample sizes in their entirety and were not considered in the Safety Performance Area needs assessment (refer to sample size criteria documented in Working Paper 2). Corridor segments that exhibited small crash sample sizes for the SHSP Top 5 Emphasis Area Behaviors were also excluded from the safety needs assessment.

Performance scores, performance objectives, and initial levels of need for each safety performance measure and for all safety performance measures combined are shown in **Table 11**. Findings reported in **Table 11** are summarized below:

- Safety Index – Two segments have a low level of need; one segment has a medium level of need, and seven segments have a high level of need.
- Directional Safety Index (Secondary Measure) – In the NB/EB direction, no segments have a low level of need; two segments have a medium level of need, six segments have a high level of need; in the SB/WB direction, no segments have a low level of need, four segments have a medium level of need, and five segments have a high level of need.
- SHSP Top 5 Emphasis Areas Behaviors – One segment has a low level of need; no segments have a medium level of need, and four segments have a high level of need.

For all safety performance measures combined, the initial need is summarized as: low for six segments; medium for one segment; and high for seven segments.

6.2 Step 2: Final Safety Needs

Once the initial safety needs by segment for the US 93/US 60 corridor were established, they were then refined in Step 2 (as described in Section 2.2) to more accurately reflect existing needs. An evaluation of crash Hot Spots, as well as relevant recently completed and under-construction projects, was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below. The results of the process are summarized in **Table 12**.

Safety Hot Spots

There are four segments containing a safety hot spot. The locations of safety hot spots are listed in **Table 12**. Only one safety hot spot is within a segment that has not already been identified as having an initial need. As there are no recently completed project or under-construction projects identified (see below) that would mitigate this safety hot spot, the final need for the segment is determined to be low.

Recently Completed and Under-Construction Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2014 that have the potential to mitigate a safety need in a corridor segment. There are three segments with a recently completed project that potentially would supersede the initial need determined from safety data shown in Table 11:

- One project of improvements (MP 124 Median Crossover) was not in a segment determined to have an initial need; therefore, this project has no effect on the rating, although it does improve safety.
- A second project (H7388 Antelope Wash) was determined to be a mitigating action for safety in the segment; therefore, this segment was upgraded from a low initial need to no need.
- A third project (H8500 Kingman Wash TI) was determined to not be a mitigating action relative to safety in the segment; therefore, the initial need rating of low for this segment remained unchanged.

The evaluation of final needs for the US 93/US60 corridor segments resulted in the following determinations: six segments have a low final need; one segment has a medium final need; and seven segments have a high final need. This result is similar to the initial need, as a result of one segment being upgraded from low need to no need, and one segment being downgraded from no need to low need.

Planned or Programmed Projects

Information is presented in **Table 12** regarding safety-related planned and programmed projects and other issues identified in previous reports cited in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

Table 11: Initial Safety Needs – Part 1 (Step 1)

Segment	Operating Environment	Offset	Segment Length (miles)	Segment Mileposts (MP)	Safety Index			Safety Index Scale			Directional Safety Index					% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors		
					Performance Score	Performance Objective	Level of Need	None <=	Low <=	High >=	NB/WB Performance Score	SB/EB Performance Score	Performance Objective	NB/WB Level of Need	SB/EB Level of Need	Performance Score	Performance Objective	Level of Need
60W-1	2 or 3 or 4 Lane Divided Highway	1	6	138-132	1.99	Average or Better	High	0.92	1.07	1.38	1.19	2.80	Average or Better	Medium	High	50%	Average or Better	Low
60W-2	2 or 3 or 4 Lane Divided Highway	1	12	132-120	0.74	Average or Better	None	0.92	1.07	1.38	0.80	0.68	Average or Better	None	None	69%	Average or Better	High
60W-3	2 or 3 or 4 Lane Divided Highway	1	9	120-111	1.44	Average or Better	High	0.92	1.07	1.38	1.52	1.35	Average or Better	High	Medium	57%	Average or Better	High
93-4	2 or 3 Lane Undivided Highway	0	17	200-183	2.58	Average or Better	High	0.98	1.02	1.1	2.51	2.66	Average or Better	High	High	50%	Average or Better	None
93-5	2 or 3 Lane Undivided Highway	0	17	183-166	1.73	Average or Better	High	0.98	1.02	1.1	0.82	2.64	Average or Better	None	High	43%	Average or Better	None
93-6	2 or 3 or 4 Lane Divided Highway	1	17	166-149	1.07	Average or Better	Low	0.92	1.07	1.38	0.61	1.53	Average or Better	None	High	29%	Average or Better	None
93-7	2 or 3 or 4 Lane Divided Highway	1	17	149-132	0.19	Average or Better	None	0.92	1.07	1.38	0.29	0.10	Average or Better	None	None	42%	Average or Better	None
93-8	2 or 3 or 4 Lane Divided Highway	1	8	132-124	0.03	Average or Better	None	0.92	1.07	1.38	0.00	0.07	Average or Better	None	None	*Insufficient Data*	Average or Better	N/A
93-9	2 or 3 Lane Undivided Highway	0	18	124-106	1.82	Average or Better	High	0.98	1.02	1.1	2.76	0.88	Average or Better	High	None	50%	Average or Better	None
93-10	2 or 3 or 4 Lane Divided Highway	1	15	106-91	0.63	Average or Better	None	0.92	1.07	1.38	0.00	1.26	Average or Better	None	Medium	*Insufficient Data*	Average or Better	N/A
93-11	2 or 3 or 4 Lane Divided Highway	1	4	71-67	2.55	Average or Better	High	0.92	1.07	1.38	1.30	3.80	Average or Better	Medium	High	17%	Average or Better	None
93-12	2 or 3 or 4 Lane Divided Highway	1	14	67-53	0.62	Average or Better	None	0.92	1.07	1.38	0.66	0.59	Average or Better	None	None	67%	Average or Better	High
93-13	2 or 3 or 4 Lane Divided Highway	1	11	53-42	1.71	Average or Better	High	0.92	1.07	1.38	1.34	2.09	Average or Better	Medium	High	59%	Average or Better	High
93-14	2 or 3 or 4 Lane Divided Highway	1	13	42-29	1.10	Average or Better	Medium	0.92	1.07	1.38	1.61	0.59	Average or Better	High	None	33%	Average or Better	None
93-15	2 or 3 or 4 Lane Divided Highway	1	12	29-17	1.02	Average or Better	Low	0.92	1.07	1.38	1.72	0.31	Average or Better	High	None	17%	Average or Better	None
93-16	2 or 3 or 4 Lane Divided Highway	1	17	17-0	0.64	Average or Better	None	0.92	1.07	1.38	1.29	0.00	Average or Better	Medium	None	*Insufficient Data*	Average or Better	N/A
Emphasis Area?			**Yes**	**Weighted Average**	1.19	Above Average	Medium											

Table 11: Initial Safety Needs (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 Trucks Scale			% 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	None <=	Low <=	High >=	Performance Score	Performance Objective	Level of Need	Performance Score	Performance Objective	Level of Need	
60W-1	2 or 3 or 4 Lane Divided Highway	6	138-132	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	High
60W-2	2 or 3 or 4 Lane Divided Highway	12	132-120	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	Low
60W-3	2 or 3 or 4 Lane Divided Highway	9	120-111	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	High
93-4	2 or 3 Lane Undivided Highway	17	200-183	*Insufficient Data*	Average or Better	N/A	6%	7%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	High
93-5	2 or 3 Lane Undivided Highway	17	183-166	*Insufficient Data*	Average or Better	N/A	6%	7%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	High
93-6	2 or 3 or 4 Lane Divided Highway	17	166-149	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	Low
93-7	2 or 3 or 4 Lane Divided Highway	17	149-132	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	None
93-8	2 or 3 or 4 Lane Divided Highway	8	132-124	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	None
93-9	2 or 3 Lane Undivided Highway	18	124-106	*Insufficient Data*	Average or Better	N/A	6%	7%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	High
93-10	2 or 3 or 4 Lane Divided Highway	15	106-91	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	Low
93-11	2 or 3 or 4 Lane Divided Highway	4	71-67	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	High
93-12	2 or 3 or 4 Lane Divided Highway	14	67-53	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	Low
93-13	2 or 3 or 4 Lane Divided Highway	11	53-42	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	High
93-14	2 or 3 or 4 Lane Divided Highway	13	42-29	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	Medium
93-15	2 or 3 or 4 Lane Divided Highway	12	29-17	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	Low
93-16	2 or 3 or 4 Lane Divided Highway	17	17-0	*Insufficient Data*	Average or Better	N/A	5%	6%	8%	*Insufficient Data*	Average or Better	N/A	*Insufficient Data*	Average or Better	N/A	Low

Table 12: Final Safety Needs (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)
60W-1	6	138-132	High	WB MP 138-137	None	High	
60W-2	12	132-120	Low	WB MP 129-128	None	Low	
60W-3	9	120-111	High	WB MP 115-114	None	High	
93-4	17	200-183	High	SB MP 195-193	None	High	
93-5	17	183-166	High	None	None	High	
93-6	17	166-149	Low	None	None	Low	
93-7	17	149-132	None	NB MP 147-146	None	Low	
93-8	8	132-124	None	None	MP 124 Median Crossover, intersection improvements (2015)	None	
93-9	18	124-106	High	None	None	High	Cane Springs Design (MP 109), construct 4-lane divided highway; programmed in FY 21 H8232 Carrow to Stephens (MP 116), construct 4-lane divided highway; programmed in FY 20
93-10	15	106-91	Low	None	H7388 Antelope Wash construct 4-lane divided highway (2015)	None	
93-11	4	71-67	High	None	None	High	
93-12	14	67-53	Low	None	None	Low	
93-13	11	53-42	High	None	None	High	H8659 Windy Point Road - Mineral Park Road (MP 48), shoulder widening (HSIP); programmed in FY18
93-14	13	42-29	Medium	None	None	Medium	H8658 11th Street - Windy Point Road (MP 38), shoulder widening (HSIP); programmed in FY17
93-15	12	29-17	Low	None	None	Low	H8657 White Hills Road - 11th Street (MP 28), shoulder widening; programmed in FY18
93-16	17	17-0	Low	None	H8500 Kingman Wash TI Cattle Guards 2015	Low	H8408 Willow Beach - White Road (MP 17), construct shoulder widening (HSIP); programmed in FY17

* Data on projects that have been constructed since 12/31/2014 supersedes condition data.
HSIP: Highway Safety Improvement Program.

6.3 Step 3: Safety Contributing Factors

As described in Section 2.3, Step 3 identifies potential contributing factors to the performance needs calculated in Step 2. These contributing factors provide information on what types of improvements may help improve performance. Contributing factors presented in **Table 13** were derived from:

- Hot spot crash summaries
- Previously completed safety-related projects
- District input on safety concerns
- Segment crash type summaries
- Section 6.2 of the 2010 Highway Safety Manual.

Hot Spot Crash Summaries

Crash summaries were developed for each identified crash hot spot to identify observable crash patterns. These crash summaries are based on crashes of all severity levels (not just fatal and incapacitating injury) to provide more information for use in identifying crash patterns.

Previously Completed Safety-Related Projects

Recently completed safety-related projects may provide insight into previously identified contributing factors along the corridor. Some recently completed safety-related projects may already address some of the crash patterns evident in the crash analysis. Other safety-related projects completed before the crash analysis time period (i.e., more than five years old) may have exceeded their respective design life and rehabilitation or replacement could increase their effectiveness. Examples include rumble strips that are worn down or retroreflective materials that have lost their retroreflectivity.

District Input on Safety Concerns

ADOT maintenance personnel provided information on locations where they had observed potential safety needs. Locations were defined by approximate milepost limits and assigned to the appropriate corridor segment. District safety concerns that corroborated the segment crash type summaries or crash hot spots summaries were noted.

Segment Crash Type Summaries

Crash frequencies for each possible crash type descriptor within each of the eight crash type summary categories were summarized for fatal and incapacitating injury crashes for each corridor segment that contained at least five crashes of that crash type descriptor (lower crash totals were not considered to have a sufficient sample size for analysis purposes). For an even more robust data set, crash types for crashes of all severity levels (not just fatal and incapacitating injury) can be reviewed to determine if crash patterns are readily identifiable. If this more detailed analysis is conducted, it is recommended that it only be conducted on segments with medium or high levels of need to minimize analysis effort.

The proportional occurrence of each possible crash type descriptor compared to the total number of fatal plus incapacitating injury crashes occurring in that respective segment was also calculated and expressed as a percentage. These segment-level crash type descriptor frequency percentages were then compared with the corresponding statewide crash type descriptor frequency percentages for all state highways with similar operating environments (as defined in the baseline corridor performance reported in Working Paper 2). Segment crash type descriptor frequency percentages that exceeded the corresponding statewide frequency percentage were identified as likely contributing factors to the level of need and illustrated with a red font. The crash type descriptors include the following components:

- First Harmful Event Type
  - Collision with Motor Vehicle
  - Overturning
  - Collision with Pedestrian
  - Collision with Pedalcyclist
  - Collision With Animal
  - Collision with Fixed Object
  - Collision with Non-Fixed Object
  - Vehicle Fire or Explosion
  - Other Non-Collision
  - Unknown
- Collision Type
  - Single Vehicle Collisions
  - Angle
  - Left Turn
  - Rear End
  - Head On
  - Sideswipe (same)
  - Sideswipe (opposite)
  - Rear to Side
  - Rear to Rear
  - Other
  - Unknown
- Violation or Behavior Type
  - No Improper Action
  - Speed too Fast for Conditions
  - Exceeded Lawful Speed
  - Failure to Yield Right-of-Way
  - Followed Too Closely
  - Ran Stop Sign
  - Disregarded Traffic Signal
  - Made Improper Turn
  - Drove in Opposing Lane
  - Faulty/Missing Equipment
  - Motorcycle Safety Equipment Use
  - Passed in No Passing Zone
  - Unsafe Lane Change

  - Failure to Keep in Proper Lane
  - Other Unsafe Passing
  - Inattention/Distraction
  - Electronic Communications Device
  - Other

- Type of Lighting Conditions
  - Daylight
  - Dawn
  - Dusk
  - Dark-Lighted
  - Dark-Unlighted
  - Dark-Unknown Lighting

- Type of Road Surface Conditions
  - Dry
  - Wet
  - Snow
  - Slush
  - Ice/Frost
  - Water (standing or moving)
  - Sand
  - Mud, Dirt, Gravel
  - Oil
  - Other
  - Unknown

- First Unit Event Description
  - Collision with Animal
  - Collision with Fixed Object
  - Ran Off the Road (Left)
  - Ran Off the Road (Right)
  - Crossed Centerline
  - Crossed Median
  - Collision with Pedestrian
  - Motor Vehicle in Transport
  - Overturn
  - Equipment Failure
  - Collision with Falling Object
  - Other Non-Collision
  - Other Non-Fixed Object
  - Unknown

- Driver Physical Condition
  - Under the Influence of Drugs or Alcohol
  - Fatigued/Fell Asleep
  - No Apparent Influence
  - Had Been Drinking
  - Medications
  - Illness
  - Physical Impairment
  - Other
  - Unknown

- Safety Device Usage
  - Shoulder and Lap Belt
  - Child Restraint System
  - None Used
  - Helmet Used
  - Air Bag Deployed/Shoulder-Lap Belt
  - Air Bag Deployed
  - Other
  - Unknown
  - Not Applicable
  - Lap Belt
  - Not Reported

Section 6.2 of the 2010 Highway Safety Manual

Section 6.2 of the 2010 Highway Safety Manual (HSM) provides potential contributing factors for corresponding crash types and patterns. Crash patterns within the corridor that match crash patterns in the HSM can reasonably be expected to have similar potential contributing factors to those listed in the HSM.

Safety Needs Contributing Factors

Likely contributing factors were derived from information obtained through the hot spot crash summaries, previously completed safety-related projects, District input on safety concerns, segment crash type summaries, and HSM potential contributing factors. These contributing factors provide guidance on the types of solutions that will likely promote improved safety performance.

Table 13 summarizes the results of the analysis of contributing factors to safety needs in the US 93/US 60 corridor. This analysis resulted in the following determinations: six segments have a low final need; one segment has a medium final need; and seven segments have a high final need.

Table 13: Safety Needs Contributing Factors (Step 3)

Segment Number		1		2		3		4		Corridor-Wide Crash Characteristics	
Segment Length (miles)		6		12		9		17			
Segment Milepost (MP)		138-132		132-120		120-111		200-183			
Final Need		High		Low		High		High			
Segment Crash Overview		4	Crashes were fatal	3	Crashes were fatal	4	Crashes were fatal	9	Crashes were fatal	56	Crashes were fatal
		7	Crashes had incapacitating injuries	12	Crashes had incapacitating injuries	12	Crashes had incapacitating injuries	9	Crashes had incapacitating injuries	138	Crashes had incapacitating injuries
		1	Crashes involve trucks	1	Crashes involve trucks	1	Crashes involve trucks	0	Crashes involve trucks	15	Crashes involve trucks
Segment Crash Summaries (Fatal and Serious Injury Crashes)	First Harmful Event Type	56%	Involve Overturning	57%	Involve Collision with Motor Vehicle	38%	Involve Collision with Motor Vehicle	76%	Involve Collision with Motor Vehicle	37%	Involve Collision with Motor Vehicle
		33%	Involve Collision with Motor Vehicle	14%	Involve Overturning	23%	Involve Overturning	12%	Involve Collision with Pedestrian	36%	Involve Overturning
		11%	Involve Collision With Animal	7%	Involve Collision with Pedestrian	15%	Involve Collision with Fixed Object	6%	Involve Overturning	11%	Involve Collision with Fixed Object
	Collision Type	56%	Involve Single Vehicle	36%	Involve Single Vehicle	54%	Involve Single Vehicle	29%	Involve Head On	57%	Involve Single Vehicle
		11%	Involve Angle	36%	Involve Rear End	15%	Involve Rear End	24%	Involve Rear End	11%	Involve Rear End
		11%	Involve Rear End	14%	Involve Angle	8%	Involve Left Turn	18%	Involve Other	8%	Involve Head On
	Violation or Behavior	33%	Involve Speed too Fast for Conditions	36%	Involve Inattention/Distraction	23%	Involve Speed too Fast for Conditions	24%	Involve Drove in Opposing Lane	32%	Involve Speed too Fast for Conditions
		22%	Involve Unknown	14%	Involve No Improper Action	23%	Involve Inattention/Distraction	18%	Involve Speed too Fast for Conditions	14%	Involve Inattention/Distraction
		11%	Involve No Improper Action	14%	Made Improper Turn	23%	Involve Other	12%	Involve Inattention/Distraction	10%	Involve No Improper Action
	Lighting Conditions	56%	Occur in Dark-Unlighted Conditions	50%	Occur in Daylight Conditions	62%	Occur in Daylight Conditions	71%	Occur in Daylight Conditions	63%	Occur in Daylight Conditions
		33%	Occur in Daylight Conditions	29%	Occur in Dark-Unlighted Conditions	38%	Occur in Dark-Unlighted Conditions	12%	Occur in Dark-Unlighted Conditions	30%	Occur in Dark-Unlighted Conditions
		11%	Occur in Dark-Lighted Conditions	14%	Occur in Dark-Lighted Conditions	0%	Occur in Dawn Conditions	6%	Occur in Dawn Conditions	4%	Occur in Dark-Lighted Conditions
	Surface Conditions	78%	Involve Dry Conditions	100%	Involve Dry Conditions	85%	Involve Dry Conditions	100%	Involve Dry Conditions	92%	Involve Dry Conditions
		11%	Involve Wet Conditions			8%	Involve Wet Conditions			4%	Involve Wet Conditions
		11%	Oil			8%	Water (standing or moving)			2%	Involve Water (standing or moving) Conditions
	First Unit Event	44%	Involve a first unit event of Motor Vehicle in Transport	64%	Involve a first unit event of Motor Vehicle in Transport	38%	Involve a first unit event of Ran Off the Road (Left)	47%	Involve a first unit event of Motor Vehicle in Transport	28%	Involve a first unit event of Motor Vehicle in Transport
		22%	Involve a first unit event of Overturn	7%	Involve a first unit event of Collision with Animal	31%	Involve a first unit event of Motor Vehicle in Transport	35%	Involve a first unit event of Crossed Centerline	22%	Involve a first unit event of Ran Off the Road (Right)
		11%	Involve a first unit event of Collision with Animal	7%	Involve Overturn	8%	Involve a first unit event of Collision with Animal	6%	Involve a first unit event of Ran Off the Road (Left)	21%	Involve a first unit event of Ran Off the Road (Left)
	Driver Physical Condition	56%	No Apparent Influence	50%	No Apparent Influence	54%	Unknown	53%	No Apparent Influence	47%	No Apparent Influence
		22%	Under the Influence of Drugs or Alcohol	21%	Under the Influence of Drugs or Alcohol	23%	No Apparent Influence	35%	Unknown	28%	Unknown
		22%	Unknown	14%	Illness	15%	Fatigued/Fell Asleep	12%	Under the Influence of Drugs or Alcohol	11%	Under the Influence of Drugs or Alcohol
	Safety Device Usage	56%	Shoulder And Lap Belt Used	43%	Shoulder And Lap Belt Used	38%	Shoulder And Lap Belt Used	41%	Shoulder And Lap Belt Used	46%	Shoulder And Lap Belt Used
		44%	None Used	14%	None Used	23%	None Used	29%	Air Bag Deployed/Shoulder-Lap Belt	21%	None Used
		0%	Child Restraint System Used	14%	Air Bag Deployed/Shoulder-Lap Belt	15%	Unknown	18%	None Used	13%	Air Bag Deployed/Shoulder-Lap Belt
Hot Spot Crash Summaries		138-137 (WB)		129-128 (WB)		115-114 (WB)		195-193 (SB)			
Previously Completed Safety-Related Projects											
District Interviews/Discussions											
Contributing Factors		- Drivers running red lights or stop signs - Failure to yield the right-of-way - Excessive speed		- Drivers running red lights or stop signs - Failure to yield the right-of-way - Pedestrian		- Roadside design - Inadequate signs, delineators, or guardrails - Excessive speed - Roadside design (non-traversable sideslopes) - Narrow shoulders		- Drivers running red lights or stop signs - Driver inattention - Failure to yield the right-of-way - Pedestrian and Bicyclist Crossing			

Table 13: Safety Needs Contributing Factors (Step 3) (continued)

Segment Number		5	6	7	8	Corridor-Wide Crash Characteristics
Segment Length (miles)		17	17	17	8	
Segment Milepost (MP)		183-166	166-149	149-132	132-124	
Final Need		High	Low	Low	None	
Segment Crash Summaries (Fatal and Serious Injury Crashes)	Segment Crash Overview	5 Crashes were fatal 9 Crashes had incapacitating injuries 3 Crashes involve trucks	4 Crashes were fatal 10 Crashes had incapacitating injuries 3 Crashes involve trucks	0 Crashes were fatal 12 Crashes had incapacitating injuries 1 Crashes involve trucks	0 Crashes were fatal 1 Crashes had incapacitating injuries 0 Crashes involve trucks	56 Crashes were fatal 138 Crashes had incapacitating injuries 15 Crashes involve trucks
	First Harmful Event Type	86% Involve Collision with Motor Vehicle 7% Involve Overturning 7% Involve Other Non-Collision	40% Involve Overturning 40% Involve Other Non-Collision 10% Involve Collision with Motor Vehicle	25% Involve Overturning 25% Involve Collision with Fixed Object 25% Involve Other Non-Collision	N/A - Sample size too small	37% Involve Collision with Motor Vehicle 36% Involve Overturning 11% Involve Collision with Fixed Object
	Collision Type	36% Involve Head On 21% Involve Sideswipe (opposite) 14% Involve Single Vehicle	90% Involve Single Vehicle 10% Involve Head On	83% Involve Single Vehicle 8% Involve Rear End 8% Involve Other	N/A - Sample size too small	57% Involve Single Vehicle 11% Involve Rear End 8% Involve Head On
	Violation or Behavior	50% Involve Drove in Opposing Lane 21% Involve Speed too Fast for Conditions 7% Involve No Improper Action	40% Involve Speed too Fast for Conditions 20% Involve No Improper Action 20% Involve Inattention/Distraction	42% Involve Speed too Fast for Conditions 33% Involve Unknown 8% Involve No Improper Action	N/A - Sample size too small	32% Involve Speed too Fast for Conditions 14% Involve Inattention/Distraction 10% Involve No Improper Action
	Lighting Conditions	57% Occur in Daylight Conditions 43% Occur in Dark-Unlighted Conditions	60% Occur in Daylight Conditions 40% Occur in Dark-Unlighted Conditions	50% Occur in Daylight Conditions 50% Occur in Dark-Unlighted Conditions	N/A - Sample size too small	63% Occur in Daylight Conditions 30% Occur in Dark-Unlighted Conditions 4% Occur in Dark-Lighted Conditions
	Surface Conditions	86% Involve Dry Conditions 7% Involve Wet Conditions 7% Involve Ice/Frost Conditions	90% Involve Dry Conditions 10% Involve Wet Conditions	83% Involve Dry Conditions 8% Involve Ice/Frost Conditions 8% Involve Water (standing or moving)Conditions	N/A - Sample size too small	92% Involve Dry Conditions 4% Involve Wet Conditions 2% Involve Water (standing or moving) Conditions
	First Unit Event	57% Involve a first unit event of Crossed Centerline 29% Involve a first unit event of Motor Vehicle in Transport 7% Involve a first unit event of Ran Off the Road (Right)	50% Involve a first unit event of Ran Off the Road (Left) 30% Involve a first unit event of Ran Off the Road (Right) 10% Involve a first unit event of Crossed Centerline	50% Involve a first unit event of Ran Off the Road (Right) 17% Involve a first unit event of Ran Off the Road (Left) 17% Motor Vehicle in Transport	N/A - Sample size too small	28% Involve a first unit event of Motor Vehicle in Transport 22% Involve a first unit event of Ran Off the Road (Right) 21% Involve a first unit event of Ran Off the Road (Left)
	Driver Physical Condition	43% No Apparent Influence 29% Unknown 14% Under the Influence of Drugs or Alcohol	50% Unknown 40% No Apparent Influence 10% Other	50% No Apparent Influence 33% Unknown 8% Fatigued/Fell Asleep	N/A - Sample size too small	47% No Apparent Influence 28% Unknown 11% Under the Influence of Drugs or Alcohol
	Safety Device Usage	50% Air Bag Deployed/Shoulder-Lap Belt 36% Shoulder And Lap Belt Used 7% None Used	40% Shoulder And Lap Belt Used 40% Helmet Used 10% None Used	42% Shoulder And Lap Belt Used 25% None Used 17% Air Bag Deployed/Shoulder-Lap Belt	N/A - Sample size too small	46% Shoulder And Lap Belt Used 21% None Used 13% Air Bag Deployed/Shoulder-Lap Belt
Hot Spot Crash Summaries		None	None	147-146 (NB)	None	
Previously Completed Safety-Related Projects					MP 124 Median Crossover, intersection improvements (2015)	
District Interviews/Discussions						
Contributing Factors		- Misjudges speed of oncoming traffic - Poor nighttime visibility or lighting - Narrow shoulders	- Excessive Speed - Inadequate signs, delineators, guardrails - Roadside design (non-traversable side slopes) - Narrow shoulders	- Excessive Speed - Inadequate signs, delineators, guardrails - Roadside design (non-traversable side slopes) - Narrow shoulders - Inadequate roadside clearance		

Table 13: Safety Needs Contributing Factors (Step 3) (continued)

Segment Number		9		10		11		12		Corridor-Wide Crash Characteristics	
Segment Length (miles)		18		15		4		14			
Segment Milepost (MP)		124-106		106-91		71-67		67-53			
Final Need		High		None		High		Low			
Segment Crash Summaries (Fatal and Serious Injury Crashes)	Segment Crash Overview	5	Crashes were fatal	4	Crashes were fatal	2	Crashes were fatal	3	Crashes were fatal	56	Crashes were fatal
		9	Crashes had incapacitating injuries	3	Crashes had incapacitating injuries	1	Crashes had incapacitating injuries	10	Crashes had incapacitating injuries	138	Crashes had incapacitating injuries
		1	Crashes involve trucks	0	Crashes involve trucks	0	Crashes involve trucks	2	Crashes involve trucks	15	Crashes involve trucks
	First Harmful Event Type	50%	Involve Overturning	80%	Involve Overturning	N/A - Sample size too small		38%	Involve Overturning	37%	Involve Collision with Motor Vehicle
		25%	Involve Collision with Fixed Object	20%	Involve Collision with Fixed Object			31%	Involve Collision with Motor Vehicle	36%	Involve Overturning
		13%	Involve Collision with Motor Vehicle	0%	Involve Collision with Motor Vehicle			15%	Involve Other Non-Collision	11%	Involve Collision with Fixed Object
	Collision Type	88%	Involve Single Vehicle	100%	Involve Single Vehicle	N/A - Sample size too small		62%	Involve Single Vehicle	57%	Involve Single Vehicle
		13%	Involve Head On					31%	Involve Angle	11%	Involve Rear End
								8%	Involve Rear End	8%	Involve Head On
	Violation or Behavior	38%	Involve Speed too Fast for Conditions	40%	Involve Speed too Fast for Conditions	N/A - Sample size too small		38%	Involve Speed too Fast for Conditions	32%	Involve Speed too Fast for Conditions
		25%	Involve No Improper Action	40%	Involve Failure to Keep in Proper Lane Conditions			15%	Involve No Improper Action	14%	Involve Inattention/Distraction
		13%	Involve Failure to Yield Right-of-Way	20%	Involve Unsafe Lane Change			15%	Involve Failure to Yield Right-of-Way	10%	Involve No Improper Action
	Lighting Conditions	88%	Occur in Daylight Conditions	60%	Occur in Daylight Conditions	N/A - Sample size too small		77%	Occur in Daylight Conditions	63%	Occur in Daylight Conditions
		13%	Occur in Dark-Lighted Conditions	40%	Occur in Dark-Unlighted Conditions			23%	Occur in Dark-Unlighted Conditions	30%	Occur in Dark-Unlighted Conditions
										4%	Occur in Dark-Lighted Conditions
	Surface Conditions	88%	Involve Dry Conditions	100%	Involve Dry Conditions	N/A - Sample size too small		85%	Involve Dry Conditions	92%	Involve Dry Conditions
		13%	Involve Wet Conditions					8%	Involve Slush Conditions	4%	Involve Wet Conditions
								8%	Involve Water (standing or moving) Conditions	2%	Involve Water (standing or moving) Conditions
	First Unit Event	38%	Involve a first unit event of Crossed Centerline	40%	Involve a first unit event of Ran Off the Road (Left)	N/A - Sample size too small		31%	Involve a first unit event of Ran Off the Road (Left)	28%	Involve a first unit event of Motor Vehicle in Transport
		13%	Involve a first unit event of Ran Off the Road (Left)	40%	Involve a first unit event of Ran Off the Road (Right)			31%	Involve a first unit event of Ran Off the Road (Right)	22%	Involve a first unit event of Ran Off the Road (Right)
		13%	Equipment Failure	20%	Involve a first unit event of Other Non-Collision			31%	Involve a first unit event of Motor Vehicle in Transport	21%	Involve a first unit event of Ran Off the Road (Left)
	Driver Physical Condition	50%	No Apparent Influence	40%	Unknown	N/A - Sample size too small		54%	No Apparent Influence	47%	No Apparent Influence
		25%	Under the Influence of Drugs or Alcohol	20%	Under the Influence of Drugs or Alcohol			23%	Fatigued/Fell Asleep	28%	Unknown
		25%	Unknown	20%	Fatigued/Fell Asleep			8%	Under the Influence of Drugs or Alcohol	11%	Under the Influence of Drugs or Alcohol
	Safety Device Usage	50%	Shoulder And Lap Belt Used	40%	Shoulder And Lap Belt Used	N/A - Sample size too small		62%	Shoulder And Lap Belt Used	46%	Shoulder And Lap Belt Used
		25%	Unknown	20%	None Used			31%	None Used	21%	None Used
		13%	None Used	20%	Air Bag Deployed/Shoulder-Lap Belt			8%	Air Bag Deployed/Shoulder-Lap Belt	13%	Air Bag Deployed/Shoulder-Lap Belt
Hot Spot Crash Summaries		None		None		None		None			
Previously Completed Safety-Related Projects				H7388 Antelope Wash construct 4-lane divided highway (2015)							
District Interviews/Discussions											
Contributing Factors		- Excessive Speed - Inadequate signs, delineators, guardrails - Roadside design (non-traversable side slopes) - Narrow shoulders - Inadequate roadside clearance		- Excessive Speed - Inadequate signs, delineators, guardrails - Roadside design (non-traversable side slopes)				- Excessive Speed - Inadequate signs, delineators, guardrails - Roadside design (non-traversable side slopes) - Narrow shoulders			

Table 13: Safety Needs Contributing Factors (Step 3) (continued)

Segment Number		13		14		15		16		Corridor-Wide Crash Characteristics	
Segment Length (miles)		11		13		12		17			
Segment Milepost (MP)		53-42		42-29		29-17		17-0			
Final Need		High		Medium		Low		Low			
Segment Crash Summaries (Fatal and Serious Injury Crashes)	Segment Crash Overview	5	Crashes were fatal	4	Crashes were fatal	2	Crashes were fatal	2	Crashes were fatal	56	Crashes were fatal
		12	Crashes had incapacitating injuries	11	Crashes had incapacitating injuries	14	Crashes had incapacitating injuries	6	Crashes had incapacitating injuries	138	Crashes had incapacitating injuries
		0	Crashes involve trucks	0	Crashes involve trucks	2	Crashes involve trucks	0	Crashes involve trucks	15	Crashes involve trucks
	First Harmful Event Type	59%	Involve Overturning	80%	Involve Overturning	50%	Involve Overturning	38%	Involve Overturning	37%	Involve Collision with Motor Vehicle
		24%	Involve Collision with Motor Vehicle	13%	Involve Collision with Motor Vehicle	38%	Involve Collision with Motor Vehicle	25%	Involve Collision with Fixed Object	36%	Involve Overturning
		6%	Involve Collision with Pedestrian	7%	Involve Other Non-Collision	6%	Involve Collision with Fixed Object	25%	Involve Other Non-Collision	11%	Involve Collision with Fixed Object
	Collision Type	65%	Involve Single Vehicle	87%	Involve Single Vehicle	63%	Involve Single Vehicle	75%	Involve Single Vehicle	57%	Involve Single Vehicle
		18%	Involve Angle	7%	Involve Rear End	13%	Involve Rear End	25%	Involve Other	11%	Involve Rear End
		12%	Involve Rear End	7%	Involve Sideswipe (same)	6%	Involve Angle			8%	Involve Head On
	Violation or Behavior	47%	Involve Speed too Fast for Conditions	60%	Involve Speed too Fast for Conditions	31%	Involve Speed too Fast for Conditions	50%	Involve Speed too Fast for Conditions	32%	Involve Speed too Fast for Conditions
		18%	Involve Inattention/Distraction	20%	Involve No Improper Action	13%	Involve No Improper Action	13%	Involve No Improper Action	14%	Involve Inattention/Distraction
		12%	Involve Failure to Yield Right-of-Way	7%	Involve Exceeded Lawful Speed	13%	Involve Failure to Yield Right-of-Way	13%	Exceeded Lawful Speed	10%	Involve No Improper Action
	Lighting Conditions	71%	Occur in Daylight Conditions	73%	Occur in Daylight Conditions	69%	Occur in Daylight Conditions	63%	Occur in Daylight Conditions	63%	Occur in Daylight Conditions
		18%	Occur in Dark-Unlighted Conditions	27%	Occur in Dark-Unlighted Conditions	25%	Occur in Dark-Unlighted Conditions	38%	Occur in Dark-Unlighted Conditions	30%	Occur in Dark-Unlighted Conditions
		12%	Occur in Dawn Conditions			6%	Occur in Dark-Lighted Conditions			4%	Occur in Dark-Lighted Conditions
	Surface Conditions	94%	Involve Dry Conditions	93%	Involve Dry Conditions	100%	Involve Dry Conditions	88%	Involve Dry Conditions	92%	Involve Dry Conditions
		6%	Involve Snow Conditions	7%	Involve Wet Conditions			13%	Involve Wet Conditions	4%	Involve Wet Conditions
										2%	Involve Water (standing or moving) Conditions
	First Unit Event	47%	Involve a first unit event of Ran Off the Road (Right)	40%	Involve a first unit event of Ran Off the Road (Left)	38%	Involve a first unit event of Ran Off the Road (Right)	38%	Involve a first unit event of Ran Off the Road (Right)	28%	Involve a first unit event of Motor Vehicle in Transport
		29%	Involve a first unit event of Motor Vehicle in Transport	20%	Involve a first unit event of Equipment Failure	31%	Involve a first unit event of Motor Vehicle in Transport	25%	Involve a first unit event of Ran Off the Road (Left)	22%	Involve a first unit event of Ran Off the Road (Right)
		18%	Involve a first unit event of Ran Off the Road (Left)	13%	Involve a first unit event of Ran Off the Road (Right)	25%	Involve a first unit event of Ran Off the Road (Left)	13%	Involve a first unit event of Crossed Centerline	21%	Involve a first unit event of Ran Off the Road (Left)
	Driver Physical Condition	35%	No Apparent Influence	73%	No Apparent Influence	63%	No Apparent Influence	38%	No Apparent Influence	47%	No Apparent Influence
		24%	Under the Influence of Drugs or Alcohol	13%	Fatigued/Fell Asleep	31%	Unknown	25%	Illness	28%	Unknown
		24%	Unknown	7%	Under the Influence of Drugs or Alcohol	6%	Under the Influence of Drugs or Alcohol	13%	Under the Influence of Drugs or Alcohol	11%	Under the Influence of Drugs or Alcohol
	Safety Device Usage	59%	Shoulder And Lap Belt Used	53%	Shoulder And Lap Belt Used	63%	Shoulder And Lap Belt Used	25%	Shoulder And Lap Belt Used	46%	Shoulder And Lap Belt Used
		24%	None Used	20%	None Used	19%	None Used	25%	None Used	21%	None Used
		6%	Air Bag Deployed/Shoulder-Lap Belt	20%	Helmet Used	6%	Helmet Used	25%	Helmet Used	13%	Air Bag Deployed/Shoulder-Lap Belt
Hot Spot Crash Summaries		None		None		None		None			
Previously Completed Safety-Related Projects								H8500 Kingman Wash TI Cattle Guards 2015			
District Interviews/Discussions											
Contributing Factors		- Excessive Speed - Inadequate signs, delineators, guardrails - Roadside design (non-traversable side slopes) - Narrow shoulders		- Excessive Speed - Inadequate signs, delineators, guardrails - Roadside design (non-traversable side slopes) - Narrow shoulders		- Excessive Speed - Inadequate signs, delineators, guardrails - Roadside design (non-traversable side slopes) - Narrow shoulders		- Excessive Speed - Inadequate signs, delineators, guardrails - Roadside design (non-traversable side slopes)			

7.0 FREIGHT PERFORMANCE NEEDS (STEPS 1-3)

The following sections describe Steps 1 through 3 of the Needs Assessment process for the US 93/US 60 corridor for the Freight Performance Area. The methodology for performing Steps 1 through 3 is provided in **Appendix A**.

7.1 Step 1: Initial Freight Needs

Baseline performance scores (from Working Paper 2) and performance objectives (from Working Paper 3) for the US 93/US 60 corridor were used to determine initial freight needs, as described in Section 2.1. Freight data used to calculate baseline performance were provided by ADOT: existing travel time data - 2014, closure data – 2010-2014, and bridge clearance data – 2014.

Step 1 uses the scores for the Freight Index primary performance measure and four secondary performance measures to determine initial level of need by segment for each performance measure individually as well as for all performance measures combined. The four secondary performance measures are: Directional Truck Travel Time Index (TTTI), Directional Truck Planning Time Index (TPTI), Directional Closure Duration, and Bridge Vertical Clearance.

Performance scores, performance objectives, and initial levels of need for each freight performance measure and all freight performance measures combined are shown in **Table 14**. Findings reported in **Table 14** are summarized below:

- Freight Index – No segments have a low level of need, two segments have a medium level of need, and four segments have a high level of need.
- Directional TTTI – In the NB/EB direction, two segments have a low level of need; one segment has a medium level of need, and no segments have a high level of need; in the SB/WB direction, no segments have a low level of need, no segments have a medium level of need, and only one segment has a high level of need.
- Directional TPTI – In the NB/EB direction, one segment has a low level of need; one segment has a medium level of need, and four segments have a high level of need; in the SB/WB direction, no segments have a low level of need, one segment has a medium level of need, and three segments have a high level of need.
- Directional Closure Duration – In the NB/EB direction, there are no segments with a determined need relative to this measure; in the SB/WB direction, one segment was determined to have a high level of need.
- Bridge Vertical Clearance – There are no segments with a determined need relative to this measure.

The determination of initial need for the overall performance of the US 93/US 60 corridor is: one segment has a low initial need, two segments have a medium initial needs, and four segments have a high initial need.

7.2 Step 2: Final Freight Needs

Once the initial freight needs by segment were established for the US 93/US 60 corridor, they were then refined in Step 2 (as described in Section 2.2) to more accurately reflect existing needs. An evaluation of vertical clearance hot spots as well as relevant recently completed and under-construction projects was performed to determine if segment need levels required adjustment. The initial needs were then refined based on this assessment to determine the final need for each segment. Planned and programmed future projects and other issues identified in previous reports were noted for future reference in developing solutions that address identified needs. The Step 2 process is described in more detail below, and results of the process are summarized in **Table 15**.

Truck Height Restriction Hot Spots

There are no segments with truck height restriction hot spots, which are bridges (or other structure) that (1) provide less than 16.25 feet of vertical clearance above the corridor mainline GP through lanes and (2) for which there is no alternate route around the restriction. There are no vertical clearance hot spots identified in **Table 15**; therefore, no adjustments were made to the initial need of any segment.

Recently Completed and Under-Construction Freight Projects

ADOT provided information on potentially relevant recently completed and under-construction projects that were not previously reflected in the baseline performance data. This includes any projects completed or under construction after 2014 that have the potential to mitigate a freight need on a corridor segment. There are three segments with a recently completed project that potentially would supersede the initial need determined from safety data shown in Table 11:

- One project of improvements (MP 124 Median Crossover) was determined to not be a mitigating action relative to freight performance in the segment; therefore, the initial need rating of high for this segment remained unchanged.
- A second project (H7388 Antelope Wash) was determined to be a mitigating action for relative to freight performance in the segment; therefore, this segment was upgraded from a medium initial need to no need.
- A third project (H8500 Kingman Wash TI) was implemented in a segment that had no initial need, and it did not affect/impact freight performance; therefore, the segment was determined to have no final need.

The evaluation of final needs for the US 93/US60 corridor segments resulted in the following determinations: one segments has a low final need; one segment has a medium final need; and four segments have a high final need.

Planned or Programmed Projects

Information is presented in **Table 15** regarding freight-related planned and programmed projects and other issues identified in previous reports cited in Working Paper 1. Planned and programmed projects and identified issues do not influence the level of need, but were documented for future reference in developing solutions that address identified needs.

Table 14: Initial Freight Needs (Step 1)

Segment	Facility Operations	Segment Mileposts (MP)	Segment Length (miles)	Freight Index			Directional TTTI* (trucks only)					Directional TPTI** (trucks only)				
				Performance Score	Performance Objective	Level of Need	Performance Score		Performance Objective	Level of Need		Performance Score		Performance Objective	Level of Need	
							NB/WB	SB/EB		NB/WB	SB/EB	NB/EW	SB/EB		NB/WB	SB/EB
60W-1	Interrupted	138-132	6	0.69	Fair or Better	None	1.14	1.05	Fair or Better	None	None	1.75	1.15	Fair or Better	None	None
60W-2	Interrupted	132-120	12	0.67	Fair or Better	None	1.09	1.15	Fair or Better	None	None	1.32	1.67	Fair or Better	None	None
60W-3	Uninterrupted	120-111	9	0.14	Fair or Better	High	1.00	2.90	Fair or Better	None	High	1.91	12.05	Fair or Better	High	High
93-4	Interrupted	200-183	17	0.32	Fair or Better	None	1.60	1.38	Fair or Better	Low	None	3.92	2.38	Fair or Better	None	None
93-5	Uninterrupted	183-166	17	*No Data*	Fair or Better	N/A	*No Data*	*No Data*	Fair or Better	N/A	N/A	*No Data*	*No Data*	Fair or Better	N/A	N/A
93-6	Uninterrupted	166-149	17	0.61	Fair or Better	High	1.14	1.11	Fair or Better	None	None	1.66	1.60	Fair or Better	High	High
93-7	Uninterrupted	149-132	17	0.53	Fair or Better	High	1.20	1.15	Fair or Better	None	None	2.03	1.71	Fair or Better	High	High
93-8	Uninterrupted	132-124	8	0.45	Fair or Better	High	1.05	1.00	Fair or Better	None	None	3.28	1.18	Fair or Better	High	None
93-9	Uninterrupted	124-106	18	1.00	Fair or Better	None	1.00	1.00	Fair or Better	None	None	1.01	1.00	Fair or Better	None	None
93-10	Uninterrupted	106-91	15	0.69	Fair or Better	Medium	1.06	1.03	Fair or Better	None	None	1.41	1.49	Fair or Better	Low	Medium
93-11	Interrupted	71-67	4	0.21	Fair or Better	Medium	2.00	1.09	Fair or Better	Medium	None	6.85	2.85	Fair or Better	Medium	None
93-12	Uninterrupted	67-53	14	0.86	Fair or Better	None	1.05	1.06	Fair or Better	None	None	1.15	1.18	Fair or Better	None	None
93-13	Uninterrupted	53-42	11	0.86	Fair or Better	None	1.04	1.06	Fair or Better	None	None	1.13	1.20	Fair or Better	None	None
93-14	Uninterrupted	42-29	13	0.86	Fair or Better	None	1.04	1.06	Fair or Better	None	None	1.13	1.20	Fair or Better	None	None
93-15	Uninterrupted	29-17	12	0.86	Fair or Better	None	1.04	1.06	Fair or Better	None	None	1.13	1.20	Fair or Better	None	None
93-16	Uninterrupted	17-0	17	0.86	Fair or Better	None	1.04	1.06	Fair or Better	None	None	1.13	1.20	Fair or Better	None	None
Emphasis Area?	Yes	**Weighted Average**		0.68	Good											

* TTTI: Truck Travel Time Index

** PTI: Truck Planning Time Index

Table 14: Initial Freight Needs (Step 1) (continued)

Segment	Facility Operations	Segment Mileposts (MP)	Segment Length (miles)	Closure Duration (hours/mile/year)					Bridge Clearance (feet)			Initial Need
				Performance Score		Performance Objective	Level of Need		Performance Score	Performance Objective	Level of Need	
				NB/WB	SB/EB		NB/WB	SB/EB				
60W-1	Interrupted	138-132	6	16.90	34.63	Fair or Better	None	None	No UP*	Fair or Better	None	None
60W-2	Interrupted	132-120	12	0.00	19.97	Fair or Better	None	None	No UP	Fair or Better	None	None
60W-3	Uninterrupted	120-111	9	11.22	38.69	Fair or Better	None	None	No UP	Fair or Better	None	High
93-4	Interrupted	200-183	17	18.86	179.42	Fair or Better	None	High	No UP	Fair or Better	None	Low
93-5	Uninterrupted	183-166	17	41.69	9.08	Fair or Better	None	None	No UP	Fair or Better	None	None
93-6	Uninterrupted	166-149	17	15.28	33.08	Fair or Better	None	None	No UP	Fair or Better	None	High
93-7	Uninterrupted	149-132	17	37.55	13.75	Fair or Better	None	None	No UP	Fair or Better	None	High
93-8	Uninterrupted	132-124	8	0.00	6.78	Fair or Better	None	None	No UP	Fair or Better	None	High
93-9	Uninterrupted	124-106	18	53.24	8.74	Fair or Better	None	None	No UP	Fair or Better	None	None
93-10	Uninterrupted	106-91	15	0.00	34.91	Fair or Better	None	None	No UP	Fair or Better	None	Medium
93-11	Interrupted	71-67	4	7.50	60.45	Fair or Better	None	None	16.85	Fair or Better	None	Medium
93-12	Uninterrupted	67-53	14	6.60	8.33	Fair or Better	None	None	No UP	Fair or Better	None	None
93-13	Uninterrupted	53-42	11	27.33	7.04	Fair or Better	None	None	No UP	Fair or Better	None	None
93-14	Uninterrupted	42-29	13	4.22	20.32	Fair or Better	None	None	No UP	Fair or Better	None	None
93-15	Uninterrupted	29-17	12	0.00	19.72	Fair or Better	None	None	No UP	Fair or Better	None	None
93-16	Uninterrupted	17-0	17	7.25	27.11	Fair or Better	None	None	17.08	Fair or Better	None	None

* UP: Underpass

Table 15: Final Freight Needs (Step 2)

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Truck Height Restriction Hot Spots (Clearance < 16')	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)
60W-1	6	138-132	None	None	None	None	Planned: -Proposed New System US 60 and SR 303L TI (MP 138) - BQAZ
60W-2	12	132-120	None	None	None	None	Planned: -Addition of WB DMS (MP 122) - AZ Statewide Dynamic Message Master Plan -US 60 and SR 74 TI Improvement (MP 120.80) - Hassayampa Framework Study for Wickenburg
60W-3	9	120-111	High	None	None	High	Planned: -Addition of EB DMS (MP 118) - AZ Statewide Dynamic Message Master Plan
93-4	17	200-183	Low	None	Wickenburg Ranch Roundabout (2015)	Low	Planned: -New Separate SB 2 Lane roadway (MP 197.90 to 193.10) - ADOT US 93: SR 89 to Wickenburg Interim Bypass Final Environmental Assessment -Construction of 4-lane divided highway (MP 193.50 to 181.30) - ADOT US 93 Projects -US 93 and SR 89 TI: Proposed Roundabout (MP196.10) - US 93: SR 89 to Wickenburg Interim Bypass Final EA, BQAZ -US 93 and Scenic Loop Rd TI Redesign (MP 194.90) - ADOT US 93: SR 89 to Wickenburg Interim Bypass Final Environmental Assessment -System Interchange at US 93 / I-11 (Planned) and SR 89 Intersection (MP 188) - Hassayampa Framework Study for Wickenburg -Service Interchange at proposed Twin Peaks Rd (MP 186) - Hassayampa Framework Study for Wickenburg -Parkway Interchange at proposed Black Mountain Pkwy (MP 184) - Hassayampa Framework Study for Wickenburg -Parkway Interchange at SR 71 Interchange (MP 183) - Hassayampa Framework Study for Wickenburg
93-5	0	183-166	None	None	None	None	Planned: -Construction of 4-lane divided highway (MP 181.30-173.50) - ADOT US 93 Projects -Addition of SB Passing Lane (MP 172-165 & MP 167-165) - ADOT Climbing and Passing lane Prioritization Study
93-6	17	166-149	High	None	None	High	Planned: -Construction of 4-lane divided highway (MP 166-161.70) - ADOT US 93 Projects -Addition of SB passing lane (MP 163-161) - ADOT Climbing and Passing lane Prioritization Study
93-7	17	149-132	High	None	None	High	None
93-8	8	132-124	High	None	MP 124 Median Crossover, intersection improvements (2015)	High	None

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Truck Height Restriction Hot Spots (Clearance < 16')	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)
93-9	18	124-106	None	None	None	None	Programmed: -Construction of 4-lane divided highway, H859501C (MP 119.70-116.30) - ADOT 5 Year Program FY 2020 -Construction of 4-lane divided highway, D (MP 108.90-106) - ADOT 5 Year Program FY 2021 Planned: -Cyprus Bagdad Copper Rd proposed TI (MP118.60) - US 93, Right-of-Way and Access Control Addendum DCR -Diamond Jow Rd proposed TI (MP 116.60) - US 93, Right-of-Way and Access Control Addendum DCR -Hofriders Crossing proposed TI (MP113.60) - US 93, Right-of-Way and Access Control Addendum DCR -Proposed TI (MP 111.50) - US 93, Right-of-Way and Access Control Addendum DCR -Upper Trout Creek proposed TI (MP 107.40) - US 93, Right-of-Way and Access Control Addendum DCR
93-10	15	106-91	Medium	None	H7388 Antelope Wash construct 4-lane divided highway (2015)	None	Planned: -Proposed TI (MP 102.60) - US 93, Right-of-Way and Access Control Addendum DCR -Proposed TI (MP 99.10) - US 93, Right-of-Way and Access Control Addendum DCR -Old US 93 proposed TI (MP 95.60) - US 93, Right-of-Way and Access Control Addendum DCR -Addition of NB DMS (MP 95) - AZ Statewide Dynamic Message Master Plan -Proposed TI (MP 93.10) - US 93, Right-of-Way and Access Control Addendum DCR -US 93 and I-40 TI Improvement (MP 92.50) - ADOT US 93 Corridor Projects, AZ Key Commerce Corridors, BQAZ
93-11	4	71-67	Medium	None	H8744 US 93 and I-40 Interim Interchange (2016)	Medium	Planned: -US 93 and I-40 TI Improvement (MP 71) - AZ Key Commerce Corridors, I-40 / US 93 System Traffic Interchange DCR and EA, BQAZ -King Port of Entry Facility Improvement (MP 68) - AZ Port of Entry Study
93-12	14	67-53	None	None	None	None	Programmed: -Shoulder widening, Mineral Park Rd to Windy Point Rd, H8659 (MP 58-48) - ADOT 5 Year Program FY 2018
93-13	11	53-42	None	None	None	None	Programmed: -Shoulder widening, Mineral Park Rd to Windy Point Rd, H8659 (MP 58-48) - ADOT 5 Year Program FY 2018 -Shoulder widening design, Windy Point Rd to 11th St, H8658 (MP 48-38) - ADOT 5 Year Program FY 2017

Segment	Segment Length (miles)	Segment Mileposts (MP)	Initial Need	Truck Height Restriction Hot Spots (Clearance < 16')	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)
93-14	13	42-29	None	None	None	None	Programmed: -Shoulder widening design, Windy Point Rd to 11th St, H8658 (MP 48-38) - ADOT 5 Year Program FY 2017 -Shoulder widening 11th St to White Hills Rd, H8657 (MP 38-28) - ADOT 5 Year Program FY 2018
93-15	12	29-17	None	None	None	None	Programmed: -Shoulder widening 11th St to White Hills Rd, H8657 (MP 38-28) - ADOT 5 Year Program FY 2018 -Construct shoulder widening White Hills Rd to Willow Beach, H8408 (MP 28-17) - ADOT 5 Year Program FY 2017
93-16	17	17-0	None	None	H8500 Kingman Wash TI Cattle Guards 2015	None	

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7.3 Step 3: Freight Contributing Factors

As described in Section 2.3, Step 3 identifies potential contributing factors to the performance needs calculated in Step 2. These contributing factors provide information on what types of improvements may help improve performance. Contributing factors listed and reported in **Table 16** include:

- Roadway variables
- Traffic variables
- Relevant mobility-related existing infrastructure
- Closure Extent
- Non-actionable conditions.

Roadway Variables

Roadway variables include functional classification, environmental type (i.e., urban or rural), terrain, number of lanes by direction, speed limit, presence of auxiliary (or Aux) lanes, if a roadway is divided or non-divided, and the percentage of the segment controlled by No Passing zones. These variables are described in more detail below:

- Functional classification indicates if a roadway is an interstate, state highway, or arterial. Capacity equations and parameters differ depending on a roadway's functional classification. In the case of the US 93/US 60 corridor, the entire corridor is on the State Highway System (SHS); therefore, all segments are functionally classified as State Highway.
- Environmental type refers to how developed the land is adjacent to the roadway. Environmental types include: urban, fringe urban, and rural. Capacity thresholds differ for each environmental type, as higher congestion levels are more acceptable in urbanized areas than in rural areas.
- Terrain (described as level, rolling, or mountainous) indicates the general roadway grade, which influences how quickly vehicles can accelerate or decelerate or maintain a constant speed.
- Number of lanes in each direction indicates how many general purpose (GP) through lanes exist.
- Speed limit indicates the posted speed limit.
- Auxiliary lanes accounts for the presence of additional lanes (other than GP lanes) for turning, weaving, or passing that can improve mobility performance by maintaining more consistent speeds in GP lanes.
- Divided/non-divided recognizes roadway segments is considered divided, i.e., there is a raised or depressed median separating the directions of traffic flow that cannot easily be traversed. A roadway with a painted paved median is considered a non-divided roadway. Dividing a roadway generally increases the roadway capacity.
- Percent (%) no passing accounts for the presence of No Passing zones that are establish to control the movement of traffic around slower-moving vehicles.

Traffic Variables

Traffic variables include: existing and future (Year 2035) levels of service (LOS), % trucks, and a buffer index (defined as the difference between PTI and TTI). These three variables can indicate how well a corridor is performing in terms of overall mobility and why certain segments of a corridor may be performing worse than others.

- Existing and Future LOS – These two variables provide a letter "grade" between "A" and "F" for mobility that generally is reflective of Existing and Future V/C calculations (refer to **Table 14**). LOS values of "A", "B", and "C" generally are considered highly acceptable. A LOS value of "D" generally is considered moderately acceptable. LOS values of "E" and "F" generally are considered unacceptable.
- Truck Traffic – The amount of truck traffic in a given segment of the corridor can be represented as a percentage of the overall total traffic volume for that specific segment. Truck volume in a corridor can impact overall mobility, based on truck travel speed, corridor grades, required inspection points, and number of lanes.
- Buffer Index – This index is calculated by subtracting the segment level TTI value (i.e., ratio of peak-hour speed to free-flow speed) from the segment level PTI value (i.e., 95th percentile speed). The TTI and PTI values are reported in Working Paper 2. The Buffer Index expresses the amount of extra time necessary to be on-time 95 percent of the time for any given trip. This calculation provides information on the reliability of travel in the corridor.

Mobility-Related Infrastructure

Mobility-related infrastructure refers to devices or features at specific locations that influence mobility performance. Examples include: dynamic message signs (DMS), passing lanes, climbing lanes, ports of entry (POE), rest areas, and parking areas.

Closure Type

The relative frequency of types of closures within each segment helps indicate potential causes of mobility-related needs. Closure types consist of closures due to an incident/crash, obstruction, or weather condition. The number of each type of closure and the corresponding percentage of all closures that are of each type are noted.

Non-Actionable Conditions

Non-actionable conditions are features or characteristics that result in poor mobility performance that cannot be addressed through an engineered solution. An example of this condition is the presence and operation of border patrol checkpoints that require all vehicles to slow down or stop for inspection.

Contributing Factors

Potential contributing factors to mobility needs identify other situations, conditions, and actions that may influence mobility in the US 93/US 60 corridor.

Table 16: Freight Needs Contributing Factors (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	NB/WB Buffer Index (TPTI-TTTI)	SB/EB Buffer Index (TPTI-TTTI)	
60W-1	138-132	6	None	Interstate	Urban	Level	2	63	No	Divided	0%	A-C	E/F	7.97	0.61	0.10	
60W-2	132-120	12	None	Interstate	Fringe Urban	Level	2	63	No	Divided	0%	A-C	E/F	7.61	0.23	0.52	
60W-3	120-111	9	High	Interstate	Rural	Level	2	57	No	Divided	0%	A-C	D	6.91	0.91	9.15	DMS MP119 (EB) MP 113.5 (EB), Rest Area MP116 (EB)
93-4	200-183	17	Low	Interstate	Fringe Urban	Level	1	61	No	Non-Divided	65%	A-C	D	10.67	2.32	1.00	
93-5	183-166	17	None	Interstate	Rural	Level	1	65	No	Non-Divided	56%	A-C	A-C	9.86	No Data	No Data	
93-6	166-149	17	High	Interstate	Rural	Level	2	65	No	Divided	0%	A-C	A-C	8.64	0.52	0.49	Climbing Lane 176-175.5 (SB) 173.5-172.5 (NB)
93-7	149-132	17	High	Interstate	Rural	Level	2	65	No	Divided	0%	A-C	A-C	7.88	0.83	0.56	
93-8	132-124	8	High	Interstate	Rural	Level	2	65	No	Divided	0%	A-C	A-C	7.88	2.23	0.18	
93-9	124-106	18	None	Interstate	Rural	Level	1	65	No	Both	14%	A-C	A-C	5.67	0.01	0.00	Rest Area MP122.5 (NB), Climbing Lane MP 117-116 (NB)
93-10	106-91	15	None	Interstate	Rural	Level	2	65	No	Both	0%	A-C	A-C	3.99	0.35	0.46	
93-11	71-67	4	Medium	Interstate	Urban	Level	2	56	No	Divided	0%	A-C	D	9.27	4.85	1.76	DMS MP70 (NB), POE MP68 (SB)
93-12	67-53	14	None	Interstate	Rural	Level	2	65	No	Divided	0%	A-C	A-C	8.71	0.10	0.12	DMS MP66 (SB)
93-13	53-42	11	None	Interstate	Rural	Level	2	65	No	Divided	0%	A-C	A-C	7.84	0.08	0.13	
93-14	42-29	13	None	Interstate	Rural	Level	2	65	No	Divided	0%	A-C	A-C	7.61	0.08	0.13	
93-15	29-17	12	None	Interstate	Rural	Level	2	65	No	Divided	0%	A-C	A-C	7.53	0.08	0.13	DMS MP27 (NB)
93-16	17-0	17	None	Interstate	Rural	Level	2	61	No	Divided	0%	A-C	A-C	7.53	0.08	0.13	

* Note: For freight, relevant existing infrastructure includes DMS, Weigh Stations, POE, Rest Areas, Parking Areas, and Climbing Lanes

Table 16: Freight Needs Contributing Factors (Step 3) (continued)

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			
60W-1	138-132	6	None	9	9	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average.
60W-2	132-120	12	None	6	6	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average.
60W-3	120-111	9	High	16	16	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. High SB Travel Time Index (TTI) and NB/SB Planning Time Index (PTI), perhaps attributable to counter location within the roundabout and/or density of driveways just south of the roundabouts.
93-4	200-183	17	Low	15	15	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. SB closure duration is extremely high.
93-5	183-166	17	None	20	20	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average.
93-6	166-149	17	High	15	15	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Need stems from High level NB/SB direction PTI.
93-7	149-132	17	High	11	11	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Need stems from High level NB/SB direction Planning Time Index.
93-8	132-124	8	High	4	4	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Need stems from High level NB direction PTI, potentially attributable to a NB pullout near Nothing , AZ.
93-9	124-106	18	None	27	27	100%	0	0%	0	0%	None	Cane Springs Design (MP 109), construct 4-lane divided highway; programmed in FY 21 H8232 Carrow to Stephens (MP 116), construct 4-lane divided highway; programmed in FY 20	Percent of closures due to incidents/accidents above statewide average. Need stems from Low/Medium level NB/SB PTI.

Table 16: Freight Needs Contributing Factors (Step 3) (continued)

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			
93-10	106-91	15	None	16	15	94%	1	6%	0	0%	None		Percent of closures due to incidents/accidents above statewide average.
93-11	71-67	4	Medium	12	12	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average. Need stems from Medium level NB PTI/TTI.
93-12	67-53	14	None	6	6	100%	0	0%	0	0%	None		Percent of closures due to incidents/accidents above statewide average.
93-13	53-42	11	None	7	7	100%	0	0%	0	0%	None	H8659 Windy Point Road - Mineral Park Road (MP 48), shoulder widening (HSIP); programmed in FY18	Percent of closures due to incidents/accidents above statewide average.
93-14	42-29	13	None	7	7	100%	0	0%	0	0%	None	H8658 11th Street - Windy Point Road (MP 38), shoulder widening (HSIP); programmed in FY17	Percent of closures due to incidents/accidents above statewide average.
93-15	29-17	12	None	7	7	100%	0	0%	0	0%	None	H8657 White Hills Road - 11th Street (MP 28), shoulder widening; programmed in FY18	Percent of closures due to incidents/accidents above statewide average.
93-16	17-0	17	None	16	16	100%	0	0%	0	0%	None	H8408 Willow Beach - White Road (MP 17), construct shoulder widening (HSIP); programmed in FY17	Percent of closures due to incidents/accidents above statewide average.
Statewide HCRS Database Closure Type Average %:						96%		3%		1%			

* Red text indicates segment % exceeds statewide average %.
HSIP: Highway Safety Improvement Program.

NOTES:
- Includes border patrol check points and other closures/restrictions not controlled by ADOT.
- Existing and Planned Infrastructure – Source: 2012 Highway Log, Climbing and Passing Lane Prioritization Study, ADOT 5-year Construction Program.
- Statewide averages determined from Highway Condition Reporting System (HCRS) data for 2009-2013 for ADOT's nine designated strategic corridors.
- Roadway vertical grade, number of lanes, and presence/lack of a climbing lane should be a consideration, if deficiencies are due to Planning Time Index (PTI) or Travel Time Index (TTI)

8.0 SEGMENT REVIEW (STEP 4)

As part of Step 4, the final needs results for each segment were combined (as described in Section 2.4) to estimate the average level of need for each segment of the US 93/US 60 corridor. During the Corridor Goals and Objectives development process for the US 93/US 60 corridor, Safety was identified as an emphasis area within the framework of the State's SHSP. Therefore, a weighting factor of 1.50 was applied to this performance area's needs, as discussed in Section 2.4. **Table 17** summarizes the average level of need for each segment in the corridor. These results, which are derived utilizing a standard performance rating process, provide a means for comparing the level of need across the eleven corridor for which profiles are being prepared. The average level of need for the 16 US 93/US 60 corridor segments is displaced graphically in **Figure 7**.

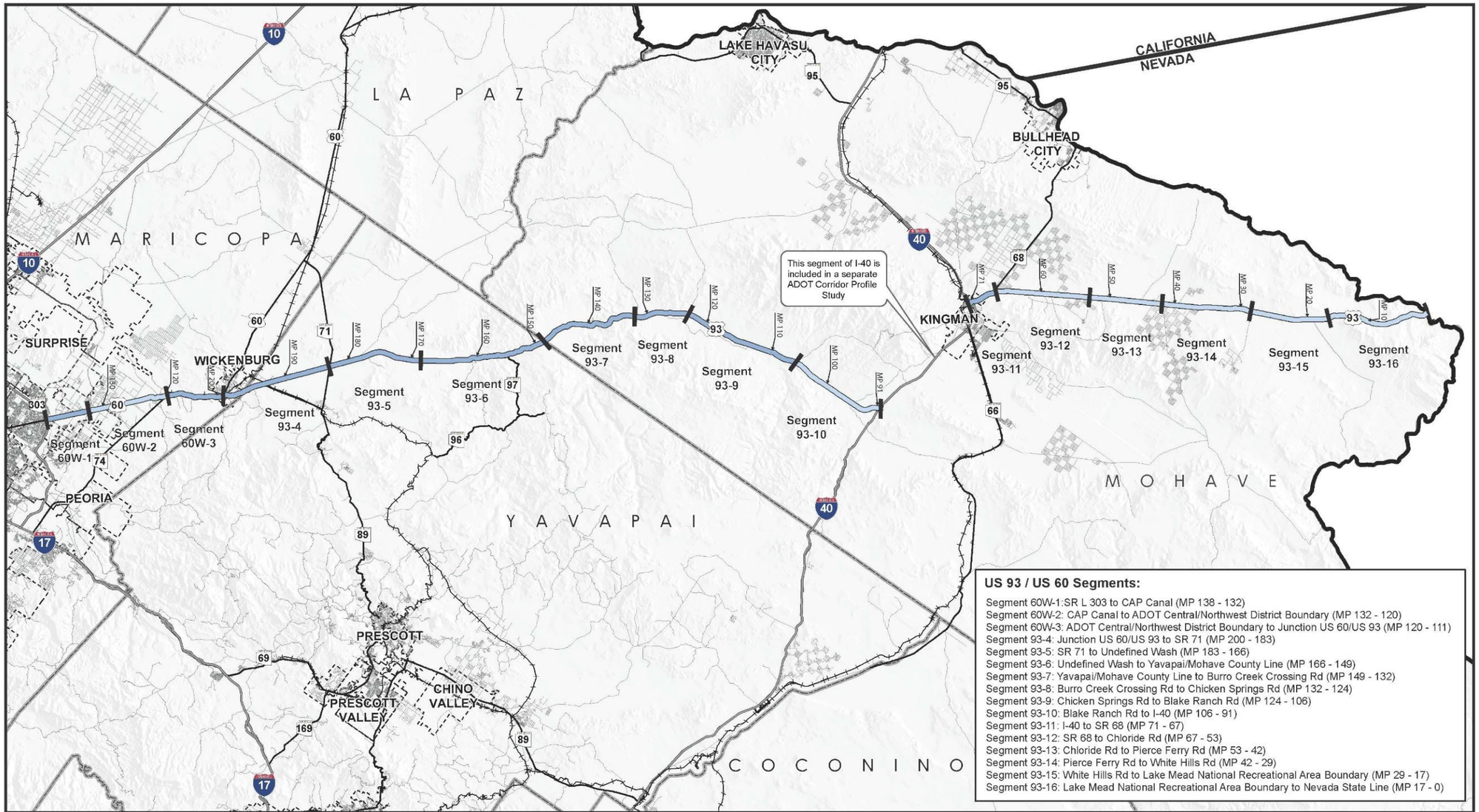
Table 17: Segment Needs Summary

Performance Area	Segment															
	60W-1	60W-2	60W-3	93-4	93-5	93-6	93-7	93-8	93-9	93-10	93-11	93-12	93-13	93-14	93-15	93-16
Pavement	None*	None*	None*	None*	None*	Low	Low	Low	None*	None*	Low	Low	None*	Low	None*	None*
Bridge	Low	Low	None*	None*	Medium	Low	Low	Low	Low	Low	None*	Low	None*	None*	None*	None*
Mobility	Low	Low	Medium	Low	N/A	Low	Low	None*	Low	None*	Low	Low	None*	Low	Low	None*
Safety*	High	Low	High	High	High	Low	Low	None*	High	None*	High	Low	High	Medium	Low	Low
Freight	None*	None*	High	Low	N/A	High	High	High	None*	None*	Medium	None	None*	None*	None*	None*
Average Need (0-3)	1.08	0.62	1.85	1.15	1.23	1.46	1.46	1.23	1.08	0.15	1.54	0.77	0.69	0.85	0.55	0.23

Need Category	Average Need Range
Low	0.10 - 1.00
Medium	1.00 - 2.00
High	> 2.00

**A segment need rating of 'None' does not indicate there is no need on that segment rather that the performance scores of that segment (based on data available for this study) meet established thresholds for strategic investment*

Figure 7: Needs Summary



Average Need (0-3)	60W-1	60W-2	60W-3	93-4	93-5	93-6	93-7	93-8	93-9	93-10		93-11	93-12	93-13	93-14	93-15	93-16
	1.08	0.62	1.85	1.15	1.23	1.46	1.46	1.23	1.08	0.15		1.54	0.77	0.69	0.85	0.55	0.23

9.0 CORRIDOR NEEDS (STEP 5)

Step 5 translates the performance-based needs into corridor needs that are "actionable." Identification of corridor needs is intended to facilitate development of solutions (projects, initiatives, countermeasures, and programs) to improve corridor performance through strategic investments in preserving, modernizing, and/or expanding the corridor. Corridor needs were developed through a segment-by-segment review of needs and contributing factors. This review also identified overlapping, common, and contrasting needs across performance areas.

Figure 8 shows the corridor need locations for each performance area and programmed projects for fiscal year (FY) 2016-2020. Programmed projects have not yet been constructed and may address identified needs or be modified as part of the development of strategic investments.

For additional detail on specific needs by location, refer to the information provided in Step 3 for each corridor segment.

9.1 Description of Needs by Performance Area

Pavement Needs

The Pavement Performance Area is not an emphasis area for the US 93/US 60 corridor. Six of 16 segments of the corridor, representing 73 miles (35.3%), exhibit "Low" level of needs in Pavement Performance. These segments include:

- Segment 93-6 MP 11166 – 149
- Segment 93-7 MP 149 – 132
- Segment 93-8 MP 132 – 124
- Segment 11 MP 71 – 67
- Segment 12 MP 67 – 53
- Segment 14 MP 42 – 29

Pavement hot spot failure needs were identified along the corridor, including areas that have levels of historical investment. Hot spots that will be addressed by a programmed project are not included.

- Hot Spots Failures
  - Segment 6 - NB MP 153-149
  - Segment 7 – SB MP 133-132
  - Segment 8 – SB MP 132-130
  - Segment 11 – NB MP 71-70
  - Segment 12 – SB MP 61-60
  - Segment 14 – SB MP 35-34 and MP 33-32
- Both Low PSR, and Composite scores
  - Segment 6 - NB MP 153-149
  - Segment 11 – NB MP 71-70
- Low Pavement Distress Index (PDI) and Composite scores
  - Segment 6 – NB MP 152-149
  - Segment 7 – SB MP 133-132
  - Segment 8 – SB MP 132-130
  - Segment 12 – SB MP 61-60
  - Segment 14 – SB MP 35-34 and MP 33-32
- The following segments were observed to have high level of historical investment with multiple mill and overlay projects and reconstruction:
  - Segment 1
  - Segment 2
  - Segment 9
  - Segment 10
  - Segment 11
  - Segment 12
  - Segment 15
  - Segment 16

Bridge Needs

The Bridge Performance Area is not an emphasis area for the US 93/US 60 corridor. Seven of 16 corridor segments exhibit a "Low" level of need and one exhibits a "Medium" level of need. The segments include:

- Low Level of Need
  - Segment 60W-1 MP 138 – 132
  - Segment 93-6 MP 166 – 149
  - Segment 93-7 MP 149 – 132
  - Segment 93-8 MP 132 – 124
  - Segment 93-9 MP 124 – 106
  - Segment 93-10 MP 106 – 91
  - Segment 93-12 MP 67 – 53
- Medium Level of Need
  - Segment 93-5 MP 183 – 166

Four of 82 bridges exhibit high levels of historical bridge maintenance investment:

- SR 68 TI Overpass – NB (#2486) MP 67.06
- Wash Bridge – NB (#2365) MP 64.63
- Cerbet Wash Bridge (#1576) MP 60.24
- Detrital Wash Bridge (#1916) MP 35.8

There are no programmed projects for existing bridges.

Key contributing factors/needs of the Performance Area are summarized below.

- McMicken Dam Floodway Bridge has a structural evaluation rating of 5.
- Morristown RR Overpass has a deck rating of 5

- Date Creek Bridge has a deck rating of 5.
- Big Jim Wash Bridge has deck and structural evaluation ratings of 5.
- Burro Creek Bridge has a deck rating of 5.
- Big Sandy River Bridge has a deck rating of 5.
- Cane Springs Bridge has superstructure and structural evaluation ratings of 5.
- Natural Corral Bridge gas a structural evaluation rating of 5.
- Kabba Wash Bridge has superstructure and structural evaluation ratings of 5.
- Wash Bridge has a structural evaluation rating of 5.

Mobility Needs

The Mobility Performance Area is not an emphasis area for the US 93/US 60 corridor. Twelve of the 16 segments of the corridor exhibit a "Low" level of need and one exhibits a "Medium" level of need. The segments include:

- Low Level of Need
  - Segment 60W-1 MP 138 – 132
  - Segment 60W-2 MP 132 – 120
  - Segment 93-4 MP 200 – 193
  - Segment 93-5 MP 183 – 166
  - Segment 93-6 MP 166 – 149
  - Segment 93-7 MP 149 – 132
  - Segment 93-8 MP 132 – 124
  - Segment 93-9 MP 124 – 106
  - Segment 93-11 MP 71 – 67
  - Segment 93-12 MP 67 – 53
  - Segment 93-14 MP 42 – 29
  - Segment 93-15 MP 29 – 17
- Medium Level of Need
  - Segment 60W-3 MP 120 – 111

Mobility needs are summarized below for specific focus areas of the US 93/US 60 corridor.

- The number of closures in the US 93/US 60 corridor, due to incidents/accidents, are above the statewide average in all segments of the corridor.
- No closures, due to obstructions/hazards or weather (e.g., flooding) are reported to have occurred in the corridor.
- Programmed improvements to enhance Mobility Performance are adopted for the following segments with a Low level of need:
  - Segment 93-9 – H8232, Carrow to Stephens (MP 116): construct a 4-lane divided highway is programmed for FY 20; Cane Springs Design (MP 109): construct a 4-lane divided highway is programmed for FY 21.
  - Segment 93-14 – H8658, 11th Street - Windy Point Road (MP 38): shoulder widening under the Highway Safety Improvement Program (HSIP) is programmed for FY17.
  - Segment 93-15 – H8657 White Hills Road - 11th Street (MP 28): shoulder widening is programmed for FY18.

Safety Needs

The Safety Performance Area is an emphasis area for the US 93/US 60 corridor. Fourteen of the 16 corridor segments exhibit needs relative to Safety Performance: six of the segments have a Low level of need; one has a Medium level of need; and seven have a High level of need. Segments for which safety needs have been determined are identified below. Key characteristics or attributes of crashes (i.e., cause of crash and cause of injury) that exceed statewide averages have been highlighted.

- Low Level of Need
  - Segment 60W-2 MP 132 – 120
    - Collision with Another Vehicle
    - Collision with Pedestrian
    - Angle Crash
    - Inattention/Distraction
    - Improper Turn
    - Dark-Unlighted Conditions
    - Dry Conditions
    - Motor Vehicle in Transport
    - Collision with Animal
    - Overturning/Rollover
    - Under the Influence of Drugs or Alcohol
    - Illness
    - Air Bag Deployed/Shoulder-Lap Belt
  - Segment 93-6 MP 166 – 149
    - Overturning/Rollover
    - Non-Collision
    - Single-Vehicle Crash
    - Head-On Collision
    - Excessive Speed
    - Inattention/Distraction
    - Dark-Unlighted Conditions
    - Wet Conditions
    - Ran Off The Road (Left and Right)
    - Lane Departure
  - Segment 93-7 MP 149 – 132
    - Collision with Fixed Object
    - Non-Collision
    - Single-Vehicle Crash
    - Excessive Speed
    - Dark-Unlighted Conditions
    - Ice/Frost Conditions
    - Water (standing or running) on the Roadway

- Ran Off the Road (Right)
- Fatigued/Fell Asleep
- Air Bag Deployed/Shoulder-Lap Belt

- Segment 93-12 MP 67 – 53
  - Overturning/Rollover
  - Non-Collision
  - Single-Vehicle Crash
  - Angle Crash
  - Excessive Speed
  - Failure to Yield the Right-of-Way
  - Daylight Conditions
  - Slush Conditions
  - Water (standing or running) on the Roadway
  - Ran Off the Road (Left and Right)
  - Motor Vehicle in Transport
  - Fatigued/Fell Asleep
  - Non-Use of Restraints

- Segment 93-15 MP 29 – 17
  - Overturning/Rollover
  - Collision with Another Vehicle
  - Single-Vehicle Crash
  - Excessive Speed
  - Failure to Yield the Right-of-Way
  - Daylight Conditions
  - Dark-Unlighted Conditions
  - Dry Conditions
  - Ran Off the Road (Left and Right)
  -

- Segment 93-16 MP 17 – 0
  - Overturning/Rollover
  - Collision with Fixed Object
  - Non-Collision
  - Single-Vehicle Crash
  - Excessive Speed
  - Daylight Conditions
  - Dark-Unlighted Conditions
  - Wet Conditions
  - Ran Off the Road (Left and Right)
  - Land Departure
  - Illness
  - Non-Use of Restraints

- Medium Level of Need
  - Segment 93-14 MP 42 – 29
    - Overturning/Rollover
    - Single-Vehicle Crash
    - Excessive Speed
    - Dry Conditions
    - Wet Conditions
    - Ran Off the Road (Left)
    - Equipment Failure
    - Fatigued/Fell Asleep

- High Level of Need
  - Segment 60W-1 MP 138 – 132
    - Collision with Another Vehicle
    - Overturning/Rollover
    - Collision with Animal
    - Rear-End Collision
    - Inattention/Distraction
    - Dark-Unlighted Conditions
    - Wet Conditions
    - Non-Use of Shoulder/Lap Belt

  - Segment 60W-3 MP 120 – 111
    - Collision with Another Vehicle
    - Overturning/Rollover
    - Single-Vehicle Crash
    - Improper Left Turn
    - Improper Turn
    - Daylight Conditions
    - Wet Conditions
    - Ran Off the Road (Left)
    - Motor Vehicle in Transport
    - Non-Use of Restraints

  - Segment 93-4 MP 200 – 183
    - Collision with Another Vehicle
    - Collision with Pedestrian
    - Head-On Collision
    - Rear-End Collision
    - Drove in Opposing Lane
    - Daylight Conditions
    - Dawn Conditions
    - Dry Conditions
    - Ran Off the Road (Left)
    - Lane Departure
    - Air Bag Deployed/Shoulder-Lap Belt

  - Segment 93-5 MP 183 – 166
    - Collision with Another Vehicle
    - Head-On Collision

- Sideswipe (opposite direction)
- Drove in Opposing Lane
- Dark-Unlighted Conditions
- Wet Conditions
- Ice/Frost Conditions
- Lane Departure
- Motor Vehicle in Transport
- Air Bag Deployed/Shoulder-Lap Belt

- Segment 93-9 MP 124 – 106
  - Overturning/Rollover
  - Collision with Fixed Object
  - Single-Vehicle Crash
  - Head-On Collision
  - Excessive Speed
  - Failure to Yield the Right-of-Way
  - Daylight Conditions
  - Dark-Unlighted Conditions
  - Wet Conditions
  - Lane Departure
  - Ran Off the Road (Left)
  - Equipment Failure
  - Under the Influence of Drugs or Alcohol
- Segment 93-11 MP 71 – 67
  - Excessive Speed
  - Roadway Obstruction
  - Insufficient Data – Sample Size Too Small
- Segment 93-13 MP 53 – 42
  - Overturning/Rollover
  - Collision with Pedestrian
  - Single-Vehicle Crash
  - Angle Crash
  - Excessive Speed
  - Inattention/Distraction
  - Failure to Yield the Right-of-Way
  - Daylight Conditions
  - Dawn Conditions
  - Dry Conditions
  - Snow Conditions
  - Ran Off the Road (Right)
  - Under the Influence of Drugs or Alcohol

Freight Needs

The Freight Performance Area is not an emphasis area for the US 93/US 60 corridor. Six of 16 segments of the corridor exhibit needs: one has a Low level of need; one has a Medium level of need; and four have a High level of need.

Similar to the Mobility Performance Area, road closures critically impact freight performance. These are summarized below that specify focus areas for the SR 95 corridor.

- The number of closures on US 93/US 60 corridor, due to incidents/accidents, are above statewide average in every segment except Segment 93-10. Operations in no segments were affected/impacted by obstructions/hazards.
- There were no weather-related roadway closures in the corridor.
- Low trip reliability in the corridor occurs in the following areas:
  - US 60 MP 120-111
  - US 93 MP 166-132
  - US 93 NB MP 132-124
  - US 93 NB MP 71 – 67

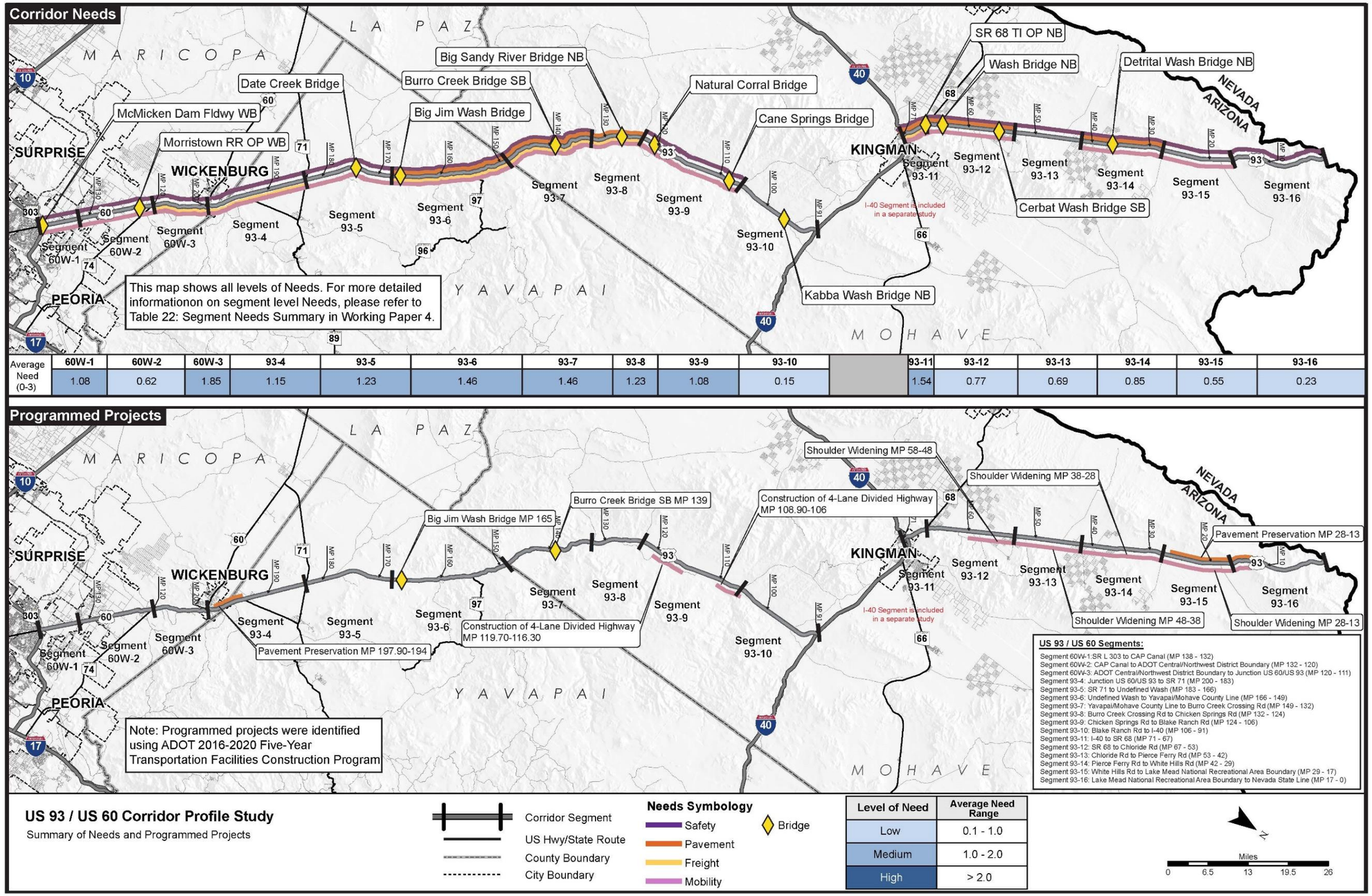
9.2 Overlapping Needs

This section identifies overlapping performance needs of the US 93/US 60 corridor, which provides guidance to develop strategic solutions that address more than one performance area. Completing projects that address multiple needs may present the opportunity for cost savings as well as more effectively improving overall performance. The map in **Figure 8** shows the extent of overlapping needs. Overlapping needs are summarized below.

- US 93 MP 166 – 132 have overlapping needs in all five performance areas. Two pavement hotpots exist in this area: MP 153-149 NB and MP 133-132 SB. The Big Jim Wash Bridge and Burro Creek Bridge are within this area. Low planning time reliability and road closures impact Mobility and Freight performance. Safety needs may be attributed to overturning and fixed object collision, with a hot spot at MP 147 - 146.
- US 93 MP 67 - 53 have overlapping needs in the Pavement, Bridge, Mobility, and Safety areas. A pavement hotspot exists at MP 61-60 SB and Wash Bridge is located in this area. Mobility is impacted by roadway closures and poor bicycle accommodations. Safety needs may be attributed to overturning and angle collisions.
- US 93 MP 71 – 67 have overlapping needs in the Pavement, Mobility, Safety, and Freight areas. A pavement hotspot exists at MP 71-70 NB. Mobility and Freight are impacted by roadway closures and low travel time and planning time reliability.
- US 93 MP 132 – 124 have overlapping needs in the Pavement, Bridge, and Freight areas. A pavement hotspot exists at MP 132-130 SB and Big Sandy River Bridge is located in this area. Mobility and Freight are impacted by roadway closures and low planning time reliability.
- MP 42 - 29 have overlapping needs in the Pavement, Mobility, and Safety areas. Pavement hotspots exist at MP 35-34 SB and MP 33-32 SB. Mobility is impacted by roadway closures and poor bicycle accommodation. Safety needs may be attributed to overturning collisions.

- US 60 MP 138 - 120 and US 93 MP 124 - 106 have overlapping needs in Bridge, Mobility, and Safety. McMicken Dam Floodway Bridge, Morristown Railroad Overpass Bridge, Cane Springs Bridge, and Natural Corral Bridge are located in this area. Mobility is impacted by roadway closures.
- US 60 MP 120 - 111 and US 93 MP 200 - 183 have overlapping needs in Mobility, Safety, and Freight. Mobility and Freight are impacted by roadway closures and low travel time and planning time reliability. Safety needs may be attributable to run-off-road collisions and collisions with other vehicles.
- US 93 MP 183 – 166 have overlapping needs in Bridge and Safety. Date Creek Bridge is located in this area. Safety needs may be attributable to head-on and sideswipe collisions associated with improper passing.
- US 93 MP 29 - 17 have overlapping needs in Mobility and Safety. Mobility is impacted by roadway closures. Safety needs may be attributable to run-off-road and overturning collisions.

Figure 8: Summary of Needs and Programmed Projects



10.0 NEXT STEPS

The principal objective of the corridor profile study is to identify strategic solutions (investments) that are performance-based to ensure available funds maximize the performance of the State's most strategic transportation corridors.

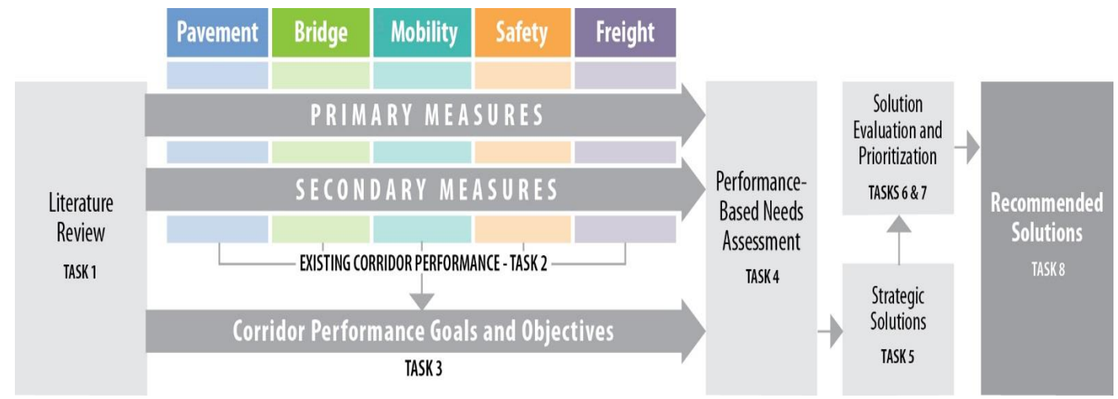
The actionable performance needs documented in Working Paper 4 will serve as a foundation for developing strategic investments for corridor preservation, modernization, and expansion. Strategic investments are not intended to be a substitute or replacement for traditional ADOT project development processes, where various candidate projects are developed for consideration in programming in the P2P Link process. Rather, strategic investments are intended to complement ADOT's traditional project development processes with non-traditional projects to address performance needs in one or more of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Strategic investments will be considered along with other candidate projects in the ADOT programming process.

Illustrative examples of strategic investments are:

- *Projects that address significant performance needs.* Projects that address a Medium or High performance need identified in the corridor profile study that have a high probability to significantly improve corridor performance may be identified as strategic investments. These projects may include a project in the current program, a planned project not in the current program, or a new project recommended in the corridor profile study.
- *Projects that address needs in multiple performance areas.* For example, a single project to rehabilitate the roadway pavement surface and multiple bridge decks on a segment of roadway would address multiple performance areas (Pavement and Bridge) and could result in significant cost savings in traffic control (as compared to traffic control costs for separate projects to rehabilitate pavement surface and bridge decks). Another example would be that a travel lane pavement rehabilitation project could be expanded to include shoulder rehabilitation and rumble strip construction to reduce safety needs associated with road and lane departures.
- *Projects that address repetitive issues.* Higher-cost strategic capital investments to correct repetitive maintenance issues can result in life cycle cost savings by reducing maintenance costs over time. For example, if there is a history of high levels of maintenance activities at a particular bridge or segment of pavement, there may be an underlying need that, if addressed properly, will reduce the need for future maintenance.
- *Phased projects that achieve a long-term improvement objective.* A life cycle cost analysis may recommend total pavement reconstruction to address a subgrade failure; however, the cost of reconstruction may not be feasible from a funding perspective. A strategic investment may be recommended to extend the life of the current pavement infrastructure until funding availability allows for full pavement reconstruction.
- *Projects that utilize innovative solutions to extend the operational life of infrastructure or improve performance.* Innovative solutions that modernize a segment of roadway may be identified as strategic investments. Examples of modernization activities include: widening of shoulders, access control, replacement/enhancement of infrastructure to address obsolescence, hazard elimination, and the application of various traffic control and management technologies to improve traffic flow at a lower cost than traditional expansion solutions.

Strategic investments will be developed in Task 5 of the corridor profile study to address specific performance needs of US 93/US 60. In addition, meetings will be conducted with ADOT staff to discuss alternatives for addressing infrastructure performance needs that can be evaluated through a systematic analysis of life cycle costs and risks. **Figure 9** shows the tasks in the corridor profile study process.

Figure 9: Corridor Profile Study Process



APPENDIX A: METHODOLOGIES FOR DETERMINING PERFORMANCE AREA NEEDS (STEPS 1-3)

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 Task 2/WP#2 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 Task 2/WP#2 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
5.0	Fair	Medium	Lower 1/3rd of Fair and top 1/3rd of Poor Performance
	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 Task 2/Working Paper #2. 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 Task 2 - 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 Task 2/Working Paper #2. 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 2014 for which the 2014 HPMS data used for traffic volumes would not include. Any completed or under construction roadway project after 2014 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 2009-2013 on ADOT's 11 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

Step 1: Initial Needs

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 Task 3. 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 Task 2. 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 are 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" has 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.

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 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 (2009 – 2013). Any completed or under construction roadway project after 2013 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-	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%

Motorized Travelers	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 Task 2 (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 Task 2. 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 Task 4 – 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 Task 4 – 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

Step 1: Initial Needs

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 Task 2. 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.

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 need from the Step 1 template to the Step 2 template.

Step 2.2

Note any truck height restriction hot spots (clearance < 16') 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 Task 4.

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 Task 4.

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 11 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 Task 4. 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 Task 4.

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