

What Moves You Arizona

Arizona Long Range Transportation Plan Update

Final Working Paper #3:

Existing Conditions, Deficiencies and Future Needs

February 20, 2017



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Acronyms

- ADOT: Arizona Department of Transportation
- AIP: Airport Improvement Program
- AWOS: Automated Weather Observing System
- CCTV: Closed-circuit Television System
- COG: Council of Government
- DMS: Dynamic Message Sign
- GA: General Aviation
- HERS-ST: Highway Economic Requirements System – State Version
- HPMS: Highway Performance Monitoring System
- ICM: Integrated Corridor Management
- IRI: International Roughness Index
- ITS: Intelligent Transportation System
- LED: Light-emitting diode
- MAG: Maricopa Association of Governments
- MPO: Metropolitan Planning Organization
- NBI: National Bridge Inventory
- NBIAS: National Bridge Investment Analysis System
- NHS: National Highway System O&M: Operations and Maintenance
- PAG: Pima Association of Governments
- SASP: State Airports System Plan
- SD: Structurally Deficient
- SHS: State Highway System
- SVMPO: Sierra Vista Metropolitan Planning Organization
- WMYA: What Moves You Arizona

1. INTRODUCTION & SUMMARY

This working paper documents the statewide transportation needs estimates that were established to support development of What Moves You Arizona (WMYA) 2040. The needs estimates cover ADOT's responsibility for highway investment over the 25-year WMYA 2040 planning horizon (2016 – 2040) and identify overall statewide needs for non-highway modes, where funding is either the sole or partial responsibility of local governments. The highway needs include the estimated costs for pavement and bridge preservation, modernization (upgrading existing highways, safety improvements, and intelligent transportation systems (ITS) deployment) and expansion (added capacity, new alignments, and new interchanges) on Arizona's State Highway System (SHS). In addition, the needs identify optimal spending on operations and maintenance (O&M) for the SHS (e.g., patching potholes, fixing guardrails, mowing, and snow removal), as well statewide non-highway transportation capital spending needs for public transportation, non-motorized transportation (bicycle and pedestrian), passenger rail, and aviation.

As identified in **Table 1**, estimated 25-year statewide transportation spending needs total **\$89.5 billion** in constant 2016 dollars.¹ This includes **\$53.3 billion** to fully meet all preservation, modernization, and expansion needs on the SHS, **\$8.7 billion** to address all SHS O&M needs, and **\$36.3 billion** to address or support non-highway transportation needs.

Table 1: Statewide Multimodal Spending Needs: 2016-2040 (all figures in millions of 2016 \$)

Investment Type		Needs
Highway & Bridge Needs		
Preservation	Pavement	\$7,902
	Bridge	\$1,334
	Subtotal	\$9,236
Modernization	Highways	\$4,273
	Bridge	\$400
	Safety	\$1,934
	ITS/Technology	\$3,355
	Subtotal	\$9,962
Expansion	Existing Highway Expansion	\$12,561
	New Roads	\$8,770
	New Bridges	\$403
	New Interchanges	\$2,320
	Key Commerce Corridors ²	\$10,000
	Subtotal	\$34,054
Total Highway & Bridge Capital Needs		\$53,252
Operations & Maintenance		\$8,694
Non-highway Needs		
Public Transit	Rural Transit	\$1,702
	Urban Transit	\$13,107
	Total Public Transportation	\$14,809
Bicycle and Pedestrian		\$913
Passenger Rail		\$6,180
Aviation		\$14,390
Total Non-highway		\$36,292
Total Highway & Non-highway Needs		\$89,544

¹ Total "Statewide Transportation spending needs" include needs for the SHS and non-highway modes; it does not include needs associated with locally-owned highways, roads, and streets.

² This figure reflects identified costs from Key Commerce Corridor studies not addressed in other needs line items.

2. ROADWAY NEEDS

The WMYA 2040 highway needs estimates focus on the investments required to maintain and improve the roadways that make up Arizona’s SHS over the next 25 years. Needs associated with bridges, both on and off the SHS, are calculated separately and are included in the next section. Developing needs estimates for something as large and complex as a statewide highway system typically requires the integration of both findings from technical analyses and more subjective results from various forms of plans and studies, as well as from expert opinion. As described below, this is the case with the WMYA 2040 highway needs estimates, which were developed by combining and corroborating technical analysis findings with inputs from ADOT Key Corridor Studies, Metropolitan Planning Organization (MPO) and Council of Government (COG) plans, and ADOT technical staff.

2.1 Highway Needs Estimation Method

The main source of highway needs estimates for WMYA 2040 is the HERS-ST (Highway Economic Requirements System - State Version) model, which estimates the investment required to achieve certain highway system performance levels based on general engineering principles and Arizona-specific design standards and unit costs. HERS-ST is a sample-based tool designed to select the most economically worthwhile projects. While HERS-ST is widely accepted as a means for estimating statewide highway needs, it provides a somewhat blunt analysis based on sampling data that does not capture several types of needs that are identified through more detailed safety, regional, corridor, and location-specific studies. For this reason, the HERS-ST findings were expanded upon to incorporate additional roadway investment needs such as new roads, passing/climbing lanes, new or reconstructed interchanges, and many of the capacity expansion improvements included in MPO plans and the Key Commerce Corridor studies. Additional information about the methodology and assumptions used to develop the roadway needs estimates for WMYA 2040 are provided in **Appendix A**.

2.1.1 Arizona Highway System Database

The highway data used for the HERS-ST analysis came from the Arizona 2014 Highway Performance Monitoring System (HPMS) database. This database provides data on the existing SHS including geometric, structural, and operational features, as well as traffic projections through 2040. ADOT staff updates the state-maintained roadway system component of the HPMS annually, and it is used by FHWA to develop national-level needs analyses, fiscal projections, and performance studies for Congress. The 2014 HPMS database assumes a population growth rate of 2.2 percent, which is consistent with the growth rate developed by the State Demographer’s “high series” projection.

2.1.2 Minimum Tolerable Conditions for Arizona Highways

In applications of HERS-ST, improvement needs are identified if a highway section is projected to fall below “minimum tolerable condition” thresholds during the analysis period. These thresholds are set in HERS-ST based on ADOT’s assumptions about the level of congestion, pavement conditions, and other considerations that the travelling public in Arizona will reasonably tolerate. They also reflect engineering inputs about acceptable lane widths, shoulder conditions, and cost effectiveness principles, which vary for facilities depending on their functional classification, traffic volume, and location (as defined by terrain and rural/urban characteristics). When current conditions are found to be below the minimum

tolerable thresholds or future conditions within the planning horizon are forecasted to breach a threshold, a highway segment is classified by HERS-ST as a deficiency (i.e., need) that must be addressed.

2.1.3 Types of Highway Needs Defined by HERS-ST

Results from the HERS-ST model analysis are grouped into three major improvement categories:

- **Preservation** is the regular maintenance and resurfacing of a roadway. When a roadway's pavement deteriorates to unacceptable levels (below minimum tolerable conditions), HERS-ST determines if resurfacing is the optimal improvement choice for maintaining the integrity of the roadway. Preservation is the most common improvement type and typically accounts for the greatest number of lane miles³ that are identified as needing improvement during the planning horizon.
- **Modernization** improvements address functional, safety, and geometric roadway deficiencies. Improvements such as widening lanes (but not adding capacity), widening shoulders, and complete roadway reconstruction are examples of modernization improvements. Roadways identified for reconstruction cannot be repaired by resurfacing alone and must be rebuilt. Additional needs for safety-specific and technology projects are not identified by HERS-ST and are identified through other studies and discussed in **Section 4**.
- **Expansion** improvements add roadway lanes to existing facilities to address or mitigate capacity deficiencies. If projected traffic volumes create congestion in excess of minimum tolerable conditions, the HERS-ST model considers adding new lanes. HERS-ST is programmed to add lanes only if doing so is technically feasible. Widening feasibility is coded into the HPMS dataset by roadway segment or defined by functional classification. Expansion needs that would be met through new roads and the addition of new interchanges to existing facilities are not identified by HERS-ST, nor does HERS-ST effectively consider the need for many of the capacity improvement requirements defined in the Key Commerce Corridor studies. These additional capacity needs are discussed in **Section 2.3.3**.

2.2 Arizona's Current Highway Conditions

ADOT reports the condition of its roadway pavement based on the percentage of centerline miles achieving desired thresholds for International Roughness Index (IRI)⁴, rutting, and cracking. Due to the importance of the Interstate System and level of traffic it carries, ADOT sets higher pavement standards (i.e., lower IRI thresholds for "good," "fair," and "poor") for it versus the non-Interstate portion of the SHS. While Arizona generally has good pavement conditions, the State's IRI ratings have slowly and steadily worsened over the past decade (see **Figure 1** and **Figure 2** for Arizona's pavement condition

³ The terms "centerline miles" and "lane miles" are both used in this report. Centerline miles reflect the total length of a road from its starting point to its end point, but the measure is not affected by the number of lanes. Lane miles are calculated by multiplying centerline mileage of a road by the number of lanes it has.

⁴ The International Roughness Index (IRI) is a scale for measuring and quantifying the smoothness of roadways.

trends). Comparing these two graphs shows that the Interstate System has a higher percentage of “good condition” miles than does the non-Interstate portion of the SHS. Details of the thresholds for the highway analysis are provided in **Appendix A**.

Figure 1: Arizona Interstate Pavement Conditions

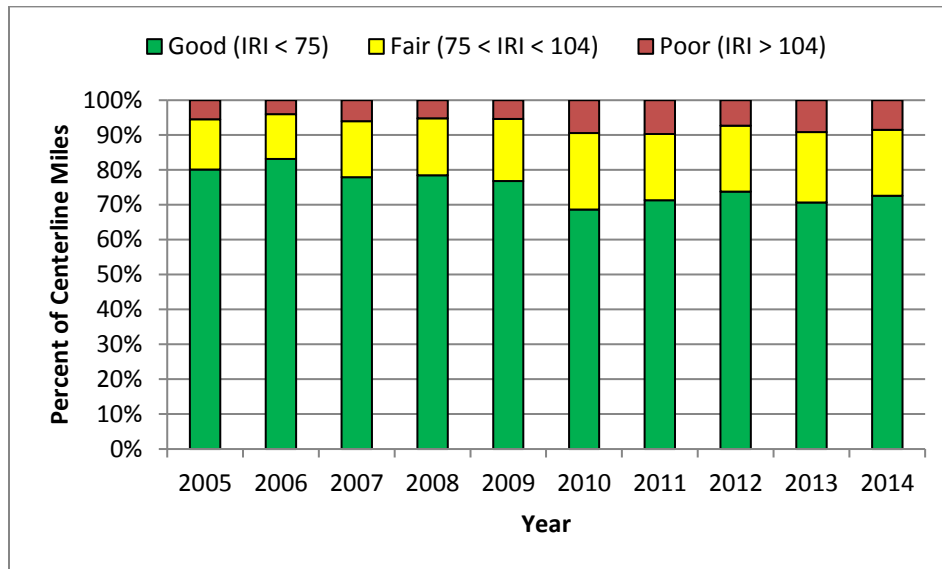
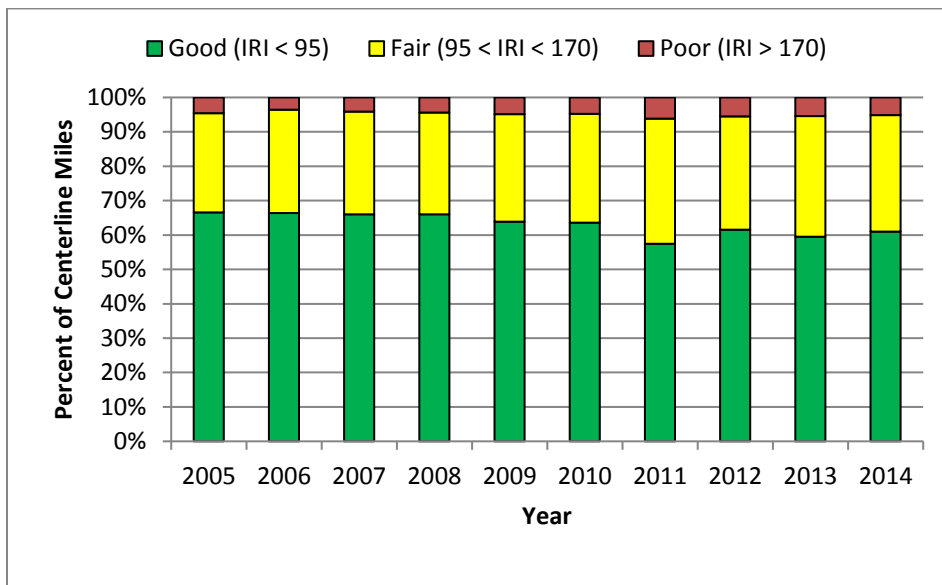
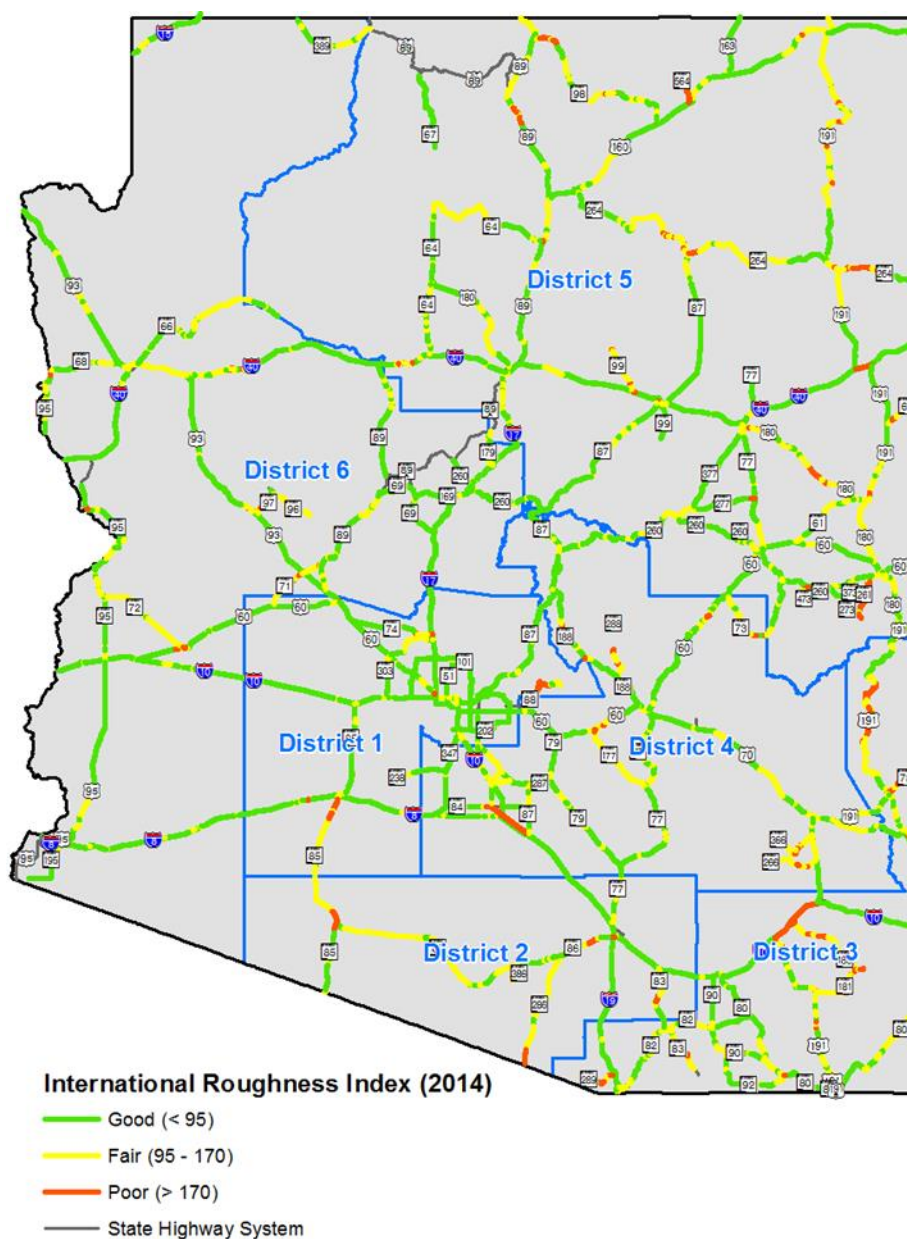


Figure 2: Arizona Non-Interstate Pavement Conditions



Source: ADOT Staff, October 2015

Based on recent HPMS data, 86 percent of Arizona’s rural Interstate centerline miles have an IRI of 95 or better, ranking Arizona 17th nationally. In comparison, approximately 86 percent of Arizona’s urban Interstate lane miles have an IRI of 95 or better, placing Arizona 10th among states. To illustrate how this data translates into actual roadway conditions throughout the State, **Figure 3** shows highway conditions by geographic location.

Figure 3: Statewide Pavement Conditions⁵

Source: ADOT Staff, October 2015

2.3 Arizona's Future HERS-ST Defined Highway Needs

Based on HERS-ST analysis and minor refinements that reflect findings identified in other plans, Arizona's total estimated needs on the current SHS over the next 25 years are **\$24.74 billion**. As shown in **Table 2** and **Figure 4**, this total need includes **\$7.9 billion⁶** (32%) in preservation needs, **\$4.27 billion** (17%) in modernization needs, and **\$12.56 billion** (51%) in expansion needs. Over the course of the 25-year planning horizon, approximately 11,400 SHS lane miles (62% of the 18,488 lane miles that comprise

⁵ The pavement ratings illustrated in **Figure 3** are based on applying ADOT's IRI thresholds for non-Interstate pavement conditions to the entire system, including the Interstate System.

⁶ The roadway preservation figure reflects \$7.74 billion in HERS-ST preservation needs and \$160 million in MAG-identified preservation needs.

the total SHS) will require some form of preservation treatments, approximately 7,100 lane miles (38% of total SHS lane miles) will need modernization improvements, and approximately 2,800 lane miles (15% of total SHS lane miles) will require added capacity.⁷

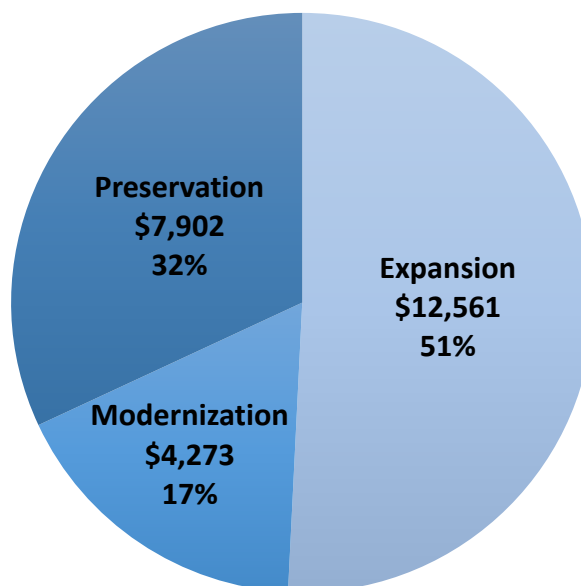
Table 2: Projected Arizona Current SHS Highway Needs: 2016-2040

(all cost figures in millions of 2016\$)

Improvement Type	Total Costs	Average Annual Costs	Lane Miles Addressed
Expansion	\$12,561	\$502	2,832
Modernization	\$4,273	\$171	7,117
Preservation	\$7,902	\$316	11,412
Total	\$24,736	\$989	21,361

Figure 4: SHS Needs by Improvement Type

(all costs in millions of 2016\$)



2.3.1 WMYA 2035 vs. WMYA 2040 Total Roadway Needs Estimates

Table 3 provides a comparison between the new estimated 25-year needs and number of lane miles requiring investment and similar estimates that were developed as part of WMYA 2035. (WMYA 2035 needs are converted to constant 2016 dollars to enable an “apples-to apples” comparison.)

Table 3: WMYA 2035 vs. WMYA 2040 Highway Needs Estimates

Improvement Type	WMYA 2035 Needs (billions)	WMYA 2040 Needs (billions)	% Change Needs	WMYA 2035 (lane miles)	WMYA 2040 (lane miles)	% Change Lane Miles
Expansion	\$14.1	\$12.6	-11%	4,238	2,832	-33%
Modernization	\$5.0	\$4.3	-14%	8,778	7,117	-19%
Preservation	\$7.6	\$7.9	4%	14,015	11,412	-19%
Total	\$26.7	\$24.8	-7%	27,031	21,361	-21%

The results show three important considerations: 1) the WMYA 2040 needs estimate reflects an overall reduction in the total lane miles requiring some form of investment; 2) despite the 19% reduction in the number of lane miles requiring preservation treatment, the cost of addressing these preservation needs increased slightly; and 3) while total lane miles requiring investment dropped by 21%, total estimated needs only dropped by 7%. The reductions in lane miles requiring investment can be attributed to

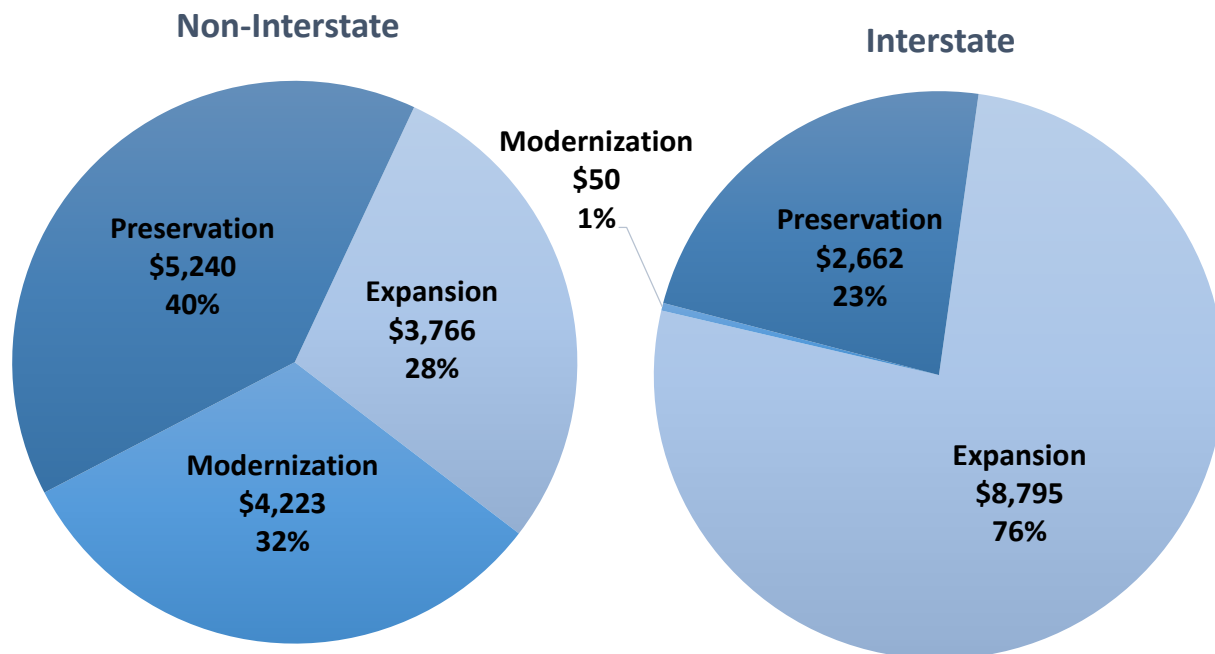
⁷ The numbers of lane miles requiring different treatment are not mutually exclusive; the same lane miles that require preservation spending may also require modernization and/or expansion investment.

general improvements in conditions over the entire system – particularly the costly portions of the system – since WMYA 2035 was approved. It also is a result of lower traffic growth forecasts and revisions to minimum tolerable conditions that, combined, resulted in decreases in the estimated number of lane miles requiring some form of treatment. The increase in preservation needs and the significant difference between the percent reduction of total lane miles needing investment vs. the percent decline in total investment needs are both largely due to significant increases in unit costs for all types of highway improvement needs, some of which may have been artificially low in the wake of the 2008/09 recession (WMYA 2035 was conducted in 2009-2011). For example, shoulder improvements for large urbanized arterial collectors increased by 70 percent and the upper range for alignment of flat urban Interstate increased by 400 percent.

2.3.2 Interstate VS. Non-Interstate Needs

Based on HERS-ST analysis, total 25-year roadway needs are split relatively evenly (47%/53%) between Interstate and non-Interstate needs. The portion of WMYA 2040 needs associated with Arizona's Interstate System totals **\$11.5 billion**. As shown in **Figure 5**, this is comprised of preservation needs totaling **\$2.6 billion** (23%), modernization needs totaling **\$50 million** (1%), and expansion needs totaling **\$8.8 billion** (76%). Over the 25-year planning horizon, 4,350 lane miles on the Interstate (72% of Arizona's Interstate system) will require preservation treatments (some Interstate segments will require two treatments); approximately 110 lane miles (2%) will need modernization improvements; and 1,574 lane miles (26%) will require increasing capacity (expansion).

Figure 5: Interstate vs. Non-Interstate Needs by Investment Type
(all cost figures in millions of 2016\$)



Estimated WMYA 2040 non-Interstate needs total **\$13.3 billion**. As shown in Figure 5 this figure includes **\$5.2 billion** (39%) for preservation, **\$4.2 billion** (32%) for modernization, and **\$3.8 billion** (29%) for

expansion. Over the 25-year planning horizon, 7,062 lane miles on the non-Interstate system (46%) will require preservation treatments; 7,007 lane miles (46%) will need modernization improvements, and approximately 1,258 lane miles (8%) will require capacity increases (expansion).

2.3.3 Additional Roadway Expansion Needs

HERS-ST cannot be used to estimate needs for new alignment roadways, nor does it identify needs for some categories of expansion improvements on existing facilities such as climbing/passing lanes and new, reconstructed, or reconfigured interchange improvements. To identify these needs, the WMYA 2040 project team worked with ADOT and MPO staff, and pulled from a range of existing documents including the *ADOT Climbing and Passing Lane Prioritization Study*, the *Corridor Profile Studies*, and various MPO and COG regional transportation plans and transportation improvement programs. Based on these sources, an additional **\$10 billion** will required in expansion spending on Key Commerce Corridors, the total cost for new roadway alignments is estimated to be approximately **\$8.77 billion**,⁸ and interchange needs are approximately **\$2.3 billion**. A complete list of the proposed new facilities that make up these needs is included shown in **Appendix B**.

⁸ The MPO and COG plans identify a total of \$8.97 billion of new alignment needs; it was assumed that \$200 million of this figure are for new bridges and are reflected in the bridge expansion needs discussed in **Section 3.3**.

3. BRIDGE NEEDS

3.1 Bridge Needs Estimation Method

Bridge improvement needs on Arizona’s SHS were assessed using FHWA’s National Bridge Investment Analysis System (NBIAS). NBIAS is an investment analysis software tool that predicts bridge repair, rehabilitation, and functional improvement needs with the objective of optimizing bridge condition and performance on a year-by-year basis. NBIAS uses a software application called “Pontis” to determine bridge deterioration over time. NBIAS outputs include bridge needs expressed in terms of dollar investment needs and by the number of bridges; distribution of work done; aggregate and user benefits; benefit-cost ratios for work performed; and physical measures of bridge conditions. This information provides information on the costs to maintain an efficient and reliable State bridge system.

At its core, NBIAS evaluates whether bridges fall below ADOT’s minimum tolerable condition criteria for structures, which vary based on each bridge’s roadway functional class, National Highway System (NHS) status, or traffic volume. For bridges that are projected to fall below the minimum tolerable condition at any time over the analysis period, NBIAS identifies potential corrective improvements needed to bring the bridge back to acceptable condition and estimates the cost of these improvements based on unit construction costs approved by ADOT. Improvements are recommended if anticipated benefits exceed costs.⁹ When the cost of maintaining a bridge exceeds the cost to replace it, NBIAS recommends replacement. Details on assumptions used for the bridge analysis are provided in **Appendix A**.

3.1.1 Arizona Bridge Database

For the development of the WMYA 2040 bridge needs, ADOT’s 2014 National Bridge Inventory (NBI) data was used in NBIAS to summarize the condition of Arizona’s bridges on the SHS. The NBI is a national database maintained by FHWA that tracks information on all roadway bridges and tunnels in the United States. NBI data is often used by state DOTs to review bridge conditions and analyze needed improvements.

3.1.2 Minimum Tolerable Conditions for Arizona Bridges

The minimum tolerable conditions criteria that are applied through NBIAS help to identify bridge improvement needs such as widening, raising, or strengthening. The criteria are specific to Arizona, contain the legal condition standards for each bridge type, and assess considerations such as shoulder width, lane width, and vertical clearance. ADOT design standards were used as inputs for bridge dimensions and engineering specifications that NBIAS applies to determine bridge replacement needs. All values used in the 25-year bridge analysis were reviewed and approved by ADOT Bridge Group engineers and are based on design manuals that reflect ADOT practices. **Appendix A** includes a summary of the minimum tolerable conditions specific to Arizona as well as other assumptions and inputs that were used in NBIAS to determine bridge needs for WMYA 2040.

⁹ Based on coordination with ADOT bridge engineers, the bridge replacement analysis in NBIAS assumes a cost of \$400 per square foot.

3.1.3 Types of Bridge Needs

Results from the NBIAS model analysis are grouped into two primary improvement categories:

- **Preservation** – bridge maintenance, repair, and rehabilitation.
- **Modernization** – widening existing bridge lanes (but not adding capacity), raising bridges to increase vertical clearances, and strengthening bridges to increase load carrying capacity. If needed functional improvement is infeasible because of the bridge design, or impractical because of its inferior structural condition, then a bridge is designated for replacement.

Similar to roadway needs, bridge needs also include an **expansion** category which covers needs for either new bridges or widening existing structures to add lanes. These needs, however, cannot be identified through NBIAS and are, instead, based on bridge expansion needs identified through the Key Commerce Corridors Study and other relevant studies.

3.2 Current Arizona Bridge Conditions

Table 4 summarizes the number of Arizona-owned bridges currently rated as “structurally deficient” (SD). A structurally deficient bridge is one with a component that needs rehabilitation (i.e., the deck, superstructure, or substructure is rated a condition 4 or less on a scale of 1 to 10). For comparison purposes, the table also provides data on non-ADOT bridges in Arizona.

Table 4: Structurally Deficient Bridges in Arizona (based 2014 NBI data)

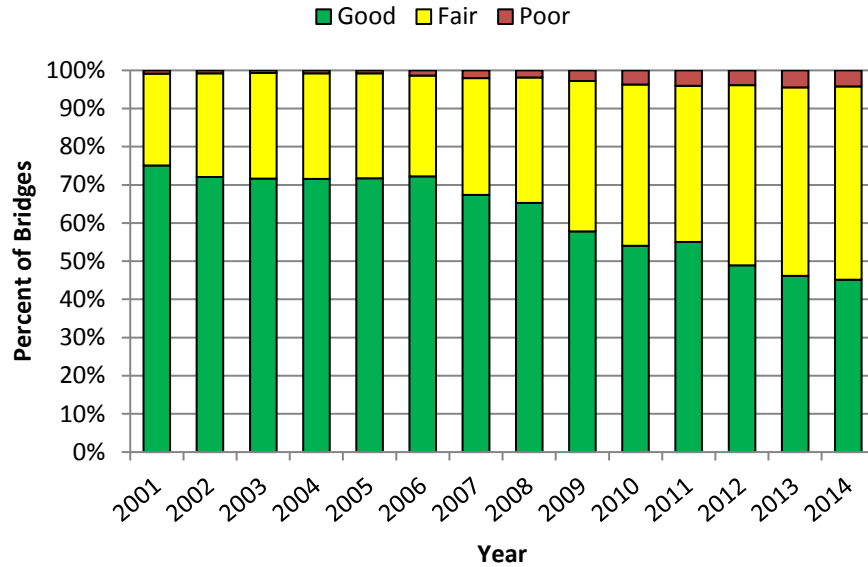
Owner/ System	Bridge Count				Bridge Deck Area			
	Total	Number SD	% SD	National Rank ⁶	Total (sq ft)	SD (sq ft)	% SD (sq ft)	National Rank ¹⁰
ADOT	4,741	109	2.3%	9	3,416,957	150,410	4.4%	20
Non-ADOT	3,548	78	2.2%	11	3,073,938	143,318	4.7%	23

Source : <https://www.fhwa.dot.gov/bridge/britab.cfm>. Retrieved October 9, 2015.

ADOT periodically reports its own Bridge Condition Rating Index (0-100) for ADOT-owned bridges, which is a composite of individual ratings for deck, sub- and superstructure condition. In 2013, ADOT’s bridges averaged a 93.1 index, but this rating has been declining over time, as shown in **Figure 3.13**. **Figure 3.13** provides a map that illustrates the statewide distribution of good, fair, and poor bridges based on the ADOT Bridge Condition Rating.

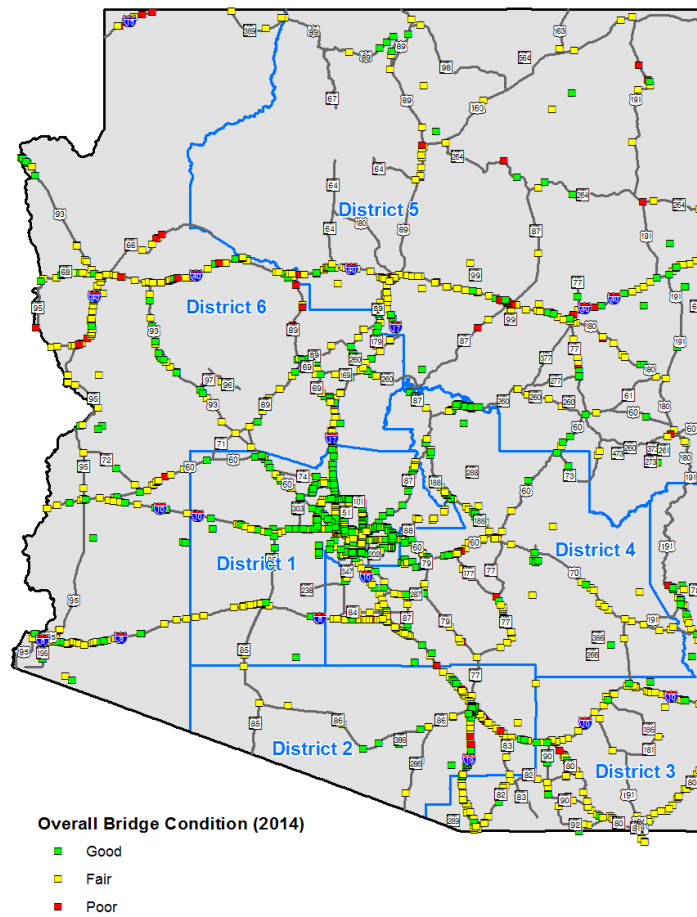
¹⁰ “National ranking” shows how a state’s percentage of total bridges or total bridge deck area that is structurally deficient compares to that of other states. It is a means for comparing the bridge preservation performance of states with different-sized systems.

Figure 6: Condition Ratings for ADOT Owned Bridges



Source: ADOT Staff, October 2015

Figure 7: Geographic Distribution of ADOT-owned Bridge Condition Ratings



Source: ADOT Staff, October 2015

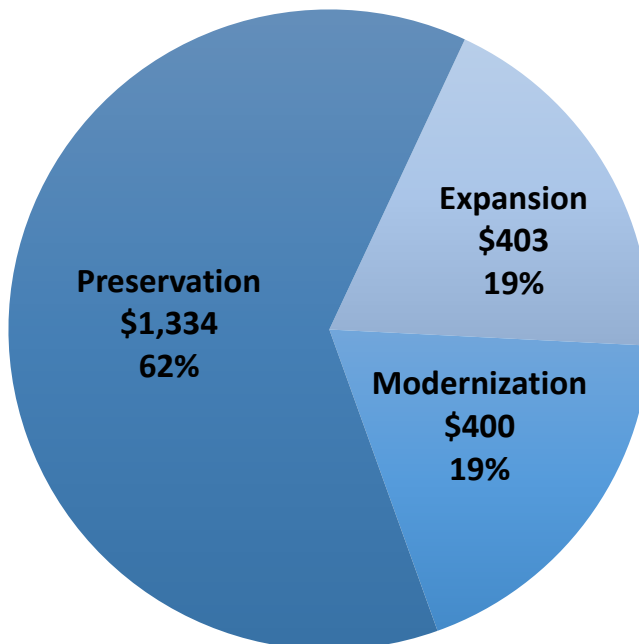
3.3 Arizona's Future Bridge Needs

Based on the bridge needs analysis, Arizona's total bridge needs on the SHS over the 25-year WMYA 2040 planning horizon are estimated to total **\$2.1 billion**. Of this amount, as shown in **Table 5** and **Figure**, bridge preservation needs are **\$1,334 million** (62%), modernization needs are **\$400 million** (19%), and expansion needs are **\$403 million** (19%). These figures are based on findings that, over the planning horizon, a total of 246 bridges will require some level of investment, including replacement of 152 bridges and widening (no added capacity), raising, or strengthening of 94 bridges.

Table 5: Projected Arizona Bridge Needs: 2016-2040
(all cost figures in millions of 2016\$)

Improvement Type	Total Costs	Average Annual Costs
Preservation	\$1,334	\$53.4
Modernization	\$400 ¹¹	\$16.1
Expansion	\$403	\$16.1
Total	\$2,138	\$85.5

Figure 8: Projected Arizona Bridge Needs by Improvement Type
(all cost figures in millions of 2016\$)



The combined preservation and modernization needs identified by NBIAS (\$69.5 million annually) represent what is required to achieve and maintain virtually no structurally deficient bridges over the

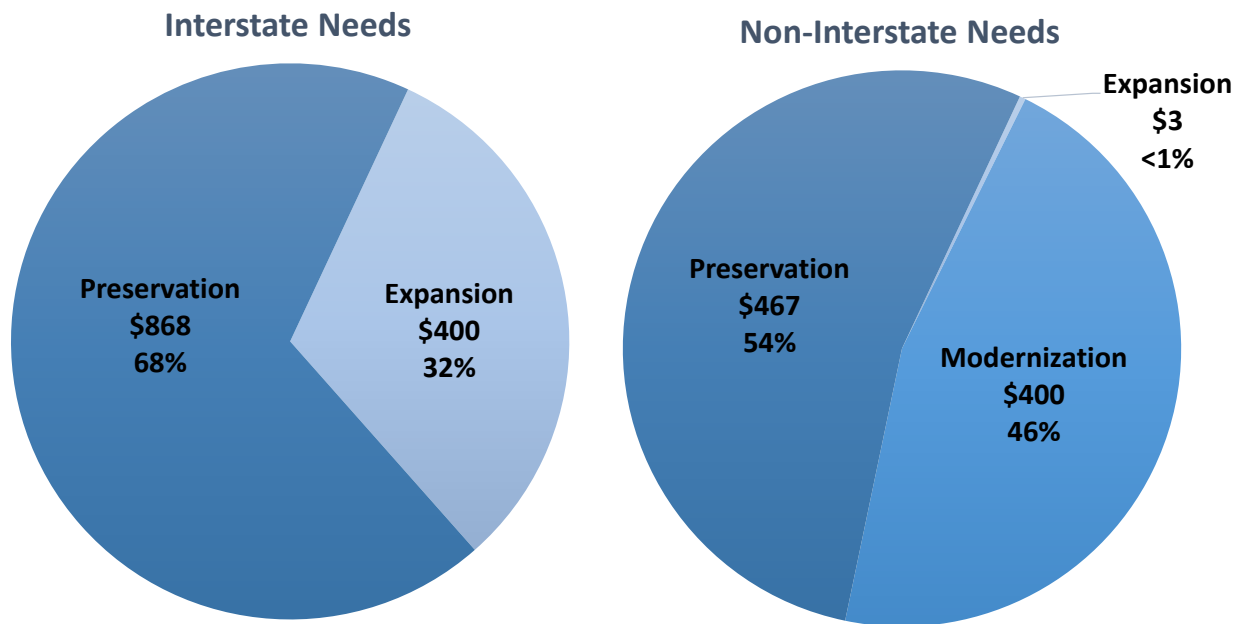
¹¹ The bridge modernization needs estimate includes \$62M in widening and strengthening needs, and \$338M in needs associated with replacement of "functionally obsolete" structures. The latter figure reflects an allocation of total bridge reconstruction needs between modernization and expansion based on the ratio of NBIAS-forecasted "functionally obsolete" vs. "structurally deficient" bridge deck area.

planting horizon. ADOT currently dedicates approximately \$30 million annually to inspection, preservation, and replacement of its nearly 5,000 ADOT-owned bridges and culverts, but Department bridge staff estimate that this amount falls short by at least \$10 million annually of the amount needed to maintain a sustainable bridge preservation and modernization program over the 25-year planning horizon.

3.3.1 Interstate vs. Non-Interstate Bridge Needs

Based on the NBIAS findings, total 25-year bridge needs for the Interstate are nearly 50 percent larger than bridge needs on non-Interstate portions of the SHS. The estimated bridge expansion needs were developed using the Key Commerce Corridors Study, the I-17 Corridor Profile Study, and the ADOT Climbing and Passing Lane Prioritization Study. As shown in **Figure 9**, Arizona's total estimated 25-year Interstate bridge needs are **\$1.27 billion**, which include **\$868 million** (68%) for preservation, and **\$400 million** (33%) for expansion.¹² ADOT's non-Interstate bridge needs over the 25-year WMYA 2040 planning horizon total **\$870 million**, and include **\$467 million** (54%) for preservation, **\$400 million** (46%) for modernization, and **\$3 million** (0.3%) for expansion.

Figure 9: Arizona Interstate and Non Interstate Bridge Improvement Needs by Type
(all cost figures in millions of 2016\$)



¹² No Interstate bridge modernization needs were identified by NBIAS, primarily because ADOT's Interstate bridges are generally already constructed to current standards.

4. OTHER STATEWIDE HIGHWAY SYSTEM NEEDS

Operation of Arizona's SHS requires a variety of routine maintenance actions (e.g., inspections, snow and ice removal, mowing, or drainage maintenance), traffic operations, construction and operation of intelligent transportation systems (ITS), safety improvements, and upkeep of rest areas, none of which are captured in the cost estimates described in the previous chapters. The estimated needs and methods for identifying them are described in this section.

4.1 Safety Needs

While safety is a primary consideration in the planning and implementation of all highway investments and thus almost all needs can be considered to have a safety component, ADOT also conducts spending that is targeted at safety issues. ADOT currently allocates **\$42 million** annually to address safety-specific initiatives identified in the Department's Highway Safety Improvement Program (HSIP). Based on discussions with ADOT safety staff, an estimated **\$60 million** per year is actually needed on safety-specific spending, or roughly **\$1.5 billion** over the 25-year WMYA 2040 planning horizon. In addition, input from other planning efforts (e.g., the *I-17 Corridor Profile Study*) and the State's MPOs and COGs identified roughly \$534 million in safety-specific needs, leading to combined 25-year estimated safety needs of just under **\$2 billion**.

4.2 Operations & Maintenance Needs

Operations and maintenance (O&M) activities include maintenance of pavement, guardrails and cable median barriers, drainage channels, canals, tunnels, retention basins, and sound walls, as well as maintenance and restoration of landscaping. In addition, O&M addresses traffic operations considerations such as roadway lighting, traffic signals, signing and striping, and freeway management system support. Other O&M functions cover utility locating services, encroachment permits, crash clearing, and repairing damaged safety features. Most O&M activities are not eligible for Federal-aid spending, thus ADOT's O&M budget is solely funded with State revenues and is set each year by the Arizona State Legislature. For this reason, shifting funding from highway capital spending to O&M (or vice versa) is currently not possible.

As identified in **Table 6**, total statewide O&M needs for the 25-year WMYA 2040 planning horizon are estimated to be **\$8.7 billion**. This estimate includes continuation of all current ADOT O&M activities, an increase in maintenance activities to meet presently unmet needs, growth of maintenance activities as a result of highway expansion, and Maricopa Association of Governments' (MAG) maintenance needs that are ADOT's responsibility. Each of these elements are described below.

Table 6: 25-Year Statewide O&M Needs

(all figures in millions of 2016 \$)

O&M Needs Category	2016-2040 Needs
Current O&M Spending	\$3,450
Current Unmet O&M Needs	\$1,250
New PAG Region O&M Needs	\$72
New MAG Region O&M Needs	\$3,922
Total O&M Needs	\$8,694

4.2.1 Current ADOT O&M Spending and Additional Needs

In fiscal year 2016, ADOT allocated **\$138 million** to O&M based on the Department’s approved budget. Based on discussions with ADOT’s Central Maintenance Division staff, it was estimated that the current O&M budget results in an annual maintenance shortfall of about **\$50 million** in constant 2016 dollars. This shortfall is comprised of annual unmet needs of about **\$30 million** for surface/shoulder maintenance, **\$10 million** for drainage maintenance, and **\$10 million** for roadside and landscaping maintenance. Combining ADOT current spending (held constant in 2016 dollars) and unmet needs, full needs for O&M of the current SHS is estimated at **\$188 million** per year or **\$4.7 billion** over the 25-year WMYA 2040 planning horizon.

4.2.2 Additional Urban Area O&M Needs

In addition to O&M needs associated with current ADOT spending and the estimated shortfall discussed above, considerable additional O&M spending will be required in the State’s two major urban areas to both address current O&M needs as well as emerging needs that will result from new facilities that are added to the SHS over the course of the 25-year planning horizon. In the MAG region, it is estimated that a total of **\$3.92 billion (\$157 million per year)** in additional O&M funding will be needed. This includes **\$2.72 billion** to adequately operate and maintain the current highway system, **\$1.0 billion** to conduct “quiet pavement”¹³ replacement, and **\$650 million** to address O&M on new facilities that will be opened by 2025.¹⁴ In the PAG region, it is estimated that new urban and rural roadways will add **\$72.3 million** over the 25-year planning horizon, based on current plans to add 219 lane miles of freeways by 2025 and average annual O&M costs of \$22,000 per lane mile.

4.3 Ports of Entry Needs

ADOT is responsible for operating and maintaining ports of entry at Arizona’s domestic borders. Arizona’s 2013 *Ports of Entry Study* identifies improvement needs for all domestic ports of entry into Arizona. The total needs identified in this study are **\$155 million** in constant 2016 dollars.

¹³ “Quiet pavement” is an ADOT initiative to reduce highway noise in the MAG region by surfacing freeways with rubberized asphalt.

¹⁴ MAG additional O&M needs estimates developed from information in a September 18, 2013 Transportation Policy Committee presentation entitled “Overview of Regional Transportation Needs.”

4.4 Rest Area Needs

Rest areas are part of system support and require both regular maintenance and occasional capital investment to maintain and improve services. Based on a review of the 2011 *Arizona Rest Area Study* and coordination with ADOT staff to address changes in needs since the study's completion, 25-year rest area needs from 2016 to 2040 are estimated to be **\$59 million** in constant 2016 dollars.

4.5 Intelligent Transportation System Needs

ITS covers a wide range of technology, from ramp metering to comprehensive freeway management systems, which help improve the operations and capacity of roadways. Total 25-year estimated statewide ITS needs are **\$3.44 billion**. ITS needs cost estimates were developed in coordination with ADOT's Transportation Technology Group through a series of meetings and reviews. ITS needs identified in the *MAG 2035 RTP* and the *PAG 2045 Draft RTP* were also included in the total statewide need. The statewide ITS needs include the following:

Statewide:

- Adaptive or new ramp metering
- Integrated corridor management (ICM)
- Dynamic message signs (DMS)
- Closed-circuit television systems (CCTV)
- Smart truck parking infrastructure
- Communications
- Vehicle to vehicle and vehicle to infrastructure technology
- Fiber optic and Wi-Fi
- LED lighting conversion
- Traffic signals with adaptive technology
- Statewide travel time data

MAG Region:

- Freeway management system

PAG Region:

- Freeway management system
- Traffic data collection stations

5. ARIZONA’S NON-HIGHWAY NEEDS

As a department of transportation, ADOT is not only responsible for building, improving, and operating the SHS, it also plays various roles in supporting non-highway modes of transportation. Arizona’s current statutes generally focus ADOT’s resources on the SHS, thus ADOT’s responsibility for funding non-highway needs is limited to either support for selected facilities or passing through federal funds for transit and aviation. Nonetheless, an important role of WMYA 2040 is to help define and articulate Arizona’s overall transportation needs, regardless of responsibility for funding them. Accordingly, the following section identifies total statewide capital needs for Arizona’s urban and rural public transportation systems, passenger rail plans, bicycle and pedestrian facilities, and airports. As summarized in **Table 7**, these needs total approximately **\$36 billion** over the 25-year WMYA 2040 planning horizon, and include spending that may need to be funded solely or partially from non-ADOT sources. These needs estimates are based on various studies and coordination with ADOT staff and MPO/COG representatives.

Table 7: ADOT Projected Non-Highway Needs

(all figures in millions of constant 2016 \$s)

Category/Mode		Estimated Needs
Public Transit	Rural Transit	\$1,702
	Urban Transit	\$13,107
	Total Public Transportation	\$14,809
Bicycle and Pedestrian		\$913
Passenger Rail		\$6,180
Aviation		\$14,390
TOTAL		\$36,292

5.1 Estimated Public Transportation Needs

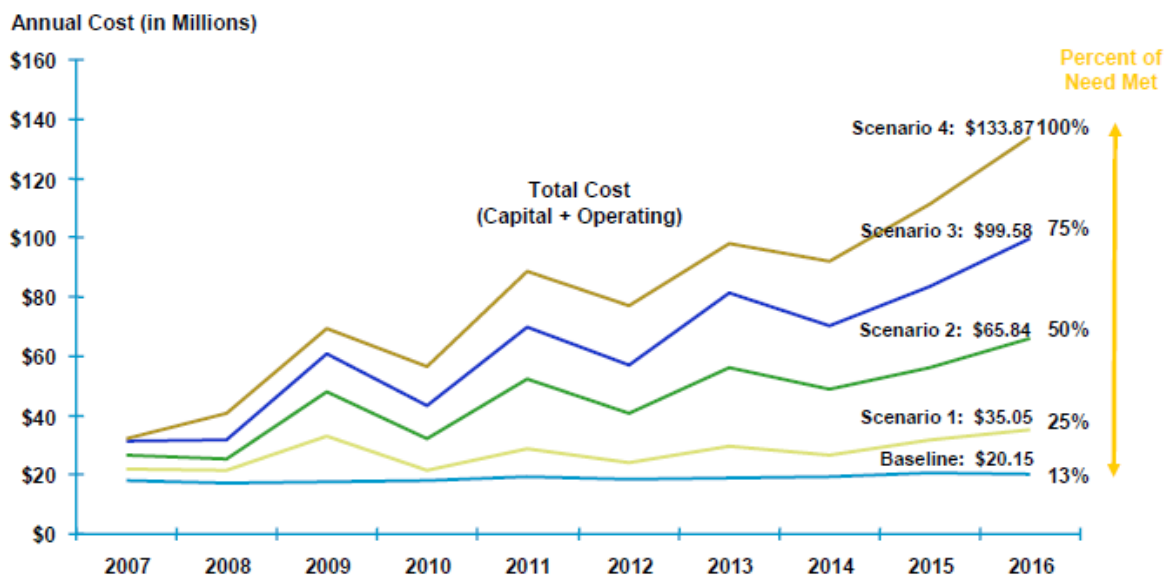
Arizona’s network of local and regional transit systems continues to grow, with new and expanding systems now operating in 13 of the State’s 15 counties. In all, there are now 38 active transit systems throughout the State providing fixed route and demand response bus service. The capital spending needs associated with maintaining and improving these facilities include operations, rolling stock investments, and capital improvements. These needs and the methodology for developing them are discussed below, broken down between urban and rural public transportation systems.

5.1.1 Rural Public Transportation Needs

The most recent comprehensive study of statewide rural transit needs in Arizona is the 2008 *Arizona Rural Transit Needs Study*, which served as the starting point for developing the WMYA 2040 rural transit needs estimates. The 2008 transit study identifies population and associated ridership projections from 2007 to 2016 and includes four scenarios developed to identify the percent of needs met based on different total annual ridership targets. The needs under each scenario include bus

replacement, capital, and operational needs. **Figure**, from the 2008 Rural Transit Needs Study, illustrates the annual dollar amount by scenario to meet full needs.

Figure 10: Annual Transit Needs by Scenario



One caveat to note is that both Sierra Vista and Lake Havasu regions were considered rural during the time of this study and are now designated as urban areas. For this reason, the total transportation dependent populations identified in this study (elderly, disabled, poverty) were reduced for both Cochise County and Mohave County. The total population in these counties is about 24 percent of the total transportation dependent population in rural areas according to the study. Based on coordination with ADOT staff, it was determined that the third scenario identified in the 2008 study most closely represents current trends and is thus used to determine the 25-year rural transit needs for WMYA 2040.

The annual rural transit needs were identified using the annual costs in **Figure** for the 2007 to 2016 period to calculate a 10-year rural transit need, which totals **\$681 million** when converted from nominal to 2016 dollars. Based on coordination with ADOT staff, it was determined a reasonable assumption that this trend will continue. The total 10-year needs number was thus multiplied by 2.5 to calculate 25-year rural transit needs of roughly **\$1.7 billion** in constant 2016 dollars.

5.1.2 Urban Public Transportation Needs

The WMYA 2040 project team reviewed the most recent Regional Transportation Plans (RTPs) for MPOs throughout Arizona in order to identify urban transit needs. These included:¹⁵

- The MAG 2035 RTP;
- The PAG Draft 2045 RTP;
- The Sierra Vista MPO (SVMPO) 2040 RTP;
- The Yuma MPO 2037 RTP; and
- Lake Havasu MPO 2040 RTP.

¹⁵ At the time the research was conducted, the Central Yavapai MPO and Flagstaff MPO were in the process of developing plans to update and refine their identification of transit needs and input on transit need was not yet available from their studies.

Specific transit projects and line items were identified from each RTP, with costs totaled for all transit project types (capital investments, rolling stock, and operations). The MAG RTP identified a general regional transit need value that included capital, rolling stock, and operational costs (but not specific projects). The combined values were then converted from nominal to 2016 dollars to yield a total estimated urban transit need for the WMYA 2040 planning period of approximately **\$13.1 billion**.

5.2 Non-Motorized Transportation Needs

The WMYA 2040 plan incorporates an assessment of bicycle and pedestrian facility needs and acknowledges the importance of ADOT’s participation in supporting bicycle and pedestrian facility investment throughout the State. The Department views its primary responsibility with respect to bicycle and pedestrian facilities as collaborating with local governments to address needs on the SHS. Funding for bicycle and pedestrian improvements typically comes from a combination of federal, local, and private and/or non-profit sources.

ADOT currently accommodates bicyclists and pedestrians on the SHS through “shared roadways,” which include paved shoulders and wide curb lanes, shared use paths, and sidewalks.¹⁶ These needs are generally included in the SHS needs assessment contained in **Section 2** of this working paper. The *Statewide Shoulder Study* notes that ADOT is committed to improving shoulder widths to at least four feet wide to accommodate bicycles, particularly along rural state roadways; the cost estimate to meet this commitment is included in the highway modernization needs.

In addition to rural bicycle and pedestrian needs, urban areas also have non-motorized transportation needs along state roadways. These needs were identified and quantified from the following MPO plans:

- The PAG 2045 DRAFT RTP;
- The SVMPO 2040 RTP; and
- The Yuma MPO 2037 RTP.

The Lake Havasu, Central Yavapai, and Flagstaff MPOs were also contacted to discuss specific bicycle and pedestrian projects that have been identified in their planning processes. The Northern Arizona Council of Governments *2016 – 2023 Transportation Improvement Program* (TIP) also contained non-motorized transportation projects, including a pedestrian bridge and Safe Routes to School projects (these proposed projects are listed in **Appendix C**). The MAG *2035 RTP* did not include non-motorized projects. In order to develop a bicycle and pedestrian facility need estimate for the MAG region, the project team obtained information regarding dedicated revenue for bicycle and pedestrian needs for the region from 2016 through 2035. This information was then converted to constant 2016 dollars and combined to represent a total need for the region.

Based on a summation of these various sources, the statewide need for non-motorized transportation facility in Arizona over the 25-year WMYA 2040 planning horizon is estimated at **\$913 million**.¹⁷

¹⁶ A full list of ADOT bicycle and pedestrian facilities are summarized in the 2012 *Bicycle and Pedestrian Plan Update*.

¹⁷ The non-motorized needs estimate is based on available data and may not include needs for investment for all local jurisdictions in the State,

5.3 Passenger Rail Needs

ADOT developed a *State Rail Plan* in March 2011 that includes a vision for passenger rail and a comprehensive assessment of the state’s rail needs to improve statewide and regional safety and mobility. The first step in implementation of the Rail Plan was conducting a *Passenger Rail Corridor Study: Tucson to Phoenix*. In late 2011, the Federal Railroad Administration (FRA), and Federal Transit Administration (FTA), along with ADOT, initiated this study to continue building on statewide and regional planning efforts to identify passenger rail alternatives between Arizona’s two largest cities, Tucson and Phoenix. Currently, “two build alternatives” and the “no-build alternative” are being considered through a *Passenger Rail Corridor Study Final Environmental Impact Statement* initiative. A source of funding for implementation of the actual rail line has yet to be identified.

The statewide passenger rail needs estimates were developed through review of multiple documents and coordination with ADOT Rail Division staff, as well as MAG and PAG staff. Based on this research, the total 25-year capital passenger rail need for Arizona is approximately **\$6.2 billion** (2016\$). A breakdown of specific needs elements that led to this figure are provided in **Appendix D**.

5.4 Aviation Needs

Arizona has 12 public airports that offer commercial air carrier service on a scheduled basis and a multitude of smaller airports designated as “relievers” or oriented to General Aviation (GA)¹⁸ activity. The *National Plan of Integrated Airport Systems* (NPIAS) identifies airports that are significant to national air transportation and thus eligible to receive federal grants under the Airport Improvement Program (AIP). Fifty-eight of the 83 public-use airports in Arizona are included in the NPIAS.

ADOT is currently in the process of updating the State Airports System Plan (SASP), which will include updated statewide airport needs. At the time of the completion of the needs analysis for WMYA 2040, the SASP was in the early stages of development and revised needs estimates were not available. For this reason, the 2008 SASP was used as the basis for estimating statewide aviation needs¹⁹. Because the 2008 SASP only covered 20 years of estimated needs, these figures were then extrapolated to calculate total 25 year needs of approximately **\$14.4 billion** in constant 2016 dollars.

¹⁸ General aviation (GA) is all civil aviation operations other than scheduled air services and non-scheduled air transport operations for remuneration or hire. General aviation flights range from gliders and powered parachutes to corporate business jet flights.

¹⁹ In addition, new airports, establishment of an Automated Weather Observing System (AWOS) Data Center, and other project costs from airport master plans and capital improvement programs were included.

APPENDIX A: HIGHWAY AND BRIDGE NEEDS METHODOLOGY

1. ROADWAY NEEDS METHODOLOGY

Technical Assumptions

The roadway needs estimates were primarily developed through the use of HERS-ST and the HPMS dataset. The application of HERS-ST requires the development of assumptions in several areas to help customize the analysis tool to a state’s unique circumstances and parameters. For the WMYA 2040 roadway needs analysis, these assumptions included the following:

- **Maximum Lane Expansion** – HERS-ST allows expansion of highway segments up to 36 lanes to address capacity needs; adjustments to this default can be required to align analyses with practicality or policy. To ensure no adjustments were needed, the consultant team reviewed the Central Phoenix Framework Study to compare the maximum lanes recommended in the study to the HERS-ST analysis recommendations. Based on the review, the HERS-ST recommendations do not exceed the maximum lanes recommended for I-10 and I-17. Since HERS-ST uses the HPMS file (sample data), the LRTP team was unable to review the max lanes on MAG arterials (US-60, SR-30, SR-51, SR-101L, SR-143, SR-202L).
- **Improvement Costs** – Unit costs for different urban and rural roadway categories (Interstates/expressways, principal arterials, minor arterials, collectors) were developed for various types of improvements (reconstruction, resurfacing, shoulder improvements, adding lanes, and alignment) based on ADOT cost data and staff input.
- **Reconstruction Levels** – Defined in coordination with ADOT asset management staff, these establish the levels of pavement smoothness and overall condition under which reconstruction (vs. lower cost treatments) are required for various categories of roadways and traffic volumes.
- **Price Index** – Developed in conjunction with ADOT planning and/or engineering staff, these provide the unit costs or values for various considerations (e.g., fuel, tires, vehicle maintenance, taxes, user time, injury, death, and delay) that are used in HERS-ST to determine the economic justification for improvements.
- **Pavement Factors** – Based on ADOT asset management staff guidance, these factors define the pavement deterioration rates and life expectancy for different roadway categories.

Deficiency Levels and User Thresholds – These are the “minimum tolerable conditions” that (often in combination with traffic projections) trigger the needs for HERS-ST to identify improvements for various considerations such as pavement smoothness, surface type, expansion based on volume-to capacity (V/C) ratios, land and shoulder width, shoulder type, and horizontal and vertical alignments. The deficiency levels used for the 2040 WMYA needs analysis were established based on ADOT engineering and design standards are identified in **Table 8**.

Table 8: ADOT Engineering and Design Standards

		PSR	Surface Type	V/C Ratio	Lane Width (ft)	Rt Shoulder Width (ft)	Shoulder Type	Horizontal Alignment	Vertical Alignment
Interstate	Flat	3.2	2-High	0.7	12	10	2-Stabilized	1-All Crv Appropriate	1-All Grd Appropriate
	Rolling	3.2	2-High	0.8	12	9	2-Stabilized	1-All Crv Appropriate	1-All Grd Appropriate
	Mountainous	3.2	2-High	0.9	12	7	2-Stabilized	1-All Crv Appropriate	1-All Grd Appropriate
Principal Arterials AADT > 6000	Flat	3.2	2-High	0.7	12	9	2-Stabilized	1-All Crv Appropriate	1-All Grd Appropriate
	Rolling	3.2	2-High	0.8	12	9	2-Stabilized	1-All Crv Appropriate	1-All Grd Appropriate
	Mountainous	3.2	2-High	0.9	12	7	2-Stabilized	1-All Crv Appropriate	1-All Grd Appropriate
Principal Arterials AADT < 6000	Flat	3.0	2-High	0.7	12	9	2-Stabilized	2-All Curves Accept	2-All Grades Accept
	Rolling	3.0	2-High	0.8	12	9	2-Stabilized	2-All Curves Accept	2-All Grades Accept
	Mountainous	3.0	2-High	0.9	12	7	2-Stabilized	2-All Curves Accept	2-All Grades Accept
Minor Arterials AADT > 2000	Flat	2.6	3-Intermediate	0.7	12	7	2-Stabilized	2-All Curves Accept	2-All Grades Accept
	Rolling	2.6	3-Intermediate	0.8	12	7	2-Stabilized	2-All Curves Accept	2-All Grades Accept
	Mountainous	2.6	3-Intermediate	0.9	12	6	2-Stabilized	2-All Curves Accept	2-All Grades Accept
Minor Arterials AADT < 2000	Flat	2.6	3-Intermediate	0.7	12	7	3-Earth	2-All Curves Accept	2-All Grades Accept
	Rolling	2.6	3-Intermediate	0.8	12	7	3-Earth	2-All Curves Accept	2-All Grades Accept
	Mountainous	2.6	3-Intermediate	0.9	12	6	3-Earth	2-All Curves Accept	2-All Grades Accept
Major Collectors AADT > 1000	Flat	2.4	3-Intermediate	0.7	12	6	3-Earth	2-All Curves Accept	2-All Grades Accept
	Rolling	2.4	3-Intermediate	0.8	12	6	3-Earth	2-All Curves Accept	2-All Grades Accept
	Mountainous	2.4	3-Intermediate	0.9	12	6	3-Earth	2-All Curves Accept	2-All Grades Accept
Major Collectors AADT > 400	Flat	2.4	4-Low	0.95	11	4	3-Earth	2-All Curves Accept	2-All Grades Accept
	Rolling	2.4	4-Low	0.95	11	4	3-Earth	2-All Curves Accept	2-All Grades Accept
	Mountainous	2.4	4-Low	0.95	11	4	3-Earth	2-All Curves Accept	2-All Grades Accept
Major Collectors AADT < 400	Flat	2.2	5-Unpaved	1.0	10	2	3-Earth	2-All Curves Accept	2-All Grades Accept
	Rolling	2.2	5-Unpaved	1.0	10	2	3-Earth	2-All Curves Accept	2-All Grades Accept
	Mountainous	2.2	5-Unpaved	1.0	10	2	3-Earth	2-All Curves Accept	2-All Grades Accept
Urban	Interstate	3.4	2-High	0.9	12	9	1-Surfaced	1-All Crv Appropriate	
	Expressway	3.2	2-High	0.9	12	9	1-Surfaced	1-All Crv Appropriate	
	Princ. Arterial	3.0	2-High	0.9	12	8	2-Stabilized	1-All Crv Appropriate	
	Minor Arterial	2.6	3-Intermediate	0.9	12	8	3-Earth		
	Collector	2.4	4-Low	0.9	12	6	3-Earth		
			2-High				1-Surfaced	1-All Crv Appropriate	1-All Grd Appropriate
			3-Intermediate				2-Stabilized	2-All Curves Accept	2-All Grades Accept
			4-Low				3-Earth	3-Some Reduced Speed	3-Some Reduced Speed
			5-Unpaved				4-Curbed	4-Significant Curves	4-Significant Grades

2. BRIDGE NEEDS METHODOLOGY

Bridge needs for Arizona were determined using National Bridge Investment Analysis System (NBIAS) software. NBIAS is an analysis tool used to predict bridge rehabilitation, reconstruction, and replacement needs. The NBIAS model forecasts bridge performance and offers recommendations for improvements based on economic concepts. The system supports analysis of different funding levels and policy assumptions for over 200 measures of effectiveness. For purposes of developing the bridge needs estimates for WMYA 2040, Arizona’s National Bridge Inventory (NBI) data file, as well as data on ADOT’s allowable deficiency levels, design standards, and unit cost estimates served as inputs to NBIAS

In order to conduct bridge needs analysis using NBIAS, the consultant team coordinated with ADOT asset management and bridge staff to determine ADOT bridge improvement policy (i.e., minimum tolerable conditions) with respect to when bridges should be widened, raised, and/or strengthened, based on a bridge’s applicable functional class, NHS status, and traffic volume. As with HERS-ST, a deficiency relative to the minimum tolerable standards triggers NBIAS to identify the need for an improvement action. The analysis also required identification of “design values” (also established in consultation with ADOT bridge and asset management staff) that define new bridge dimensions where NBIAS determines the need for a replacement bridge. Values account for design and legal standards for lane and shoulder widths, as well as the swell factor which is a cost-increase coefficient.

Cost factors that were used by NBIAS included tool defaults as well as refinements developed in coordination with ADOT bridge engineers based on applying a cost adjustment factor to default value of 2.5. This resulted in the following costs for NHS and non-NHS bridges (all in \$/sq ft):

NHS Bridges

- Replacement: \$418.97
- Widening: \$311.80
- Raising and Strengthening: \$155.90

Non-NHS Bridges

- Replacement: \$401.55
- Widening: \$298.83
- Raising and Strengthening: \$149.41

To ensure improvement costs were accurate for Arizona, the project team compared predicted costs and conditions to actual costs and conditions from 2004 to 2014. Then, based on this calibration run, system defaults for all costs were used, and an agency cost adjustment factor of 2.5 was established, which equated to a replacement cost of approximately \$400/sq ft.

APPENDIX B: NEW ROADWAY ALIGNMENT PROJECTS

The following is a list of new roadway facilities that were incorporated into the WMYA 2040 needs analysis, organized by the MPO/COG where they are in existing plans.

Central Arizona Governments

- Bella Vista Road
- McCartney/Randolph Road
- Peters and Nall Road
- Montgomery Road
- Burris Road
- US 60 Alternate Route
- SR 87/SR 260 High-Capacity Corridor
- SR 24 4-lane access controlled facility
- North-South Corridor

Pima Association of Governments

- Sunset Road
- SR 210 Palo Verde to I-10
- SR 210 extension (including 2 interchanges)
- Sonoran Corridor

Maricopa Association of Governments

- Loop 202 (South Mountain Freeway)
- Loop 303 (remaining portions of Estrella Freeway)
- SR 30 (I-10 Reliever)
- SR 24 (Gateway Freeway)

APPENDIX C: NON-MOTORIZED TRANSPORTATION NEEDS

The following is a list of non-motorized facilities (or associated methodology) that were incorporated into the WMYA 2040 needs analysis, organized by the MPO/COG where they are in existing plans.

Flagstaff MPO

- Rio de Flag Pedestrian Crossing
- Sheep Crossing Pedestrian Crossing

Lake Havasu MPO

- SR 95 Pedestrian Crossing

Maricopa Association of Governments

- Estimated Based on Dedicated Revenues

Northern Arizona Council of Governments

- Billy Creek Pedestrian Bridge
- City of Holbrook Safe Routes to School
- Town of Clarkdale Safe Routes to School

Pima Association of Governments

- Bicycle Boulevards
- Bicycle Lanes
- Bikeways Continuity and Maintenance
- Bicycle Parking
- Local Bicycle Infrastructure
- Safe Routes to School
- Shared Use Paths
- Signalized Pedestrian and Bicycle Crossings
- Urban Loop Path
- Bicycle Signage and Stenciling

Sierra Vista MPO

- SR 90 Multi-use Path
- SR 92 Multi-use Path
- 7th Street Multi-use Path
- SR 90 Multi-use Path

Yuma MPO:

- US 95 Pedestrian Crossings
- 4th Ave. Pedestrian Crossing

APPENDIX D: PASSENGER RAIL NEEDS

The following is a list of passenger rail based on existing studies and input from ADOT and MPO staff.

- Capital investment components of the cost estimate developed and presented in the 2013 Tucson to Phoenix Corridor Draft Environmental Impact Statement (DEIS) for the yellow corridor alternative is included - approximately \$3.86 billion.
- Cost to rehabilitate the Wellton Branch rail line is included and was obtained from the 2014 Wellton Branch Rehabilitation Study – approximately \$441.58 million.
- Cost estimates for the passenger rail connection from the West Valley to the Tucson International Airport – approximately \$1.40 billion.
- PAG region passenger station – approximately \$5.13 million.
- PAG region Green Valley to Tucson commuter rail – approximately \$471.5 million.
- New passenger rail service between Tucson and Phoenix and the West Valley to the Tucson International Airport connection will also require approximately \$12 million dollars annually to operate.