ADOT

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Transportation Asset Management Plan

Arizona Department of Transportation

Transportation Asset Management Plan

June 30, 2021

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Executive Summary

Arizona's economic competitiveness, quality of life and travel safety depend on the successful management of the State's highway assets. This risk-based Transportation Asset Management Plan (TAMP) documents a systematic approach for maintaining and improving the Arizona Department of Transportation's (ADOT) bridges and pavements. The objective is to develop data-oriented investment strategies to achieve the desired state of good repair over the life cycle of assets. These asset management practices help ensure that ADOT can provide dependable and efficient operation of its transportation network to improve Arizona's economic competitiveness, quality of life and safety of the traveling public.

1.1 Aging Assets and Growth Trends

The advancing age of highway bridges and pavements is one of the primary challenges facing ADOT. Over 50 percent of State Highway System (SHS) bridges and 60 percent of the pavements are over 50 years old. The majority of ADOT's bridge and pavement infrastructure will reach the end of the normal life cycle over the next ten years.

Figure 1 | **Bridge Age (SHS and local NHS)**

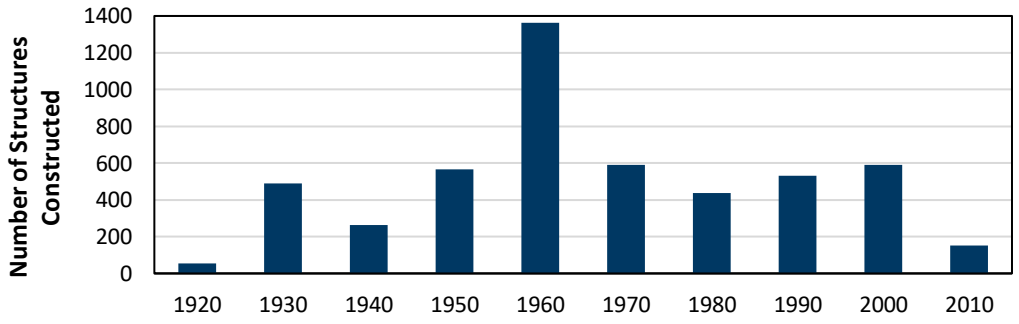
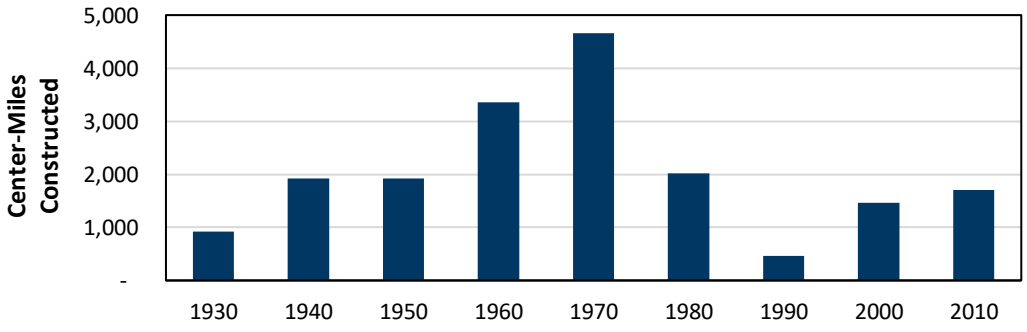


Figure 2 | **Pavement Age (State SHS and local NHS)**



Additionally, Arizona continues to experience strong population growth. This growth, combined with a more mobile society, has led to a substantial increase in highway travel. Greater travel demand has outpaced the growth of the highway network, resulting in an increased traffic burden on existing roadways. Growing trade with Mexico and freight traffic from Los Angeles ports are contributing to higher truck volumes on key commerce corridors throughout the state.

Increased highway utilization, particularly by commercial trucks, is accelerating the deterioration of Arizona's aging bridges and pavements. This has occurred during a lengthy period of stagnant transportation funding that has not kept up with increasing construction costs or highway preservation, modernization, and expansion needs. Although the COVID-19 pandemic has recently reduced travel demand, historic growth trends are expected to return over the long term. Furthermore, the impacts of the pandemic have introduced additional funding constraints. The challenge of maintaining aging highway assets in a tightly constrained fiscal environment, along with recent federal laws that place an increased emphasis on preserving the existing transportation system, has caused ADOT to re-evaluate and update asset management practices.

1.2 Risk-Based Life Cycle Planning

In the past, like most other Departments of Transportation (DOTs), ADOT's asset management was reactive. Periodic condition assessments were performed, and treatments were applied to the assets in the worst condition. Although some resources were devoted to life-prolonging preventative treatments, minimal preservation resulted in bridges and pavements deteriorating until expensive rehabilitation and replacement were the only options. This approach was inexpensive when Arizona's highway infrastructure was young and lightly used, as newer assets seldom required rehabilitation or replacement and minimal spending on preservation saved money in the short run. As Arizona's highway system ages, the costs of an increasing number of rehabilitations and replacements will eventually surpass the asset management budget, making a reactive strategy unsustainable. Applying preservation treatments before assets significantly deteriorate can extend asset lifespans at lower costs; but the inability to accurately forecast the long-term cost savings of using these treatments has made it difficult to justify a sufficient level of preservation expenditures to transportation stakeholders.

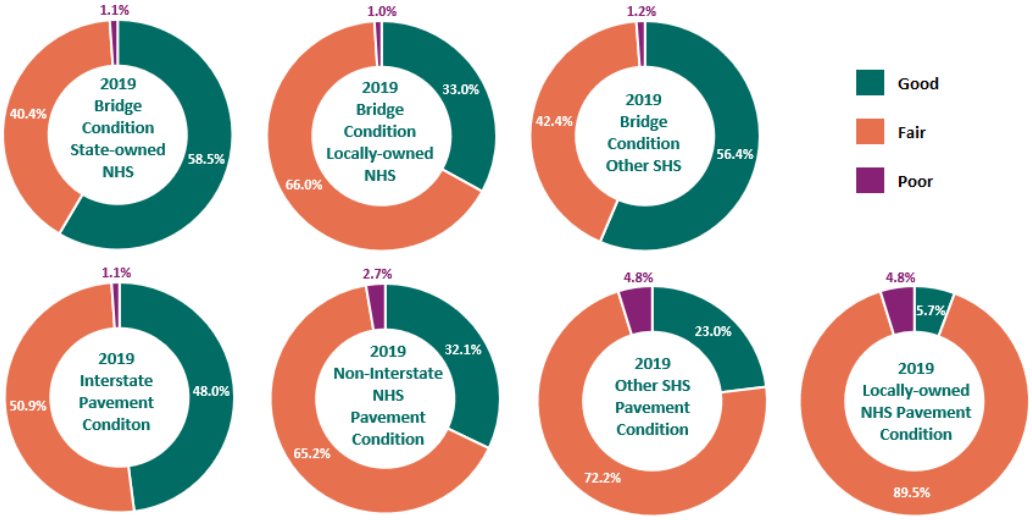
In recent years, technological advances have revolutionized asset management practice by enabling the prediction of asset life cycle costs over long periods under different treatment, funding, and risk scenarios. ADOT has implemented the AASHTOWare Bridge Management (BrM) System for bridges and the Deighton Total Infrastructure Management System (dTIMS) for pavement to support life cycle analyses and inform investment planning and prioritization.

1.3 Asset Inventory and Condition

ADOT is responsible for the operation and management of the State Highway System (SHS) which includes most of Arizona's portion of the National Highway System (NHS). Local governments own and operate a small portion of the NHS. This TAMP evaluates bridges and pavements on the

SHS and NHS; future TAMPs may include additional assets. The TAMP covers 23,067 lane miles of pavement and 5,052 bridges. Most of these assets are currently in Good or Fair condition.

Figure 3 | **2019 Bridge and Pavement Condition**



1.4 Federal Performance Targets and State of Good Repair

As required by the federal performance management rules for bridges and pavements (23 Code of Federal Regulations (CFR) Part 490.105), ADOT has formally adopted performance targets based on current and historical condition. These targets consist of six pavement and bridge measures of Good and Poor condition.

Table 1 | **ADOT Asset Performance Targets (established in 2018)**

Performance Target	2020 Target (%)	2020 Performance (%)	2022 Target (%)
Percent of NHS bridges classified as in Good condition	52	57.8	52
Percent of NHS bridges classified as in Poor condition	4	1.2	4
Percent of Interstate pavements in Good condition	-	47.0	44
Percent of Interstate pavements in Poor condition	-	1.1	2
Percent of non-Interstate NHS pavements in Good condition	31	32.3	28
Percent of non-Interstate NHS pavements in Poor condition	6	2.8	6

ADOT's state of good repair (SOGR) for bridges and pavements establishes a safe and reliable level of service that can be efficiently sustained over the life cycle of network assets. The SOGR is expressed as targets that represent an acceptable level of performance at the end of the ten-year life of the TAMP. As assets age, an increased rate of deterioration is inevitable and difficult to slow with limited funding. At ADOT, insufficient transportation revenues have necessitated both

the shifting of resources from highway expansion to asset preservation and the establishment of realistic SOGR targets that reflect the declining condition of the SHS's bridges and pavements.

Table 2 | **Desired Long-Term SOGR for Bridges and Pavements**

Asset Class	Network	Minimum % Good/Fair	Maximum % Poor
Bridges	NHS	96	4
	SHS	96	4
Pavements	Interstates	98	2
	Other NHS – State Maintained	93	7
	Other NHS – Locally Maintained	-	-
	Non-NHS – High Volume	93	7
	Non-NHS – Low Volume	85	15

1.5 Risk Management

The importance of considering risk in the management of transportation assets is highlighted by the federal requirement to develop a risk-based TAMP. ADOT maintains a risk register that identifies risks, assigns ratings, defines risk ownership, and provides a high-level summary of the recommended risk mitigations. Although this TAMP focuses on bridges and pavements, the risk analysis includes consideration of other assets on the NHS and SHS. There are 33 total risks identified in this TAMP, of which 17 are high and very high priority. Mitigations are recommended for these high priority risks, which include extreme weather, inadequate funding, staff attrition, and flooding damage, among others. Risks directly associated with bridges and pavements were incorporated into the TAMP analysis and included:

Bridges

- **Scour** – Many older bridges over water are subject to scour impacts from undermining of foundations and have an increased risk of damage or failure.
- **Overloading** – Bridges that have fracture critical elements or are posted with weight restrictions have an increased risk of damage or failure.
- **Low clearances** – Bridges that have lower vertical clearances than current design standards have an increased risk of damage from collisions.

Pavements

- **Expansive soils** – Some soils can swell significantly in the presence of water and shrink by a like amount when dry. This volume change adversely affects and shortens the life of pavements.
- **Flooding** – Roadways that have insufficient drainage structures can be subject to flooding that undermines all the road layers.

Per Federal regulations, ADOT also identified five locations where pavement and bridge assets have been repeatedly damaged by emergency events and conducted statewide evaluations to determine if there are reasonable alternatives. These locations are:

- State Route 87 near Milepost 224
- State Route 71 near Milepost 86.6
- Salome Road at Centennial Wash
- State Route 89A from Milepost 395 to 399
- State Route 88 – Apache Trail

1.6 Life Cycle Scenarios

Life Cycle Planning (LCP) is a systematic process that identifies the best options to preserve or improve the condition of an entire asset class or across asset classes at the minimum practical cost. The LCP analysis models different combinations of work types, including maintenance, preservation, rehabilitation, and reconstruction, over the whole life of assets on the network to compare the effectiveness of different investment strategies on asset condition and system performance. Analysis was performed using the AASHTOWare BrM 6.0 bridge management system and the recently implemented Deighton dTIMS pavement management system.

ADOT evaluated the following life cycle scenarios for bridge and pavements:

- **Reactive Scenario (Worst First)**: Using minimal preservation treatments; allowing the asset to deteriorate until rehabilitation or reconstruction are the only options.
- **Hybrid Scenario**: A balance between preservation and rehabilitation/ reconstruction treatments. This scenario was formulated to enable a phased and implementable transition from the reactive strategy that ADOT has historically used to a strategy that puts a greater focus on preservation treatments.
- **Preservation Scenario**: A focus on preservation treatments. In this scenario, treatments that provide the highest cost-benefit ratio for managing the bridge and pavement network were selected. Funding was evenly distributed between preservation and rehabilitation activities under this scenario.

1.7 Investment Strategies

Based on the expected funding available for managing pavements and bridges over the next ten years, the results of the LCP and consideration of risks, ADOT has identified investment strategies for preserving the performance of bridges and pavements to maintain a state of good repair. The analysis revealed that the hybrid scenario met the SOGR targets for bridges and pavements and provided the most cost-effective balance between preserving assets in good condition and fixing or replacing critical assets in poor condition on important highway corridors. The recommended scenario phases-in a greater emphasis on preservation during the early part of the transportation program and gradually increasing preservation treatments over time, to shift away from the worst-first approach used in the past.

Table 3 through **Table 6** show the annual investment, state of good repair target, and projected condition at the beginning of 2030 for the recommended investment strategy.

Table 3 | **Recommended Bridge Investment Strategy Annual Investment ($Millions)**

($ Millions)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
National Highway System (INCLUDING STATE AND LOCAL NHS)											
Initial Const.	34	4	1	70	0	0	0	0	0	0	109
Maintenance	2	2	2	2	2	2	2	2	2	2	20
Preservation	2	5	6	13	9	12	8	9	10	9	83
Rehabilitation	2	15	7	3	15	20	1	7	6	10	86
Recon	61	7	127	11	0	36	0	0	2	3	247
Total NHS	101	33	143	99	26	70	11	18	20	24	545
State Highway System (INCLUDING NHS AND NON-NHS)											
Initial Const.	34	4	1	70	0	0	0	0	0	0	109
Maintenance	3	3	3	3	3	3	3	3	3	3	30
Preservation	3	10	9	15	15	23	18	17	18	24	152
Rehabilitation	22	33	11	16	41	33	31	28	18	22	255
Recon	71	42	136	44	3	38	0	4	13	3	354
Total SHS	133	92	160	148	62	97	52	52	52	52	900

Table 4 | **Recommended Bridge Investment Strategy Projected Performance Summary**

Bridge Class	Minimum % Good/Fair Target	Projected % Good/Fair (Year 10)	Maximum % Poor Target	Projected % Poor (Year 10)
NHS	96	98.8	4	1.2
SHS	96	98.7	4	1.3

Table 5 | **Recommended Pavement Investment Strategy Annual Investment ($Millions).**

($ Millions)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
National Highway System (EXCLUDING LOCAL NHS)											
Initial Const.	184	144	0	0	0	0	0	0	0	0	328
Maintenance	5	5	5	5	5	5	5	5	5	5	50
Preservation	59	184	32	39	72	69	70	80	74	71	750
Rehabilitation	96	58	176	140	69	98	109	108	112	109	1,075
Recon	0	0	0	0	0	0	0	0	0	0	0
Total NHS	**344**	**391**	**213**	**184**	**146**	**172**	**184**	**193**	**191**	**185**	**2,203**
Other Highway System (NON-NHS)											
Initial Const.	0	0	0	0	0	0	0	0	0	0	0
Maintenance	2	2	2	2	2	2	2	2	2	2	20
Preservation	10	44	20	25	38	40	40	30	36	39	322
Rehabilitation	6	7	51	21	180	154	142	143	140	142	986
Recon	0	0	0	0	0	0	0	0	0	0	0
Total Non-NHS	**18**	**53**	**73**	**48**	**220**	**196**	**184**	**175**	**178**	**183**	**1,328**
TOTAL PAVEMENT SPENDING	**362**	**442**	**286**	**232**	**366**	**368**	**368**	**368**	**369**	**368**	**3,531**

Table 6 | **Recommended Pavement Investment Strategy Projected Performance Summary**

Pavement Class		Target Minimum % Good/Fair	Projected % Good/Fair (Year 10)	Target Maximum % Poor	Projected % Poor (Year 10)
NHS	Interstate	98	100	2	<1
	State-Maintained NHS	93	94	7	6
Non – NHS	High-Volume	93	98	7	2.0
	Low-Volume	85	86	15	14

1.8 Local Public Agency (LPA) Engagement

ADOT is in the process of engaging local public agencies (LPAs) to develop a collaborative plan for information exchange and performance target setting that satisfies federal requirements. The goal of engagement is to make LPAs aware of the TAMP, its contents, and the analyses used to develop the content, and to provide information on the recommended investments in LPA-owned NHS assets that would allow the state to maintain assets at or above target condition. In 2021, a workshop was held with LPA and MPO representatives to formally launch TAM and TAMP discussions and introduce goals for long-term engagement, which is expected to support the following activities:

- Coordination of asset inventory and condition data, and funding and investment information;

- Identification of projects for the Statewide Transportation Improvement Program (STIP);
- Development of the ten-year investment strategy as documented in the TAMP.

1.9 Continuous Improvement

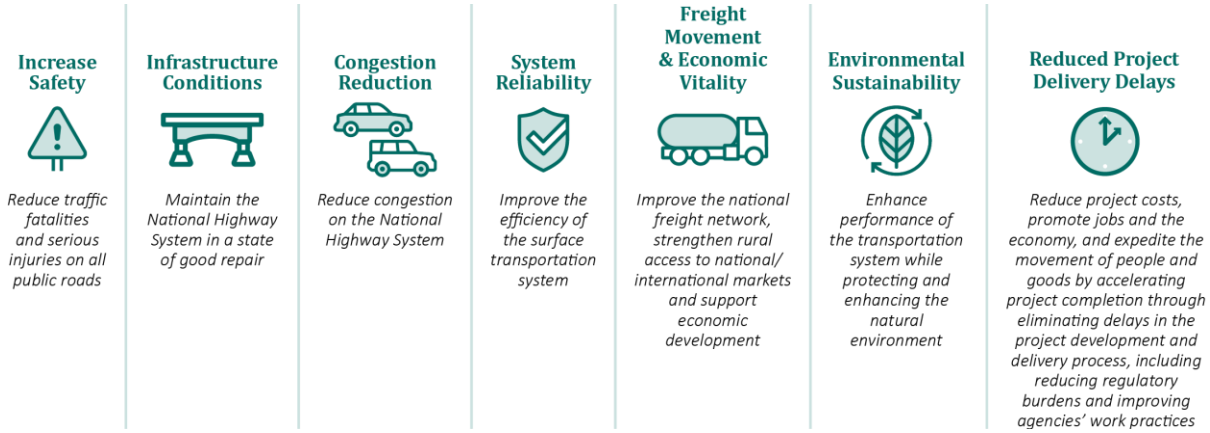
Based on the current state of TAM at ADOT and the gaps identified in TAM practice during the development of this document, the following opportunities for improvement have been identified for consideration:

- Review and update bridge and pavement management system cost-benefit and utility formulas, treatment rules and costs as needed. Update bridge and pavement deterioration models once 5-6 cycles of data have been collected;
- Review routine maintenance practices and document how these practices contribute to whole life management of network assets and investment strategies. Evaluate risks associated with reactive maintenance practices and identify recommended mitigations.
- Evaluate the benefits and best uses of bridge and pavement preservation treatments to ensure that they are being used effectively; and,
- Work with LPAs including regional and metropolitan planning organizations to encourage and facilitate their participation in future TAMP updates.
- Work with the Infrastructure Prioritization Team, formed in February 2021, to seek ways and explore alternatives to improve the condition of ADOT's bridges and pavements without funding increases.

Section 2
Introduction

Federal legislation has identified seven national transportation system goal areas shown in **Figure 4**. Transportation asset management regulations associated with the *Infrastructure Conditions* goal require the development of a risk-based Transportation Asset Management Plan (TAMP) covering National Highway System (NHS) bridges and pavements. As defined in legislation, asset management is a strategic and systematic process of operating, maintaining and improving physical assets, with a focus on both engineering and economic analyses based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation and replacement actions that will achieve and sustain a desired state of good repair over the life-cycle of assets at the minimum practical cost.

Figure 4 | **National Transportation System Goal Areas**



The required components of the TAMP are:

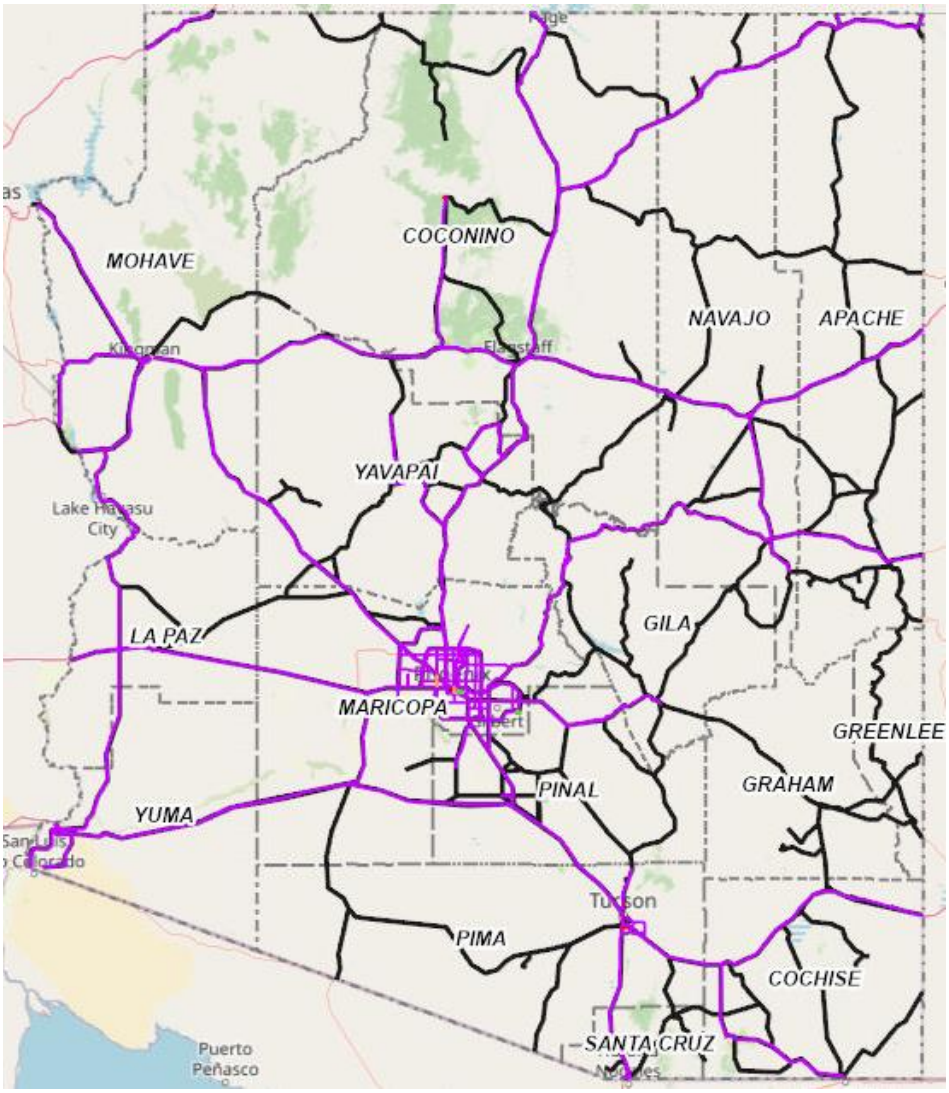
- Asset management objectives
- A summary description of NHS bridge and pavement condition
- Performance measures and targets for asset condition
- Risk management analysis
- A financial plan
- Life cycle planning
- Performance gap analysis
- Investment strategies

ADOT has elected to exceed the federal requirements for a TAMP by including all the bridges and pavements on the Arizona State Highway System (SHS) (**Figure 5**) and the NHS (**Figure 6**) in the TAMP to align it with current bridge and pavement management practices in the state. Combined, these systems represent more than 23,000 lane miles and 5,000 bridges. The NHS, developed by the U.S. Department of Transportation in conjunction with local, state,

and metropolitan planning organizations, includes the interstate highway system and other roads important to the nation's economy, defense, and mobility. Most of the NHS is a part of the SHS. In Arizona, a small portion of the NHS routes are owned and operated by local public agencies. Unless otherwise specified, a reference to the NHS in this report will include both the state and local portions.

Figure 5 | **Arizona State Highway System (SHS)**

Figure 6 | **National Highway System (NHS) in Arizona**



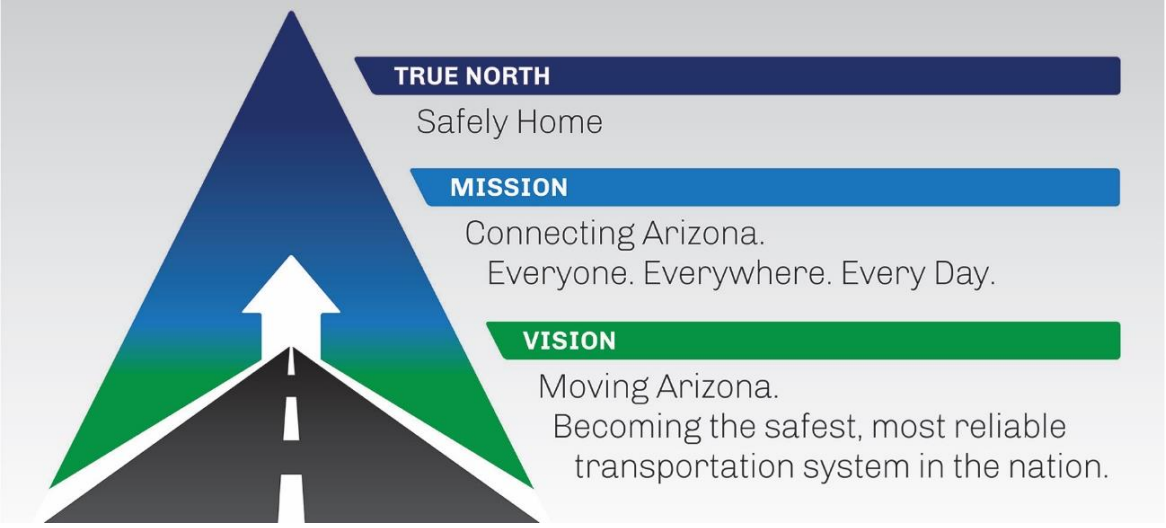
In future years, TAMP updates may include other assets, such as pump stations, tunnels, and signs. To effectively include other assets in the TAMP, it will be necessary to develop inventory and condition data sets for these assets, which could take several years. The TAMP covers a ten-year planning horizon, although some of the analysis covers a longer period to assist with the development of ADOT's Long Range Transportation Plan (LRTP).

2.1 Asset Management Objectives

ADOT is responsible for the construction, operation, and management of the SHS which includes more than 23,000 lane miles and 5,000 bridges and has a historical valuation of about $23 billion. Over 50% of ADOT's bridge and pavement infrastructure will reach the end of its design life over the next ten years. With proper preservation treatments, the life of this infrastructure can be extended. However, as Arizona's highway system ages, the resources needed to maintain it will increase. This makes the identification and implementation of strategies that preserve existing assets while controlling costs essential to sustaining a balanced, fiscally-sound state highway program.

This TAMP is a comprehensive blueprint for extending the life of Arizona's highway system while maintaining reliable performance and minimizing long-term costs. The TAMP supports ADOT's mission, vision, and true north (**Figure 7**).

Figure 7 | **ADOT's Mission, Vision and True North**



ADOT's objectives for transportation asset management are to:

- Develop a collaborative process that integrates the efforts of all stakeholders, including data managers, engineers, planners, financial specialists, and executives, in the management of ADOT's transportation assets.
- Maintain a safe and reliable level of service that can be efficiently sustained over the life cycle of network assets (state of good repair).

- Factor risk into asset management planning.
- Communicate financial needs for maintaining the highway system in a state of good repair to transportation stakeholders.
- Provide information and technical assistance to local jurisdictions to support their management of NHS bridges and pavements. Include steps to support TAMP elements in Metropolitan Planning Organization (MPO) planning agreements.
- Use Arizona Management System (AMS) principles and practices to improve transparency, accountability, and decision-making in the management of ADOT's transportation assets.

2.2 Asset Management Oversight and Operating Structure

Developing and implementing transportation asset management within ADOT is a major undertaking and requires the involvement of staff throughout the agency. **Table 7** lists the committees responsible for implementation of this effort. Although the TAM program is led and facilitated by the Multimodal Planning Division (MPD), numerous specialists from ADOT's planning, data management, risk management, finance and other areas also participated in the development of this TAMP, as needed.

Table 7 | **ADOT Asset Management Committees**

Committee	Purpose	Membership
Asset Management Steering Committee	Sets the general direction for the TAMP, including ensuring that transportation asset management is integrated across the appropriate levels of the organization; approval of policies, programs, processes and performance targets necessary for the implementation of transportation asset management; approval of the final TAMP.	• Director, Chair • FHWA Arizona Division Administrator • Deputy Director for Transportation • Deputy Director for Policy • Deputy Director for Business Operations • Chief Financial Officer • Secretary (Transportation Asset Manager and/or Assistant Director for Multimodal Planning Division)
Asset Management Working Group	Supports the implementation of the TAMP, including developing performance measures and state targets to be reviewed for approval by the steering committee; identifies and prioritizes risks to ADOT's transportation infrastructure; recommends changes to policies, procedures and processes to improve transportation asset management at ADOT; ensures different groups and sections within ADOT work together to accomplish the development and implementation of the TAMP; reviews the draft TAMP.	• Transportation Asset Manager, Facilitator • FHWA Arizona – Division Representative • Assistant Director for Transportation Systems Management and Operations Division • Assistant Director for Infrastructure Delivery and Operations Division • Assistant Director for Multimodal Planning Division • Deputy State Engineer – Operations • Deputy State Engineer – Design • Federal Aid Administrator – Financial Management Services • Chief Economist – Financial Management

		Services • Debt Management and Compliance Administrator – Financial Management Services
Asset Management Technical Teams	Supports the development of performance targets and the TAMP, including compiling and analyzing data to support the development of performance targets; uses bridge and pavement management systems to perform gap and life cycle analysis that cover a range of funding scenarios; identifies investment strategies for the cost-effective management of these assets; assists with the development of the TAMP.	**BRIDGE TECHNICAL TEAM** • Transportation Asset Manager, Facilitator • State Bridge Engineer • FHWA Arizona-Division Representative • Assistant State Bridge Engineer – Design • Assistant State Bridge Engineer – Operations • Bridge Management Systems Engineer • Financial Management Services Staff • Multimodal Planning Staff **PAVEMENT TECHNICAL TEAM** • Transportation Asset Manager, Facilitator • State Maintenance Engineer • FHWA Arizona-Division Representative • Pavement Management Engineer • Pavement Design Engineer • Financial Management Services Staff • Multimodal Planning Staff

2.3 Asset Management and the Planning Process

Over the last decade, long-range transportation planning in Arizona evolved from an emphasis on individual projects to a focus on overall system performance. ADOT's long-range transportation plan, *What Moves You Arizona 2040* (WMYA 2040), uses performance measures and data-driven analyses to evaluate different investment scenarios to recommend the most effective allocation of resources for the expansion, modernization, and preservation of Arizona's highway system. To channel these high-level investment choices into the selection of specific projects, ADOT adopted a new planning-to-programming (P2P) process known as P2P. P2P combines performance criteria with professional judgement to select and prioritize projects for ADOT's Five-Year Transportation Facilities Construction Program within the Statewide Transportation Improvement Program (STIP).

The ability to implement performance-based planning is being enhanced by improvements in the collection of asset condition data, combined with the availability of sophisticated analytical tools that model future asset performance. These developments together make it feasible to evaluate a range of asset management planning scenarios to identify one that best meets agency goals at a minimum practical cost. This TAMP provides the analytical basis

to support both high level resource allocation decisions in long-range transportation plan updates, and the development of asset specific investment strategies to guide project selection under the P2P Link process. Over time, the incorporation of TAMP findings in ADOT's performance-based planning process is expected to improve accountability and decision-making by:

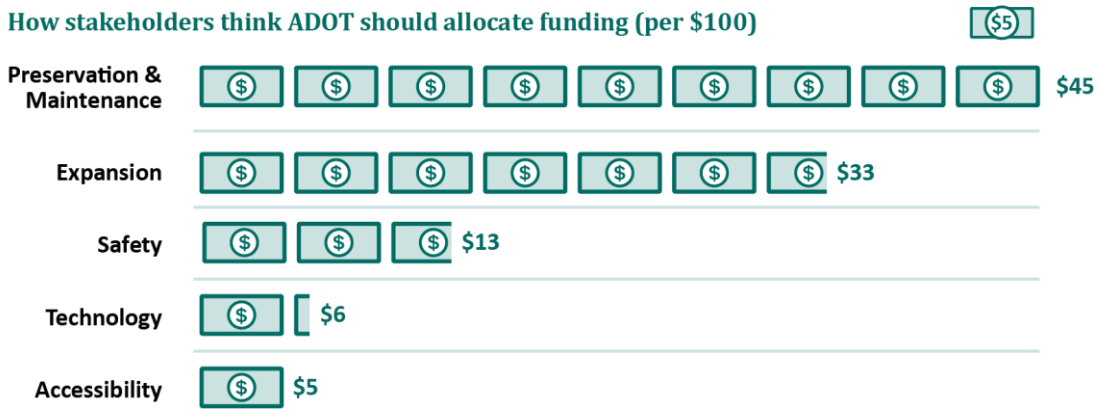
- Providing feedback on progress towards performance targets; and
- Increasing transparency by showing how data and analysis informs funding recommendations.

Local governments who own and operate NHS bridges and pavements are also involved in asset management planning through participation in the development of Metropolitan Transportation Plans (MTPs) and Transportation Improvement Programs (TIPs), and/or by working directly with ADOT to incorporate asset improvement projects in the STIP. ADOT has worked with Arizona's Metropolitan Planning Organizations (MPOs) to develop a planning agreement that identifies how data collection, performance targets and asset management planning will be coordinated and how each party will contribute. The planning agreements are available in **Appendix A**.

2.4 Public Support for Highway Preservation

During the development of WMYA 2040, ADOT worked collaboratively with Arizona's MPOs and Council of Governments (COGs) to implement an extensive public involvement process that included outreach sessions, workshops, a plan website, and the use of social media. Outreach efforts included an interactive online survey that asked for input on future investment priorities, funding allocation strategies and preferred trade-offs. As illustrated in **Figure 8**, Arizona's citizens place the highest priority on preserving and maintaining the existing highway system (WMYA 2040, 2018). It should be noted that outside of Phoenix and Tucson areas, citizens identified safety as the second highest priority after preservation and maintenance.

Figure 8 | **Investment Priority Survey Results**



2.5 Arizona Management System (AMS)

AMS is a people-centered, results-driven approach to continuously improving state government with a focus on customer service, transparency, and accountability to the citizens of Arizona. AMS uses the principles of Lean Management to enable state government to operate effectively and efficiently by understanding customer needs, identifying problems, improving processes, and measuring results.

Arizona's TAMP aligns well with this performance-based approach. This document outlines the resources needed to preserve both bridge and pavement assets, supporting the achievement of agency performance targets in the most cost-effective manner. The TAMP is a living document that will be updated at least every four years, or with significant changes in any aspect of the asset management program. Initial and on-going improvements to ADOT's Asset Management program will utilize AMS principles, practices, and tools. The AMS can be viewed here: **https://ams.az.gov**.

In the 2019 TAMP, several improvements were highlighted including the complete implementation of the dTIMS pavement management system and process enhancements for the AASHTOWare BrM to improve life cycle planning and generate more detailed performance and funding need projections. This 2021 TAMP reflects those updates and documents the associated changes to investment strategies and performance targets. In addition, the asset life cycle analyses have been updated to reflect impacts of the COVID-19 global health pandemic, with changes to the financial plan influencing modified asset performance forecasts.

Section 3
Asset Inventory & Condition

3.1 Introduction

ADOT regularly performs condition inspections of state-owned and, in some cases, locally-owned roadway assets. This section summarizes the inventory and the condition of Arizona's SHS and NHS bridges and pavements.

3.2 Bridge Assets

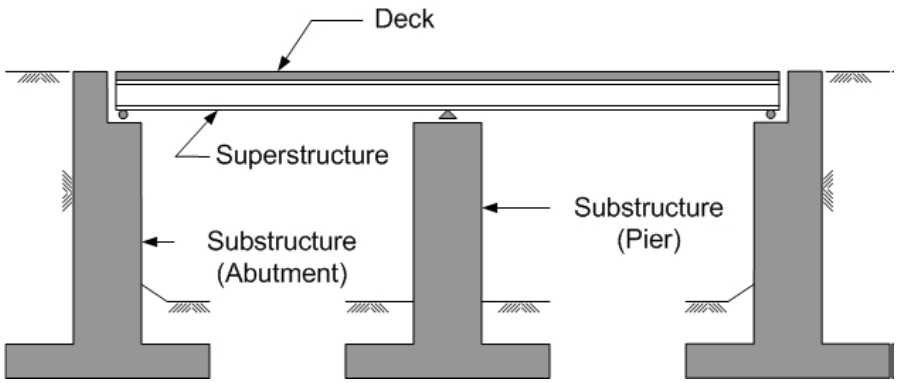
3.2.1 Bridge Data Management

ADOT inspects most of Arizona's publicly owned bridges, including all the bridges on the SHS and most of the bridges owned or operated by local governments. Routine bridge inspections occur every two years and include an assessment of the condition of a bridge's primary components: deck, superstructure, and substructure (**Figure 9**).

Culverts with openings measuring 20-feet along the centerline of the road are considered bridge structures and are inspected every four years. Culverts in Arizona are typically either a reinforced concrete box structure that supports the pavement (**Figure 10**), or steel or concrete pipes (**Figure 11**).

All bridge and culvert inspections are performed in accordance with ADOT's bridge inspection guidelines, which comply with the National Bridge Inspection Standards (NBIS). ADOT's bridge inspection guidelines are referenced in **Appendix A**. These guidelines, along with bridge inspector training for ADOT staff and consultants, provide consistent inspections which result in accurate, reliable data.

Figure 9 | **Schematic Bridge Elevation View**



SOURCE: U.S. Department of Transportation 2012; FHWA Publication No. NHI 12-049

Figure 10 | **Box Culvert**

Figure 11 | **Pipe Culvert**

ADOT performs bridge inspections for all jurisdictions except Maricopa County DOT. **Appendix A** references an intergovernmental agreement between the State of Arizona and Maricopa County outlining bridge inspection standards, protocols, and coordination. For an agency to perform their own bridge inspections, they must demonstrate compliance with the NBIS, and submit quarterly progress reports and an annual electronic National Bridge Inventory (NBI) record to the ADOT. Border bridges with California and Nevada are inspected by Caltrans or the Nevada DOT under intergovernmental agreements with Arizona.

3.2.2 Monitoring Bridge Condition

The NBI component rating system is used to assess bridge general condition for deck, superstructure, and substructure. The culvert condition rating is based on the same scale, but rather than a component rating, there is one rating for the entire culvert. This rating system features a scale from 0 to 9. Each structure is assigned a Good, Fair or Poor designation (**Figure 12**) based on the lowest scoring component.

Figure 12 | **NBI Bridge Rating Scale**

These categories are defined as follows:

- **Good**. Primary structural components exhibit a range from no problems to some minor deterioration.
- **Fair.** Primary structural components are sound but may have deficiencies such as minor concrete deterioration (cracking, spalling, scaling) or scour (erosion around piers or abutments caused by flowing water).

- **Poor.** Advanced deterioration, scour or seriously affected primary structural components (**Figure 13** to **Figure 15**). Bridges in poor condition need repair in addition to maintenance and monitoring and may be programmed for rehabilitation or replacement. The poor condition label does not necessarily mean that a bridge is unsafe. Bridges that are considered unsafe are closed until they can be repaired or replaced.

Figure 13 | **Cracking and Spalling on a Bridge Deck**

Figure 14 | **Scour at a Bridge Pier**

Figure 15 | **Scaling on a Bridge Deck**

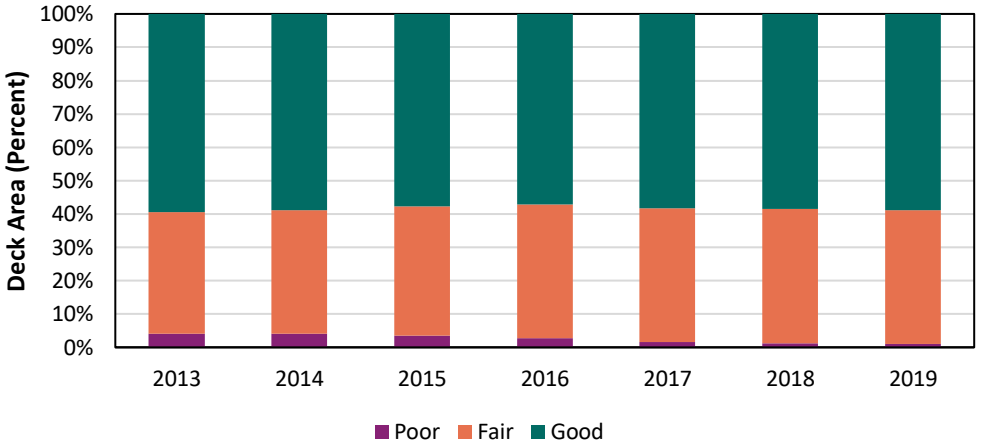
In addition to evaluating bridges at the component level, in 2014, ADOT began collecting more detailed element-level data during bridge inspections. Examples of bridge elements are railing, deck wearing surface, deck slab, expansion joint, bearing, column, and abutment. Element-level inspection data enables improved forecasting of deterioration and life cycle costs which can result in better treatment selection.

Figure 16 shows the condition of Arizona's NHS bridges over the past seven years. The number of bridges in Poor condition has steadily decreased over the past five years due to increased spending over this period.

Currently, more than 56 percent of the bridges on the Arizona SHS and NHS are in Good condition. In fact, Arizona ranks in the top 10 in the nation for having the fewest poor

condition bridges. This is largely due to the temperate climate and ADOT's focus on rehabilitating or replacing poor condition bridges.

Figure 16 | **State-Owned NHS Bridge Condition**



3.2.3 Bridge Inventory and Condition

ADOT owns and operates all the bridges and culverts on the SHS, and most of these structures on the NHS. Local governments own and operate the remaining bridges and culverts on the NHS. This TAMP covers a total of 5,052 bridges, of which 3,275 are on the NHS. **Table 8** shows the breakdown of the bridge inventory included in this TAMP by bridge category, and **Table 9** shows a breakdown of the locally-owned NHS bridges. Each table also shows bridge condition as a percentage of deck area.

Table 8 | **2019 Arizona Highway System Bridges**

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet) †	Good (%)	Fair (%)	Poor (%)
State-owned NHS Bridges	3,031	31,578,573	58.5	40.4	1.1
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Total NHS Bridges	**3,275**	**33,891,240**	**56.8**	**42.2**	**1.0**
Total Other SHS Bridges	**1,777**	**12,352,239**	**55.0**	**43.5**	**1.5**
Total Bridges Covered in the TAMP	**5,052**	**46,243,479**	**56.4**	**42.4**	**1.2**

** Includes culverts* with openings measuring 20 feet along the centerline of the road.

† System-wide bridge condition ratings are reported by deck area to account for the variance in bridge size throughout the state.

Source: ADOT 2020

Table 9 | 2019 Locally-Owned NHS Bridges

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Fountain Hills	1	3,300	100	0	0
Glendale	7	130,242	82.6	17.4	0
Goodyear	2	9,368	100	0	0
Marana	9	31,868	100	0	0
Maricopa Co	5	44,434	17.3	82.7	0
Mesa	13	164,635	19.8	80.2	0
Paradise Valley	1	2,176	100	0	0
Peoria	2	66,876	0	100	0
Phoenix	52	692,671	22.4	74.3	3.3
Pima Co	42	424,461	29.1	70.9	0
Sahuarita	2	3,912	100	0	0
Scottsdale	16	93,008	45.2	54.8	0
Sierra Vista	4	13,872	55.9	44.1	0
Surprise	2	6,186	0	100	0
Tempe	2	9,400	0	100	0
Tucson	82	551,480	42.7	57.3	0
Yavapai Co	1	22,226	0	100	0
Yuma City	1	42,552	0	100	0
Total	**244**	**2,312,667**	**33**	**66**	**1**

3.3 Pavement Assets

3.3.1 Pavement Data Management

Historically, ADOT has performed annual pavement condition evaluations for state highways using in-house staff and equipment. ADOT used the Federal Highway Administration (FHWA) Highway Performance Monitoring System (HPMS) Field Manual (2016) methodology to collect pavement data. Local governments were expected to collect pavement condition data for the NHS routes they own. However, ADOT was unable to consistently obtain this data. To resolve this problem, beginning in 2017, ADOT hired a contractor to perform automated pavement data collection for the entire SHS and the locally owned NHS. It is ADOT's intent to continue to collect pavement data for locally owned NHS routes in future years. This data will be made available to local NHS asset owners for their use. All data collected using the automated method is subject to a rigorous quality control review by ADOT's Pavement Management Section. A Data Quality Management Plan outlining pavement data collection and processing standards and procedures can be found in **Appendix A**.

ADOT's pavement inventory consists of asphalt, concrete, and composite pavements. Each pavement type has a different life cycle and is managed differently. Descriptions are provided in **Table 10**.

Table 10 | **Pavement Type**

Pavement Type	Management
Asphalt	Constructed with petroleum-based bituminous materials and is commonly referred to as flexible pavement. More than 90 percent of the pavement on the SHS is asphalt. It can last 50+ years if properly maintained with periodic preservation and rehabilitation treatments.
Concrete	Consists of Portland cement concrete and is commonly referred to as rigid pavement. It may be constructed with or without joints to control cracking. Concrete pavement may or may not be reinforced with steel. Most of the concrete pavement on the SHS is jointed and unreinforced and can last 60+ years.
Composite	Consists of a foundation of concrete pavement overlaid with a 1-inch-thick open-graded asphalt rubber friction course. ADOT's open-graded asphalt has a high amount of air voids making the pavement water permeable and contains ground tire rubber to reduce road noise. About 7 percent of the pavement on the SHS is composite.

3.3.2 Pavement Condition Assessment Summary

Asphalt and composite pavement condition are evaluated using three metrics: International Roughness Index (IRI), percent cracking and rutting. Concrete pavement condition is evaluated using IRI, percent cracking and faulting metrics. A description of these metrics is presented in **Table 11**.

Table 11 | **Pavement Condition Rating Metrics**

Metric	Description	Example
IRI	International method for measuring the smoothness (or roughness) of pavements. This measure is strongly correlated to ride quality.	
Cracking	A fissure or discontinuity of the pavement surface not necessarily extending through the entire thickness of the pavement. Cracking is generally caused by repeated traffic loads or pavement shrinkage due to low temperatures.	
Rutting*	Surface depressions that run lengthwise, usually in the wheel path, in an asphalt pavement. Rutting results from permanent deformation of any of the pavement layers or the subgrade. It is usually caused by the consolidation or lateral movement of the pavement materials due to heavy traffic loads.	
Faulting*	An elevation difference between two concrete slabs typically caused by poor load transfer between slabs, slab settlement or movement induced by erosion of material beneath the slab.	

** Photo taken from the 2016 HPMS Field Manual*

If the condition for all three applicable metrics is Good, then the pavement section is rated in Good condition. If two or more metrics are rated Poor, then the pavement section is rated in

Poor condition. All other rating combinations are Fair condition. **Table 12** shows the federal thresholds for these metrics.

Table 12 | **Federal Thresholds for Pavement Rating Metrics**

Condition Rating	Good	Fair	Poor
IRI (inches/mile)	<95	95-170	>170
Cracking (percent)	<5	5-20 (asphalt)	>20 (asphalt)
		5-15 (jointed concrete)	>15 (jointed concrete)
		5-10 (continuously reinforced concrete)	>10 (continuously reinforced concrete)
Rutting (inches)	<0.20	0.20 - 0.40	>0.40
Faulting (inches)	<0.10	0.10 - 0.15	>0.15

ADOT makes a significant investment in maintaining interstate pavements. Historically, interstate pavements have been in Good condition, although the amount of Fair condition pavements has increased in recent years. The condition data shown in **Figure 17** and **Figure 18** is only for the period of 2017 to 2019 due to the transition to automated data collection in 2017. Pre-2017 data is not comparable to the automated data since it was collected by a different method.

Figure 17 shows that almost 50 percent of the interstate pavements have been in Good condition over the past three years. There was one percent (1%) or less Poor condition interstate pavements during the same period. Arizona's non-interstate NHS pavements receive less funding than the interstates, and have deteriorated more due to lower investment levels, as presented in **Figure 18**.

Figure 17 | **Interstate NHS Pavement Condition**

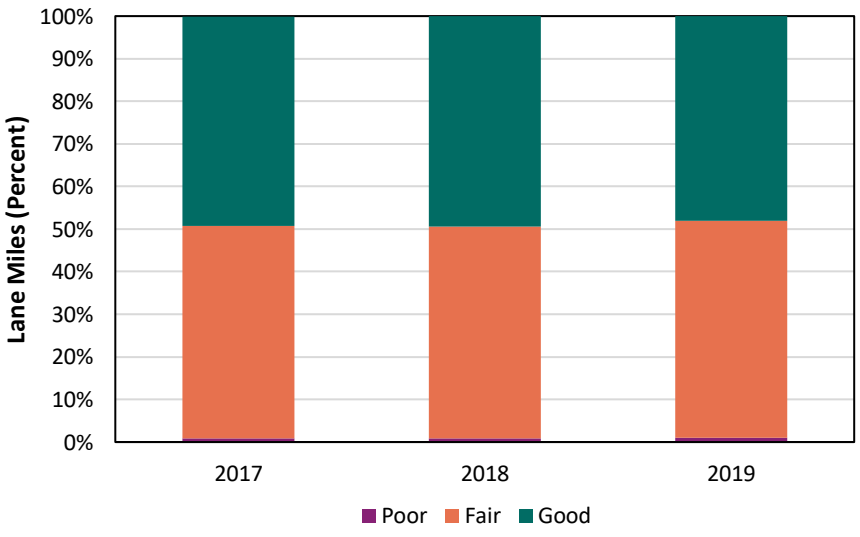
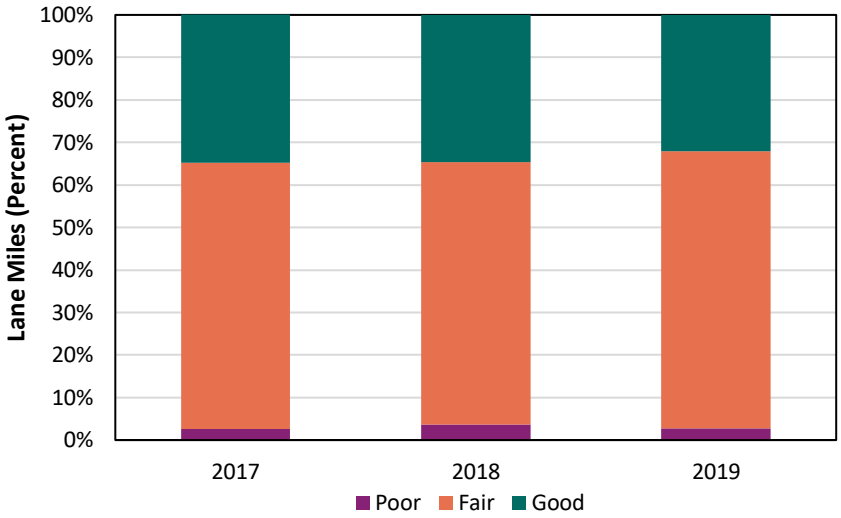


Figure 18 | **Non-Interstate NHS Pavement Condition**



3.3.3 Pavement Inventory and Condition Summary

This TAMP covers 23,067 lane miles of pavement, owned and managed by ADOT and local agencies. The Arizona NHS represents about 60 percent of the SHS. ADOT maintains all the pavement on the SHS, which includes the state-owned NHS. Local, tribal and other government entities own and maintain pavement on about 11 percent of the NHS. The estimated 2019 lane miles for paved roads by asset category are shown in **Table 13** with the breakdown of the locally-owned portion shown in **Table 14**. Each table also shows pavement condition as a percentage of lane miles.

Table 13 | **2019 Lane Mile Breakdown and Condition for Paved Roads**

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Interstate	5,422	48.0	51.0	1.1
State-owned, Non-Interstate NHS	6,559	32.1	65.2	2.7
Locally-owned NHS	1,692	5.7	89.5	4.8
Total NHS Pavements	**13,673**	**38.6**	**59.3**	**2.1**
Other SHS Pavements	**9,394**	**23.0**	**72.1**	**4.8**
Total Pavements Covered in TAMP	**23,067**			

As shown, almost 50 percent of the interstate pavements are classified as Good. Approximately one percent (1%) of interstate pavements, three percent (3%) of non-interstate NHS pavements, and five percent (5%) of Other SHS are classified as Poor. Locally

owned NHS pavements are mostly in Fair condition, with approximately five percent (5%) in Poor condition.

Table 14 | **2019 Locally-Owned NHS Pavements**

Locally Owned	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Buckeye	4.2		100.0	
Bureau of Indian Affairs*	10.2			
US Customs and Border Patrol*	1			
Casa Grande	15.7	7.6	92.4	
Cave Creek	2.5		100.0	
Chandler	61.7	2.9	97.1	
Douglas	0.1			100.0
El Mirage	3.5		33.4	66.6
Flagstaff	10.3	18.4	74.1	7.5
Fountain Hills	20.9	16.8	83.2	
Grand Canyon Airport Authority*	0.6			
Grand Canyon National Park*	19.8			
Glendale	64.8	0.6	89.2	10.2
Goodyear	18.2		100.0	
Kingman	13.2	39.6	49.8	10.6
Litchfield Park	4.7	10.7	80.8	8.5
Maricopa County	84.6	11.7	88.3	
Mesa	64.7		90.3	9.7
Nogalas	0.6		100.0	
Paradise Valley	21.2	7.8	92.2	
Peoria	23.5		87.4	12.6
Phoenix	657.6	3.6	91.4	4.9
Pima County	26.5	6.3	87.4	6.3
Quartzite	7.7		89.1	10.9
Salt River Indian Community*	0.6			
San Luis	6.9		93.8	6.2
Scottsdale	156.8	12.7	82.8	4.5
Somerton	10.9		100.0	
Surprise	33.9	7.4	92.6	
Tempe	66.8	0.9	92.2	6.9
Tucson	129.9	14.2	80.1	5.6
Williams	1.9		100.0	
Yuma City	66.7	1.2	96.8	2.0
Yuma County Public Works*	80			
Total Locally Owned	**1,692.50**	**5.7**	**89.5**	**4.8**

** Pavement condition data is unavailable - ADOT does not collect pavement condition data for these local agencies. Locally-owned NHS assets for these agencies represent a small percentage of the total NHS.*

3.4 Asset Performance Measures & Targets

In this TAMP, performance measures and targets for managing bridges and pavements are the basis for assessment, analysis, and planning. ADOT uses both short- and long-term performance measures and targets. The short-term performance metrics are federally required, and the long-term metrics are used to quantify the goal for achieving a state of good repair for the SHS over a ten-year period.

3.4.1 Federal Performance Measures – Bridges and Pavements

The federal performance management rules for bridges and pavements (23 CFR Part 490.105) require state DOTs to establish targets for six pavement and bridge measures of Good and Poor condition. In addition, the rule sets the following minimum condition requirements:

- The percentage of interstate pavement lane-miles in Poor condition shall not exceed 5 percent.
- The percentage of the deck area of NHS bridges classified in Poor condition shall not exceed 10 percent.

On May 20, 2018, ADOT formally adopted two- and four-year performance targets for the applicable bridge and pavement performance measures, based on current and historical condition. Two-year performance was reported in October 2020 and ADOT met the applicable targets. **Table 15** presents updated targets based on refined life cycle planning processes using the improved management systems.

Table 15 | **ADOT Bridge and Pavement Performance Targets (established in 2018)**

Performance Target	2020 Target (%)	2020 Performance (%)	2022 Target (%)
Percent of NHS bridges classified as in Good condition	52	57.8	52
Percent of NHS bridges classified as in Poor condition	4	1.2	4
Percent of Interstate pavements in Good condition	-	47.0	44
Percent of Interstate pavements in Poor condition	-	1.1	2
Percent of non-Interstate NHS pavements in Good condition	31	32.3	28
Percent of non-Interstate NHS pavements in Poor condition	6	2.8	6

3.4.2 State of Good Repair

ADOT's goal is to maintain the highway system in a state of good repair (SOGR). This concept is interpreted at both the asset level and the network level.

- At the asset level, a state of good repair means that the asset is providing the desired level of service and is in sufficient condition to enable cost-effective maintenance and preservation.

- At the network level, a state of good repair means a performance level that can be sustained at minimal long-term cost to the agency and to road users. This requires that maintenance and preservation are applied consistently and strategically, that risks are managed, and that performance deficiencies are corrected in a timely manner.

3.4.2.1 Bridges

ADOT considers its National Highway System bridge and culvert inventory to be in excellent condition, at the current level of 56.8 percent Good and 1.2 percent Poor. As ADOT's bridge inventory ages, the overall system condition is expected to decline, and ADOT's long-term performance targets take this into consideration. The aging bridge inventory includes some very large bridges which are expected to deteriorate from Good to Fair condition in the coming years and have a proportionately large effect on overall system condition. Given the objectives listed previously and the age of the bridge network, ADOT has set ten-year targets of 96 percent Good/Fair and four percent Poor to maintain a state of good repair (**Table 16**).

Table 16 | **Desired Long-Term SOGR for Bridges**

Bridge Class	Minimum % Good/Fair	Maximum % Poor
NHS	96	4
SHS	96	4

3.4.2.2 Pavements

Limited funding has caused ADOT to prioritize pavements that carry high traffic volumes and are important for commerce and mobility. In order to accomplish this, the NHS was sub-divided into three pavement classes (Interstates, Other NHS State-maintained routes, and Other NHS Locally-maintained routes); the Non-NHS routes were subdivided into two pavement classes (high- and low-volume routes). **Table 17** presents the desired pavement SOGR for each pavement class, except the locally-maintained class. This class is such a small percentage of the total NHS that its performance is not expected to affect the NHS's desired long-term target. ADOT is in the process of engaging these agencies to develop a collaborative plan for data exchange and performance target setting that satisfies federal requirements.

Table 17 | **Desired Long-Term SOGR for Pavements**

Pavement Class	Minimum % Good/Fair	Maximum % Poor
Interstates	98	2
Other NHS – State Maintained	93	7
Other NHS – Locally Maintained	-	-
Non-NHS – High Volume	93	7
Non-NHS – Low Volume	85	15

Section 4
Risk Management

4.1 Overview

FHWA defines risk as ***"the positive or negative effect of uncertainty or variability on agency objectives."***

Risk management is defined as "the processes and framework for managing potential risks, including identifying, analyzing, evaluating, and addressing the risks to assets and system performance." (23 CFR Part 515.5) This section describes ADOT's risk policy and procedure, risk management process, and risk mitigation plans for high priority risks for the entire state system (NHS and non-NHS). Additionally, this section summarizes an assessment of pavements and bridges repeatedly damaged by emergency events.

4.2 Risk Policy and Procedure

The foundation of risk-based asset management is an agency commitment to adopt policies and procedures that support the identification, analysis, and treatment of risks.

A risk-based asset management process has many benefits including the following:

- Reduce crisis management by anticipating likely risks and developing strategies to avoid or mitigate them.
- Enable risk to be factored into the selection of an asset improvement alternative or investment option.
- Identify the positive aspects of risk so the agency can prepare to benefit from potential opportunities.
- Aid communication with stakeholders regarding the risks and uncertainties associated with different asset management solutions, including 'no action' alternatives.
- Facilitate the assignment of risk management duties to the appropriate parties.
- Help make the case for allocating adequate resources to asset preservation in a transportation plan or program.

In 2018, ADOT began holding annual Asset Management Risk Workshops, attended by key agency personnel, including subject matter experts who identified a process for considering risks in the management of agency assets and developed an asset management risk register. Three Risk Workshops have been held to-date, the outcome of which is described below.

4.3 Risk Management Process

ADOT followed the basic risk framework identified in the FHWA guidance document titled, "Incorporating Risk Management into Transportation Asset Management Plans." The process was implemented during a Risk Workshop with technical staff from different parts of the agency. The framework includes five components:

- **Establish the Context**. Identifying risk management objectives based on agency asset management goals and targets.
- **Risk Identification**. Identifying risks to highway assets, including facilities that are repeatedly damaged by emergency events.
- **Risk Analysis**. Estimating the magnitude of risk impacts by assessing the likelihood and consequence of each risk identified.
- **Risk Evaluation**. Prioritizing risks based on the combination of likelihood and consequence.
- **Manage Risks**. Preparing a response and mitigation plan, with a focus on top priority risks and repeated emergency events.
- **Monitor Risks**. Risks are assigned to a risk owner who is responsible for managing and monitoring the risk on a regular basis. ADOT holds an annual workshop to evaluate existing risks and identified emerging risks.

ADOT seeks for its risk-based asset management to:

- Be comprehensive.
- Be easy to understand.
- Prioritize risks.
- Identify long-term vulnerabilities.
- Identify strategies for the prevention and avoidance of risks.
- Inform decision-making.
- Identify the appropriate party to manage the risks.
- Monitor top priority risks.
- Aid in the prioritization of projects in the STIP.
- Support communication regarding asset management with stakeholders, including the public.

To be comprehensive, this plan considers several categories of risk (**Table 18**).

Table 18 | **Risk Type**

Risk Type	Effect
Agency	Risk to the agency that affects the implementation of the strategic goals of the asset management plan. Examples include changes in leadership, legislative actions, unfunded mandates, and the ability to convey the importance of asset management to decision-makers and the public.
Financial	The availability of adequate funding or the accurate prediction of future funding needed to implement the TAMP. Examples include inflation, unexpected funding shortfalls, solvency of the Highway Trust Fund, financial markets, interest rate increases and inaccurate predictions in financial plans.
Program	Affect the ability to deliver a program of projects in a timely manner and meet performance targets. Risks may include the inability to effectively manage data, the loss of institutional knowledge via attrition, competing spending priorities, inaccurate cost estimates and construction/materials price volatility.
Asset	Affect individual assets, such as structural deterioration, extreme weather, and obsolescence. Asset risks include flooding, landslides, hazardous materials spills, collisions with bridge elements and assets that do not meet changing design standards.
Project	Associated with projects to restore or replace individual assets. Project risks include cost factor uncertainty, traffic delays, lengthy detours and project delays caused by environmental, utilities, right-of-way, geotechnical, procurement, scope creep and inter-governmental agreements.
Activity/Operations	Associated activities like routine maintenance, including slow or inadequate response to damaged assets (e.g., pothole or guardrail repair) or extreme weather events (e.g., clearing blocked drainage structures, repairing scour-weakened bridge foundations or risks to workers such as heat, fires, etc.).

4.3.1 Risk Register

A risk register is an easy to understand and commonly used tool to identify, evaluate and prioritize risks. Using a risk register, the significance and priority of a risk event (R) is determined by considering both the seriousness of the consequences (C) if the event occurs and the likelihood (L) that it will occur; in other words, L x C = R. A color-coded "heat" scale assists in the evaluation of risks (**Table 19**).

Table 19 | **Risk Rating Matrix – Heat Map**

Likelihood	Consequence				
	Negligible (1)	**Low (2)**	**Medium (3)**	**Very High (4)**	**Extreme (5)**
Almost Certain (5)	L (5)	M (10)	H (15)	VH (20)	VH (25)
Likely (4)	L (4)	M (8)	M (12)	H (16)	VH (20)
Possible (3)	L (3)	M (6)	M (9)	M (12)	H (15)
Unlikely (2)	L (2)	L (4)	M (6)	M (8)	M (10)
Rare (1)	L (1)	L (2)	L (3)	L (4)	L (5)

‡R = Risk Rating; categories include Low (1-6) = L, Medium (7-13) =M, High (14-19) =H, Very high (20-25) =VH

The Risk Register also contains a summary of response actions to address risks. The "Five Ts" is a commonly used approach to describing the standard response options for asset risk.

TREAT means to take proactive action to prevent or mitigate risk. This approach can include a plan or a program to address specific risks, such as an extreme weather adaptation plan or a scour counter-measures program.

TOLERATE means taking minimal measures to monitor and periodically reassess risks. It is adopted in response to risks with a low likelihood or consequence rating, that the agency is willing to cope with, or that are difficult or not cost-effective to mitigate.

TERMINATE means to discontinue an activity that leads to risk.

TRANSFER means to pass on some or all the responsibility for managing a risk to another party.

TAKE ADVANTAGE means to be prepared to capitalize on beneficial change or emerging opportunities.

The following Risk Register (**Table 20**), which was updated during the 2020 workshop, contains the risks, ratings, risk owner, and a high-level summary of the recommended risk mitigations that were identified at the Asset Management Risk Workshop along with a corresponding heat scale rating. Although this TAMP focuses on bridges and pavements, the risk analysis was not limited to these assets. All the risks identified in the Risk Register could affect state-owned NHS and non-NHS routes. Since the last TAMP update, several actions have been implemented in response to risks that were previously identified, including incorporating risk into the bridge and pavement management system project prioritization processes. More detailed descriptions of the mitigations for the high and very high priority risks (17) are presented beneath the Risk Register.

Table 20 | **Asset Management Risk Register**

Risk Category	Risk Event (Risk Owner)	L*	X	C†	=	R‡	Risk Mitigation	Heat Type
AGENCY	1. Inadequate preservation funding for the existing system (MPD, Asset Groups, Financial Management Services [FMS])	5	x	5	=	25	Identify funding gaps and investment strategies that could close those gaps in the TAMP.	VERY HIGH
	2. Changing legislation (Government Relations)	5	x	4	=	20	Monitor proposed State and Federal legislation and communicate impacts to management, the Transportation Board, the governor, and legislature.	VERY HIGH

Risk Category	Risk Event (Risk Owner)	L*	X	C†	=	R‡	Risk Mitigation	Heat Type
	3. **Extreme weather trends** (Environmental Planning Resilience Program, Districts, Transportation System Management & Operations [TSMO])	5	x	4	=	20	Implementation of ADOT's Resilience Program 2021/22 Work Plan. Pump station reliability tool implemented. Complete probabilistic risk modeling development for bridge design.	**VERY HIGH**
	4. **Effectively communicating asset needs** (Asset Groups, Multimodal Planning Division [MPD])	3	x	4	=	12	Share output of TAMP with decision-makers; focus on long-term preservation needs.	**MEDIUM**
	5. **Impact of deteriorated infrastructure on public perception** (MPD, Communications)	5	x	2	=	10	Use TAMP to communicate the connection between funding levels and asset deterioration over time. Share condition data with public and describe asset preservation efforts undertaken by ADOT.	**MEDIUM**
	6. **Leadership changes** (ADOT)	4	x	2	=	8	Succession planning; standardizing and documenting regular processes; maintaining and updating SOP documents to help inform new leadership.	**MEDIUM**
	7. **Ability to accurately forecast asset performance** (MPD, Asset Groups)	1	x	4	=	4	Refine data collection practices and bridge and pavement management system deterioration models after about 6 years of data is collected. Implement the pavement preservation treatment monitoring program being developed through research.	**LOW**
	8. **Expansion without new maintenance funding** (MPD, TSMO)	2	x	2	=	4	Evaluate the true costs of infrastructure maintenance activities. Communicate impacts to Transportation Board.	**LOW**
FINANCIAL	9. **Coronavirus pandemic** (FMS, MPD)	5	x	5	=	25	Adjust program to new fiscal reality, document impacts on funding and communicate with the Transportation Board, Governor and Legislature.	**VERY HIGH**

Risk Category	Risk Event (Risk Owner)	L*	X	C†	=	R‡	Risk Mitigation	Heat Type
	10. **Viability of Revenue Sources** (FMS, MPD)	5	x	5	=	25	Prepare revenue forecasts, fiscally constrained programming, monitor and address.	**VERY HIGH**
	11. **Liability losses associated with assets** (Risk Management)	5	x	3	=	15	Self and supplemental Insurance; utilize liability loss data in decision making.	**HIGH**
	12. **Losses caused by third parties** (Risk Management)	5	x	3	=	15	Insurance loss recovery program for collisions involving assets.	**HIGH**
	13. **Changing interest rates and inflation** (FMS, MPD)	4	x	3	=	12	Prepare financial forecasts to monitor and adjust transportation program.	**MEDIUM**
PROGRAM	14. **Construction/materials price volatility** (FMS, Contracts and Specifications)	5	x	5	=	25	Price adjustments for volatile commodities – contingency fund. Move projects to future years.	**VERY HIGH**
	15. **Obsolete infrastructure** (Asset Groups, MPD)	3	x	3	=	9	Evaluate obsolete asset features during project scoping and recommend cost effective improvements.	**MEDIUM**
	16. **Competing spending priorities** (MPD, FMS)	5	x	4	=	20	P2P process to prioritize projects. Address in the Long-Range Transportation Plan.	**VERY HIGH**
	17. **Ability to collect accurate asset and performance data** (MPD)	3	x	4	=	12	Continue to improve data collection and quality control practices.	**MEDIUM**
	18. **Staff attrition** (ADOT Executive Team, HR)	5	x	3	=	15	Cross-training and succession planning. Hire more in-house staff.	**HIGH**
	19. **Lack of data governance for asset, GIS, and planning data** (MPD, ITG)	5	x	3	=	15	Create a strategic data management/governance plan that applies total systems thinking to the collection, management, analysis, dissemination and implementation of asset and GIS data to support the P2P process. Integrate this into an agency-wide data governance plan.	**HIGH**

Risk Category	Risk Event (Risk Owner)	L*	X	C†	=	R‡	Risk Mitigation	Heat Type
	20. Geohazard mitigation delays caused by project bundling (IDO)	5	x	3	=	15	Allocate separate project or program funding for geohazard mitigation.	**HIGH**
PROJECT	**21. Scope creep and project cost uncertainty** (MPD, Project Review Board, PPAC, FMS)	5	x	2	=	10	Planning-level scoping to provide clear definition to the project needs. Control at Project Review Board and the Priority Planning Advisory Committee.	**MEDIUM**
ASSET	**22. Flood damage including scour** (Bridge Group, TSMO, Environmental Planning Resilience Program)	5	x	4	=	20	Statewide scour evaluation; scour-counter measures program. Use ADOT Resilience Program Natural Hazard Risk Assessment Process.	**VERY HIGH**
	23. Collision damage to bridges (Bridge Group, Risk Management)	5	x	3	=	15	Raise low bridges. ADOT to seek reimbursements from responsible parties.	**HIGH**
	24. Non-permitted overweight load related damage (MPD, ECD)	5	x	3	=	15	More weigh-in-motion infrastructure; increased resources for enforcement; awareness training for enforcement officers and border liaisons	**HIGH**
	25. Lack of redundant routes if an asset fails (TSMO, Asset Groups)	3	x	5	=	15	Update emergency detour plans; electronic signage; identify vulnerable assets and maintain in good condition. Flex lanes.	**HIGH**
	26. Permitted over-weight load related damage (TSMO, Enforcement and Compliance Division [ECD], Asset Groups)	4	x	3	=	12	Monitor impacts of overweight loads and adjust permitting accordingly.	**MEDIUM**
	27. Landslides and/or slope failures (Geotechnical Section)	2	x	5	=	10	Identify unstable areas, remediate storm water infiltration, re-contour or stabilize slopes, install monitoring devices.	**MEDIUM**
	28. Subsidence due to groundwater pumping (IDO)	3	x	2	=	6	Account for this in design, corridor studies, etc. Expand the use of the Resilience Program GIS database to map subsidence locations of concern.	**LOW**

Risk Category	Risk Event (Risk Owner)	L*	X	C†	=	R‡	Risk Mitigation	Heat Type
	29. **Rock Fall and geohazards** (Geotechnical Section, District Maintenance)	5	x	1	=	5	Expand the use of the Resilience Program GIS database to map geohazard locations of concern. Consider creating a fund for this ongoing challenge.	**LOW**
	30. **Retaining Wall Failures** (Geotechnical Section)	1	x	5	=	5	Screen wall products in the Product Evaluation Program. Perform routine retaining wall inspections and maintenance, identify failing walls, initiate repair, or replacement projects.	**LOW**
	31. **Events inside tunnels resulting in loss of service** (Bridge Group, TSMO)	1	x	5	=	5	Routine, comprehensive tunnel inspections and maintenance. Replace obsolete lighting. Emergency response plan.	**LOW**
	32. **Failure of small (<20 feet in length) culverts** (TSMO)	1	x	5	=	5	Statewide small culvert evaluation, consider culvert upgrades when developing pavement projects.	**LOW**
ACTIVITY/ OPERATIONS	33. **Inadequate maintenance budget** (TSMO, FMS)	5	x	5	=	25	Defer maintenance, inform legislators of impacts.	**VERY HIGH**

**L = Likelihood; categorized as Rare (1), Unlikely (2), Possible (3), Likely (4), Almost certain (5)*

†C = Consequence; categorized as Negligible (1), Low (2), Medium (3), Very high (4), Extreme (5)

‡R = Risk Rating; categories include Low (1-6), Medium (7-13), High (14-19), Very high (20-25)

4.3.2 Mitigation for High Priority Risks

Many of the risks identified are known to the agency and have formal or informal strategies in place for mitigation. Others were identified as part of this risk analysis effort. ADOT's risk mitigation strategies for high priority risks follow.

4.3.2.1 High Priority Agency Risks

INADEQUATE PRESERVATION FUNDING FOR THE EXISTING SYSTEM

SHS bridges and pavements are aging, making them costlier to maintain. At the same time the highway system continues to expand, adding to the costs of maintaining the system. The resources available for preservation have not kept up with needs, resulting in an increasing amount of deterioration of SHS bridges and pavements. To address this issue, ADOT increased its investment to preserve Arizona's highway assets. WMYA 2040 recommended investing $326 million annually for asset preservation, about 30 percent more than the funding identified in the previous long-range plan. Although the original plan was to fully phase in this funding level by FY 2025, the COVID-19 pandemic introduced projected revenue

shortfalls which have resulted in short term funding cuts to the program. While impacts from this global health pandemic have affected funding in the near term, ADOT maintains a long-term financial commitment to preserve aging bridge and pavement assets.

CHANGING LEGISLATION

The Government Relations Office is responsible for coordination and oversight of ADOT legislative initiatives, rules, and policies. The office provides a proactive process through which ADOT communicates with and serves Arizona's Congressional Senators and Representatives, State Legislators, Governor's Office and the people of Arizona to ensure the priority of ADOT's mission is reflected in state and Federal legislation, rules and policies.

During Federal and state legislative sessions, the office tracks bills and informs ADOT's executive team of issues that may affect the agency. The office works closely with ADOT staff to gather information to assist the Governor's Office and legislators to assess the impacts of proposed legislation/rules on the agency, highway system or revenues available for transportation purposes. Identifying potential legislative issues early provides the agency an opportunity to comment and potentially influence the outcome. Impacts of legislation on resources and policies that affect the asset management program, and the implementation of investment strategies, are important to monitor and address.

EXTREME WEATHER TRENDS

ADOT prepared a *Preliminary Study of Climate Adaptation for the Statewide Transportation System in Arizona* (March 2013) and an *Extreme Weather Vulnerability Assessment* (January 2015) to address concerns related to extreme weather trends in the state (see **Appendix A**). Study findings include:

- **Extreme Heat**. The number of days exceeding 100°F annually is predicted to double in low desert areas by 2080. Impacts could include pavement deformation, shorter pavement construction windows, heat-related worker safety issues and public safety issues during lengthy delays. Higher temperatures would stress vegetation, thereby reducing ground cover and contributing to increased dust storms. Wildfires would also be more likely and larger in mountainous areas where temperatures are expected to increase as well. Burned areas are subject to increased runoff potentially overwhelming roadway drainage structures. Benefits include less freeze-thaw impacts to pavement and less snow removal in the high country.

- **Extreme Precipitation**. Increases in yearly rainfall are expected to be modest, but there is the potential for more intense individual precipitation events which may damage or overwhelm drainage structures and pump stations. Saturated soils contribute to an increased risk of rockfall and landslides.

The *Extreme Weather Vulnerability Assessment* recommended the systematic integration of extreme weather risks into the TAMP as well as the incorporation of cost-effective adaptation strategies. To accomplish this, ADOT prepared an *Asset Management, Extreme Weather, and Proxy Indicators Infrastructure Resilience Report* updated in March 2020 (see **Appendix A**). Recommendations for improving resilience include:

- Roadside Vegetation Management Guidelines (implemented)
- Probabilistic Bridge Design Pilot Project (underway)
- 2019 Pump Station Reliability Tool Pilot Project (implemented)
- Scour Counter Measures Program (implemented)
- Culvert Repair Program (implemented)
- Geo-hazard Plan (plan completed – implementation unfunded)
- Resilience Program 2021/22 Work Plan (under development)
- Resilience Program Natural Hazard Risk Assessment engineering design and project development process (implemented)

ADOT's Environmental Planning Group is currently managing the infrastructure resilience project.

4.3.2.2 High Priority Financial Risks

CORONAVIRUS PANDEMIC

The COVID-19 pandemic has introduced an unprecedented level of uncertainty into all ADOT's operations. On March 30th, 2020, the Governor issued a stay-home order for all state residents, except for certain essential businesses. In addition to social distancing protocols recommended around the world, this has brought new challenges for ADOT, specifically related to funding and revenues. With reduced travel, there is a risk of revenue shortfalls as well as potential declines in state and federal funding. Since legacy assets require increasing amounts of funding for preservation as they age, reduced funding could impact ADOT's ability meet short term pavement and bridge performance targets and the long-term state of good repair. To manage these risks, adjustments to the Five-year Facilities Construction program to delay some projects have been made. While this TAMP has attempted to capture updated analyses of asset condition and funding data to reflect early impacts of the pandemic on projections, a level of uncertainty of the future remains, based on how travel trends, asset condition trends, and funding will be affected by the pandemic.

VIABILITY OF REVENUE SOURCES

Like the ongoing Coronavirus Pandemic, the Great Recession of 2007-2009 impacted ADOT's ability to fund asset preservation, contributing to a deterioration of asset condition. Generally, transportation revenues are not keeping pace with needs, making it difficult to adequately fund expansion, modernization, and preservation projects. The solvency of the Federal Highway Trust Fund and the availability of Federal funds in future years may create a revenue risk. The expiration of local transportation excise taxes, and the decline of gas tax revenues, would also have a significant effect on revenues. Further, transportation excise taxes are highly sensitive to economic cycles. With reduced revenues occurring and projected from the ongoing Coronavirus Pandemic, ADOT's ability to meet performance targets could be impacted.

ADOT's *Long-Range Transportation Plan* process evaluates different revenue and investment scenarios and considers revenue variations when recommending investment choices. Additionally, ADOT's planning and programming process is putting an increasingly high priority on preservation projects for bridges and pavements. FHWA's decision to allow Federal funds to be used on certain types of preservation activities has increased the state's flexibility to adjust to funding shortfalls. ADOT actively monitors revenues and prepares monthly financial reports for management and State Transportation Board review.

LIABILITY LOSSES ASSOCIATED WITH ASSETS

ADOT's FY *2020 Comprehensive Financial Report* states that:

> *"The Department is exposed to various risks of loss related to torts; thefts of, damage to, and destruction of assets; errors and omissions; injuries to employees; and natural disasters. The Department is a participant in the State's self-insurance program and, in the opinion of the Department's management, any unfavorable outcomes from these claims and actions would be covered by the self-insurance program. Accordingly, the Department has no risk of loss beyond adjustments to future years' premium payments to the State's self-insurance program. All estimated losses for unsettled claims and actions of the State are determined on an actuarial basis and are included in the State of Arizona's Comprehensive Annual Financial Report."*

It should be noted that while premiums paid to the state's self-insurance program have not increased in recent years, transportation liability losses have caused the state's insurers to increase retention amounts (deductibles) and premiums for excess coverage.

LOSSES CAUSED BY THIRD PARTIES

One way to reduce direct property loss (state highway items not covered by the state's self-insurance program) is to increase the amount recovered from the responsible party (**Table 21**). In 2014, ADOT initiated an effort to improve the recovery process and increase the insurance recovery rate. The process improvement drove the recovery rate from 63 percent in FY2014 to 111 percent in FY2019.

Table 21 | **Insurance Recovery Metrics**

Year	Recoveries ($)	Repairs ($)	Recovery Rate (%)
FY2014	3,084,575	4,860,045	63
FY2015	2,800,930	5,061,118	55
FY2016	4,938,565	5,945,449	83
FY2017	5,409, 843	5,399,292	100
FY2018	6,577,775	6,124,784	107
FY2019	5,829,654	5,261,355	111
FY2020	5,047,575	5,642,729	89
AVERAGE	4,812,702	5,470,682	88

4.3.2.3 High Priority Program Risks

CONSTRUCTION/MATERIALS PRICE VOLATILITY

ADOT has formed a methodology to produce a Construction Cost Index to evaluate construction cost inflation on an annual basis, to aid in short- and long-term planning for resource allocation to the construction program. Construction contractors can adjust volatile commodities, like asphalt, if the market price varies from the bid price by a specified percentage. This eliminates the need to adjust bids to hedge for price volatility. ADOT monitors construction and materials prices so that programming adjustments can be made to adapt to volatile prices. ADOT maintains a contingency fund that can be used to adjust for short-term price volatility.

COMPETING SPENDING PRIORITIES

The state and the federal government have numerous spending priorities which can cause transportation funding to be diverted to other purposes. These diversions can have a significant impact on a transportation agency's ability to maintain its assets. ADOT monitors changes in funding and communicates the impacts to the Governor and the State Transportation Board. This TAMP provides a data-driven strategic process that prioritizes investment strategies to achieve and sustain ADOT's desired state of good repair serving as mitigation of this risk.

STAFF ATTRITION

In recent years, ADOT has been increasingly relying on consultants and contractors to perform certain duties. At the same time, the agency continues to lose highly experienced engineers and other professional staff to retirement or external opportunities. This has diminished institutional knowledge and reduced the number of potential candidates available for promotion into management positions.

To address this issue, ADOT has initiated a Succession Development Plan that prepares individuals for possible promotion to positions of increased responsibility. The elements of the plan include providing one-on-one coaching, management training classes and cross-functional training to provide opportunities for employees to move up in the agency, improving retention and knowledge transfer.

In 2019, ADOT was able to use long-term cost savings, derived from efficiencies obtained by using Arizona Management System practices to improve agency processes, to increase salaries for engineering positions with the goal of attracting and retaining qualified staff.

LACK OF OVERARCHING DATA MANAGEMENT/GOVERNANCE FOR ASSET, GIS, AND PLANNING DATA

Accurate, accessible, and easily digestible data underpins successful asset/performance management and short- and long-range planning. Data that support asset management and planning at ADOT, including inventory, condition, and planning data, are held in separate systems with limited integration and multiple data owners, who often use unique legacy methods for maintaining their data. The lack of an overarching data management and governance framework increases the chance of inconsistent data quality with implications for

decisions made throughout the asset management and planning process. To operate at peak efficiency, asset management software needs to consume geospatial data from an enterprise linear referencing system (LRS) such as ESRI Roads and Highways. Implementation and monitoring of performance metrics also relies on LRS-based analysis. Combining multiple data sources into one format requires a strategic data governance and management plan to be efficient and effective. The Multimodal Planning Division will work with data owners and the Information Technologies Group to create an integrated, agency-wide strategic data governance and management plan that applies total systems thinking to the collection, management, analysis, dissemination and implementation of asset and GIS data, that is compatible with ADOT's data policies.

4.3.2.4 High Priority Asset Risks

FLOOD DAMAGE INCLUDING SCOUR

Scour around bridge piers can lead to bridge failure if not addressed. In 1992, as a result of bridges lost due to scour during the 1970s and 1980s, a statewide scour evaluation work plan was developed for all bridges located over waterways. Inspections during the 1990s identified several hundred bridges as at high risk of scour. Many of these bridges were constructed before 1980 when the adoption of more stringent design criteria improved scour resistance. In the mid-1990s, a subprogram was set up to implement scour counter-measures for high-risk bridges. Ongoing inspections since then have identified additional bridges at high risk for scour.

Currently, there are about 100 ADOT bridges (including some on the NHS) that fit in this category. The scour counter-measures subprogram is still in place and new improvement projects are developed yearly. Culverts are subject to blockage, which can lead to flooding or washout of the roadway. Steel pipe culverts can corrode, affecting the structural integrity of the pipe. The FY2016 level of service evaluation rated drainage structure conditions at a C+. To address this issue, $4.3 million was approved by the Legislature in the FY 2018 State budget to begin repair of these culverts. The program began by repairing the most severely affected culverts starting with 75 percent blockage and/or 50 percent rusting.

ADOT operates 72 storm water pump stations on 275 miles of urban freeway in the Phoenix Metropolitan area. The ability of these facilities to adequately remove storm water from the freeways is critical to prevent flooding. Construction of the pump station system began in 1964 and pump stations have been incrementally added over time. Per an *ADOT Phoenix District Pump Station Evaluation*:

> *"The incremental construction of the system, over the long-time period, has resulted in a system that lacks uniformity, standardization, and a long-term maintenance and/or replacement plan. This has led to maintenance concerns and issues that have compounded over time and now challenge the System Maintenance Section's maintenance staff resources to adequately maintain and repair the facilities."*

Furthermore, many of the older pump stations were not designed to handle the additional storm water generated by the addition of travel lanes to freeways that has occurred.

ADOT does not have a dedicated funding source to upgrade and repair aging pump stations; thus, the focus has become how to manage the inventory most efficiently. In the past, ADOT pump station operators used an Excel spreadsheet to assess pump station needs based on periodic inspections. The Excel tool lacked a predictive capability and is of limited use for identifying long-term maintenance and capital needs.

ADOT has implemented a dynamic reliability analysis decision-support tool to provide real-time monitoring of pump station equipment and environmental conditions to aid in the prioritization of maintenance, rehabilitation and replacement projects. The web-based tool is positioned to reduce costs associated with maintenance and rehabilitation of pumps, while increasing reliability by identifying which hardware should be serviced ahead of failure. Since pumping stations are vulnerable to failure under heavy storm events, the tool will evaluate outcomes under different precipitation magnitude scenarios.

COLLISION DAMAGE TO BRIDGES

Vehicle collisions with bridges happen several times per year. Occasionally, these collisions result in partial or complete bridge closures, sometimes affecting both the crossroad and mainline. Since many highways in Arizona lack redundant routes, these closures can cause lengthy delays. ADOT's bridge clearances are clearly posted and almost all the collisions are the result of driver error. ADOT mitigates this by seeking reimbursement from at fault third parties for damage to bridges subject to collision.

Regularly updated emergency detour plans are an important way to mitigate the impacts of road closures. Some of ADOT's emergency detour plans are outdated and will need to be systematically updated. Raising low bridges also could reduce the opportunity for collisions and is considered in the project scoping process.

NON-PERMITTED OVERWEIGHT LOADS

The maximum weight limit for trucks (five axles or greater) in Arizona is 80,000 pounds without a special permit. Per an ADOT research study:

> *"The overloaded truck, whether legal or illegal, contributes to premature pavement fatigue. Pavement deterioration accelerates with axle weight, the number of axle loadings and the spacing within axle groups. The axle loads and spacing on trucks also affect the design and fatigue life of bridges. Steel bridges and pre-stressed concrete spans, if overloaded, are susceptible to fatigue."*

Because fatigue from the repeated stress of overweight trucks can shorten the life of bridges and pavements, it is important to ensure that truckers comply with the weight limit. There are numerous opportunities for trucks to "run heavy" without proper permits and a low chance of being identified when:

- Port of entry facilities are closed.
- Trucks enter the state where there are no ports of entry.
- Inspection queues at ports get too long and trucks are waved past.
- Trucks "run" by ports without stopping for inspection.
- Trucks unload some of the cargo at the border to cross separately, as sometimes occurs with car trailers.
- Truck trips originate within the state.

A cost-effective way to detect unpermitted overweight trucks is the installation of weigh-in-motion (WIM) stations in the roadway. WIM stations measure the weight of a truck as it passes over a device in the pavement. Unlike ports of entry, WIM stations operate twenty-four-hours-a-day, every day of the year. Data from WIM stations indicate that about 7 to 10 percent of the trucks on Arizona highways run overweight. In recent years, ADOT expanded and upgraded WIM stations with the latest law enforcement grade Piezo-quartz sensors for improved accuracy. ADOT operates WIM stations at 18 locations. Some locations have dual scales for a total of 25 WIM scales.

The weight measured with the WIM station is confirmed on a static scale before a citation is issued. ADOT also operates static scales at three rest areas (Sacaton westbound, McGuireville southbound, and Canoa Ranch northbound) and portable scales that can be placed at other rest areas to detect overweight vehicles that bypassed the port of entry or originate in Arizona.

LACK OF REDUNDANT ROUTES IF AN ASSET FAILS

Due to geographical constraints, Arizona has many highways without viable alternatives to re-route traffic should an asset failure require a closure. Thus, it is critical that these highways are maintained in good condition to minimize closures and impacts to travelers and freight. ADOT has long considered the importance of a route/asset in the prioritization of asset preservation, rehabilitation and reconstruction projects. ADOT accounts for the relative importance of a route/asset by considering the following network strategic factors when prioritizing projects:

- Number of lanes
- Functional classification of the route
- Current average annual daily traffic volume
- Future average annual daily traffic volume
- Percent truck traffic
- Route on the National Truck Network
- Existence of a parallel bridge
- Defense highway
- Designated emergency route
- Detour length
- Border crossing affected
- Historical significance

4.3.2.5 High Priority Project Risks

DELAYS IN GEOHAZARD MITIGATION IMPLEMENTATION

ADOT monitors geohazards and identifies mitigations to prevent severe consequences from occurring. However, mitigation implementation is managed with other projects, which can potentially result in lengthy delays while projects move through approvals and procurement. Managing and mitigating this risk can be accomplished by allocating separate funding through a geohazard subprogram or individual geohazard projects that can be accelerated. This and other alternative risk response options are being explored.

4.3.2.6 High Priority Activity/Operations Risks

INADEQUATE MAINTENANCE BUDGET

There are more than 250 maintenance activities needed on a routine basis to keep over 23,000 lane-miles of Arizona highways open for business. The maintenance area most susceptible to inadequate funding is the pavement surface treatment program. Deteriorated roadway surfaces require higher-cost restoration work to re-establish the structural integrity and capacity of the pavement system. This rehabilitation work includes expensive pavement overlays and milling and replacement of existing pavements. These expensive treatments could be reduced if low cost surface treatments are applied at strategic intervals. For example, the cost of surface treatments range from $20,000 to $80,500 per lane mile. In comparison, the rehabilitation of roadway surfaces costs ADOT between $220,000 to $359,000 for one lane mile on non-interstate and interstate, respectively. Reconstruction can cost more than $639,000 per lane mile.

The average historical funding level for pavement surface treatments was about $15 million per year from 2015-2019, allowing the surface treatment of just 300 to 400 travel lane miles, which is less than 2 percent of the entire system. This level of investment is insufficient to keep pavements on the highway system from deteriorating to the point when expensive rehabilitation and reconstruction are the only options. To prevent this, the Arizona Legislature provided $36.1 million for surface treatments in FY 2021 and this funding is expected to continue for the foreseeable future. Additionally, ADOT's pavement investment strategy will gradually increase the percentage of funding devoted to these restoration treatments over the course of the TAMP planning horizon.

4.4 Incorporation of Risk into Life Cycle Analysis and the Financial Plan

Specific risks to bridges and pavements, such as scour and expansive-contracting soils, were incorporated into the LCP analysis and are discussed in detail in **Section 6**. Uncertainties regarding predictions of future transportation funding are described in the Financial Plan in **Section 5**.

4.5 Facilities Repeatedly Damaged by Emergency Events

Moving Ahead for Progress in the 21st Century (MAP-21) regulations require that state DOTs "conduct statewide evaluations to determine if there are reasonable alternatives to roads, highways, and bridges that have required repair and reconstruction activities on two or more occasions due to emergency events." The evaluations must include repeated emergency events on any road, highway or bridge that occurred January 1, 1997, or later. The statewide evaluation for all NHS roads, highways and bridges must have been completed by November 23, 2018. Beginning on November 23, 2020, a state DOT must prepare evaluations covering the affected portion of all other roads, highways and bridges "prior to including any project relating to such facility in its STIP" (23 CFR Part 667). The statewide evaluation must be updated every four years. State DOTs must consider the results of the evaluations when developing a TAMP and during preparation of the STIP.

ADOT identified five locations that received emergency funding on at least two occasions for similar events, as listed below.

- State Route 87 near Milepost 224. Landslide and related slope stability issues (NHS).
- State Route 71; Milepost 86. Scour and embankment repair.
- Salome Road, Centennial Bridge (La Paz County). Flow over the roadway.
- State Route 89A; Mileposts 375 to 399. Erosion due to storm events.
- State Route 88; Mileposts 197 to 240. Damaged drainage infrastructure.

Summaries of each event are provided in **Appendix B**. Every January, ADOT performs an annual review to determine if new eligible emergency events have occurred during the previous calendar year and if those events are repeated. In 2020, a repeated emergency event was identified for SR 88 caused by heavy storms, as indicated above. Reviews will be continued on an annual basis and relevant amendments will be included in future updates of the TAMP.

Section 5
Financial Plan

5.1 Overview

This section summarizes ADOT's financial planning over the next ten years in alignment with the financial planning approach outlined in 23 CFR 515.7. The financial plan includes a summary of the estimated valuation for ADOT's pavement and bridge assets, historical funding sources and uses, and a ten-year estimate of projected funding that can be used for asset management and other preservation activities. This section contains estimated post-COVID-19 available funding for pavement and bridge preservation activities.

5.2 Asset Valuation

Under the Governmental Accounting Standards Board Statement No. 34, *Basic Financial Statements – and Management's Discussion and Analysis – for State and Local Governments (GASB 34),* as amended, ADOT reports asset valuations of its roads and bridges using the "modified approach". This approach allows asset values to be maintained without depreciation if the following required actions are undertaken:

- Maintain an asset management system that includes an up-to-date inventory of eligible infrastructure assets.
- Perform condition assessments of eligible assets and summarize the results using a measurement scale.
- Estimate the annual amount to maintain and preserve the assets at the condition level established and disclosed by ADOT each year.
- Document that assets are being preserved approximately at or above the established condition level.

The undepreciated value of ADOT's transportation infrastructure as of June 30, 2020 is provided in **Table 22** . Reporting infrastructure assets under Generally Accepted Accounting Principles (GAAP) requires ADOT to report all asset value at historical cost. As part of the GAAP requirements, ADOT also reports the cost to maintain the infrastructure value (See **Section 8**).

Table 22 | **Undepreciated Value of ADOT Transportation Infrastructure (YOE* $Billions)**

	Pavement	Bridges	Land	CIP***	Total
SHS**	$6.09	$0.76	$1.52	$1.45	$9.82
NHS	$7.77	$1.94	$1.94	$2.05	$13.70
Total ADOT-Owned	**$13.86**	**$2.70**	**$3.46**	**$3.50**	**$23.52**

**YOE: Year of Expenditure*

***SHS excludes state-owned portions of the NHS.*

****CIP: Construction in Progress*

Note: Valuation method is pursuant to Governmental Accounting Standards Board Statement 34 (GASB 34).

5.3 Long-Range Funding Plan

The long-range strategic direction outlined as part of the *What Moves You Arizona (WMYA) 2040 Statewide Long-Range Transportation Plan* includes three programs: preservation, modernization, and expansion.

- **Preservation**. Spending to maintain pavements and bridges in a state of good repair.[1]
- **Modernization**. Non-capacity spending that improves safety and operations of the existing SHS through activities such as adding shoulders and implementing smart road technologies.
- **Expansion**. Improvements that add capacity to the SHS through new roads, adding lanes to existing highways and constructing new interchanges.

WMYA 2040 was prepared prior to COVID-19 and envisioned a shift in ADOT investments in highways from physical expansion of highways (outside the Phoenix and Tucson areas) to preservation of existing assets. In WMYA 2040, ADOT developed "Recommended Investment Choices" (RIC) that were data-driven and incorporated input from stakeholders and the public. The process centered on developing a series of "Alternative Investment Choices" (AICs) that represented different perspectives on how ADOT's resources could or should be allocated in the future. The AICs, in effect, served as data points to inform development of the final RIC. More information on the development of the RIC can be found in *Recommended Investment Choice (RIC) Development*[2] in **Appendix A**.

Table 23 shows the final twenty five-year statewide highway capital needs using the RIC development process and included in the WMYA 2040 Plan. In contrast, the twenty five-year pre-COVID revenue estimate for WMYA 2040 in 2018 indicates that $23 billion will be

[1] *Note that preservation program should not be confused with the preservation work type which describes specific treatments that extend asset service life (e.g. chip seals, deck overlays, etc.). These preservation treatments can be included in both modernization and expansion projects as well.*

2 *Arizona Long Range Transportation Plan Update. Recommended Investment Choice (RIC) Development. October 2017.*

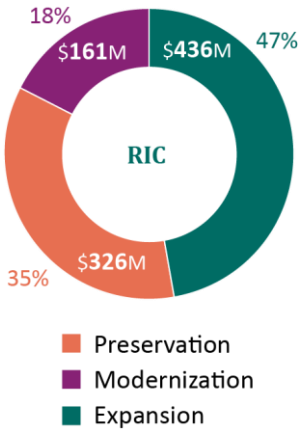
available for highway capital spending. This equates to average annual revenue of $923 million, which was used as the available funding estimate for developing the Statewide and regional RICs. More information on the capital needs, revenue forecast and gap can be found in *Existing Conditions, Deficiencies and Future Needs*[3] and *Revenue Forecast and Gap Analysis*[4] in **Appendix A**.

Figure 19 shows the resulting annual average allocations by investment area (expansion, modernization, preservation) which corresponds to the final RIC.

Table 23 | **25-Year Statewide Capital Needs**

Investment Category	25-Year Need ($Billions)
Preservation	9,236
Pavement Preservation	*7,902*
Bridge Preservation	*1,334*
Modernization	9,862
Expansion	34,054
Total	**53,152**

Figure 19 | **Recommended Investment Choices Average Annual Allocation**



WMYA 2040 recommended investing $326 million annually for bridge and pavement preservation, about 30 percent more than was allocated in the previous program (WMYA 2035). The additional funding was made available by phasing out expansion projects in greater Arizona, outside the Maricopa Association of Governments (MAG) and Pima Association of Governments (PAG) areas.

ADOT is required to update the Statewide Long-Range Transportation Plan every five years. The last one was produced in 2018 before the coronavirus pandemic. ADOT will monitor the impact of preservation investments on system performance and progress towards pavement and bridge performance targets and make recommendations to adjust the RIC during the next plan update, if warranted. Although bridge and pavement funding increased in WMYA 2040, the cumulative total funding over the 25-year Long-Range Transportation Plan is over $1 billion less than the estimated preservation needs, which translates to $40 million of preservation deficit annually. Therefore, it is expected that overall system condition will continue to decline over time.

3 Arizona Long Range Transportation Plan Update. Existing Conditions, Deficiencies and Future Needs. February 2017.

4 Arizona Long Range Transportation Plan Update. Revenue Forecast and Gap Analysis. April 2017.

5.4 Funding Sources & Projections

ADOT relies on federal, state, and regional sources of funding to finance asset preservation. Local governments also have funding that is used for asset preservation on the NHS. Primary funding sources are listed below:

1. Federal Aid Highway Program (FAHP)
2. State Funding – Highway User Revenue Funds (HURF)
    a. Motor Vehicle Fuel Tax
    b. Motor Vehicle License Tax
    c. Motor Vehicle Registration Fee
    d. Motor Carrier Tax
    e. Motor Vehicle Operator License Fees and Miscellaneous Fees
3. Regional Funding – such as the Regional Area Road Fund (RARF) in Maricopa County and Regional Transportation Authority (RTA) funding in Pima County
4. Local Funding

5.4.1 Historical Funding by Source

Figure 20 shows the FY 2020 funding available for highway investments from the federal, state and local funding sources described above. Total funding from all four funding types was approximately $1.85 billion. The State Highway Fund and Federal Aid Programs provided 78 percent of the available funding for highway investment.

Figure 20 | **FY 2020 Highway Available Funds by Source**

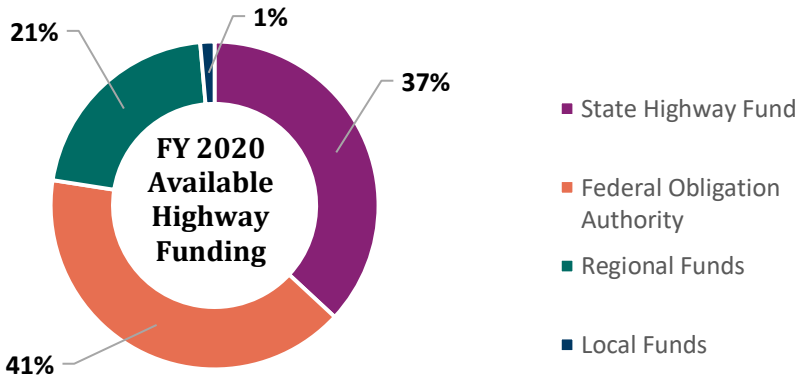


Table 24 presents the historical funding by type for highway investment in the past ten years. Note that the State Highway Fund is used for capital and operating purposes and the Maricopa Association of Governments (MAG) funding shown is 66.7 percent of the regional transportation excise tax.

Table 24 | **Historical Revenues by Funding Type ($Millions)**

Fund Types and Sources	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
State Highway Fund	504	370	524	538	566	589	611	625	657	682
Federal Obligation Authority	713	700	685	708	714	767	758	696	701	750
Regional Funds										
*MAG (RARF)**	206	216	228	244	255	263	275	291	311	327
*PAG (RTA)***	41	57	55	53	59	80	80	23	79	64
Local Funds	26	26	26	26	26	26	26	26	26	26
TOTAL	**1,490**	**1,369**	**1,518**	**1,569**	**1,620**	**1,727**	**1,751**	**1,663**	**1,774**	**1,849**

** MAG (RARF): Maricopa Association of Governments (Regional Area Road Fund)*

*** PAG (RTA): Pima Association of Governments (Regional Transportation Authority)*

5.4.2 Federal Funding

ADOT's primary source of federal funding comes from the Federal-Aid Highway Program (FAHP) administered by FHWA, primarily funded through the Federal Highway Trust Fund. Funding under the FAHP is provided to states through a multi-step funding cycle that includes: 1) *multi-year authorization* by Congress of the funding for various highway programs; 2) *apportionment and allocation* of funds to the states each federal fiscal year (FFY) according to statutory formulas or, for some funding categories, through administrative action; 3) *obligation* of funds, which is the Federal government's legal commitment to reimburse states for the federal share of a project's eligible costs; 4) *appropriations* by Congress specifying the amount of funds available for the year to liquidate obligations; 5) *program implementation* which covers the programming and authorization phases; and 6) *reimbursement* by the Federal government of the eligible project costs.

The current multi-year program, Fixing America's Surface Transportation (FAST) Act, was signed into law on December 4, 2015, and provides funding for FFY 2016 extended through FFY 2021. The FAST Act establishes apportionment formulas using such data as highway system mileage, lane miles, traffic volumes, and estimated Federal fuel tax contributions.

The apportionments are provided to states in various categories which define eligible types of investment, the largest of which are the National Highway Performance Program (NHPP) and Surface Transportation Block Grant Program (STBGP). Eligible uses in these categories include:

- Surface Transportation Block Grant Program (STBGP). This is the most flexible of Federal transportation funds and may be used for a wide variety of highway, transit, or street projects, including pavement and bridge maintenance activities.

- National Highway Performance Program (NHPP). Under the FAST Act, this category combined the Interstate Maintenance Program, the National Highway System, and the Highway Bridge Replacement and Bridge Rehabilitation Program. NHPP is the primary Federal funding source utilized for pavement and bridge preservation but can only be used for routes on the National Highway System.

- Only NHPP and STBGP funds are eligible to be used for bridge and pavement preservation. **Table 25** shows ADOT federal funding for the remainder of the FAST Act (FY 2021). For FY 2022 and beyond, funding levels are held constant, conservatively assuming no growth, to estimate federal aid beyond the FAST Act. In 2021, ADOT received $150 million of COVID relief funds. This table shows the estimated amount of funds eligible to be used by ADOT for asset management, although these funds may also be used for other transportation purposes.

Table 25 | **Estimated Federal Aid ($Millions)**

Federal Fiscal Year	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030
Federal Obligation Authority	717	717	717	717	717	717	717	717	717	717
NHPP	432	432	432	432	432	432	432	432	432	432
STBGP	115	115	115	115	115	115	115	115	115	115
CRRSAA*	150									
Total Eligible Amount	**697**	**547**	**547**	**547**	**547**	**547**	**547**	**547**	**547**	**547**

** Coronavirus Response and Relief Supplemental Appropriations Act (CRRSAA) is one-time funding. These funds were received in FY 2021 and are expected to be spent in FY 2022.*

The FAHP is a reimbursement program. Once projects are authorized in advance by FHWA and federal funds are obligated, the federal government reimburses states for costs as they are incurred. With few exceptions, federal reimbursements must be matched with state or local funds. For most projects in Arizona, the federal share is 94.3 percent, and the state/local share is 5.7 percent.

5.4.3 State Funding

The state of Arizona taxes motor fuels and collects a variety of fees and charges relating to the registration and operation of motor vehicles on the public highways of the state. These collections include gasoline and use-fuel taxes, motor-carrier taxes, vehicle-license taxes, motor vehicle registration fees and other miscellaneous fees. These revenues are deposited in the Highway User Revenue Fund (HURF) and are then distributed to the cities, towns and counties, and the State Highway Fund and for other transportation related purposes.

Figure 21 depicts HURF revenues by source for FY 2020, the most recently completed state fiscal year. As shown, fuel tax and Vehicle License Tax (VLT) comprised 82 percent of total HURF revenues. **Table 26** shows historical HURF revenues by source for the ten-year period of state FY 2011 through FY 2020.

Figure 21 | **FY 2020 HURF Revenue by Source**

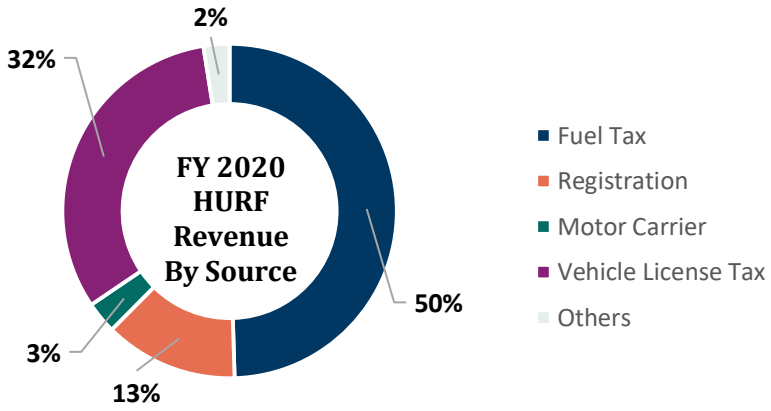
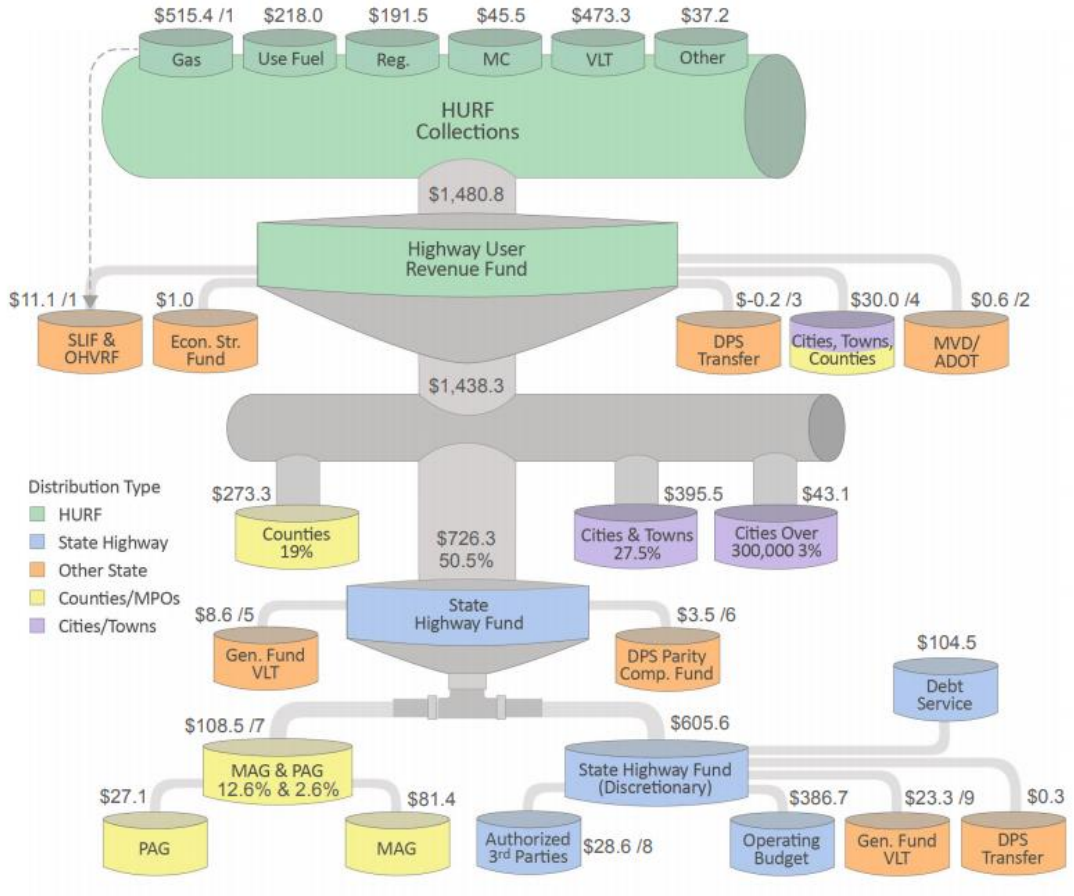


Table 26 | **Actual Highway User Revenue Fund Revenues by Source (FY 2011-2020, $Millions)**

Year	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Fuel Tax	635	635	631	634	655	688	706	729	750	733
Registration	156	158	158	164	169	174	178	181	193	191
Motor Carrier	36	37	37	39	40	41	42	43	46	45
Vehicle License Tax	322	321	327	349	370	396	422	445	469	473
Others	56	59	57	56	57	58	58	58	62	37
Total	**1,205**	**1210**	**1,210**	**1,242**	**1,291**	**1,357**	**1,406**	**1,456**	**1,520**	**1,481**

HURF revenues are allocated and distributed by statute and through annual budget legislation. **Figure 22** shows actual HURF revenues and distributions for FY 2020, in which funding from all sources was $1,480.8 million. Allocations and distributions from HURF are made to various stakeholders, such as the Department of Public Safety, Motor Vehicles Division, State Highway Fund, and cities, towns and counties. The State Highway Fund is further allocated between Arizona's two largest metropolitan planning organizations, ADOT and other transfers.

Figure 22 | **FY 2020 HURF Revenue Distribution Flow ($Millions)**



NOTES:

**See notes in FY 2020 HURF Actual Revenue Distribution Flow.*

MC – Motor Carrier, VLT – Vehicle License Tax, Division, Reg. – Registration, DPS – Department of Public Safety

SOURCE: ADOT FINANCIAL MANAGEMENT SERVICES

Since 1986, ADOT has estimated HURF revenues using a comprehensive regression-based econometric model. To deal with uncertainty regarding this estimate, ADOT introduced its risk analysis process in 1992. This process relies upon probability analysis and the independent evaluation of the model's variables by an expert panel of economists. This results in a series of forecasts with specified probabilities of occurrence, rather than a single or "best guess" estimate. More information about the HURF forecast can found in *Arizona Highway User Revenue Fund Forecasting Process & Results FY 2021-2030* in **Appendix A**.

ADOT's official September 2020 forecast for FY 2021-2030 HURF amounts to $17,927.2 million with a compound growth rate of 3.6 percent. The official forecast incorporates the 50 percent confidence interval growth rates produced by the Risk Analysis Process model for each year of the forecast except for FY 2021. The FY 2021 forecast of $1,514.2 million was developed in August 2020 by ADOT staff using time-series techniques, historical and

projected growth rates, and recent legislative changes. **Table 27** presents the estimated HURF funds by category for FY 2021-2030.

Table 27 | **HURF Official Revenue Forecast with Category Details (FY 2021 – 2030, $Millions)**

State Fiscal Year	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030
Gasoline Tax	497	510	523	539	549	558	567	578	587	596
Use Fuel Tax	223	226	231	237	243	250	257	264	271	279
Motor Carrier Fee	48	50	52	54	57	59	61	63	66	68
Vehicle License Tax	505	531	567	604	638	674	711	750	790	830
Registration	200	205	212	219	226	232	239	246	253	260
Other	41	43	44	45	47	48	49	51	52	54
Total HURF	**1,514**	**1,564**	**1,628**	**1,699**	**1,759**	**1,821**	**1,885**	**1,952**	**2,019**	**2,087**
State Highway Fund	**746**	**766**	**798**	**832**	**862**	**893**	**925**	**958**	**991**	**1,025**

SOURCE: Arizona Highway User Revenue Fund Forecasting Process & Results FY 2021-2030.

After allocations and distributions are made, the projected amount of State Highway Funds available to be programmed for transportation projects by ADOT is shown in **Table 28**.

Table 28 | **Forecasted State Funding Available for Transportation Purposes (FY 2021 - 2030, $Millions)**

State Fiscal Year	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030
Funding	**117**	**203**	**146**	**168**	**340**	**288**	**238**	**248**	**303**	**325**

5.4.4 Regional and Local Funding

Several counties in the state collect taxes that support regional transportation needs. They include Maricopa, Pima, Pina, and Gila counties. Of these, Maricopa and Pima, which have the largest contributions to regional transportation needs, are described below.

5.4.4.1 Maricopa County

In November 2004, voters in Maricopa County approved a county excise tax for transportation purposes which primarily includes expansion and modernization but may include preservation projects on the NHS, although this is rare. These tax revenues are collected by the Arizona County Regional Area Road Fund (RARF). In 2004, Maricopa County voters approved a ½ cent sales tax that sunsets after twenty years and, thus, is set to expire

on December 31, 2025 unless extended. If the sales tax is not extended by the voters of Maricopa County, funding for roadway projects, pavement, and bridge projects in the Phoenix region could drop dramatically, creating an even larger funding gap for preservation activities. The gross receipts from the tax are collected by the Arizona Department of Revenue and split 66.7 percent to the Maricopa County RARF and 33.3 percent to the Public Transportation Fund (PTF).

Like HURF revenue estimation approaches, since 1986, ADOT has used a comprehensive regression-based econometric model to estimate Transportation Excise Tax revenues in Maricopa County. These revenues, which flow into the RARF, are the major funding source for the Maricopa County Freeway Program. To deal with uncertainty regarding this estimate, ADOT introduced its risk analysis process in 1992. This process relies upon probability analysis and the independent evaluation of the model's variables by an expert panel of economists. This results in a series of forecasts with specified probabilities of occurrence, rather than a single or "best guess" estimate. More information about the RARF forecast can found in *Maricopa County Transportation Excise Tax Forecasting Process & Results* in **Appendix A**.

ADOT's September 2020 official forecast for FY 2021-2026 RARF revenue amounts to $3,224.1 million with a compound growth rate of 5.0 percent. The Official Forecast result incorporates the 50 percent confidence interval growth rates produced by the Risk Analysis Process model for each year of the forecast except for FY 2021. The FY 2021 forecast of $514.5 million was developed by ADOT staff independently of the econometric model using time series techniques, historical growth rates, projected growth rates and recent legislative changes. From this total forecast, 56.2 percent is used for freeways and other routes in the SHS, including capital expenses. Furthermore, 10.5 percent is allocated to arterials, including capital expenses and implementation studies. **Table 29** presents the estimated RARF funds (excluding the Public Transportation Fund) showing how they are expected to be subdivided from 2021 to 2026.

Table 29 | **RARF Available for Freeway and Arterial Street Transportation Projects**

Fiscal Year	Freeways ($Million)	Arterial Streets ($Million)	Total ($Million)
2021	289	54	343
2022	302	56	358
2023	319	60	379
2024	335	63	397
2025	352	66	418
2026	216	40	256
Totals	**1,812**	**339**	**2,151**

5.4.4.2 Pima County

In Pima County, a $2.1 billion Regional Transportation Authority (RTA) plan was approved by Pima County voters on May 16, 2006. At the same time, voters approved a transaction privilege tax, or excise tax, to fund the 20-year plan. The RTA is managed by the Prima Association of Governments (PAG).

The half-cent sales tax collection began on July 1, 2006, and the tax is collected from the state-established RTA special taxing district within Pima County to deliver RTA projects. The Plan will be implemented through June 30, 2026. Some of the projects will be funded with RTA funds only, and other projects will be supplemented by regional funding. The 2006 RTA plan approved by voters and developed by a 35-member citizen advisory committee, public/private technical management committee; extensive public input includes a Roadway Improvement Element consisting of $1.2 billion in RTA funding, and $334 million in Federal and local funds allocated to expanding, modernizing, and preserving roadways. The RTA funding allocated to roadway projects over the next ten years is summarized in **Table 30**.

Table 30 | **Programmed RTA Funds Allocated to Roadway Projects ($Millions)**

Year	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
RTA	89	94	97	100	103	106	28

Regional funds from MAG, PAG (RARF and RTA, respectively) and other entities have generally been used to fund expansion projects (as opposed to preservation) pursuant to the enabling language governing such funds. As a result, preservation projects in these regions are typically done with federal, state and local funds. Future iterations of the TAMP will provide greater detail on the use of regional funds specifically for bridge and pavement preservation purposes.

5.4.4.3 Other Jurisdictions

In addition to excise taxes for regional transportation funding in Maricopa, Pima, Gila and Pinal counties, other municipalities and counties throughout Arizona utilize local resources, including taxes, bonds, general funds, HURF, and impact fees to locally fund transportation projects, operations and maintenance, and pavement preservation, and to meet various match requirements for local capital projects.

Local government investments in NHS bridge and pavement preservation treatments, rehabilitation and reconstruction are included in Metropolitan Transportation Improvement Plans and TIPs for jurisdictions within MPO boundaries and directly in the STIP for jurisdictions within COG boundaries. These additional contributions generated from local excise taxes, bonds, and CIP funds add funding for pavement and bridge preservation projects throughout Arizona. Contributions reflected in COG and MPO TIPs include local match on federally-funded preservation projects, and funds for projects that are 100 percent locally-funded.

Local funding for preservation projects is highly variable and difficult to predict due to fluctuating priorities at local levels of government. For the 2021-2025 Five-Year Transportation Facilities Construction Program[5], local programmed amounts for transportation asset preservation projects averaged $33 million per year. This average funding was kept constant for the remaining of the ten-year period. Future iterations of the TAMP will provide greater detail on the use of local funds specifically for bridge and pavement preservation purposes. **Table 31** shows the regional and local funding projected for all transportation purposes.

Table 31 | **Projected Regional and Local Funding for All Transportation Purposes ($Millions)**

Year	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030
Local	33	33	33	33	33	33	33	33	33	33
Federal Obligation Authority	155	155	155	155	155	155	155	155	155	155
Regional (RARF and RTA)	432	452	476	498	521	362	28	0	0	0
State Highway Funds allocated to MAG and PAG Regions*	113	116	121	127	131	136	141	146	151	156
Total	**734**	**757**	**785**	**812**	**840**	**686**	**356**	**334**	**339**	**344**

** State Highway Fund share allocated to MAG (12.6%) and PAG (2.6%). These allocations were also considered in the State Funding Section.*

5.4.5 Total Projected Funding Sources

Table 32 presents a summary of the projected revenues for each funding source described in the previous sections. The table shows that about $19.2 billion in funding would be available for investment in transportation-related projects over the next ten years.

[5] ADOT's Five-Year Transportation Facilities Construction Program. **https://azdot.gov/planning/transportation-programming/tentative-five-year-program**

Table 32 | **Projected Revenue Available for Preservation and Other Transportation Purposes ($Millions)**

Fund Types and Sources	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030
Federal Obligation Authority*	867	717	717	717	717	717	717	717	717	717
State Highway Fund**	746	766	798	832	862	893	925	958	991	1025
Regional Funds	432	452	476	498	521	362	28	0	0	0
MAG (RARF)	343	358	379	397	418	256	0	0	0	0
PAG (RTA)	89	94	97	100	103	106	28	0	0	0
Local Funds	33	33	33	33	33	33	33	33	33	33
TOTAL	**2,078**	**1,968**	**2,024**	**2,080**	**2,133**	**2,005**	**1,702**	**1,708**	**1,741**	**1,775**

** Includes the CRRSAA one-time funding*

*** Includes the allocation from State Highway Fund: MAG (12.6%) and PAG (2.6%)*

Regional funds from MAG and PAG are not typically used to fund preservation projects, since these funds are primarily used for expansion projects. Preservation projects in these regions are typically completed with federal, state and local funds. This funding, shown in **Table 31**, is available to local and regional entities to be used for pavement and bridge preservation projects on portions of the NHS that they own.

5.4.6 Projected Revenue Available for Preservation

Table 33 shows a ten-year estimate of Federal and State Highway Funds available to be programmed for capital asset preservation, although these funds also may be used for other Arizona State Transportation Board approved priorities.

Table 33 | **Projected State Funding Available for State Preservation and Other Transportation Purposes ($Million)**

Year	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030
State Highway Fund	117	203	146	168	340	288	238	248	303	325
Federal Obligation Authority	697*	547	547	547	547	547	547	547	547	547
Total	**814**	**750**	**693**	**715**	**887**	**835**	**785**	**795**	**850**	**872**

** Includes the CRRSAA one-time funding*

In addition to the capital funding shown in **Table 33**, ADOT's maintenance budget also provides some funding for non-capital preservation treatment activities. The budget is approved annually by the Arizona Legislature and can be difficult to forecast. The approved FY 2021 maintenance budget included $36.1 million for surface treatments. It is anticipated that pavement surface treatment funding will remain at FY 2021 levels in the foreseeable future.

5.4.7 Estimated Funds Available to be Programmed for Bridges and Pavements

The ongoing COVID-19 pandemic has created uncertainty regarding the amount of future funding that will be available for the management of the state's bridges and pavements. ADOT has developed a tentative post-COVID-19 program for pavements and bridges based on the best available April 2021 re-forecasted revenues. **Table 34** presents the estimated amount expected to be programmed for bridge and pavement preservation over the next ten years based on post-COVID-19 forecasts.

Table 34 | Post-COVID 19 Estimated Amounts of Funds available to be programmed for State Bridge and Pavement Preservation ($Millions)

Year	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	FY 2030
Bridge	**97**	**90**	**159**	**78**	**62**	**98**	**52**	**52**	**52**	**52**
NHS	66	30	142	29	27	72	13	22	20	30
Non-NHS	31	60	17	49	36	26	38	30	31	22
Pavement	**183**	**302**	**288**	**234**	**368**	**370**	**370**	**370**	**371**	**370**
NHS	162	247	213	184	146	172	184	193	191	185
Non-NHS	21	55	75	50	222	198	186	177	180	185
Total	**280**	**392**	**447**	**312**	**430**	**468**	**422**	**422**	**423**	**422**

Section 6
Life Cycle Planning (LCP)

6.1 Introduction

Life Cycle Planning (LCP) is a systematic process that identifies the best options to preserve or improve the condition of an entire asset class or across asset classes, at the minimum practical cost. LCP analysis models different combinations of work types, such as maintenance, preservation, rehabilitation and reconstruction, over the whole life of network assets to compare the effectiveness of different investment strategies on asset condition and system performance. In addition, this analysis facilitates asset management planning as it estimates network funding needs and identifies the impacts to the asset class if a sufficient investment is not made.

6.2 Asset Performance and Transportation Goals

Bridges and pavements influence the achievement of all federal transportation system goals enumerated in 23 USC 150(b). Specifically:

- **Safety** – Keeping bridge decks and pavements in Good condition may reduce the likelihood of crashes due to sudden maneuvers to avoid potholes. The ability of bridges to endure natural or man-made hazards, such as flooding and over-height truck collisions, may impact safety. Treatments that preserve a pavement's surface characteristics or reduce rutting may lower the likelihood of wet-weather accidents and hydroplaning.

- **Infrastructure Condition** – Bridges and pavements that are allowed to deteriorate beyond the point where maintenance or preservation are effective require much more expensive rehabilitation or replacement, making condition a primary driver of life cycle costs.

- **Congestion Reduction & System Reliability** – As bridge decks and pavements deteriorate vehicles typically travel at slower speeds, affecting mobility. Mobility is also impacted by work zone closures. ADOT's plans to increase the use of maintenance and preservation treatments will help reduce the number of rehabilitation and reconstruction projects which tend to require more lengthy work zone closures.

- **Freight Movement and Economic Vitality** – Efficient freight movement requires reliable roadways that are subject to minimal disruptions, including construction delays. At the same time, heavy truck traffic can increase deterioration rates ultimately affecting system performance. A safe and effective transportation system is key to the economic vitality of a region.

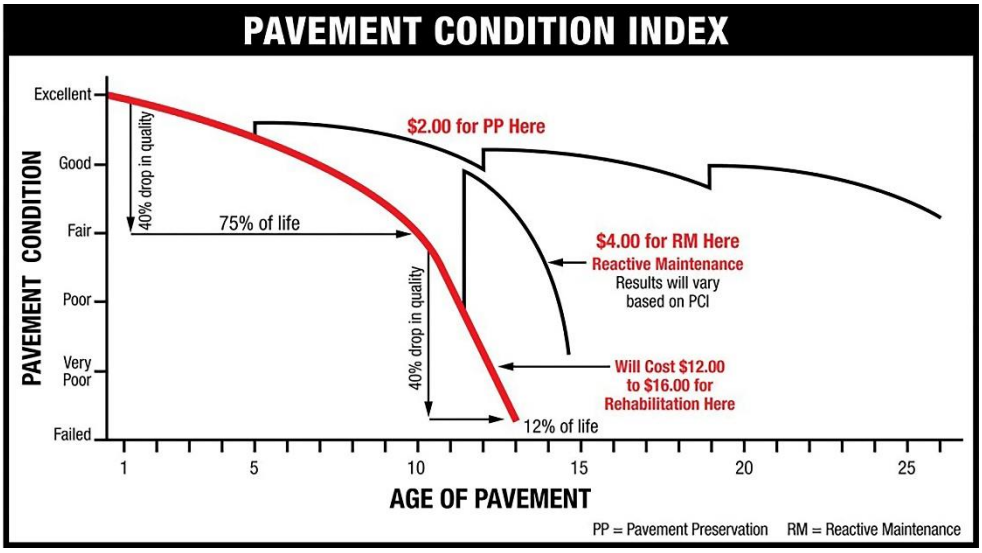
- **Environmental Sustainability** – Slower traffic speeds, resulting from poor infrastructure condition, contribute to greater vehicle emissions from idling and reduced fuel efficiency. Good condition roads have less rolling resistance and support higher speeds leading to greater fuel efficiency and lower environmental impacts. Further linking environmental considerations and asset management can measurably improve the development of life cycle strategies.

- **Reduce Project Delivery Delays** – Preservation projects can be delivered more quickly and at a significantly lower cost than rehabilitation and reconstruction projects. Preservation projects also tend to require fewer road restrictions and closures. ADOT strives to coordinate its bridge and pavement preservation work with other needs on a corridor in order to reduce work zone traffic restrictions.

6.3 Life Cycle Planning at ADOT

Applying maintenance and preservation treatments while asset condition is still good is the most cost-effective way to maximize an asset's life cycle. This concept is demonstrated in the Pavement Condition Index (PCI) shown in **Figure 23**, which illustrates that regularly spending a small amount for preservation keeps a pavement in Good condition for much longer and at a lower cost than waiting until rehabilitation is needed.

Figure 23 | **Illustration of the Cost-effectiveness of Pavement Preservation (PP) Treatments**



SOURCE: International Slurry Seal Association (ISSA)

Life Cycle Planning will enable ADOT to identify the tradeoffs and benefits of incorporating differing levels of preservation into its management strategy in order to identify a mix of treatments that optimize performance and investments for an entire asset class.

6.4 Life Cycle Planning Process

ADOT is using the AASHTOWare Bridge Management (BrM) System for bridges and the Deighton Total Infrastructure Management System (dTIMS) for pavement to support life cycle and investment planning. These management systems meet the requirements outlined in 23 CFR 515.17. These systems are part of a multi-step process used for conducting LCP analysis:

- Form an LCP analysis team.
- Select the asset classes and networks to be analyzed.
- Establish performance targets that support a state of good repair.
- Use historical inspection data to develop models of asset deterioration rates.
- Identify treatment costs and options for various states of asset deterioration.
- Identify risks that could affect the assets, including changes in system demand.
- Identify agency priorities for the selection and ranking of treatments.
- Identify anticipated funding, constraints, inflation and discount rates.
- Develop asset management treatment strategies and funding scenarios to analyze with dTIMS and BrM.
- Use the analysis and professional judgment to identify the best strategy to carry forward in the planning process.

The selected strategy is used to inform investment choices in the Long-Range Transportation Plan, the Five-Year Transportation Facilities Construction Program, and the development of the STIP.

6.5 Risk in the Life Cycle Planning Process

Each step of the Life Cycle Planning Process factors in risk:

- **Networks and Asset Classes:** The selection of networks and asset classes enables prioritization based on the relative importance of the risk impacts to various parts of the system.
- **Targets:** Targets address risk by defining acceptable performance so that gaps that would lead to an underperforming network, and management strategies that are not cost effective or sustainable, can be identified.
- **Deterioration models:** Annual and bi-annual condition assessments help to identify excessive deterioration due to weather, defects or exceptionally heavy use. Historical data used to develop and update models captures variation in deterioration rates caused by these risks.

- **Treatment options and costs:** Different treatment options can be applied to different networks and asset classes depending on the relative importance and risks associated with each. Treatment cost comparisons enable the weighing of costs against benefits, including risk reduction.
- **Risk identification and agency priorities:** Bridge and pavement risks and priorities have been incorporated into cost-benefit and priority formulas in the BMS and PMS to prioritize strategies that reduce risks.
- **Available funding:** The evaluation of different funding and inflation scenarios enables financial risk and the risk of devoting insufficient resources to asset management to be considered during the development of investment strategies.
- **Professional judgement:** Professional judgement allows the consideration of risks that are not easily captured by the management system analysis, such as project delivery risks.

6.6 Bridge Life Cycle Planning

Arizona's bridges are subject to constant deterioration as they age. Most existing bridges on the SHS were designed for a 50-year life span. In recent years bridge materials and construction methods have vastly improved, so that after 2007, ADOT was able to design bridges to have a 75-year life span. Bridges can last longer if appropriate steps are taken to preserve them.

Arizona's varied climate makes it difficult to predict bridge asset lifespans due to large variations in temperature and precipitation. High elevation areas frequently undergo freeze and thaw cycles and receive heavy snowfall. Low elevation areas receive scant rainfall and freeze-thaw cycles are rare, however, these areas have the largest population centers with higher traffic and truck volumes. Heavy traffic increases the wear and tear on bridges. Various hazards, such as, weather, deicing chemicals, heavy trucks, and accidents contribute to the rate of decay.

Different parts of a bridge deteriorate at different rates; for example, expansion joints wear out quickly, while decks deteriorate at a moderate rate and piers last a long time. These different deterioration rates influence the timing of the work that must be done to overcome deterioration and keep bridges performing well. ADOT bridge inspectors regularly monitor bridge conditions so they can detect the best opportunities for maintenance and preservation.

These factors are closely associated with life cycle cost and risk. Preservation work is selected in a manner that tries to offset deterioration and reduce long-term costs, while also minimizing near-term inconvenience to the public. The risks associated with natural and man-made hazards are regularly assessed to consider the economic effect on road users when service is disrupted by bridge closures or restrictions. The steps ADOT undertakes for bridge LCP analysis are presented in the following sections.

6.6.1 Bridge Life Cycle Planning Team

The following individuals form the team which prepares, evaluates, and updates the life cycle plan for bridges.

- State Bridge Engineer
- Assistant State Bridge Engineer-Operations
- Senior Bridge Engineers (2)
- TAMP Manager

6.6.2 Analyzed Bridge Networks

Scenarios were developed for three overlapping networks, as follows:

- **State-owned Bridges including State-owned NHS Bridges**. This network represents the complete set of bridges whose preservation is managed and funded by ADOT, often with federal assistance.
- **State-owned NHS bridges separately from non-NHS bridges**. This network, a subset of the previous, provides specific metrics required to satisfy federal requirements, representing the federal interest in the National Highway System and funding opportunities associated with that network.
- **Locally-owned NHS Bridges**. This network, much smaller than the previous, consists of bridges whose preservation is managed and funded by local agencies, often with federal and/or state assistance. The results of this analysis are discussed in **Section 7**.

6.6.3 Bridge Performance Targets

In addition to the two- and four-year targets established for compliance with the Transportation Performance Management rules (23 USC 150), a desired SOGR target was established (**Table 35**). The desired SOGR was used to compare the results of each LCP scenario to evaluate the level of service that could be achieved at the expected funding level.

Table 35 | **Desired State of Good Repair**

Bridge Class	Minimum % Good/Fair	Maximum % Poor
NHS	96	4
SHS	96	4

6.6.4 Bridge Deterioration Models

BrM can analyze bridges at two levels of detail:

- **NBI components**. This is the deck, superstructure, substructure, and culvert 0-9 rating system that ADOT has used since 1995.
- **AASHTO elements**. Bridges consist of more than 100 types of elements of varying functions and materials. Each element is rated on a scale of 1 (no defects) to 4 (severe defects). ADOT has been gathering condition data in this format since 2014. A subset of these elements is reported to the FHWA annually as a part of the National Bridge Inventory.

Currently ADOT is using a bridge element deterioration model that was developed in 2016 for the National Bridge Investment Analysis System (NBIAS), a software tool used by the Federal Highway Administration (FHWA) for national planning of bridge needs as required for a periodic report to Congress. This model was based on bridge inspection data from 15 states, including Arizona. Deterioration rates vary by climate, so Arizona is using the model for hot and dry states, which have relatively slow deterioration.

The NBIAS model was developed using bridge element inspection data gathered under the 1997 AASHTO Guide for Commonly-Recognized (CoRe) Structural Elements. Arizona data used in the model start with year 1999 inspections. After the model was developed in terms of the 1997 element definitions, it was converted to be compatible with the 2013 AASHTO Manual for Bridge Element Inspection, using a methodology developed by the Florida Department of Transportation. Review of the models by ADOT experts resulted in further adjustments to a few elements to slow the onset of deterioration, to better fit Arizona experience.

To account for uncertainty in predicting bridge condition, BrM uses a predictive deterioration model to estimate the fraction of a population of elements in each condition state at any future point in time. Deterioration models are typically expressed in terms of the median number of years to transition from each condition state to the next-worse state. Since the models quantify year-to-year changes in condition, they can be developed using a relatively small amount of data, as little as two inspection cycles (four years). However, the models are more reliable if developed using data from more inspection cycles and if the data used to establish the models is exclusively from Arizona bridges. Because of changes in AASHTO element inspection standards in 2013, ADOT has made plans to revise its deterioration models once it has three or four cycles of bridge inspections gathered under the newest manual.

In addition to the element deterioration models, ADOT also uses a deterioration model for NBI components. This model was developed using expert judgment, informed by the research-based element models. However, element-level models are preferred for life cycle planning analyses, because they are more detailed and more directly tied to preservation activities; thus, element-level models were used for the current round of scenarios.

6.6.5 Life Cycle Strategies

ADOT maintains a Bridge Preservation Program manual to guide the planning of work on existing bridges. ADOT also uses the FHWA Bridge Preservation Guide to support this purpose. The treatments documented in the ADOT manual can be categorized as follows:

- **Initial Construction**. Complete construction of a new bridge structure on a new alignment.
- **Replacement**. Removal of an existing bridge and construction of a replacement bridge to serve the same alignment as the removed bridge. Bridge replacement in Arizona has costs in the range of $300 to $450 per square foot. Since replacements are often necessitated by traffic growth or other functional requirements, there are often additional costs associated with bridge expansion and approach roads above and below the structure.
- **Rehabilitation**. Major work required to restore or increase the structural integrity of a bridge, as well as improvements to function, capacity, resilience, or safety. These activities may cost $50 to $100 per square foot to improve a Poor bridge to Fair condition, or $150 to $250 per square foot to raise a bridge to Good condition. Rehabilitation treatments include:
  - *Partial or complete replacement of deck or wearing surface*
  - *Partial or complete replacement of bridge railing*
  - *Retrofit of fatigue-prone steel details*
  - *Retrofit of fracture critical members to add redundancy*
  - *Partial or complete replacement of superstructure*
  - *Bridge strengthening*
  - *Bridge widening*
  - *Bridge jacking to reset bearings or increase vertical clearance*
- **Preservation**. Actions or strategies that prevent, delay, or reduce deterioration of bridges or bridge elements. These activities have costs in the range of $15 to $150 per square foot. Preservation treatments are listed below:
  - *Seal or replace a leaking deck joint*
  - *Removal of deck joints where feasible*
  - *Rehabilitation or replacement of deck drains*
  - *Application of thin overlays on bridge decks*
  - *Installation of rigid deck overlays*
  - *Repair or restoration of major structural elements such as beams, piers, or culverts*
  - *Fiber-reinforced polymer wrap of structural elements*

- *Painting of steel elements*
- *Seismic retrofit of superstructure and/or substructure*
- *Installation of scour countermeasures*
- *Repair of slope paving*
- *Deck sealing on a 3-5 year interval*

- **Maintenance**. Condition-based or interval-based activities that do not require engineering or multi-year programming, usually determined by inspectors or local crews. These typically do not improve condition measures but serve to delay deterioration. Typical costs are in the range of $10 to $50 per square foot. Maintenance activities include:
  - *Bridge cleaning on a 1-5 year interval*
  - *Lubrication of bearings and pins on a 2-5 year interval*
  - *Sealing of substructure caps and bearing seats on a 3-5 year interval*
  - *Apply protective coatings on beam ends on a 10-15 year interval or as needed*
  - *Repair of bridge rail deterioration or collision damage*
  - *Minor deck spall repairs or deck crack sealing as needed*
  - *Approach slab repairs or mudjacking*
  - *Cleaning of scuppers and expansion joints as needed*
  - *Arrest of steel fatigue cracks as needed*
  - *Removal of channel or culvert debris as needed*
  - *Cleaning of brush from under or around bridges as needed*

ADOT considers bridge replacement as an alternative to rehabilitation when the estimated rehabilitation cost exceeds 60 percent of the replacement cost. The distinction between rehabilitation and preservation is mainly determined by the severity of defects. Preservation work is programmed on bridges that are in generally good structural condition, to maintain Good condition at minimal cost. Postponement of large costs by using preservation treatments strategically stretches the benefit of the significant investment Arizonans make in their bridges and reduces overall costs in the long run.

BrM groups the individual treatment actions into preservation, rehabilitation and reconstruction categories for bridge deck, superstructure, and substructure to limit the number of treatment combinations that have to be analyzed. BrM does a top-down analysis from a general to a specific treatment for a given bridge element and, to increase efficiency, determines if any other elements on that bridge are eligible for treatment, so that the treatments may be combined in one construction project. Since the routine maintenance treatments and costs have not yet been configured into the bridge management software at ADOT, this treatment type was not included in the analysis. However, since maintenance

activities typically do not improve condition levels, the absence of this information is not expected to affect the results of the analysis.

LCP strategies are developed for each asset class based on expected and desired funding levels over a ten-year analysis period.

6.6.6 Risks to Bridges

Arizona bridges are subject to several primary risks:

Scour – As discussed in the Risk Section, many older bridges over water are subject to scour impacts and have an increased risk of damage or failure.

Overloading – Bridges that have fracture critical elements or are posted with weight restrictions have an increased risk of damage or failure. Repeated loading with heavy vehicles can cause fatigue fractures.

Under-clearances – Bridges that have lower vertical clearances than current design standards have an increased risk of damage from collisions. BrM factors in risk both by weighting certain risks for the purposes of prioritizing projects and by including risks in the calculation of the cost vs. benefit for each project. This is discussed further in the Bridge Management Objectives and Criteria Section that follows.

6.6.7 Bridge Management Objectives and Criteria

ADOT has three bridge management objectives: maximize condition, minimize life cycle costs and manage risks. The objectives and supporting criteria are the basis for assessing the benefits of a project vs. the costs. These objectives are weighted on a 100-point scale by relative importance as follows:

- Condition – 60%
- Life Cycle Costs – 30%
- Risk – 10%

Condition is evaluated by two criteria. The criteria are weighted equally, as follows:

- Element level ratings – 30%
- NBI ratings – 30%

Life Cycle Costs are evaluated by determining the treatment giving the lowest long-term cost for a given condition state and age, as determined by a net present value calculation over 50 years, using a 3% discount rate.

Risk is evaluated using four criteria. The criteria weights are shown below.

- Scour critical – 3%
- Facture critical – 3%

- Weight posting – 3%
- Under-clearances – 1%

6.6.8 Life Cycle Planning Scenarios and Analysis

ADOT evaluated the following scenarios:

- **Reactive Scenario (Worst First)**: Using minimal preservation treatments; allowing the asset to deteriorate until rehabilitation or reconstruction are the only options.
- **Hybrid Scenario**: A balance between preservation and rehabilitation/reconstruction treatments. This scenario was formulated to enable a smooth and implementable transition from the reactive strategy that ADOT has historically used to a strategy that puts a greater focus on preservation treatments.
- **Preservation Scenario**: A focus on preservation treatments.

These scenarios use the annual bridge budgets identified in the 5-year Facilities-Construction Program post-COVID and are carried forward using the planned allocations identified in WMYA 2040. **Figure 24** and **Figure 25** summarize the projected condition at the beginning of 2030 for the three scenarios evaluated.

Figure 24 | **SHS bridges projected condition at the beginning of 2030 for all scenarios**

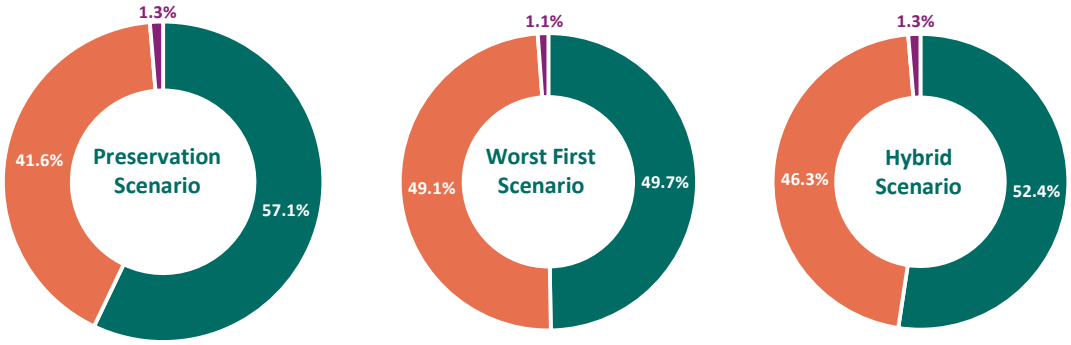
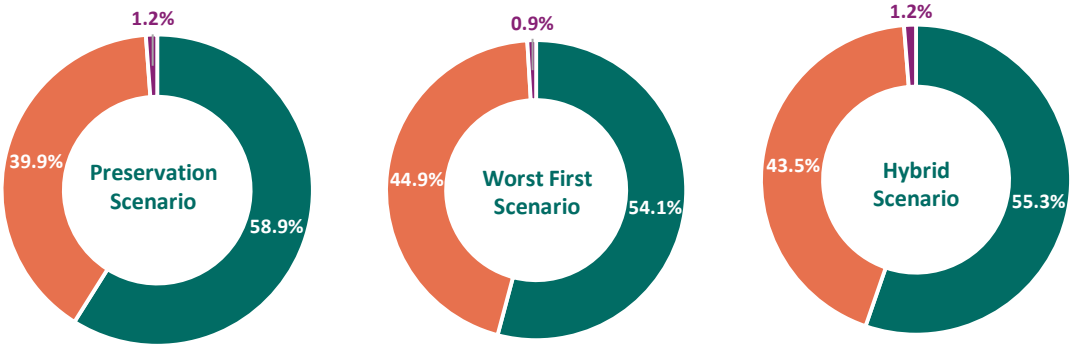


Figure 25 | **NHS bridges projected condition at the beginning of 2030 for all scenarios**



Of the three, the pure preservation scenario produced the best conditions on the SHS, with 57.1 percent by deck area in good condition in year 2030. However, this scenario consisted of a large number of small projects, which would not have been realistic in the Arizona construction market. Moreover, BrM does not consider indirect costs and work zone user costs which, if included, would have moved the optimal solution toward fewer, larger projects. At the other extreme, the worst-first scenario produced only one-third as many projects, but much worse conditions with 49.7 percent good after ten years. The hybrid approach fell in between the two extremes, with 52.4 percent good forecast after ten years. Similar results were observed for the NHS.

Figure 26 and **Figure 27** show the forecast of Good and Fair bridges weighted by deck area over the next ten years for the SHS and NHS for the three bridge LCP scenarios.

Figure 26 | **SHS bridges Good and Fair conditions over the next ten years for all three scenarios**

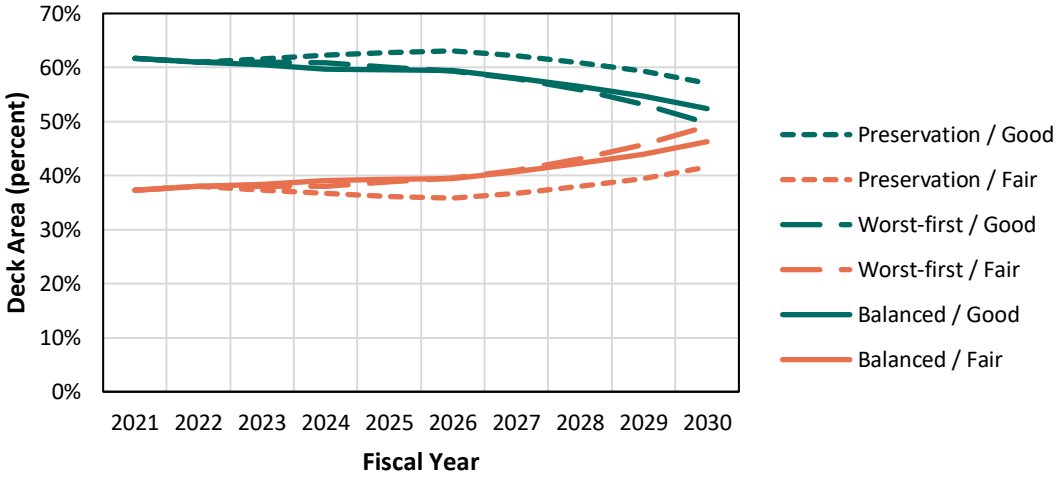
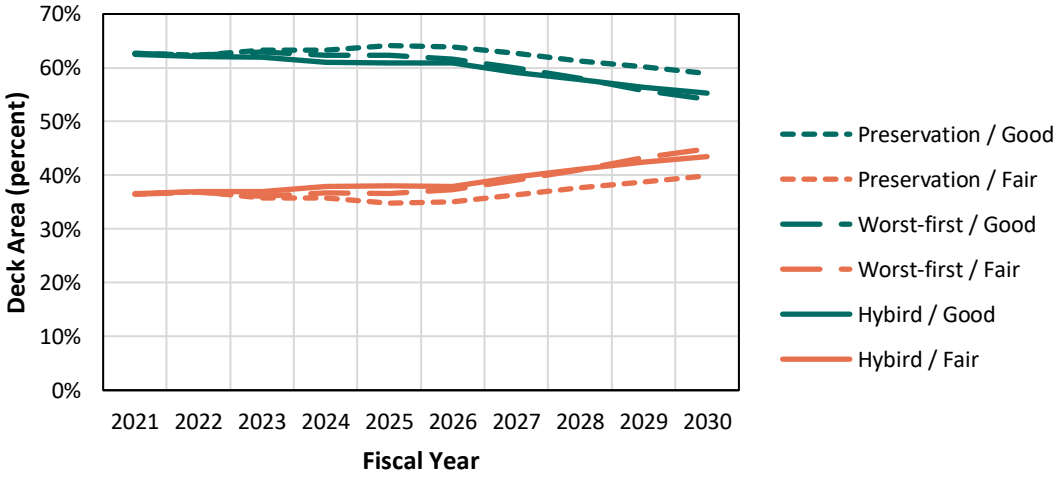


Figure 27 | **NHS bridges Good and Fair conditions over the next ten years for all three scenarios**



For the SHS and NHS, all three scenarios show a decline in Good condition and an increase in Fair condition. This is driven mainly by the aging of many of Arizona's largest bridges, which are newer than the inventory average age. Moreover, all the investigated scenarios used funding projections believed to be most realistic given current tax rates. However, it should be noted that the funding assumption drops off markedly after 2026. Before this date, funding averages $94 million per year for bridges on the SHS, while subsequent funding is less than half of this, $50 million per year in 2020 dollars. Inflation is assumed to be 3 percent per year, further reducing ADOT's buying power.

A scenario to maintain current conditions was considered but resulted in much higher costs while conditions improved only minimally. It was concluded that the hybrid approach was a more realistic path to a long-term state of good repair. A conclusion to be drawn from the analysis is that near-term funding projections are sufficient to maintain a state of good repair.

6.7 Pavement Life Cycle Planning

As with bridges, pavements deteriorate with time based on a variety of factors:

- Traffic volumes and loads, including the effects of heavier truck traffic on pavement deterioration rates across the state.
- Lack of maintenance and preservation, due to an historical focus on addressing the pavements in the worst condition first.
- Climatic conditions, reflecting the differences across the state in terms of daily temperature variations and freeze-thaw cycles as well as the potential for increases in the number of extreme heat days and in the intensity of individual precipitation events that may lead to flooding.
- Pavement age, recognizing that a significant percentage of the pavements on the state-maintained system have exceeded their design life and require extensive repairs.

Most flexible pavements are designed to last twenty years before major rehabilitation is needed, but the timely application of low-cost preservation treatments, such as chip seals, can slow the rate of deterioration and extend pavement life so major rehabilitation is not needed as often. From a long-term perspective, the most cost-effective approach to managing a pavement network includes a combination of planned maintenance, preservation, and rehabilitation activities to sustain pavement performance in good condition for as long as possible. The steps ADOT undertook for pavement LCP analysis are presented in the following sections.

6.7.1 Pavement Life Cycle Planning Team

The following individuals form the team which prepares, evaluates, and updates the life cycle plan for pavements.

- Pavement Management Section Manager with overall responsibility for pavement management.
- Pavement Performance Engineer who is familiar with the pavement condition information.
- Surface Treatments Engineer who oversees ADOT's preservation program.
- Two senior Pavement Engineers involved in the pavement management system implementation.
- TAMP Manager responsible for the updates to the TAMP.

6.7.2 Analyzed Pavement Networks

In order to account for different usage patterns, the highway system was subdivided into different pavement networks for analysis, as shown below. The applicable treatments are dependent of the usage pattern and importance of each network.

- NHS Pavements
  - *Interstates*
  - *Other State-owned NHS*
  - *Locally-owned NHS*
- Non-NHS Pavements
  - *High volume*
  - *Low volume*

6.7.3 Pavement Performance Targets

In addition to the two- and four-year targets established for compliance with the Transportation Performance Management rules (23 USC 150), a desired SOGR target was established (**Table 36**) for each network. The desired SOGR was used to compare the results of each LCP scenario to evaluate the level of service that could be achieved at the expected funding level. Since the NHS locally-owned network is a small percentage of the total NHS, its performance is not expected to affect the NHS's desired long-term target. However, ADOT is in the process of engaging local NHS owners to develop a collaborative plan for data exchange and performance target setting that satisfies federal requirements. More information about ADOT's efforts to engage local NHS owners is presented in Section 7.

Table 36 | **Desired Long-Term SOGR for Pavements**

Pavement Class	Minimum % Good/Fair	Maximum % Poor
Interstates	98	2
Other NHS – State Maintained	93	7
Other NHS – Locally Maintained	-	-
Non-NHS – High Volume	93	7
Non-NHS – Low Volume	85	15

6.7.4 Pavement Deterioration Models

In 2017, ADOT began collecting pavement condition data using automated vans with cameras and lasers. This data does not correlate with historic pavement condition data since the automated method differed from the manual approach that had been used previously. Thus, it was decided to use only the automated data points from the 2017 to 2019 annual pavement condition surveys to develop the empirical deterioration models to be used in dTIMS. These data collection events covered pavements with different ages, climate characteristics and traffic conditions throughout the SHS, so there were numerous data points from which to derive the deterioration models. When at least five years of automated pavement condition data has been collected, ADOT plans to revise its models.

Pavements were separated into homogenous families based on pavement type (concrete, asphalt, etc.), climate zones, traffic loads and foundation quality. Statistical analysis of the dependent (IRI, cracking, rutting, faulting) and independent (traffic loads, age, seasonal variation factors) variables was used to develop deterioration models for each pavement family. The Performance Prediction Modelling Report describing the methodology used to establish the deterioration models is presented in **Appendix A.**

6.7.5 Life Cycle Strategies

ADOT uses a range of treatments to address the needs of the state-maintained pavement network, including routine maintenance, preservation, major and minor rehabilitation, and reconstruction. ADOT's pavement management system is being used to identify pavement treatments and timing that optimize pavement life cycle and reduce long-term costs. ADOT uses the following treatment/work type categories:

- **Initial Construction**. Complete construction of pavement on a new alignment.
- **Routine and Preventive Maintenance**. Maintenance includes treatments such as pothole repair. Maintenance activities are primarily intended to keep the pavements operational. Maintenance is typically performed by ADOT District maintenance staff.
- **Preservation**. This category includes low-cost treatments that are applied to pavements in Good to Fair condition to slow the rate of deterioration and/or address surface characteristics. Preservation treatments are not designed to add structure to the pavement. This category includes a range of treatments, but fog seals, chip seals, friction courses, and micro-surfacing are probably most common. ADOT is undertaking a pavement life extension test project to evaluate the cost-effectiveness of two types of

cape seals as additional preservation options. The cost of treatments in this category range from $20,000 to $80,500 per lane mile.

- **Rehabilitation**. This category includes major rehabilitation activities that address surface deterioration and add structure to the existing pavement. Major rehabilitation treatments include milling off the existing surface and replacing it with 4.5 to 5 inches of asphalt. They are applied to pavements in Poor condition with significant amounts of deterioration present. Traditionally, major rehabilitation has been the most common treatment used by ADOT. Average costs ranging from $220,000 to $359,000 per lane mile are typical for treatments in this category.

- **Reconstruction**. Reconstruction is applied to a pavement when both the surface and underlying layers need to be replaced. Reconstruction is the most expensive of all the treatment options, so strategies that defer the need for this type of treatment help reduce life cycle costs. The average cost of reconstruction in Arizona ranges from $636,000 to $1,062,000 per lane mile.

The typical treatments included in each category are presented in **Table 37.** Not all treatment categories are applied to the entire SHS. For example, non-NHS routes are typically maintained with low-cost treatments since funding is not adequate to perform rehabilitation or reconstruction on this portion of the network. Decision trees are configured within the dTIMS software to determine the types of treatments that are feasible for each pavement section based on pavement conditions and other road features. This supports ADOT's analysis of different treatment strategies in terms of their impact on network conditions over the long term.

Table 37 | **Typical treatments per category**

Treatment Type Category	Typical Treatments	Typical Cost per Lane-Mile (per ADOT)
Preservation	Asphalt concrete (AC) grinding / milling	$20,000 to $80,500
	Cape seal	
	Chip seal	
	Crack seal / fill	
	Fog seal / flush	
	Friction course (Asphalt rubber – asphalt concrete friction course [AR-ACFC / ACFC]) / mill & fill or overlay of friction course	
	Micro surface	
	Portland cement concrete pavement (PCCP) cross stitching	
	PCCP dowel-bar retrofit (DBR)	
	PCCP diamond grinding	
	Slurry seal	
	Spot repair	

Treatment Type Category	Typical Treatments	Typical Cost per Lane-Mile (per ADOT)
	Thin bonded overlay	
Rehabilitation	Major AC overlays	$220,000 to $359,000
	Mill & fill (existing AC)	
Reconstruction	Removal and replacement of existing roadway section	$636,000 to $1,062,000
	Spot reconstruction	

6.7.6 Risks to Pavements

Arizona pavements are subject to several risks:

- **Expansive-contractive soils (unstable subgrade)** – Some soils can swell significantly in the presence of water and shrink by a like amount when dry. This volume change adversely affects and shortens the life of pavements.
- **Flooding (unstable subgrade)** – Roadways that have insufficient drainage structures can be subject to flooding and wash out that undermines all the road layers.
- **Overweight vehicles** – As mentioned in the Risk Section, overweight vehicles shorten bridge and pavement lifespans. This risk is addressed through enforcement.
- **Erosion and embankment failure –** This can include landslides and rockfall that may cause damage to the pavement or force the road to be closed for a period of time.

ADOT's Pavement and Geotechnical Sections reviewed each mile of the SHS for these risks and rated each risk identified for likelihood and consequence. The resulting risk scores were entered into the PMS for consideration in the benefit-cost calculations. If the risk associated with a pavement segment is addressed by the treatment being considered, the full benefit of applying the treatment is used. If the risk is not addressed by the treatment, only a partial benefit is applied.

6.7.7 Pavement Management Benefit-Cost Analysis

ADOT's PMS uses benefit/cost analysis to prioritize projects that are triggered using the treatment decision trees. Treatment decisions are based on a number of factors, such as pavement condition (e.g., cracking, IRI, rutting, faulting), traffic, and life cycle strategies. The treatment prioritization process first converts pavement distress and performance metrics to a 0- to 25-point scale, then weights each distress and factor by its relative importance, as summarized below:

- Condition – 75% - evaluated using the following criteria and weights:
    - Asphalt: IRI (25%), cracking (40%), and rutting (10%)
    - Concrete: IRI (25%), cracking (25%), and faulting (25%)

- Risk – 25% - calculated on a 1 to 25 scale (with 1 representing the lowest risk and 25 representing the highest risk), determined by multiplying the probability of failure and the consequence of failure (each rated on a 1 to 5 scale).

Treatment benefit is calculated as the area between the "do nothing" performance and the performance associated with the treatment application. The benefit area is multiplied by an Average Annual Daily Traffic factor to compute the overall benefit obtained from the treatment. The calculated benefit divided by the treatment cost represents the cost-benefit ratio, which is used to prioritize the suggested projects and treatment under constrained budgets.

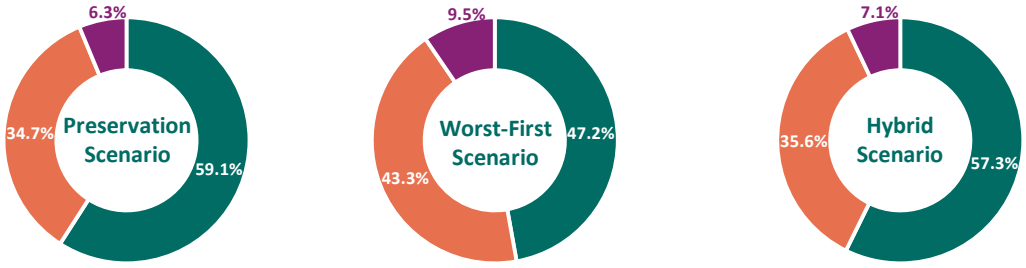
6.7.8 Life Cycle Planning Scenarios and Analysis

ADOT developed three LCP scenarios that allocate different fractions of the total funding for pavement preservation and rehabilitation activities:

- **Preservation Scenario:** In this scenario, the PMS uses the decision trees to select treatments that provide the highest cost-benefit ratio for managing the pavement network. Funding is almost evenly distributed between preservation and rehabilitation activities under this scenario.
- **Worst-First Scenario:** This scenario is very similar to ADOT's historical practices. Pavements in the worst conditions have the highest priority for funding. Most of the funding is used for major rehabilitation and reconstruction activities and approximately 14 percent is allocated to preservation treatments.
- **Hybrid Scenario:** The hybrid scenario represents the ADOT Pavement Section's recommendations to slowly phase in more preservation treatments over time in order to have a scenario that is realistically implementable in the context of ADOT's project development and programming processes. It is similar to the preservation scenario but is tempered by special projects, existing project commitments, and professional judgement. Professional judgement might consider sites initiated by a call for projects, district visits and input, legislative mandates, exceptions to PMS recommendations, contracting and staffing issues, high-profile projects, programming and financial challenges, and preliminary scoping. Under this strategy, approximately 30 percent of the total funding is allocated to preservation treatments.

Figure 28 summarizes the projected pavement condition at the beginning of 2030 for the three scenarios evaluated for the entire state-owned network.

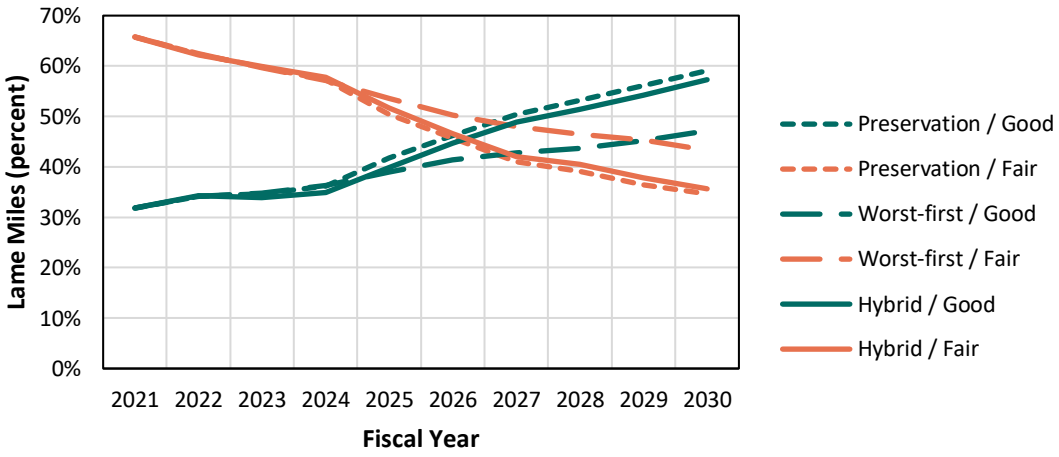
Figure 28 | **SHS pavement projected condition at the beginning of 2030 for all scenarios**



Of the three, the preservation scenario produced the best conditions for the entire network, with 59.1 percent by lane miles in Good condition in year 2030. At the other extreme, the worst-first scenario produced much worse conditions with 47.5 percent Good and 9.5 percent Poor after ten years. The hybrid scenario generates similar conditions as the preservation scenario and demonstrates the ADOT's effort to transition a proactive approach, where funding is evenly distributed between preservation and rehabilitation.

Figure 29 shows the forecast of Good and Fair pavements weighted by lane miles over the next ten years for the entire pavement network for all three LCP scenarios.

Figure 29 | **Good and Fair conditions for entire pavement network over the next ten years for all three scenarios**



All three scenarios show a significant increase in Good condition and a decrease in Fair condition. This is driven mainly by the projected funding and distribution of funds into work types, which vary considerably from one scenario to the next. In the worst-first scenario most of the funding is used for major rehabilitation and reconstruction activities, whereas the preservation scenario distributed funds evenly between rehabilitation and preservation activities. The projected condition in the hybrid scenario support ADOT Pavement Section's recommendations to slowly phase in more preservation treatments over time in order to have a scenario that is realistically implementable in the context of ADOT's project development and programming processes to achieve a better pavement performance, as shown in **Figure 29**.

Section 7
Local Public Agency (LPA) Engagement

7.1 Overview

In the FHWA asset management Final Rule, 23 CFR 515, minimum requirements include developing a process for obtaining data from other NHS Owners as follows:

> *"The processes established by State DOTs shall include a provision for the State DOT to obtain necessary data from other NHS owners in a collaborative and coordinated effort."*

If a State DOT, despite reasonable efforts, is unable to obtain data or reach agreement from another NHS owner on implementation of an investment strategy in the plan, the State DOT can provide an explanation in the documentation on TAMP implementation provided under 23 CFR 515.13(b).

In addition, this provision (23 CFR 515.7(f)) is consistent with 23 CFR 450.208(a)(7), "Coordination of planning process activities," which requires State DOTs, in carrying out the statewide transportation planning process, to coordinate data collection and analysis with MPOs and public transportation operators to support statewide transportation planning and programming priorities and decisions.

It is important to note that the FHWA understands that MPOs should be involved and encourages their involvement. However, because the asset management statute specifies the state as the responsible entity, it is the state's responsibility to develop the necessary relationships with other owners to permit the state to successfully develop its required TAMP. If other NHS owners decide to develop their own TAMPs, the details of how these plans should be integrated into the State DOT's NHS TAMP should be developed by the involved entities.

In addition, FHWA requires states to coordinate with MPOs to the maximum extent practicable when establishing performance targets, which MPOs can agree to support or consider in setting their own targets specific to the MPO planning area.

Following federal requirements, ADOT is in the process of engaging these agencies to develop a collaborative plan for data exchange and performance target setting that satisfies federal requirements. Outcomes from this initiative will enable ADOT to develop statewide investment strategies that include locally-owned NHS assets in future TAMP updates. This section identifies the Local Public Agencies (LPAs) in Arizona and summarizes ADOT's LPA engagement strategy to obtain support from LPAs to improve TAM processes overall.

7.2 LPA NHS Ownership Summary

The NHS includes 3,275 bridges, of which 244 are owned by LPAs. Similarly, the NHS includes 13,672 lane miles of pavement of which 1,693 are owned by LPAs. Altogether, there are 38 local entities that own these NHS assets. **Table 38** summarizes these local, tribal and other government entities and their correspondent NHS-locally owned assets.

Table 38 | **Arizona Local Public Agencies NHS Asset Ownership**

Local Public Agencies with NHS Ownership	Number of Bridges	Bridge Deck Area (square feet)	Total Pavement Lane Miles (mi)
Buckeye	-	-	4.2
Bureau of Indian Affairs*	-	-	10.22
US Customs and Border Patrol*	-	-	15.73
Casa Grande	-	-	2.54
Cave Creek	-	-	61.69
Chandler	-	-	0.14
Douglas	-	-	3.49
El Mirage	-	-	10.28
Flagstaff	-	-	20.95
Fountain Hills	1	3,300	64.79
Grand Canyon Airport Authority*	-	-	18.17
Grand Canyon National Park	-	-	0.56
Glendale	7	130,242	19.77
Goodyear	2	9,368	13.23
Kingman	-	-	4.69
Litchfield Park	-	-	0
Marana	9	31,868	84.6
Maricopa County	5	44,434	64.69
Mesa	13	164,635	0.57
Nogalas	-	-	21.2
Paradise Valley	1	2,176	23.54
Peoria	2	66,876	657.64
Phoenix	52	692,671	26.54
Pima County	42	424,461	7.74
Quartzite	-	-	0
Sahuarita	2	3,912	0.59
Salt River Indian Community	-	-	6.99
San Luis	-	-	156.83
Scottsdale	16	93,008	0
Sierra Vista	4	13,872	10.85
Somerton	-	-	33.92
Surprise	2	6,186	66.76
Tempe	2	9,400	129.87
Tucson	82	551,480	1.04

Local Public Agencies with NHS Ownership	Number of Bridges	Bridge Deck Area (square feet)	Total Pavement Lane Miles (mi)
Williams	-	-	1.87
Yavapai Co	1	22,226	0
Yuma City	1	42,552	66.71
Yuma County Public Works	-	-	80.03
Total Locally Owned	244	2,312,667	1,692.47

* ADOT did not coordinate with these federal NHS owners because they own a small percentage of the total NHS assets which is not expected to affect ADOT's overall asset management and performance strategy.

7.3 LPA Engagement Strategy

The goal of the initial engagement is to make LPAs aware of the TAMP and the analysis used to develop its content and provide information on the recommended investments that would allow the state to maintain NHS assets at or above target condition. To facilitate long-term collaboration, ADOT has developed an External Stakeholder Engagement Plan. This engagement plan is a roadmap for coordination and collaboration between ADOT and local NHS owners to support the development and implementation of the TAMP. This plan identifies stakeholders, defines the coordination required, proposes communication channels and contains an action plan for managing the engagement process. Engagement activities described in the plan include:

- **Initial Stakeholder Workshop:** To introduce stakeholders to the TAMP and begin formal engagement and communication (January 2021; one-time event).
- **TAM Data Coordination:** To collect asset and finance data from stakeholders and share data as needed (every four years).
- **TAMP Analysis Output & Target Communication:** To share outputs from asset life cycle analyses and proposed performance targets (coordinated through MPOs and COGs; every four years).
- **TAMP Implementation Updates:** To provide updates to stakeholders and obtain input for Annual Consistency Determination and Performance Period Progress Reports (coordinated through MPOs and COGs; annually in April/May).

Even though locally-owned assets make up a small portion of the NHS in Arizona, it is important that local owners ultimately participate in the TAMP in several important respects. The LPA Engagement Strategy goal is to achieve the following objectives:

- Verify local inventory and condition as provided by ADOT.
- Participate in the establishment of performance targets for locally-owned NHS bridges and pavements.
- Identify a fiscally-constrained investment strategy for NHS assets for the TAMP planning horizon.

- Support annual consistency documentation related to the implementation of TAMP objectives.

7.4 LPA Asset Life Cycle Planning Analysis

ADOT does not control how NHS locally-owned agencies commit their transportation funding. Therefore, NHS assets owned by local agencies were not included in the pavement and bridge life cycle strategies outlined in previous sections. These assets represent a small percentage of the total NHS and are not expected to affect proposed performance targets.

However, ADOT's new asset management system capabilities presented an opportunity to analyze the locally-owned NHS assets. ADOT evaluated various funding scenarios to determine the recommended investments that would allow the state to maintain NHS assets at- or above-target condition in the next ten years. The life cycle planning analysis for LPAs was based on the processes described in **Section 6**. ADOT utilized state deterioration models and the latest inspection data to predict performance. Treatment decision trees based on ADOT's treatment strategies were used to identify optimal treatments for the network over a 10-year period. ADOT evaluated different scenarios to determine the best investment strategies for NHS locally-owned assets over the next ten years. Bridge and pavement life cycle planning scenarios are presented in the following sections.

7.4.1 LPA Bridge Life Cycle Scenarios and Strategy

ADOT evaluated various funding scenarios to determine the funding levels required to maintain the LPA bridges' current conditions over the analysis period. In the life cycle planning analysis, funding levels were varied from $3.9 million to $10 million annually. **Figure 30** and **Figure 31** show forecasted conditions over the next ten years for the $3.9 million and $10 million scenarios along with the projected conditions at the beginning of 2030. The results show similar conditions over the ten-year period for both scenarios. The ADOT used the $3.9 million strategy to share results with the LPAs since it produced reasonable conditions for the least amount of resources.

Figure 30 | **Projected LPA bridge conditions over the next ten years for the $3.9 million funding scenario (percent of bridges weighted by deck area)**

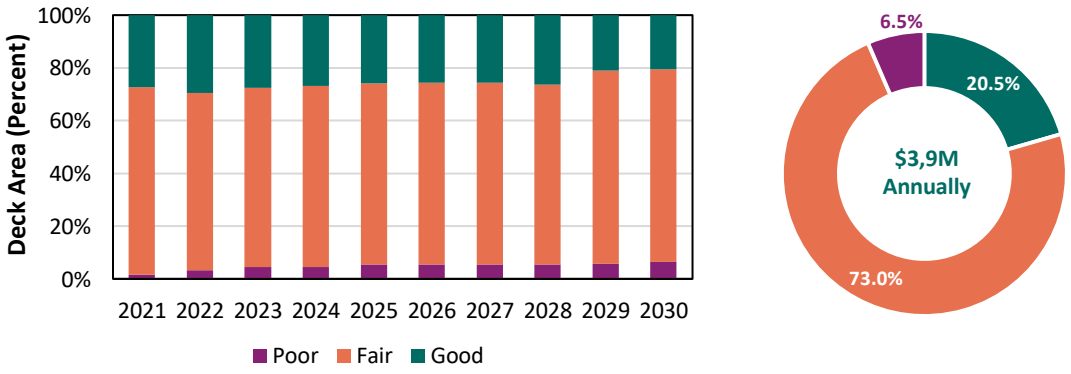
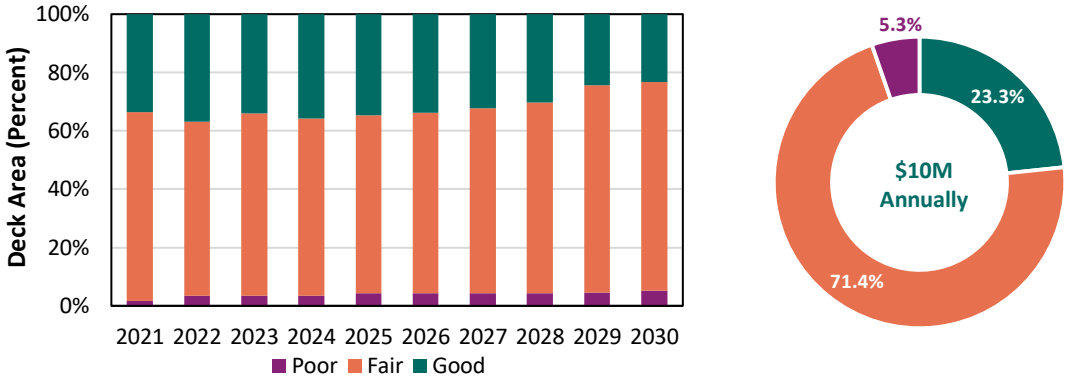


Figure 31 | **Projected LPA bridge conditions over the next ten years for the $10 million funding scenario (percent of bridges weighted by deck area)**



7.4.2 LPA Pavement Life Cycle Scenarios and Strategy

To evaluate the impact of different levels of local investment on the locally-owned NHS pavements, ADOT evaluated four funding scenarios:

- $25 million annually
- $37 million annually
- $50 million annually
- $100 million per year first 4 years and $25 million per year thereafter

Figure 31 through **Figure 34** show the forecast of conditions over ten years for each funding scenario along with the projected conditions at the beginning of 2030. The results show dramatically different conditions over the ten-year period. ADOT used the $100 million per year for the first four years and $25 million per year thereafter strategy to share results with the LPAs since it produced the best projected conditions.

Figure 32 | **Projected LPA pavement conditions over the next ten years for the $25 million funding scenario (percent of pavements weighted by lane miles)**

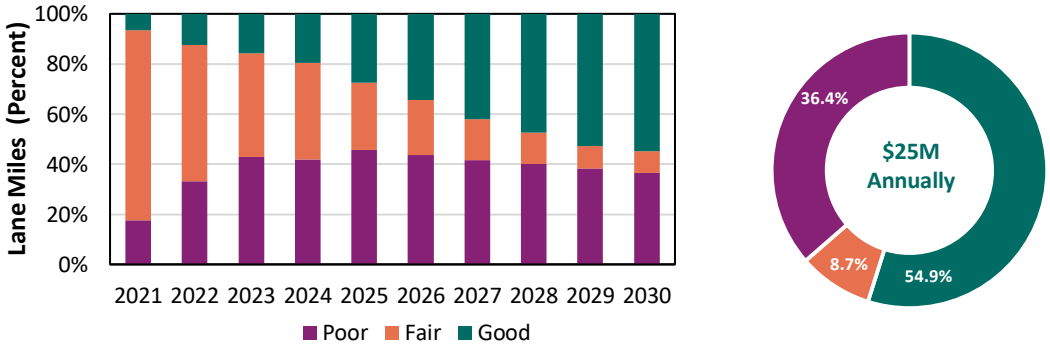


Figure 33 | **Projected LPA pavement conditions over the next ten years for the $37 million funding scenario (percent of pavements weighted by lane miles)**

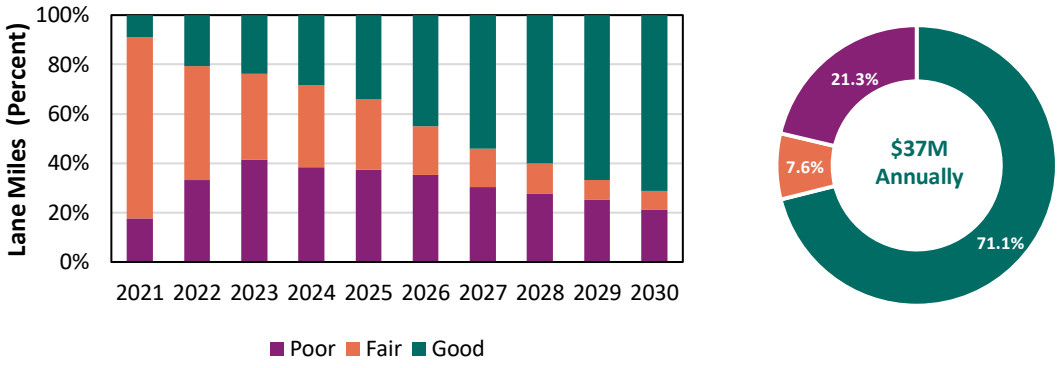


Figure 34 | **Projected LPA pavement conditions over the next ten years for the $50 million funding scenario (percent of pavements weighted by lane miles)**

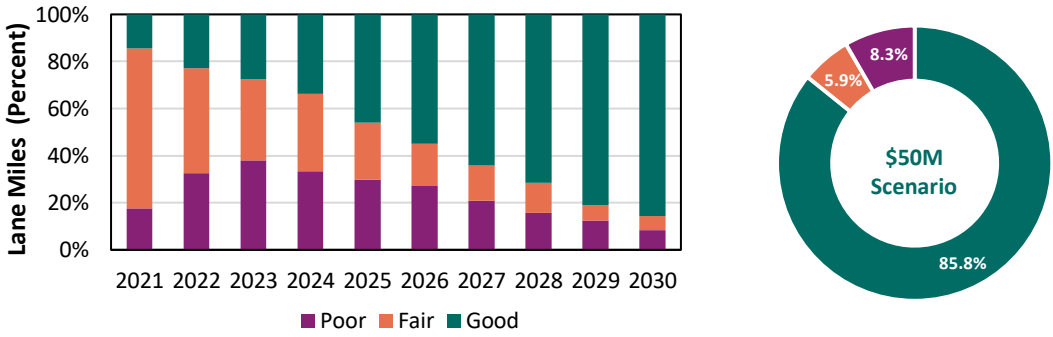
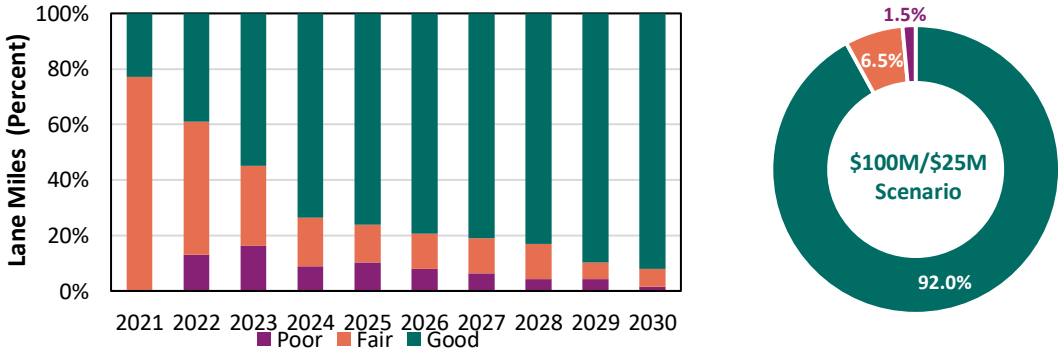


Figure 35 | **Projected LPA pavement conditions over the next ten years for the $100/$25 million funding scenario (percent of pavements weighted by lane miles)**

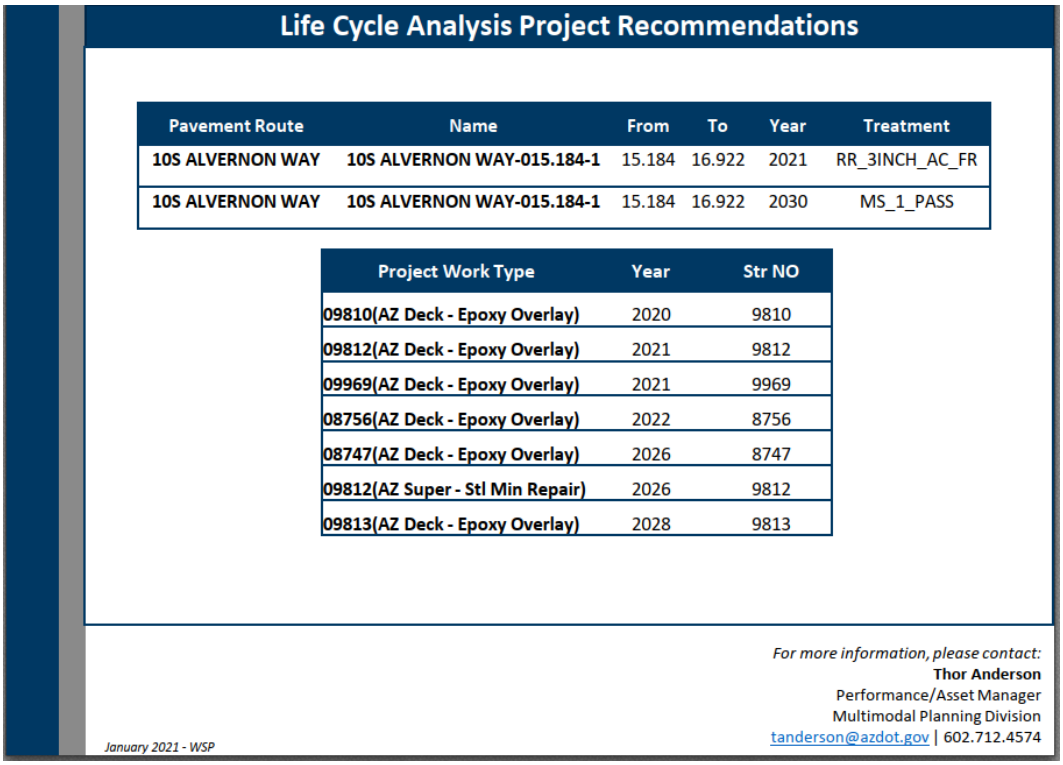


7.4.3 Recommended Candidate Projects

The selected life cycle planning scenarios for NHS locally-owned assets included a list of candidate projects that were generated by the bridge and pavement management systems. ADOT created a summary of recommended projects for each LPA. These summaries were distributed in the Initial Engagement Workshop as described in the following section. An example of the life cycle planning project recommendation is shown in **Figure 36**. ADOT

provided the recommendations to help inform future LPA programming activities, build interest in its asset management activities, and support statewide efforts to meet performance target and long-term performance targets. The complete set of LPA snapshots is provided in **Appendix C**.

Figure 36 | **Example of the life cycle project recommendation**



Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
10S ALVERNON WAY	10S ALVERNON WAY-015.184-1	15.184	16.922	2021	RR_3INCH_AC_FR
10S ALVERNON WAY	10S ALVERNON WAY-015.184-1	15.184	16.922	2030	MS_1_PASS

Project Work Type	Year	Str NO
09810(AZ Deck - Epoxy Overlay)	2020	9810
09812(AZ Deck - Epoxy Overlay)	2021	9812
09969(AZ Deck - Epoxy Overlay)	2021	9969
08756(AZ Deck - Epoxy Overlay)	2022	8756
08747(AZ Deck - Epoxy Overlay)	2026	8747
09812(AZ Super - Stl Min Repair)	2026	9812
09813(AZ Deck - Epoxy Overlay)	2028	9813

7.5 LPA Engagement Workshop

ADOT convened LPA and MPO representatives, FHWA representatives, and ADOT key players across the state to the Initial Stakeholder Workshop, the first step in ADOT's LPA engagement plan to formally introduce the stakeholders to the TAMP and begin formal engagement and communication. The workshop was held virtually on January 20, 2021, and gathered 50 attendees representing 19 public agencies, including FHWA and ADOT (See **Appendix C** for list of attendees). The two-hour workshop was intended to accomplish the following outcomes:

- Establish formal communication channels for data coordination, including asset inventory and condition data and financial information.
- Share life cycle planning analyses results and recommend investment strategies to align with TAMP federal requirements.
- Identify risks on the non-ADOT NHS network.
- Establish statewide performance targets consistent with investment strategies.

The workshop was facilitated by a team comprised of ADOT's Performance/Asset Manager, ADOT pavement and bridge engineers, and representatives from the consultant team and FHWA. Key individuals along with their responsibilities are listed in **Table 39**.

Table 39 | **Initial Stakeholder Engagement Workshop Key Players and Responsibilities**

Key Group	Members	Roles and Responsibilities
ADOT	• Thor Anderson (Performance/Asset Manager) • Maria Burton-Sunder (Pavement Management Engineer) • Yongpi Li (Pavement Management Engineer) • Mafiz Mian (Pavement Management Engineer) • Ramon Gama (Senior Bridge Engineer)	• Facilitated and led workshop • Provided bridge analysis for local NHS • Provided pavement analysis for local NHS
Consultant Team	• Margaret-Avis Akofio-Sowah (WSP) • Juan Diego Porras-Alvarado (WSP) • Katie Zimmerman (APTech)	• Supported Performance/Asset Manager to facilitate workshop • Led sections of the workshop • Developed communication and material for the workshop
FHWA	• Chad Matty • Christina Leach	• Provided support to the Performance/Asset Manager • Supported the workshop

The workshop was initiated with the motivation to convene stakeholders to the event. These motivations are listed below:

- FHWA requires that State DOTs prepare a TAMP for NHS bridges and pavements, including those owned by local governments, and requires performance targets for NHS assets.
- FHWA envisions that State DOTs and local governments maintain their respective NHS bridges and pavements in a state of good repair.
- Over the past several years, ADOT has made a significant investment in tools that can aid in the management of NHS assets, including those NHS locally-owned assets. This workshop presented an opportunity to present results obtained for the LPA network as recommended investment strategies for the next ten years.

The content of the workshop was divided into five sections:

- **Asset Management & Performance Regulations:** In this section, the workshop facilitator provided a detailed discussion of federal asset management regulations, and the link between federal regulations and the national highway performance program. Moreover, the facilitation team members provided an overview of an asset management plan benefits and presented the minimum asset management plan requirements, in particular, those related to coordination with NHS Asset Owners as described at the beginning of this section.

- **ADOT TAMP Overview:** This section began with a summary of ADOT's TAMP journey and identified relevant milestones, including improvements in the data collection procedures, establishing performance targets, development and certification of the first TAMP, implementation of BrM and dTIMS, and the ongoing TAMP update effort. The discussion continued with a brief overview of the bridge and pavement inventory and condition, and how ADOT broke down the highway network to facilitate the implementation of the TAMP. This was followed by a presentation on infrastructure performance measures, four-year performance targets, and state of good repair targets.

- **Bridge & Pavement Management Systems & Analysis Outputs:** The facilitation team described the importance of LCP in the context of transportation asset management. It was defined as a process to estimate the cost of managing an asset class over the whole life with consideration for minimizing cost while maintaining or improving asset condition. LCP allows ADOT to select the right treatment at the right time for bridges and pavements to last longer at the minimum cost to keep the system in a state of good repair. The facilitator continued discussing the link between LCP and performance targets, performance gap analysis, risk management, investment strategies, and ultimately to the planning process. This section also covered the implementation of BrM and dTIMS, and how ADOT used these new decision-support tools in the development of the TAMP. After an introduction to LCP, ADOT presented the results of the LCP analysis conducted for the locally-owned NHS assets. ADOT evaluated various funding scenarios for bridge and pavements assets to determine the recommended investment strategy over the ten years, which were described in detail. Additionally, ADOT presented the recommended investment strategies for the assets covered in the TAMP over the next ten years.

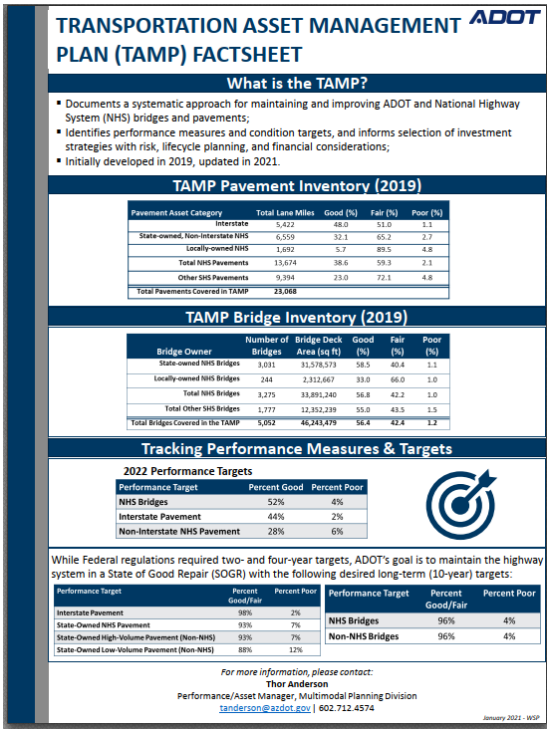
- **Using the TAMP & Analysis Outputs:** In this section, the consultant team provided an overview of agency trends for using TAMP analysis outputs. Transportation agencies are placing an increasing emphasis on balancing asset preservation needs with other priorities, including safety, mobility, resilience, and inclusion. Moreover, agencies are relying more heavily on data to drive investment decisions thanks to improved data collection procedures and analytical tools. Relying on data for monitoring and increases accountability and the use of dashboards helps to communicate performance improvements to stakeholders. The TAMP can help agencies tell a more effective story of the asset management journey by documenting needs, improving accountability in decisions, assessing and managing risks, conveying realistic targets, and providing more informed responses to stakeholders' demands. The TAMP can also change the way assets are managed by transitioning away from traditional silos to an approach that considers the most effective use of available funds across asset classes.

- **Future Stakeholder Engagement & Coordination:** In this last section, ADOT listed the stakeholder engagement needs that include the following items: data coordination, sharing life cycle outputs and recommended strategies, identifying risks on the non-ADOT NHS network, statewide NHS performance targets, and annual implementation progress and performance reports. Also, ADOT provided a list of data items on how LPAs can help in improving the TAMP in the next updates. These data items are listed below:

- When identifying a bridge or pavement project in the STIP use the ADOT work type (preservation, rehabilitation, reconstruction)
- Identify estimated annual expenditures on your NHS assets and provide to ADOT
- Develop a plan of projects for NHS assets and share with ADOT
- Identify expenditures for NHS assets over the previous year for the consistency determination due to FHWA June 30 annually

To finalize the workshop, ADOT distributed the Agency Asset Snapshot to each LPA as shown in **Figure 36** and **Appendix C**. These snapshots summarize the locally-owned NHS assets included in the TAMP and life cycle analysis recommendations. ADOT expects each LPA to confirm the total NHS assets, consider project recommendations, and identify actions for continued engagement to support TAMP updates.

Figure 37 | **Example of an Agency Asset Snapshot**



TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP) FACTSHEET

ADOT

What is the TAMP?

- Documents a systematic approach for maintaining and improving ADOT and National Highway System (NHS) bridges and pavements;
- Identifies performance measures and condition targets, and informs selection of investment strategies with risk, lifecycle planning, and financial considerations;
- Initially developed in 2019, updated in 2021.

TAMP Pavement Inventory (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Interstate	5,422	48.0	51.0	1.1
State-owned, Non-Interstate NHS	6,559	32.1	65.2	2.7
Locally-owned NHS	1,692	5.7	89.5	4.8
Total NHS Pavements	13,674	38.6	59.3	2.1
Other SHS Pavements	9,394	23.0	72.1	4.8
Total Pavements Covered in TAMP	23,068			

TAMP Bridge Inventory (2019)

Bridge Owner	Number of Bridges	Bridge Deck Area (sq ft)	Good (%)	Fair (%)	Poor (%)
State-owned NHS Bridges	3,031	31,578,573	58.5	40.4	1.1
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Total NHS Bridges	3,275	33,891,240	56.8	42.2	1.0
Total Other SHS Bridges	1,777	12,352,239	55.0	43.5	1.5
Total Bridges Covered in the TAMP	5,052	46,243,479	56.4	42.4	1.2

Tracking Performance Measures & Targets

2022 Performance Targets

Performance Target	Percent Good	Percent Poor
NHS Bridges	52%	4%
Interstate Pavement	44%	2%
Non-Interstate NHS Pavement	28%	6%

While Federal regulations required two- and four-year targets, ADOT's goal is to maintain the highway system in a State of Good Repair (SOGR) with the following desired long-term (10-year) targets:

Performance Target	Percent Good/Fair	Percent Poor
Interstate Pavement	98%	2%
State-Owned NHS Pavement	93%	7%
State-Owned High-Volume Pavement (Non-NHS)	93%	7%
State-Owned Low-Volume Pavement (Non-NHS)	88%	12%

Performance Target	Percent Good/Fair	Percent Poor
NHS Bridges	96%	4%
Non-NHS Bridges	96%	4%

For more information, please contact:
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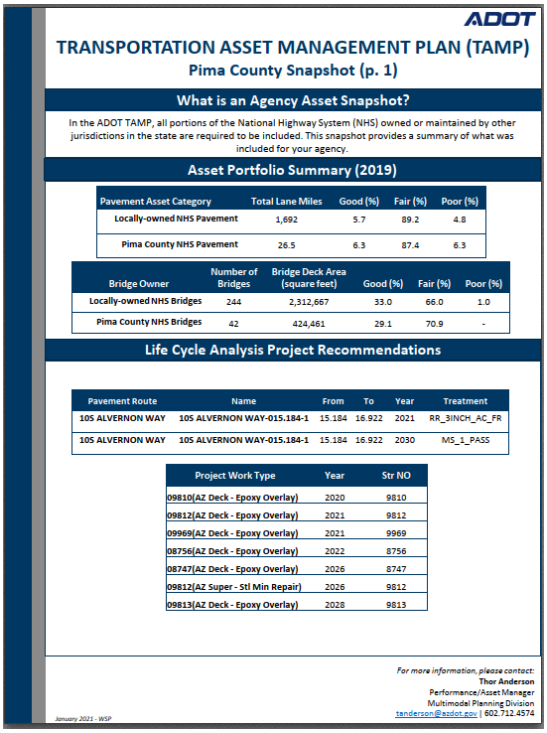
January 2021 - WSP



ADOT

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)
Pima County Snapshot (p. 1)

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Pima County NHS Pavement	26.5	6.3	87.4	6.3

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Pima County NHS Bridges	42	424,461	29.1	70.9	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
10S ALVERNON WAY	10S ALVERNON WAY-015.184-1	15.184	16.922	2021	RR_3INCH_AC_FR
10S ALVERNON WAY	10S ALVERNON WAY-015.184-1	15.184	16.922	2030	MS_1_PASS

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08747(AZ Deck - Epoxy Overlay)	2026	8747
09812(AZ Super - Stl Min Repair)	2026	9812
09813(AZ Deck - Epoxy Overlay)	2028	9813

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Multimodal Planning Division
tanderson@azdot.gov | 602.712.4574

January 2021 - WSP

7.6 Next Steps for NHS Owners

To continue to engage LPAs who own NHS assets and ensure their involvement in statewide asset management efforts, ADOT plans to conduct the activities listed in **Table 40** in the next four years.

Table 40 | **Stakeholder Engagement Activities**

Activity	Timeline
Provide local governments who own NHS assets with an annual snapshot of NHS bridge and pavement asset inventory and conditions	Annually – July 31st
Add proposed language to the COG work program agreements and agreements with the MPOs that support the identification of projects on NHS bridges and pavements in the TIPS regardless of funding source and to assist with the development of local NHS bridge and pavement performance targets	January, 2022
Make modifications to e-STIP to help ensure that the proper work type definitions (following TAMP requirements) are used for projects that are identified in the STIP	June, 2022
Establish a process to obtain information regarding annual fiscal year expenditures on locally-owned NHS assets for ADOT's preparation of the annual consistency report due to FHWA	June, 2022
Establish a process to obtain an estimate for annual NHS bridge and pavement expenditures from the jurisdictions who own the preponderance of NHS assets for the ten-year horizon of the TAMP	December, 2024

Section 8 **Gap Analysis & Investment Strategies**

8.1 Overview

FHWA defines investment strategies as "a set of strategies that result from evaluating various levels of funding to achieve State DOT targets for asset condition and system performance effectiveness at a minimum practicable cost while managing risks[6]." The development of investment strategies for ADOT's bridges and pavements was based on life cycle planning analysis, a consideration of risks and anticipated available funding presented in previous sections, as well as other factors discussed below.

8.2 Factors Influencing Projected Performance Gaps

8.2.1 Projected Traffic Growth

Arizona has experienced strong population growth for the past several decades. From 1970 to 2010, the state grew from a population of 1.77 million to 6.40 million. The rate of growth slowed during the Great Recession, but population is still expected to grow another 58 percent to 10.10 million by 2050[7].

Although the COVID-19 pandemic has reduced highway travel in the near term and could change travel patterns in the longer term, population growth is expected to continue and will lead to increased highway travel. **Table 41** shows the projected increase in daily vehicle miles traveled for the SHS (including the state-owned NHS) and locally owned NHS routes between 2016 and 2035.

Table 41 | **2016 and Projected 2035 Daily Vehicle Miles Traveled**

Network	2019 Vehicle Miles Traveled	2035 Vehicle Miles Traveled	Percent Increase (%)
SHS	91,008,934	120,547,062	32.5
Locally-owned NHS	10,052,615	12,599,256	25.3

Note: Projections from the Arizona Statewide Travel Demand Model 2016.

Increased highway utilization, particularly by commercial trucks, accelerates the deterioration of pavements and bridge decks requiring more frequent maintenance, preservation, rehabilitation and reconstruction. Although traffic growth will be gradual,

[6] *Federal Highway Administration (FHWA). 2017b. Using a Life Cycle Planning Process to Support Asset Management-Interim Document.*

[7] *Arizona Long Range Plan Working Paper WMYA 2040. 2016. Arizona Department of Administration projections.*

keeping up with impacts will require a substantial investment in infrastructure preservation; it also will make improvements to network-wide asset conditions more challenging.

8.2.2 Infrastructure Age

The advancing age of state highway assets is one of the primary challenges facing ADOT. Approximately 54 percent of the bridges on the SHS and the local NHS are more than fifty years old; by the end of the TAMP planning horizon, more than 60 percent of bridges will exceed this age (**Figure 38**). Until 2007, ADOT designed bridges to have a fifty-year lifespan; however, these bridges may last significantly longer with the proper care. After 2007, new bridges were designed with a service life of seventy-five years.

Approximately 63 percent of the pavements on the SHS are more than fifty years old; by the end of the TAMP planning horizon, more than 70 percent of pavements will exceed this age (**Figure 39**). Asphalt pavements are designed to last twenty years before an initial rehabilitation is needed. Rehabilitation treatments typically last ten to fifteen years. However, preservation treatments can be used during the twenty-year design life to delay the need for rehabilitation by seven to fifteen years. Since preservation treatments cost substantially less than rehabilitation treatments, the use of preservation treatments to defer more expensive treatments can be very cost-effective strategy.

Figure 38 | **Bridge Construction Dates (SHS and local NHS)**

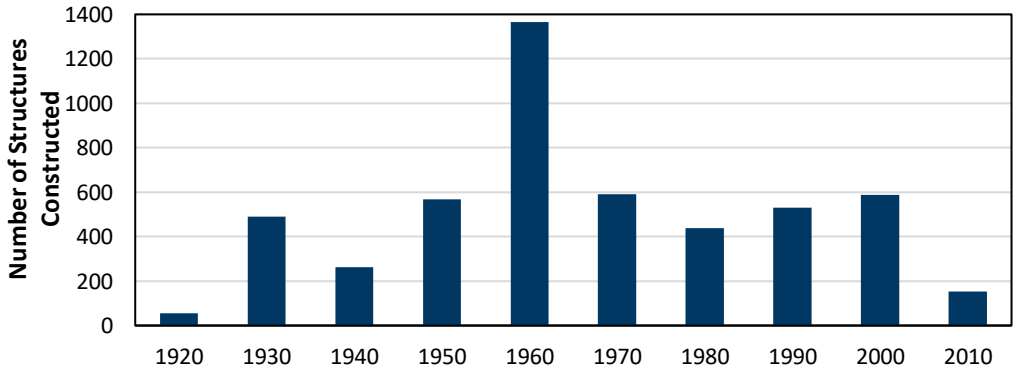
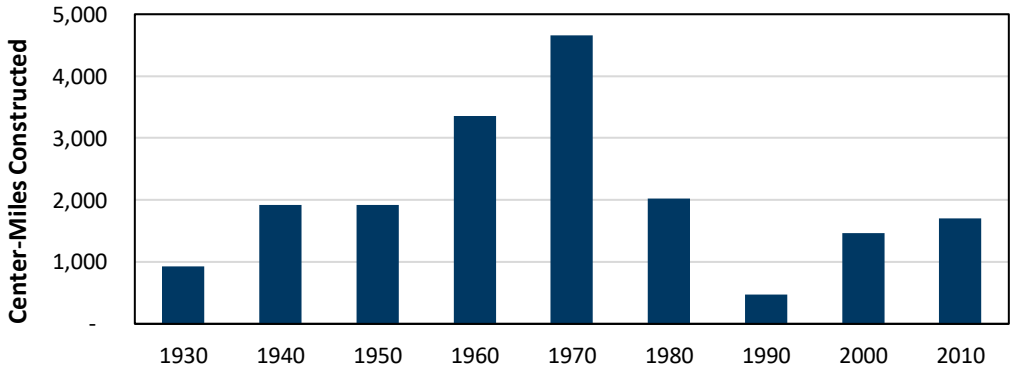


Figure 39 | **Pavement Age – State Highway System**



Note: Represents initial construction and reconstruction.

8.3 Current Performance Gap Assessment

ADOT currently exceeds federal minimum conditions and meets statewide targets for bridge and pavement performance (**Table 42**). The life cycle planning analysis showed that ADOT will continue to exceed federal minimum condition requirements for the TAMP planning horizon. The approved WMYA 2040 Long-Range Transportation Plan recommended an increase to the long-term funding for bridges and pavements by about 30 percent. Based on the life cycle analysis for this TAMP, projected funding revenues post-COVID 19 are expected to enable ADOT to continue to meet performance targets and maintain a state of good repair. Thus, ADOT does not anticipate any performance gaps for the TAMP planning horizon.

Table 42 | **ADOT Bridge and Pavement Performance Targets (established in 2018)**

Performance Target	2020 Target (%)	2020 Performance (%)	2022 Target (%)
Percent of NHS bridges classified as in Good condition	52	57.8	52
Percent of NHS bridges classified as in Poor condition	4	1.2	4
Percent of Interstate pavements in Good condition	-	47.0	44
Percent of Interstate pavements in Poor condition	-	1.1	2
Percent of non-Interstate NHS pavements in Good condition	31	32.3	28
Percent of non-Interstate NHS pavements in Poor condition	6	2.8	6

8.4 Risk Management Analysis

The following investment strategies were adopted by ADOT to address risks associated with bridges and pavements:

- **Scour counter measures subprogram**. $2 million to $3 million annually has been allocated to implement scour counter measures on scour-critical bridges.
- **Infrastructure resilience.** ADOT is taking several steps to invest in infrastructure resilience, including:
    - Improving infrastructure at repeated emergency event locations to better withstand the effects of extreme weather events, such as upgrading the drainage infrastructure on SR 71 at MP 86.
    - Implementing better tools for the management of pump stations, including a Pump Station Reliability Tool.
    - The development of Roadside Vegetation Management Guidelines to help improve drainage and reduce erosion.
    - Development of improved design that accounts for extreme weather, such as the Probabilistic Bridge Design Pilot Project.

- **Installation of weigh-in-motion (WIM) stations**. ADOT has installed WIM stations at 18 locations to detect unpermitted overweight trucks which can damage both bridges and pavements. Some locations have dual scales bringing the total to 25 WIM scales.

- **Increased funding for pavement surface treatments**. In FY 2019, the pavement surface treatment budget was increased from $15 million to $40.6 million to increase the amount of preventive surface treatments that can be applied to Arizona highways. The investment strategies reflected in this TAMP recommend a gradual increase in preservation treatments over several years, representing a realistic estimate of how quickly ADOT can transition to the desired level of preservation treatments.

- **Consideration of risk mitigation.** the bridge and pavement management systems factor risks into the benefit-cost analysis.

Some of these funds (e.g., scour countermeasures fund) are ongoing and will continue until the risks are mitigated. Risks that have a lower likelihood, such as rock fall remediation, are addressed using contingency funds or the redistribution of program funds.

8.5 Investment Strategies Methodology

Preserving the performance and condition of the state's transportation system requires a long-term financial plan that supports the implementation of the life-cycle strategies documented earlier in this TAMP. Based on the expected funding available for managing pavements and bridges over the next ten years, ADOT analyzed different combinations of investments in maintenance, preservation, rehabilitation, and reconstruction to determine their impact on future conditions. The selected strategies build on the results of the LCP described in **Section 6** and consider the risks documented in **Section 4** and the financial plan in **Section 5**. In addition, the recommended strategies aim to ensure that no performance gaps occur over the TAMP period and ADOT achieves a state of good repair for both bridge and pavement assets. The resulting investment strategies reflect an increased investment in preservation activities and a shift away from the worst-first approach used in the past. This increased use of low-cost treatments slows the rate of asset deterioration, extends the useful life of an asset and defers the need for more costly rehabilitation treatments. These treatments are applied to pavements and bridges while they are still in Good or Fair condition to keep these assets in a state of good repair.

The process that was followed to identify a recommended investment strategy is described below.

- **Develop LCP scenarios**. The TAMP technical team provided long-term, fiscally constrained funding availability to the asset managers so that different treatment scenarios could be considered. The scenarios analyzed by the asset managers considered different combinations of maintenance, preservation, rehabilitation, and reconstruction to achieve and sustain a state of good repair over asset life cycles, while achieving performance targets, supporting national goals, and managing risks. The scenarios were evaluated based on their ability to achieve a state of good repair and manage risks.

- **Attempt to close performance gaps**. One of the primary considerations in evaluating the LCP scenarios was whether a performance gap existed between desired and projected conditions. If gaps were identified, ADOT considered approaches, such as, shifting resources, lowering performance targets, changing LCP strategies, or increasing risk tolerance to close the performance gap. Impacts to other performance areas were also considered in selecting the best overall scenario.

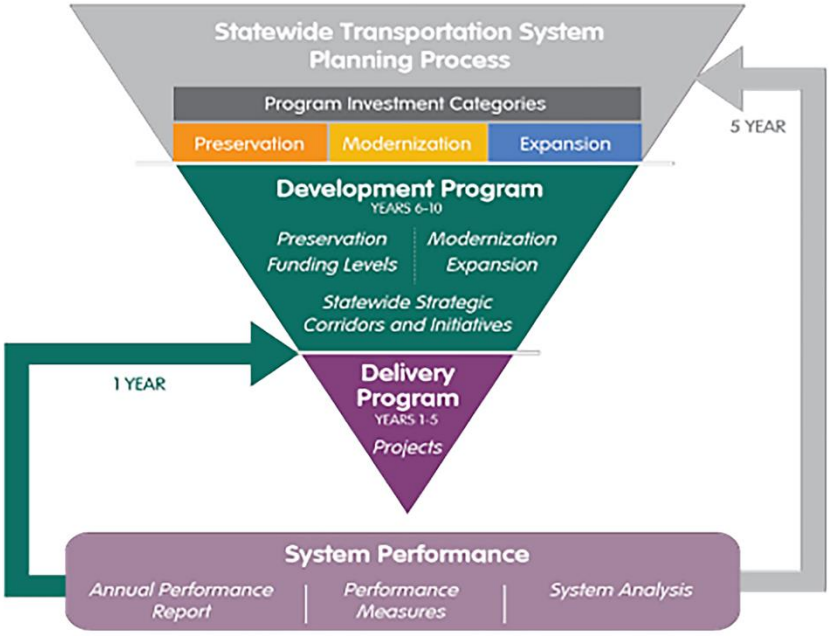
- **Determine the recommended investment strategy**. The technical team worked with agency management to identify a strategy and funding levels for pavements and bridges that could be realistically implemented over the next ten years. ADOT was able to develop a fiscally-constrained strategy that did not result in a performance gap for pavements or bridges.

- **Incorporate the recommended investment strategy into the planning and programming process**. The recommended investment strategy fits into a larger context of transportation performance management and performance-based planning and programming. Safety, mobility, and commerce also are important transportation needs that are considered during the long-range transportation planning process. Since transportation needs outpace available funding, ADOT must make difficult choices about where to best spend limited resources. To ensure the best choices, ADOT started using a data-driven, performance-based approach to planning, programming, and financial decision making that connects the goals of the state's performance-based Long-Range Transportation Plan to the ADOT Five-Year Construction Program and the Statewide Transportation Improvement Program (STIP), known as P2P. To incorporate longer-term planning into the process, ADOT added a development program representing an additional five years (years six through ten) of tentative programming that feeds the five-year transportation facilities construction program.

Planning documents like the TAMP, Freight Plan, and other major corridor studies, inform the development of high-level recommended investment choices in the Long-Range Transportation Plan and support the achievement of performance targets by providing category-specific investment strategies that can be used to develop a package of projects for the ten-year Development Program and the STIP, as shown in **Figure 40**. For bridges and pavements, the recommended investment strategies in this TAMP will serve as the primary basis for selecting and prioritizing projects throughout this process.

In addition to the amount planned to be invested in preserving the system described in the following sections, some additional funds are anticipated for initial construction. Initial construction projects are typically programmed to address safety and mobility issues that improve the overall performance of the network on a system-wide basis and add new capacity in areas of population growth.

Figure 40 | **Linking Planning to Programming**



SOURCE: PARSONS BRINCKERHOFF 2014[8]

8.6 Bridge Investment Strategies

In its investigation of investment alternatives for the Arizona bridge inventory, ADOT considered the following three alternative scenarios over a ten-year period, generating outputs using AASHTOWare Bridge Management (BrM):

- A "worst-first" strategy, where only the bridges in worst condition receive any treatment, with a focus on replacement and rehabilitation.
- A preservation strategy which includes maintenance, preservation, rehabilitation and reconstruction, and emphasizes preservation.
- A hybrid strategy that reflects the cost-effectiveness of preservation but also includes highest priority rehabilitation and replacement.

For each scenario considered, funding was allocated to determine whether the desired bridge state of good repair could be achieved. As a reminder, the desired state of good repair for bridges was defined in terms of a targeted percent of the network deck area in Good or Fair condition and a maximum amount of the network deck area in Poor condition (**Section 3.4.2).**

[8] Parsons Brinckerhoff. 2014. P2P Link Methodologies and Implementation Plan, June 2014.

8.6.1 Recommended Bridge Investment Strategy

The evaluation of the various investment strategies led ADOT to select a planned program of investment that reflects the need to have an implementable, balanced approach that realistically transitions to an increased amount of preservation treatments over a normal programming cycle. This hybrid approach represents a significant shift from the reactive, worst-first approach that ADOT has traditionally used.

8.6.1.1 Funding and Treatment Distributions

Scenario for bridge preservation was developed for the SHS as a whole, and the performance, projects and funding for the NHS was extracted from that analysis. The SHS scenario include all state-owned bridges, on or off the NHS, thus reflecting all ADOT resources available for investment in existing bridges. **Table 43** shows the annual funding levels that were projected as available for investment.

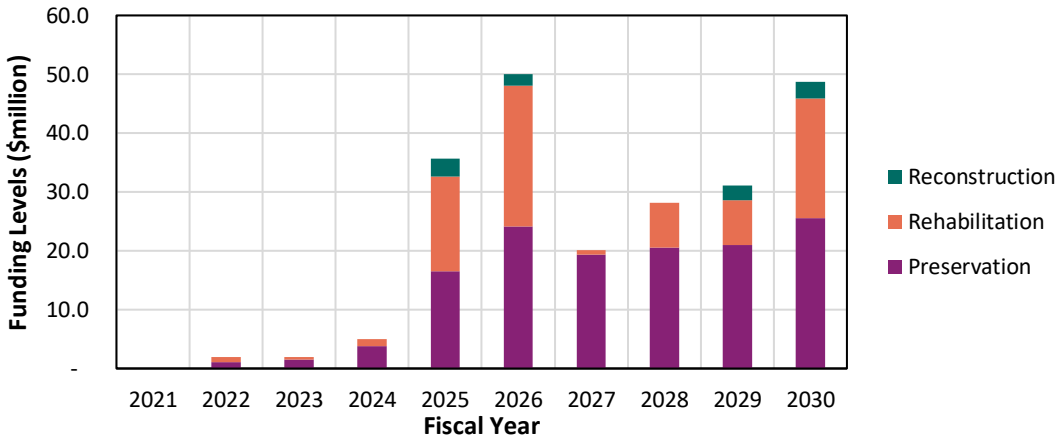
Table 43 | **Bridge investment scenarios – assumed funding available ($Millions)**

Fiscal Year	SHS
2021	95
2022	87
2023	156
2024	75
2025	59
2026	95
2027	49
2028	49
2029	49
2030	49
Total	**762**

ADOT is transitioning from a reactive approach to selecting projects to a data-driven approach that relies on sophisticated bridge and pavement software to analyze the most cost-effective strategy to manage assets over the network life cycle. The most cost-effective strategy tends to emphasize low cost preservation treatments that maximize asset life and enables funding to be distributed to more network assets. However, state law requires that ADOT update the five-year Facilities-Construction program annually. The update focuses on the later years of the program, so the earlier years of the program are established and are not easily changed. This is due to the lengthy amount of time need to plan, design and implement bridge projects. To account for these factors, ADOT evaluated and selected a balanced scenario that preserves the early part of the transportation program and gradually increasing preservation treatments over time.

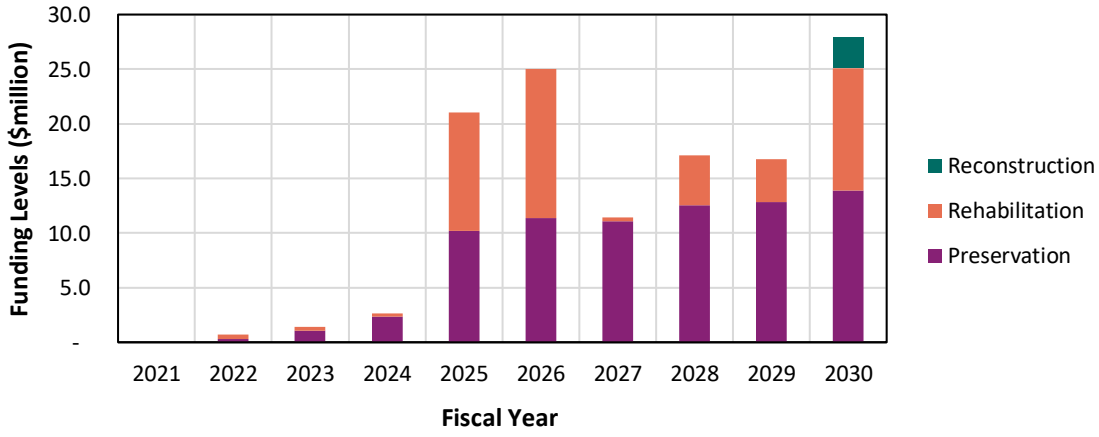
In the balanced ten-year program for the SHS, approximately 70 percent of the anticipated funding is dedicated to projects previously planned by using earlier methods, including previous editions of the STIP. Similarly, for the NHS, approximately 72 percent of anticipated funding is committed to projects planned with previous methods. **Figure 41** and **Figure 42** represent the funding allocation for the remaining 30 percent for the SHS and 28 percent for the NHS. The breakdown of work types for this newly proposed work over the next ten years is shown in **Table 44**.

Figure 41 | **SHS bridge allocation by work type at predicted funding level for newly proposed work**



Note: These funding levels represent the newly planned work for the ten-year program for the SHS and do not include committed funding for projects planned in previous years.

Figure 42 | **NHS bridge allocation by work type at predicted funding level for newly proposed work**



Note: These funding levels represent the newly planned work for the ten-year program for the SHS and do not include committed funding for projects planned in previous years.

Table 44 | **Bridge funding allocation by work types at predicted funding level (percent of the program for newly proposed work developed in the bridge management system)**

Work Type	SHS (% funding)	NHS (% funding)
Preservation	60.0	62.7
Rehabilitation	35.4	35.0
Reconstruction	4.6	2.3
Total	**100**	**100**

8.6.1.2 Predicted Conditions

Figure 43 and **Figure 44** show the forecast of conditions over ten years under the funding scenario considered most likely with current sources along with the projected conditions at the beginning of 2030.

Figure 43 | **Projected bridge conditions over the next ten years, SHS hybrid scenario (percent of bridges weighted by deck area)**

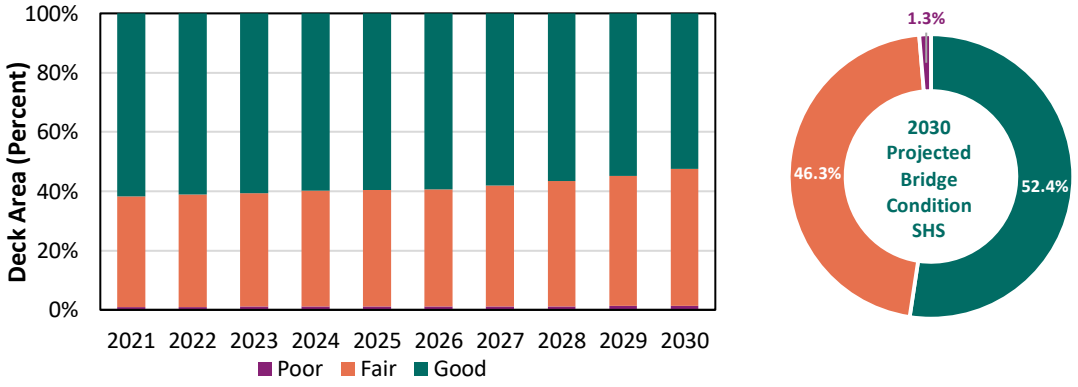
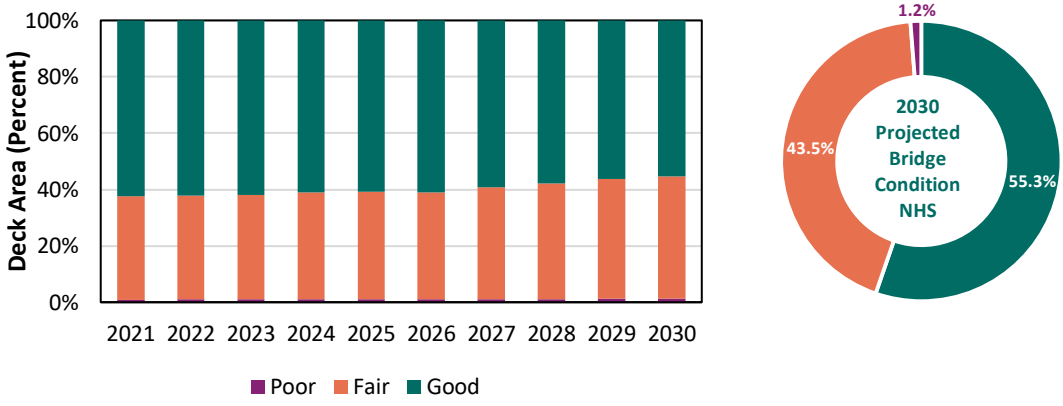


Figure 44 | **Projected bridge conditions over the next ten years, NHS hybrid scenario (percent of bridges weighted by deck area)**



For the SHS, the recommended scenario shows a decline of Good bridges from the current 61.7 percent to 52.4 percent, and an increase of Fair bridges from 37.3 percent to 46.3, over the next ten years. For the NHS, this scenario shows a decline of Good bridges from the current 62.5 percent to 55.3 percent, and an increase of Fair bridges from 36.6 percent to 43.5 percent. This is driven mainly by the aging of many of Arizona's largest bridges, which are newer than the inventory average age. The ten-year projection is still better than ADOT targets, especially for the NHS, and is considered to be a state of good repair as shown in **Table 45**.

Table 45 | **Projected bridge conditions at the beginning of 2030**

	% Good Bridge Sq Ft.		% Poor Bridge Sq Ft.	
	TARGET MINIMUM % GOOD/FAIR	PROJECTED % GOOD/FAIR (YEAR 10)	TARGET % POOR	PROJECTED % POOR (YEAR 10)
NHS	96.0%	98.8%	4.0%	1.2%
SHS	96.0%	98.7%	4.0%	1.3%

8.6.1.3 Planned Ten-Year Bridge Investment

Using the annual funding level and planned breakdown of expenditures, **Table 46** shows the projected investment separately for the NHS and the SHS. Note that this table also shows initial construction funding which is not included in the scenario analysis.

Table 46 | **Planned bridge annual investment by ADOT over the ten-year period from FY21-FY30 ($Millions)**

($ Millions)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
National Highway System (INCLUDING STATE AND LOCAL NHS)											
Initial Const.	34	4	1	70	0	0	0	0	0	0	109
Maintenance	2	2	2	2	2	2	2	2	2	2	20
Preservation	2	5	6	13	9	12	8	9	10	9	83
Rehabilitation	2	15	7	3	15	20	1	7	6	10	86
Recon	61	7	127	11	0	36	0	0	2	3	247
Total NHS	**101**	**33**	**143**	**99**	**26**	**70**	**11**	**18**	**20**	**24**	**545**
State Highway System (INCLUDING NHS AND NON-NHS)											
Initial Const.	34	4	1	70	0	0	0	0	0	0	109
Maintenance	3	3	3	3	3	3	3	3	3	3	30
Preservation	3	10	9	15	15	23	18	17	18	24	152
Rehabilitation	22	33	11	16	41	33	31	28	18	22	255
Recon	71	42	136	44	3	38	0	4	13	3	354
Total SHS	**133**	**92**	**160**	**148**	**62**	**97**	**52**	**52**	**52**	**52**	**900**

8.6.2 Bridge Performance Gap Analysis

A comparison of the ten-year targeted bridge conditions and the conditions projected to be achieved by implementing the most likely bridge funding investment strategy was presented earlier as **Table 45**. As shown, ADOT is expected to achieve its desired state of good repair over the ten-year analysis period so there is no gap expected in bridge conditions.

8.7 Pavement Investment Strategies

As discussed in the LCP section, ADOT is making a commitment to increase the level of investment in maintenance and preservation activities to defer the need for costly rehabilitation treatments and reduce the life cycle cost of managing the pavement network. However, the agency is taking a realistic approach to complete the transition that gradually builds the investment in preservation treatments over several years. ADOT is using its new pavement management software to analyze the long-term impact of the three treatment strategies on system condition. The three treatment strategies being considered include:

- **Preservation Strategy** – has an emphasis on preservation treatments for the entire planning horizon.
- **Worst-First Strategy** – in which most of the funding is used for major rehabilitation and reconstruction, leaving approximately 14 percent for preservation treatments.
- **Hybrid Strategy** – in which preservation treatments are slowly phased in over time until approximately 30 percent of the total funding available is allocated to preservation.

8.7.1 Recommended Pavement Investment Strategy

The evaluation of the various investment strategies led ADOT to select a planned program of investment that reflects the need to have an implementable, balanced approach that realistically transitions to an increased amount of preservation treatments over a normal programming cycle. This hybrid approach represents a significant shift from the reactive, worst-first approach that ADOT has traditionally used.

8.7.1.1 Funding and Treatment Distributions

The pavement investment strategy used a total ten-year budget of $3.203 billion to address the state-maintained portion of the network distributed as shown in **Table 47**.

Table 47 | **Assumed funding available over ten years**

Fiscal Year	Assumed State Pavement Budget ($Millions) *
2021	178
2022	300
2023	286
2024	232
2025	366
2026	368
2027	368
2028	368
2029	369
2030	368
Total	**3,203**

Note: These assumed budgets include $7 million per year in maintenance work, which was not considered in the LCP analysis.

Note that the funding shown here reflects an expected drop in revenue until 2025 when the effects of the COVID pandemic are projected to have passed. Additionally, the investment strategy incorporates the expected gradual increase in preservation investments until 2026, when the amount allocated to preservation stabilizes at a little over $110 million. On top of this ten-year budget, ADOT plans to allocate $7 million annually in maintenance work ($5 million to the NHS pavements $2 million to the non-NHS pavements). The available funding each year was divided by network, as noted in **Table 48**.

Table 48 | **Allocation of projected state funding available over ten years.**

Pavement Category	Network	Percent of State Funding Allocated Over 10 Years (%)	Total Amount Allocated Over 10 Years ($Millions)	Total Amount Allocated Over 10 Years for NHS and Non-NHS ($Millions)
NHS	Interstates	25.9	831	1,859
	State-Maintained NHS	32.1	1,028	
Non-NHS	High Volume	8.3	264	1,344
	Low Volume	33.7	1,080	
Totals		**100**	**3,203**	**3,203**

Note: These assumed budgets include $7 million per year in maintenance work, which was not considered in the LCP analysis

The pavement management software was used to determine the best allocation of funding into each of four treatment categories (or work types), including maintenance, preservation, rehabilitation (including both major and minor rehabilitation), and reconstruction. The recommended strategy used the allocation of funding shown in **Table 48** over the ten-year analysis period. The distribution of funds reflects a gradual increase in the amount of pavement preservation work until 2026 when approximately $110 million is allocated for preservation treatments annually. It also reflects little to no spending for reconstruction activities since most of the pavement network will be managed in a way to keep it in Good or Fair condition. The exception to this is the low-volume non-NHS pavements, which are expected to deteriorate significantly over the analysis period. Even though conditions on this portion of the network are expected to deteriorate, reconstruction has not been used historically on this portion of the network, which is consistent with the funding distribution presented in **Table 49**.

Table 49 | **Funding distribution by work type.**

		Percent (%) of Funds Allocated To:			
Pavement Category	**Pavement Class**	**Maintenance**	**Preservation**	**Rehabilitation**	**Reconstruction**
NHS	Interstates	0.7	10.8	14.4	0.0
	State-Maintained NHS	0.9	11.9	19.3	0.0
Non-NHS	High Volume	0.6	2.2	5.5	0.0
	Low Volume	0.6	8.1	25.0	0.0

Note: These assumed budgets include $7 million per year in maintenance work, which was not considered in the LCP analysis

8.7.1.2 Predicted Conditions

Figure 45 through **Figure 48** show the forecast of conditions over ten years under the funding scenario considered for each pavement class category along with the projected conditions at the beginning of 2030.

Figure 45 | **Projected pavement conditions over the next ten years for NHS Interstates, hybrid scenario (percent of pavements weighted by lane miles)**

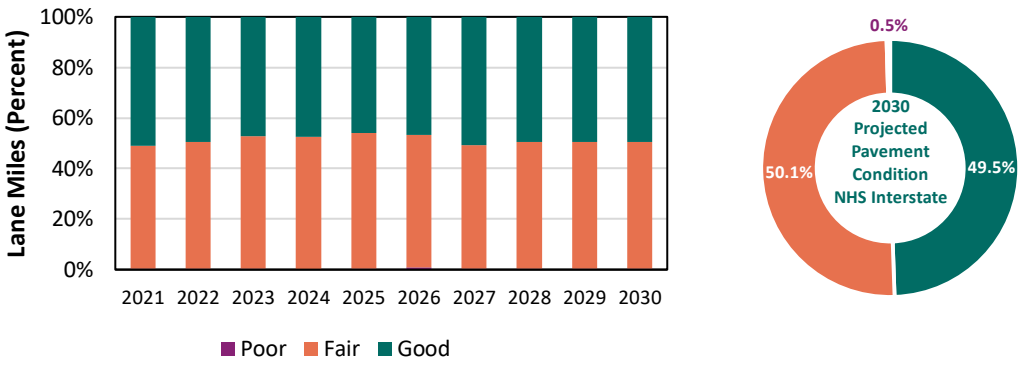


Figure 46 | **Projected pavement conditions over the next ten years for NHS Non-Interstates, hybrid scenario (percent of pavements weighted by lane miles)**

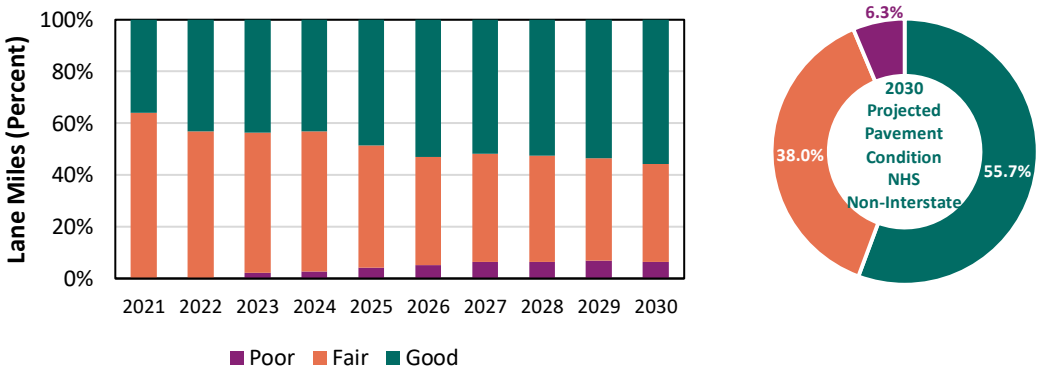
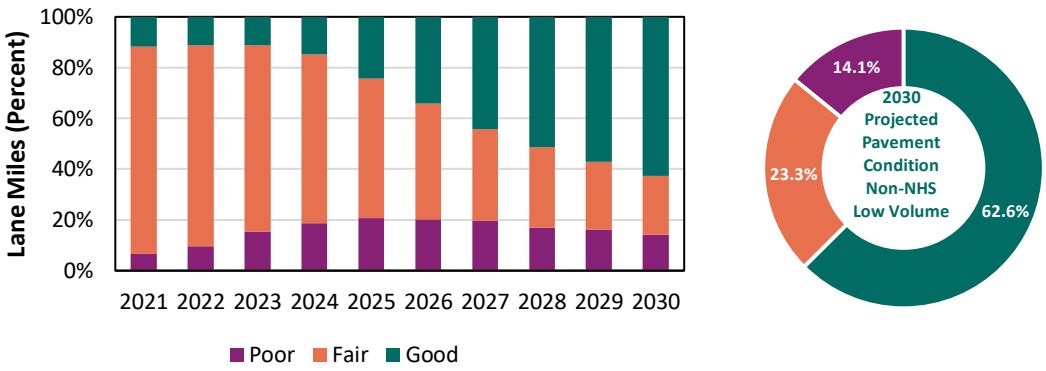


Figure 47 | **Projected pavement conditions over the next ten years for Non-NHS High Volume, hybrid scenario (percent of pavements weighted by lane miles)**

Figure 48 | **Projected pavement conditions over the next ten years for Non-NHS Low Volume, hybrid scenario (percent of pavements weighted by lane miles)**



The implementation of the recommended ten-year investment strategy is expected to result in the projected conditions at the beginning of 2030 reflected in **Table 50**. As shown in the table and figures above, the investment strategy achieves the percent Good and Fair targets for each pavement class and at no time over the ten-year period is the Interstate pavement network expected to exceed the federal minimum condition target of five percent (5%) Poor.

Table 50 | **Projected bridge conditions at the beginning of 2030**

		% Good PAVEMENT Miles		% Poor PAVEMENT Miles	
	Class Category	**Target Minimum % Good/Fair**	**Projected % Good/Fair (Year 10)**	**Target Maximum % Poor**	**Projected % Poor (Year 10)**
NHS	Interstate	98	100	2	<1
	State-Maintained NHS	93	94	7	6
Non – NHS	High-Volume	93	98	7	2.0%
	Low-Volume	85	86	15	14
MINIMUM Check: % Interstates in POOR condition:				**<1**	**Target: <= 5**

8.7.1.3 Planned Ten-Year Pavement Investment

On an annual basis, the recommended pavement strategy reflects the distribution of investment in maintenance, preservation, rehabilitation, reconstruction, and new construction for the state-maintained system shown in **Table 51.** Note that this table also shows initial construction funding which is not included in the scenario analysis.

Table 51 | **Planned pavement annual investment by ADOT over the ten-year period from FY21-FY30 ($Millions).**

($ Millions)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
National Highway System (EXCLUDING LOCAL NHS)											
Initial Const.	184	144	0	0	0	0	0	0	0	0	328
Maintenance	5	5	5	5	5	5	5	5	5	5	50
Preservation	59	184	32	39	72	69	70	80	74	71	750
Rehabilitation	96	58	176	140	69	98	109	108	112	109	1,075
Recon	0	0	0	0	0	0	0	0	0	0	0
Total NHS	**344**	**391**	**213**	**184**	**146**	**172**	**184**	**193**	**191**	**185**	**2,203**
Other Highway System (NON-NHS)											
Initial Const.	0	0	0	0	0	0	0	0	0	0	0
Maintenance	2	2	2	2	2	2	2	2	2	2	20
Preservation	10	44	20	25	38	40	40	30	36	39	322
Rehabilitation	6	7	51	21	180	154	142	143	140	142	986
Recon	0	0	0	0	0	0	0	0	0	0	0
Total Non-NHS	**18**	**53**	**73**	**48**	**220**	**196**	**184**	**175**	**178**	**183**	**1,328**
TOTAL PAVEMENT SPENDING	**362**	**442**	**286**	**232**	**366**	**368**	**368**	**368**	**369**	**368**	**3,531**

8.7.2 Pavement Performance Gap Analysis

A comparison of the ten-year targeted pavement conditions and the conditions projected to be achieved by implementing the recommended pavement investment strategy was presented earlier as **Table 50**. As shown, ADOT is expected to achieve its desired state of good repair over the ten-year analysis period so there is no gap expected in pavement conditions.

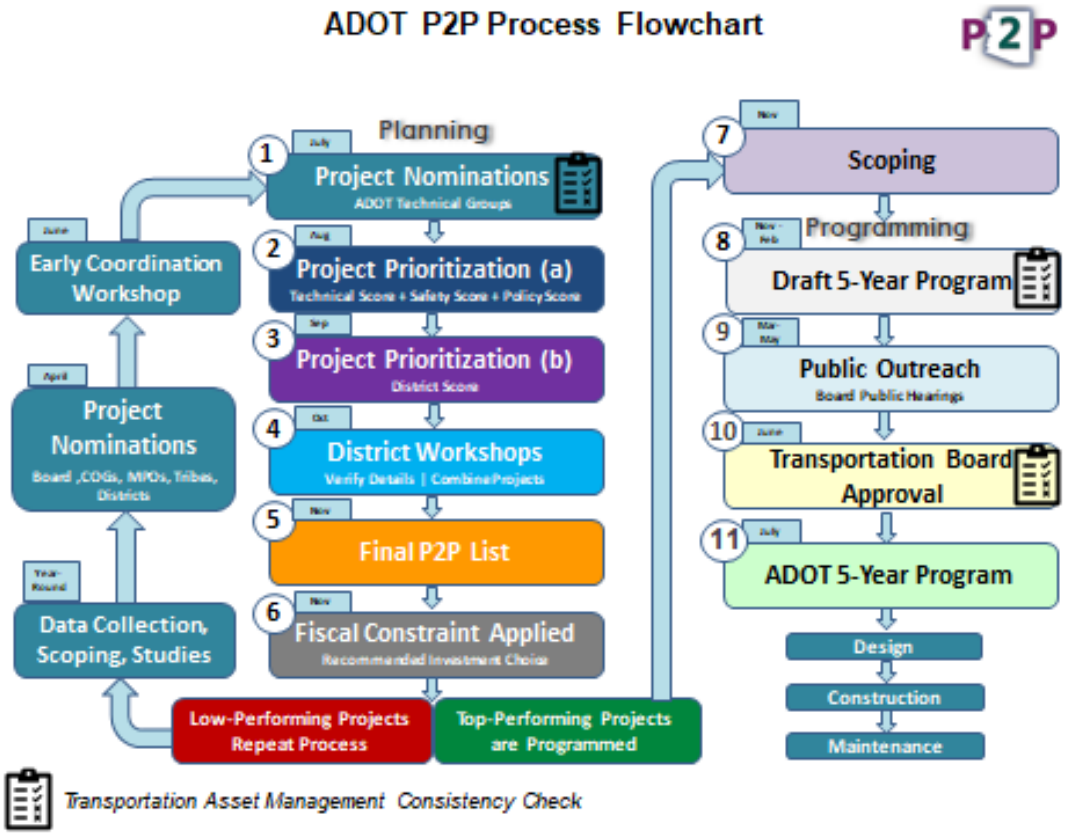
8.8 System Performance, Programming and TAMP Consistency

When considering the selection of pavement and bridge improvement projects, ADOT uses an objective, data-driven approach to consider the needs within each performance area to maintain the overall performance of the transportation system. In addition to attention to asset needs, this involves consideration of safety, mobility, freight, economic vitality, and environmental sustainability objectives through ADOT's P2P process. This performance-based process connects ADOT's Long-Range Transportation Plan (WMYA 2040) to the Five-Year Construction Program.

Under P2P, projects are selected for funding based on their contribution to the improvement of system performance when compared to other projects. Projects are ranked by technical, safety and policy scores. The P2P process also gives stakeholders such as transportation board members, regional planning organizations and ADOT's construction districts an opportunity to provide input to the selection of projects. The output of the TAMP

investments strategies will be the basis of the technical score which is the primary driver of the selection of bridge and pavement projects. Freight and mobility are factored into the technical score. As shown in **Figure 49** TAMP consistency checks have been added at three points in the P2P process to assure that the investment strategy allocations in the TAMP are followed throughout the P2P process.

Figure 49 | **ADOT's P2P Approach to System-Wide Investments**



Section 9
Continuous Improvement

Generally, the TAM process is a continuous one with course-corrections expected along the way, as an agency matures in its asset management practice. This document should be viewed as a living document, to be updated as ADOT continues to improve asset management and preservation activities, towards a state of good repair. Per federal regulations, this TAMP is required to be updated every four years with revised processes submitted for recertification. In addition, FHWA will be conducting an annual consistency determination, to ensure that the plan is implemented. Between iterations of TAMP versions and the annual consistency determination, there will be opportunities to improve ADOT's TAM practice and compliance with federal regulations.

Based on the current state of TAM at ADOT and the gaps identified in TAM practice during the development of this document, the following opportunities for improvement have been identified for consideration:

- Review and update bridge and pavement management system cost-benefit and utility formulas, treatment rules and costs as needed. Update bridge and pavement deterioration models once 5-6 cycles of data have been collected;
- Review routine maintenance practices and document how these practices contribute to whole life management of network assets and investment strategies. Evaluate risks associated with reactive maintenance practices and identify recommended mitigations.
- Evaluate the benefits and best uses of bridge and pavement preservation treatments to ensure that they are being used effectively; and,
- Work with LPAs including regional and metropolitan planning organizations to encourage and facilitate their participation in future TAMP updates.
- Work with the Infrastructure Prioritization Team, formed in February 2021, to seek ways and explore alternatives to improve the condition of ADOT's bridges and pavements without funding increases.
- Evaluate the incorporation of other highway asset classes into the TAMP to improve management practices.

ADOT will continue to work to improve management of bridge and pavement assets on both the NHS and the SHS with the overall goal of achieving a sustained state of good repair.

Section 10
Glossary of terms

Asset — A physical component or resource related to the transportation infrastructure.

Asset Class — A grouping of the same type of asset, such as bridges.

Asset Management — A strategic and systematic process of operating, maintaining and improving physical assets, with a focus on engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation and replacement actions that will achieve and sustain a desired state of good repair over the life cycle of the assets at minimum practicable cost. (23 United States Code 101(a)(2))

Bridge component — A major functional unit of a bridge (e.g., deck, superstructure, substructure).

Bridge element — A sub-component of a bridge (e.g., expansion joint, girder).

Deterioration model — A mathematical model that predicts the future condition of an asset, if only minimal or routine maintenance is performed.

Expansion — Increasing transportation system traffic volume capacity by expanding a roadway or constructing a new transportation facility.

Long Range Transportation Plan — Federal regulations (23 United States Code 135) require states to develop a long-range statewide transportation plan that provides for the development and implementation of the intermodal transportation system. The plan must cover a minimum of twenty years and be developed in consultation with local governments and other parties within the state. ADOT's plan covers twenty-five years and is updated every five years.

Maintenance — Routine activities that maintain the functional condition of existing roadways.

Modernization — Improvements to address functional, safety and geometric deficiencies.

Performance (transportation asset) — The condition of an asset, specifically how well and safely it fulfills its intended function and lifespan.

Performance Gap — The difference between an asset's current condition and the desired condition.

Preservation (Work Type) — A program of preventative maintenance that extends asset service life and maintains the functional condition of existing roadways. Repairs and minor rehabilitation that do not restore or enhance the structural capacity of an asset also are included in the category. The terms preventative maintenance or preservation treatments may be used convey this meaning in the TAMP.

Preservation (Planning) — For planning purposes, ADOT uses this term to describe all the activities and work types needed to maintain transportation infrastructure meeting the functional requirements of the as built highway system. Often this usage will be in conjunction with the terms modernization and expansion.

Preventative maintenance — Periodic maintenance that is applied when an asset is in good condition to prevent deterioration and extend asset life.

Rehabilitation — Treatments that restore or strengthen an asset's structural capacity to extend service life and/or increase load carrying capability.

Reconstruction or replacement — Replacement of an entire asset to restore or update functionality and/or increase traffic volume capacity.

State Transportation Implementation Plan (STIP) —Federal regulations (23 United States Code 135) require that states develop a STIP containing a fiscally-constrained listing of projects covering a minimum of four years and developed in consultation with local governments and other parties in the state. ADOT's STIP covers five years and is updated annually.

Work Type — Refers to initial construction, maintenance, preservation, rehabilitation and reconstruction (23 CFR 515.5).

Section 11
Acknowledgements

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Section 12

Appendix A: Documents referenced

All documents listed below may be found at: **www.azdot.gov/tamp**

1. What Moves You Arizona 2040, Long-Range Transportation Plan
2. MPO/COG Planning Agreements
3. Bridge Inspection Guidelines
4. ADOT/City of Phoenix Bridge Inspection Intergovernmental Agreement
5. Pavement Data Quality Management Plan
6. Preliminary Study of Climate Adaptation for the Statewide Transportation System
7. Extreme Weather Vulnerability Assessment
8. Asset Management, Extreme Weather, and Proxy Indicators Infrastructure Resilience Report
9. Evaluation of the State Route (SR) 87 Landslide and Related Slope Stability Issues
10. Arizona Long Range Transportation Plan Update. Recommended Investment Choice (RIC) Development. October 2017.
11. Arizona Long Range Transportation Plan Update. Existing Conditions, Deficiencies and Future Needs. February 2017.
12. Arizona Long Range Transportation Plan Update. Revenue Forecast and Gap Analysis. April 2017.
13. Arizona Highway User Revenue Fund Forecasting Process & Results FY 2019-2028
14. Maricopa County Transportation Excise Tax Forecasting Process & Results
15. Bridge Preservation Program
16. Performance Prediction Modelling Report

Section 13

Appendix B: Emergency Event Descriptions

13.1 Summary of Evaluation for State Route 87 near Milepost 224

Since 2005 there have been seven emergency events on SR 87 near Milepost (MP) 224:

- Heavy rains in 2004 and 2005 caused the cut slopes and soil nail walls between MP 224 and MP 226 to begin to experience localized failures. Project ER-087-224 ($2.4 Million) removed several of the failed soil nail walls and regraded the cut slopes to reduce the steepness of the grades. The excavated material was utilized to buttress an existing 100+ foot embankment with 1.5:1 (H:V) slope rate. This embankment was exhibiting signs of failure with tension cracking affecting the pavement.

- Project ER-087-B-NFA ($5.1 Million) began construction in March 2008. The project removed additional soil nail walls that had failed, flattened the existing cut slopes, and continued the embankment buttress stabilization. During the early portion of the project, and after a period of heavy precipitation events, a landslide at MP 224.3 closed the highway for approximately 1 week. Additional excavation, soil-nail wall removal, and embankment construction was added to the project. Eighty-nine soldier piles (30" diameter x 43' deep) and 9 drilled shafts (48" diameter x 65' deep) were also added to the project. Approximately 186,300 cubic yards (CY) of material was excavated and utilized to improve stability of the 100+ foot embankment.

- Project ER-087-B(201)A ($1.8 Million), was constructed in 2009 as a result of the geotechnical investigation and monitoring. The drilled shafts and soldier piles installed in 2008 as emergency mitigation measures were being displaced and bent by a continued slow slide movement. A total of 26 drilled shaft shear piles (66" diameter x 73' deep) were installed in the landslide, and approximately 75,000 CY of material was excavated and used to construct an additional northbound embankment buttress near MP 226 in anticipation of a possible alignment shift. A rock buttress was placed behind the southbound barrier between MP 224.3 and MP 224.4 to aid in stabilizing the local slide at that location. A separate rock buttress was placed behind the southbound barrier from MP 224.0 to MP 224.1 to stabilize a partially failed soil nail wall. The 12-foot diameter multi-plate pipe in Slate Creek (MP 226) was extended.

- Heavy rains in January 2010 caused an increased rate of movement in the slide due to increased pore water pressure heads in the perched groundwater trapped in the landslide near MP 224.3. To save the shear piles, Project ER-087-B(208)A excavated approximately 62,000 CY above the shear piles, and installed a series of horizontal slope drains to reduce the groundwater in the slopes adjacent to the roadway.

- Project ER-087-B(207)A ($1.5 Million) was constructed in February of 2012. This project removed the northbound upper tiered wall and a portion of the damaged northbound lower wall near MP 224.2. An estimated 124,000 CY of material were excavated and used to construct additional northbound embankment buttress near MP 226.

- Project STP-087-B(222)T was constructed in 2017. This project removed a failing soil nail wall on the northbound slope, and reduced the lower portion of the slope.

- Project ER-087—B(224) started construction in February 2021. Heavy rains in late 2018 increased the erosion and saturation of the lower slope resulting in cracking and shallow soil slides. The project will reduce the slope and install horizontal drains and inclinometers.

Heavy rainfall and catastrophic failure of the slopes have shown a strong cause and effect relationship. Piezometer instrumentation has documented significant increases in groundwater elevation following periods of heavy rainfall. Historic landslides in this region have resulted in areas of silt and clay deposits that exhibit low plasticity and shear strength. Fractures and fissures in these soils produce zones of water infiltration and retention causing the soils to become saturated. The excess water further lowers the soil shear strength and adds weight to the soil mass which exerts increased lateral forces to the slope causing landslides and failures of earth retaining structures.

Mitigation measures to date have included slope flattening, shear piles, lateral drains, rock buttresses, and drainage channeling. Installation of shear piles has proven ineffective due to inability to control large lateral forces due to saturated soils. Control of the subsurface water content through lateral drains is the most cost-effective mitigation strategy. Use of vegetation to stabilize the slope surface should be investigated. Initial layback of slopes where wall failures have occurred are necessary to provide a slope angle that is suitable for vegetation establishment and erosion control. Slope flattening should be minimized to limit impacts to right of way.

Rock buttressing provides stability and a highly permeable pathway to remove water from the toe of slope. However, the importation of angular rock and disposal of displaced soil is expensive. Surface drainage control provides low cost and benefits the management of slope erosion. Control of surface water also reduces the volume of water that may infiltrate the site soils. Lining of drainage channels with an impermeable barrier may be an effective strategy.

Continued monitoring of the area is recommended. Installed instrumentation and lateral drainage systems should be maintained. The following two slopes have been identified for immediate mitigation:

- Northbound slope from station 2804+00 to station 2810+00 has developed surficial indications of a slope failure following heavy rains from the remnants of hurricane Rosa.

- The southbound slope from station 2801+00 to 2806+00 upper tier was removed in a previous project. Since the upper tier removal, the lower tier has begun failing. Heavy

erosion is also occurring above the lower tier. The slope is more than 100 feet tall and will continue to fail.

13.2 Summary of Evaluation for State Route 71 near Milepost 86

Two emergency events occurred on State Route (SR) 71 at MP 86.6. The first event occurred on October 10, 2000 and the second on December 29, 2004. Both events were caused by storm water runoff.

- **October 10, 2000 event:** Heavy storm water runoff was diverted by a railroad embankment and flowed west joining the drainage for SR 71 flowing south. All of the water collected at the SR 71, MP 86.6 culvert inlet. The combination of high-water levels, high velocity flows and saturated conditions lead to significant erosion of the channel embankment and unprotected highway prism. ADOT forces restored the embankment and roadway prism.
- **December 29, 2004 event:** Heavy storm water runoff again eroded and undermined the embankment and roadway prism. ADOT forces restored and armored the embankment and roadway prism.

The region has experienced significant subsidence due to groundwater pumping for agriculture. See the attached Arizona Department of Water Resources Land Subsidence Map and the Maricopa County Flood Control District Drainage Map for McMullen Valley both which include the drainage for SR 71 at MP 86.6. This has cause storm water drainage patterns and flows to be altered resulting in a faster accumulation of water during extreme events then the drainage system was designed for at this location.

After these repeated flood events it was determined that there is a high risk of recurring damage; therefore, ADOT improve the drainage channel and embankments both on the inlet and outlet of the culvert. On the inlet of the culvert the flow channels were restored, and the embankments were armored with rip rap. A concrete apron was extended on the outlet to prevent downstream scour and undercutting.

A recent inspection in December 2019 revealed that these mitigations have held up well. Moreover, the culvert was well-maintained and free of debris. Based on the inspection it was determined that the mitigation has been successful and no further work, beyond routine maintenance, is needed at this time.

13.3 Summary of Evaluation for Salome Road at Centennial Wash

Two emergency events occurred at the Salome Road culvert over Centennial Wash in La Paz County. This structure is owned and operated by La Paz County. The first event occurred in

October 2000 and the second on January 21, 2010. Both events were related to heavy storm water runoff.

- **October 2000 event**: Heavy storm water runoff damaged the Salome Road culvert that consisted of four 60-inch diameter concrete reinforced pipes. This culvert was replaced with a five opening (8' high x 12' wide) reinforced concrete box culvert.
- **January 21, 2010 event**: Sediment and debris from heavy storm water runoff blocked the box culvert openings causing overtopping of the bridge deck resulting in severe damage including loss of pavement, guardrail and end terminals. The outlet concrete apron and the channel embankment were also damaged. The box culvert was repaired, and concrete bank protection was added after this event.

Centennial Wash and Salome Road are in McMullen Valley which has experienced significant land subsidence due to groundwater pumping for agriculture. The subsidence has steepened the gradient in McMullen Valley resulting in a faster accumulation of storm water runoff in the area. Upstream (north) of Salome Road, Centennial Wash curves sharply which has allowed runoff to erode the eastern bank of the channel. Another small wash intersects Centennial Wash at the curve contributing additional runoff which has eroded the western bank of the channel. In the past, this eroded material has contributed to the blockage of the culvert openings. The addition of a concrete bank protection has minimized further erosion. However, increased runoff from subsidence and disrupted flow patterns from the nearby curve in Centennial Wash tend to deposit sediment and debris near the culvert which, if left unchecked, has the potential to block the openings.

A recent site visit (December 2019) revealed the presence of built-up sediment in the channel partially blocking the box culvert openings. About 2 feet of sediment have accumulated in and around the culvert openings with the greatest accumulation on the west side. Some debris was observed in the box culvert guardrail that could indicate overtopping, although the pavement appeared to be in good condition. The presence of vegetation in the accumulated sediments indicates that the channel has not been cleaned out in some time. Another site visit near the end of March 2020 shows that debris from recent storms has blocked almost all of one culvert opening and most of another. If built-up sediments continue to accumulate near the culvert inlets there is a high risk of overtopping and damage during large storm events. This issue has been identified in past bridge inspection reports which have been provided to La Paz County. It was recommended that La Paz County clear the accumulated debris from the culvert inlets.

13.4 Summary of Evaluation for SR 89A

Four emergency events occurred at SR 89A from Milepost 375 to 399. The first event occurred in December 2004, the second in January 2010, the third in September 2010 and the fourth in October 2018. The events were related to heavy storm water runoff.

- **December 2004 event:** Between MP 375 and 399 there were multiple erosion events due to flooding from heavy storm water runoff. Maintenance forces cleaned cuts, performed drainage repairs, remove slide debris and restored road shoulders and slopes.
- **January 2010 event:** Slope failure at MP 387.9 due to heavy storm water runoff. Contractors remove debris from the drainage ditch, cleaned storm drain pipes, inlets and channel and stabilized the slope with a small retaining wall and barrier.
- **September 2010 event:** Between MP 375 and 390 there were multiple erosion events due to heavy storm water runoff. Maintenance forces performed drainage and shoulder cleaning to remove mud and rock deposits.
- **September 2018 event:** Between MP 378 and 390 there were multiple erosion events due to heavy storm water runoff from Hurricane Rosa. Rock slides and accumulated sediments closed SR 89A for 17 hours. ADOT is developing a project to mitigate slope failures using concrete barriers, gabion mattresses and drainage improvements. It is estimated that these projects will be implemented in FY 2021.

Oak Creek Canyon is a fault alignment drainage feature of the transition zone between the Colorado Plateau and the Basin and Range province. As the canyon increases in elevation from south to north exposed soft sedimentary rocks are subject to storm water erosion and stream down-cutting which creates unstable slope conditions throughout the canyon. This is an environmentally sensitive region and is also an important tourist recreational area that is located on National Forest and State Park land. There are also numerous privately held landholdings located near Oak Creek that are dependent on the current alignment of SR 89A for access.

ADOT has implemented mitigation for the most critical and common slide areas in the canyon; however, the complexity of the Canyon's geology makes the location of all potential slides difficult to predict and the sensitive nature of the area limits preemptive mitigation. ADOT will continue to address active slide zones as needed.

13.5 Summary of Evaluation for SR 88

SR 88, also known as the Apache Trail, was subject to numerous impacts from heavy storm events that occurred in December 2004 – January 2005, July 2017 and September 2019. SR 88 is paved until MP 222 and is unpaved to MP 241.

- **Winter 2004-5 Event**: Flooding caused damage to road shoulders, headwalls, retaining walls and drainage pipes at various locations between MP 225 to 230. Maintenance crews performed repairs.
- **July 2017 Event**: A flash flood eroded roadside slopes and washed out the road at various locations between MP 196 and 220. Maintenance crews performed repairs.
- **September 2019 Event**: Nearly six inches of precipitation from Tropical Storm Lorena caused severe damage at multiple locations from MP 197 to 240. Damage included slope washouts, eroded cut sections, undercut pavement, landslides, scour damage

and overtopping Davis Wash Bridge, buried and plugged drainage structures and sediment deposition across the roadway. Sections of the roadway were closed. Debris removal, pavement repair and drainage improvements have occurred between MP 197 and MP 222 and closed portions have been reopened. SR 88 remains closed from MP 222 to 229. The roadway also sustained damage from MP 229 to 242 but remains open. ADOT currently is evaluating repairs, improvements and costs for the remaining damaged portions of the roadway.

SR 88 is in a mountainous region and is surrounded by steep slopes covered with desert vegetation. Although traffic volumes are very low, this historic route provides access to a popular recreational area. The road crosses numerous steep washes. In some locations SR 88 is located adjacent to Lewis and Pranty Creek which can flood during storm events undercutting and/or overtopping the road. This area contains relatively soft volcanic extrusive rock that is subject to erosion during storm events producing rock and sediment debris flows that can block the road and clog drainage structures. Additionally, a 2018 wildfire (Woodbury fire) in the Superstition Wilderness significantly reduced vegetation groundcover increasing storm water runoff in the area. Reduced groundcover combined with the regional topography and geology make it likely that severe storm events will continue to damage SR 88 in the future.

Eroded portions of SR 88 from MP 197 to 222 have been repaired and fortified with grouted rip rap on the fill side of the roadway, large rip rap on the cut side and scaling of rock faces. Asphalt gutters were repaired, and pipe culvert headwalls were grouted. Drainage improvements including upsizing drainage pipes and further improvements to head walls are being planned. ADOT's Southeast District is developing a plan to restore and improve the portion of the roadway from MP 222 to 229 including measures to make the road more resilient, such as, replacing 10 pipe culverts with box culverts, building retaining walls and preserving the 97 year old Lewis and Pranty Creek Bridge. A proposed Emergency Response project, from MP 229 to 242, would build resiliency improvements into planned drainage repairs and replacements. This would be accomplished by applying the emergency funds to a pending Central Federal Lands Federal Land Access Project that is scheduled to bid in August 2021.

Section 14

Appendix C: Local Public Agency (LPA) NHS Owners

14.1 LPA Contact List

	Stakeholder	Primary Point of Contact
1.	Buckeye	Scott Lowe, PE CEM Public Works Director
2.	Bureau of Indian Affairs	N/A
3.	Casa Grande	Duane Eitel
4.	Cave Creek	Hal E. Marron, PE Town Engineer / Public Works Director
5.	Chandler	Allan Zimmerman Streets Project Manager
6.	Douglas	Dave Swietanski Public Works Director
7.	El Mirage	Bryce Christo, P.E. Assistant City Engineer
8.	Flagstaff	Scott Overton
9.	Fountain Hills	Justin T. Weldy Public Works Director
10.	Glendale	Javier Gurrola
11.	Goodyear	Brian Harvel Pavement Management Coordinator
12.	Grand Canyon Airport Authority	N/A
13.	Grand Canyon National Park	N/A
14.	Kingman	Eric Sparkman Assistant City Engineer
15.	Litchfield Park	Richard Alvarado
16.	Marana	Keith Brann, P.E., CFM Town Engineer
17.	Maricopa Co	Angela Horn Senior Planner
18.	Mesa	Matt Manthey Pavement Management Supervisor
19.	Nogales	Juan Guerra City Engineer
20.	Paradise Valley	Jason Harris, MBA, PE, PMP, CPPO Capital Projects Administrator
21.	Peoria	Kelly Lehner
22.	Phoenix	Ryan Stevens Derek S. Rogers P.E., M.S. Civil Engineer Bridge & Dam Safety – Street Maintenance

Stakeholder	Primary Point of Contact
23. Pima Co	Kathryn Skinner, P.E. Deputy Director, Pima County DOT
24. Quartzite	Emmett Brinkerhoff Public Works Director
25. Sahuarita	Beth Abramovitz Public Works Director/Town Engineer
26. Salt River Indian Community	Jennifer Jack, PE Roads Section Manager
27. San Luis	Eulogio Vera, P.E. Public Works Director
28. Scottsdale	Christian Fritz
29. Sierra Vista	Sharon Flissar
30. Somerton	Samuel Palacios Public Works Director
31. Surprise	John McFarland
32. Tempe	Sue Taaffe Edward Bond
33. Tucson	Diana W. Alarcon Director, DOT & Mobility Robin L Raine, P.E. Deputy Director, DOT & Mobility Lance Peterson
34. US Customs and Border Patrol	N/A
35. Williams	Tim Pettit Public Works Director Mark Woodson City Engineer – Consultant
36. Yavapai Co	Dan Cherry Public Works Director
37. Yuma City	Michael Flowers Public Works Manager
38. Yuma County Public Works	Joshua Scott Public Works Director

14.2 Initial Stakeholder Engagement List of Attendees

First Name	Last Name	Title/Role	Organization
Margaret-Avis	Akofio-Sowah	Consultant	WSP
Thor	Anderson	Performance/Asset Manager	ADOT
David	Atler	Deputy Director	Pima Association of Governments
Hugh	Bigalk	City Traffic Engineer	City of Goodyear
Edward	Bond		City of Tempe
Edward	Brown	Transportation Performance Program Manager	Maricopa Association of Governments
Jessica	Buckner	Management Assistant	City of Peoria
Maria	Burton-Sunder	Transportation Engineer	ADOT

First Name	Last Name	Title/Role	Organization
		(Pavement Management)	
Paul	Casertano	Transportation Planning Director	Pima Association of Governments
Isaac	Chavira		City of Tempe
Josh	Conover	Senior Engineering Technician	City of Yuma Public Works Department
Duane	Eitel	City Traffic Engineer	City of Casa Grande
Michael	Flowers	Public Work Manager	City of Yuma Public Works Department
Rich	Franz-Under	Division Manager - Network Management Systems	Pima County DOT
Dan	Gabiou	Regional Planning Manager	ADOT
Ramon	Gama	Senior Bridge Engineer	ADOT
Anh	Harambasic	Town Engineer	Town of Fountain Hills
Brian	Harvel	Pavement Manager	City of Goodyear
Nasreen	Hasan	Senior Civil Engineer	City of Tempe
Mark	Hoffman	Regional Planner	ADOT/MPD
Catherine	Hollow	City Traffic Engineer	City of Tempe
Angela	Horn	Senior Planner	MCDOT
Jennifer	Jack	Roads Section Manager	SRPMIC
Jason	James	Transportation Planning Program Manager	ADOT/MPD
Robert D	Johnson		
Robert	Lane	Division Manager - Maint. & Oper.	Pima County DOT
Christina	Leach	Senior Transportation Specialist	FHWA
Kelly	Lehner	Pavement Coordinator	City of Peoria
Yongqi	Li	Pavement Management Engineer	ADOT
Clement	Ligocki		ADOT
Scott	Lowe	Public Works Director	City of Buckeye
Chad	Matty		FHWA
John	McFarland	Streets Manager	City of Surprise
Mafiz	Mian		ADOT
David	Mitchell	Senior Transportation Planner	Pima Association of Governments
Pete	Montalvo	Public Works Manager-Highway Maintenance/Fleet Services	Yuma County Public Works
Samuel	Palacios	Public Works Director	City of Somerton
Lance	Peterson	Engineering Manager	City of Tucson
Juan Diego	Porras-Alvarado	Consultant	WSP
Kevin	Robertson	Surface Treatment Engineer	ADOT - Pavement Management
Frank	Sanchez	Dep. Co. Engr	Yuma County Department of Engineering
Woody	Scoutten	City Engineer	City of Litchfield Park
Ryan	Stevens		City of Phoenix
Lynn	Sugiyama	Transportation Planner	ADOT
Patrick	Sweeney	Streets Superintendent	City of Goodyear
Dave	Swietanski		City of Douglas
Paul	Ward	Executive Director	Yuma Metropolitan Planning Organization
Justin	Weldy	Public Works Director	Town of Fountain Hills
Mark	Woodson	Project Manager	Woodson Engineering and Surveying, Inc.
Katie	Zimmerman	Consultant	Applied Pavement Technology, Inc.

14.3 LPA Asset Snapshots

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP) FACTSHEET

What is the TAMP?

- Documents a systematic approach for maintaining and improving ADOT and National Highway System (NHS) bridges and pavements;
- Identifies performance measures and condition targets, and informs selection of investment strategies with risk, lifecycle planning, and financial considerations;
- Initially developed in 2019, updated in 2021.

TAMP Pavement Inventory (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Interstate	5,422	48.0	51.0	1.1
State-owned, Non-Interstate NHS	6,559	32.1	65.2	2.7
Locally-owned NHS	1,692	5.7	89.5	4.8
Total NHS Pavements	13,674	38.6	59.3	2.1
Other SHS Pavements	9,394	23.0	72.1	4.8
Total Pavements Covered in TAMP	**23,068**			

TAMP Bridge Inventory (2019)

Bridge Owner	Number of Bridges	Bridge Deck Area (sq ft)	Good (%)	Fair (%)	Poor (%)
State-owned NHS Bridges	3,031	31,578,573	58.5	40.4	1.1
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Total NHS Bridges	3,275	33,891,240	56.8	42.2	1.0
Total Other SHS Bridges	1,777	12,352,239	55.0	43.5	1.5
Total Bridges Covered in the TAMP	**5,052**	**46,243,479**	**56.4**	**42.4**	**1.2**

Tracking Performance Measures & Targets

2022 Performance Targets

Performance Target	Percent Good	Percent Poor
NHS Bridges	52%	4%
Interstate Pavement	44%	2%
Non-Interstate NHS Pavement	28%	6%

While Federal regulations required two- and four-year targets, ADOT's goal is to maintain the highway system in a State of Good Repair (SOGR) with the following desired long-term (10-year) targets:

Performance Target	Percent Good/Fair	Percent Poor
Interstate Pavement	98%	2%
State-Owned NHS Pavement	93%	7%
State-Owned High-Volume Pavement (Non-NHS)	93%	7%
State-Owned Low-Volume Pavement (Non-NHS)	88%	12%

Performance Target	Percent Good/Fair	Percent Poor
NHS Bridges	96%	4%
Non-NHS Bridges	96%	4%

For more information, please contact:
Thor Anderson
Performance/Asset Manager, Multimodal Planning Division
tanderson@azdot.gov | 602.712.4574

January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Buckeye Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Buckeye NHS Pavement	4.2	-	100.0	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Buckeye NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
- **Consider** the project recommendations above which will positively impact our statewide efforts to meet performance targets and the long-term state of good repair; if no projects are recommended at this time, consider how your investment decisions will maintain or improve pavement and bridge condition
- **Be prepared** to share estimated annual expenditure and your plan of projects for your NHS assets

An Outward Look

The ADOT TAMP will be updated **at least every four years,** with continued engagement to identify:

- Updates to asset inventory & condition data;
- Supporting financial information and risks;
- Lifecycle analysis output and proposed performance targets;
- Inputs for annual performance progress reports.

For more information, please contact:
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tanderson@azdot.gov | 602.712.4574

January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Bureau of Indian Affairs (BIA) Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
BIA NHS Pavement	10.2	N/A	N/A	N/A

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
BIA NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
- **Consider** the project recommendations above which will positively impact our statewide efforts to meet performance targets and the long-term state of good repair; if no projects are recommended at this time, consider how your investment decisions will maintain or improve pavement and bridge condition
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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Customs & Border Patrol (CBP) Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
CBP NHS Pavement	1.0	N/A	N/A	N/A

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
CBP NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
- **Consider** the project recommendations above which will positively impact our statewide efforts to meet performance targets and the long-term state of good repair; if no projects are recommended at this time, consider how your investment decisions will maintain or improve pavement and bridge condition
- **Be prepared** to share estimated annual expenditure and your plan of projects for your NHS assets

An Outward Look

The ADOT TAMP will be updated **at least every four years,** with continued engagement to identify:

- Updates to asset inventory & condition data;
- Supporting financial information and risks;
- Lifecycle analysis output and proposed performance targets;
- Inputs for annual performance progress reports.

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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Casa Grande Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Casa Grande NHS Pavement	15.7	7.6	92.4	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Casa Grande NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
S 287	**S 287-000.002-1**	0.002	4.149	2021	SR_3INCH_AC_MS
S 287	**S 287-0-000.001-1**	0.002	4.162	2022	SR_3INCH_AC_MS
S 287	**S 287-0-000.001-1**	0.002	4.162	2030	FOG_COAT
S 287	**S 287-000.002-1**	0.002	4.149	2030	MS_1_PASS

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
- **Consider** the project recommendations above which will positively impact our statewide efforts to meet performance targets and the long-term state of good repair; if no projects are recommended at this time, consider how your investment decisions will maintain or improve pavement and bridge condition
- **Be prepared** to share estimated annual expenditure and your plan of projects for your NHS assets

An Outward Look

The ADOT TAMP will be updated **at least every four years,** with continued engagement to identify:

- Updates to asset inventory & condition data;
- Supporting financial information and risks;
- Lifecycle analysis output and proposed performance targets;
- Inputs for annual performance progress reports.

For more information, please contact:
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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Cave Creek Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Cave Creek NHS Pavement	2.5	-	100.0	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Cave Creek NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
07 CAVE CREEK RD	**07 CAVE CREEK RD-016.975-1**	16.975	17.610	2021	RR_3INCH_AC_FR
07 CAVE CREEK RD	**07 CAVE CREEK RD-016.975-1**	16.975	17.610	2030	MS_1_PASS

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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An Outward Look

The ADOT TAMP will be updated **at least every four years,** with continued engagement to identify:

- Updates to asset inventory & condition data;
- Supporting financial information and risks;
- Lifecycle analysis output and proposed performance targets;
- Inputs for annual performance progress reports.

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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Chandler Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Chandler NHS Pavement	61.7	2.9	97.1	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Chandler NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
S 087	**S 087-050.730-1**	50.730	54.867	2022	RR_3INCH_AC_FR
S 087	**S 087-045.656-1**	45.656	50.730	2024	SR_3INCH_AC_MS
S 087	**S 087 0-045.660-1**	45.660	50.833	2027	SR_3INCH_AC_MS
S 087	**S 087-050.730-1**	50.730	54.867	2030	FOG_COAT

How Should I Use This Information?

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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Douglas Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Douglas NHS Pavement	0.1	-	-	100.0

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Douglas NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

El Mirage Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
El Mirage NHS Pavement	3.5	-	33.4	66.6

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
El Mirage NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Flagstaff Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Flagstaff NHS Pavement	10.3	18.4	74.1	7.5

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Flagstaff NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
SB040 4	**SB040 4-009.100-1**	9.100	9.845	2021	RR_3INCH_AC_FR
U 089 0	**U 089 0-000.237-1**	0.237	1.970	2021	RR_0p5INCH_FR
U 089	**U 089-000.237-1**	0.237	1.961	2021	SR_3INCH_AC_MS
SB040 4	**SB040 4-009.100-1**	9.100	9.845	2030	RR_0p5INCH_FR
U 089 0	**U 089 0-000.237-1**	0.237	1.970	2030	RR_3INCH_AC_FR
U 089	**U 089-000.237-1**	0.237	1.961	2030	RR_0p5INCH_FR

How Should I Use This Information?

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Fountain Hills Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Fountain Hills NHS Pavement	20.9	16.8	83.2	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Fountain Hills NHS Bridges	1	3,300	100.0	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Grand Canyon Airport Authority (GCAA) Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
GCAA NHS Pavement	0.6	N/A	N/A	N/A

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
GCAA NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Grand Canyon National Park (GCNP) Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
GCNP NHS Pavement	19.8	N/A	N/A	N/A

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
GCNP NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
03 CENTER RD	**03 CENTER RD-000.000-1**	0.000	1.609	2021	RR_0p5INCH_FR
03 SOUTH ENTRANCE RD	**03 SOUTH ENTRANCE RD-002.306-1**	2.306	2.960	2021	MS_2_PASS
03 SOUTH ENTRANCE RD	**03 SOUTH ENTRANCE RD-000.000-1**	0.000	2.304	2028	RR_2p5INCH_AC_FR
03 CENTER RD	**03 CENTER RD-000.000-1**	0.000	1.609	2030	RR_2p5INCH_AC_FR
03 SOUTH ENTRANCE RD	**03 SOUTH ENTRANCE RD-002.306-1**	2.306	2.960	2030	RR_2p5INCH_AC_FR

How Should I Use This Information?

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Glendale Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Glendale NHS Pavement	64.8	0.6	89.2	10.2

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Glendale NHS Bridges	7	130,242	82.6	17.4	-

Life Cycle Analysis Project Recommendations

Bridge Project Work Type	Year	Str NO
09124(AZ Deck - Epoxy Overlay)	2020	9124
09124(AZ Sub - Conc Maj Repair)	2023	9124
11164(AZ Deck - Epoxy Overlay)	2030	11164

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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An Outward Look

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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Goodyear Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Goodyear NHS Pavement	18.2	-	100.0	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Goodyear NHS Bridges	2	9,368	100.0	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Kingman Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Kingman NHS Pavement	13.2	39.6	49.8	10.6

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Kingman NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
SB040 0	**SB040 0-000.086-1**	0.086	4.084	2027	SR_3INCH_AC_MS

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Litchfield Park Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Litchfield Park NHS Pavement	4.7	10.7	80.8	8.5

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Litchfield Park NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
- **Consider** the project recommendations above which will positively impact our statewide efforts to meet performance targets and the long-term state of good repair; if no projects are recommended at this time, consider how your investment decisions will maintain or improve pavement and bridge condition
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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Marana County Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Marana County NHS Pavement	-	-	-	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Marana County NHS Bridges	9	31.868	100.0	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Maricopa County Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Maricopa County NHS Pavement	84.6	11.7	88.3	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Maricopa County NHS Bridges	5	44,434	17.3	82.7	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
07 NORTHERN PKWY	07 NORTHERN PKWY-000.060-1	0.060	4.156	2021	CPR
07 POWER RD	07 POWER RD-008.315-1	8.315	14.557	2023	RR_3INCH_AC_FR
07 NORTHERN PKWY	07 NORTHERN PKWY-000.060-1	0.060	4.156	2029	DIAMOND_GRIND

Bridge Project Work Type	Year	Str NO
09927(AZ Deck - Epoxy Overlay)	2020	9927
09928(AZ Deck - Epoxy Overlay)	2025	9928
09928(AZ Super - Conc Maj Repair)	2030	9928

How Should I Use This Information?

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Mesa Snapshot (p. 1)

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Mesa NHS Pavement	64.7	-	90.3	9.7

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Mesa NHS Bridges	13	164,635	19.8	80.2	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
S 087 0	S 087 0-058.110-1	58.111	61.418	2021	RR_3INCH_AC_FR
S 087	S 087-057.436-1	57.437	58.107	2021	RR_3INCH_AC_FR
S 087	S 087-058.106-1	58.107	61.414	2021	RR_3INCH_AC_FR
07 POWER RD	07 POWER RD-014.557-1	14.557	18.777	2024	RR_3INCH_AC_FR
S 087 0	S 087 0-058.110-1	58.111	61.418	2030	RR_0p5INCH_FR
S 087	S 087-057.436-1	57.437	58.107	2030	MS_1_PASS
S 087	S 087-058.106-1	58.107	61.414	2030	RR_0p5INCH_FR

Bridge Project Work Type	Year	Str NO
07870(AZ Deck - Epoxy Overlay)	2020	7870
09131(AZ Super - Conc Maj Repair)	2020	9131
09131(AZ Deck - Epoxy Overlay)	2021	9131
09828(AZ Deck - Epoxy Overlay)	2023	9828
07870(AZ Super - Conc Maj Repair)	2024	7870
09148(AZ Deck - Epoxy Overlay, AZ Super - FRP Wrap)	2025	9148
10505(AZ Deck - Epoxy Overlay)	2025	10505
09828(AZ Super - Conc Maj Repair)	2029	9828

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Mesa Snapshot (p. 2)

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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An Outward Look

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Nogalas Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Nogalas NHS Pavement	0.6	-	100.0	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Nogalas NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
- **Consider** the project recommendations above which will positively impact our statewide efforts to meet performance targets and the long-term state of good repair; if no projects are recommended at this time, consider how your investment decisions will maintain or improve pavement and bridge condition
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An Outward Look

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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Paradise Valley Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Paradise Valley NHS Pavement	21.2	7.8	92.2	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Paradise Valley NHS Bridges	1	2,176	100.0	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Peoria Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Peoria NHS Pavement	23.5	-	87.4	12.6

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Peoria NHS Bridges	2	66,876	-	100.0	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
07 NORTHERN AVE	**07 NORTHERN AVE-036.562-1**	36.562	43.564	2022	RR_3INCH_AC_FR
07 NORTHERN AVE	**07 NORTHERN AVE-036.562-1**	36.562	43.564	2030	FOG_COAT

Bridge Project Work Type	Year	Str NO
09125(AZ Deck - Epoxy Overlay)	2024	9125
10243(AZ Deck - Epoxy Overlay)	2025	10243

How Should I Use This Information?

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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Phoenix Snapshot (p. 1)

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Phoenix NHS Pavement	657.6	3.6	91.4	4.9

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Phoenix NHS Bridges	52	692,671	22.4	74.3	3.3

Life Cycle Analysis Project Recommendations

Bridge Project Work Type	Year	Str NO
08509(AZ Deck - Epoxy Overlay)	2020	8509
09202(AZ Deck - Epoxy Overlay)	2020	9202
09203(AZ Deck - Epoxy Overlay, AZ Super - FRP Wrap)	2020	9203
09321(AZ Deck - Epoxy Overlay)	2020	9321
09440(AZ Deck - Polyester Overlay)	2020	9440
09585(AZ Deck - Epoxy Overlay)	2020	9585
09706(AZ Deck - Epoxy Overlay)	2020	9706
09732(AZ Deck - Epoxy Overlay)	2020	9732
09208(AZ Deck - Epoxy Overlay, AZ Super - FRP Wrap)	2021	9208
09675(AZ Deck - Epoxy Overlay)	2021	9675
07593(AZ Deck - Epoxy Overlay)	2023	7593
07599(AZ Deck - Epoxy Overlay)	2023	7599
09187(AZ Deck - Epoxy Overlay)	2024	9187
09585(AZ Super - FRP Wrap)	2027	9585
09198(AZ Super - Conc Maj Repair)	2029	9198
09198(AZ Deck - Epoxy Overlay)	2030	9198
09732(AZ Super - FRP Wrap)	2030	9732
07918(AZ Deck - Epoxy Overlay, AZ Super - FRP Wrap)	2031	7918
07921(AZ Deck - Epoxy Overlay)	2031	7921
09188(AZ Super - Conc Maj Repair)	2031	9188
09599(AZ Deck - Epoxy Overlay)	2031	9599

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Phoenix Snapshot (p. 2)

Life Cycle Analysis Project Recommendations (cont'd)

Pavement Route	Name	From	To	Year	Treatment
07 3RD AVE	07 3RD AVE-009.650-1	9.650	10.419	2021	RR_3INCH_AC_FR
07 3RD ST	07 3RD ST-010.933-1	10.933	11.698	2021	RR_3INCH_AC_FR
07 7TH ST	07 7TH ST-023.599-1	23.599	25.529	2021	RR_3INCH_AC_FR
07 BASELINE RD	07 BASELINE RD-072.400-1	72.400	73.063	2021	MS_2_PASS
07 BUCKEYE RD	07 BUCKEYE RD-069.400-1	69.400	70.325	2021	RR_3INCH_AC_FR
07 SKY HARBOR BLVD D	07 SKY HARBOR BLVD D-000.000-1	0.000	0.163	2021	SR_3INCH_AC_MS
07 VAN BUREN ST	07 VAN BUREN ST-068.225-1	68.225	68.673	2021	RR_3INCH_AC_FR
07 44TH ST	07 44TH ST-012.442-1	12.442	16.872	2022	RR_3INCH_AC_FR
07 7TH ST	07 7TH ST-010.399-1	10.399	15.399	2022	RR_3INCH_AC_FR
07 7TH ST	07 7TH ST-005.301-1	5.301	10.399	2023	RR_3INCH_AC_FR
07 CAVE CREEK RD	07 CAVE CREEK RD-005.000-1	5.000	11.100	2025	SR_3INCH_AC_MS
07 CAVE CREEK RD	07 CAVE CREEK RD-011.100-1	11.100	16.975	2026	SR_3INCH_AC_MS
07 3RD AVE	07 3RD AVE-009.650-1	9.650	10.419	2030	MS_1_PASS
07 3RD ST	07 3RD ST-010.933-1	10.933	11.698	2030	MS_1_PASS
07 44TH ST	07 44TH ST-012.442-1	12.442	16.872	2030	FOG_COAT
07 7TH ST	07 7TH ST-010.399-1	10.399	15.399	2030	FOG_COAT
07 7TH ST	07 7TH ST-023.599-1	23.599	25.529	2030	MS_1_PASS
07 BASELINE RD	07 BASELINE RD-072.400-1	72.400	73.063	2030	RR_3INCH_AC_FR
07 BUCKEYE RD	07 BUCKEYE RD-069.400-1	69.400	70.325	2030	MS_1_PASS
07 SKY HARBOR BLVD D	07 SKY HARBOR BLVD D-000.000-1	0.000	0.163	2030	MS_1_PASS
07 VAN BUREN ST	07 VAN BUREN ST-068.225-1	68.225	68.673	2030	MS_1_PASS

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Pima County Snapshot (p. 1)

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Pima County NHS Pavement	26.5	6.3	87.4	6.3

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Pima County NHS Bridges	42	424,461	29.1	70.9	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
10S ALVERNON WAY	**10S ALVERNON WAY-015.184-1**	15.184	16.922	2021	RR_3INCH_AC_FR
10S ALVERNON WAY	**10S ALVERNON WAY-015.184-1**	15.184	16.922	2030	MS_1_PASS

Project Work Type	Year	Str NO
09810(AZ Deck - Epoxy Overlay)	2020	9810
09812(AZ Deck - Epoxy Overlay)	2021	9812
09969(AZ Deck - Epoxy Overlay)	2021	9969
08756(AZ Deck - Epoxy Overlay)	2022	8756
08747(AZ Deck - Epoxy Overlay)	2026	8747
09812(AZ Super - Stl Min Repair)	2026	9812
09813(AZ Deck - Epoxy Overlay)	2028	9813

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Pima County Snapshot (p. 2)

How Should I Use This Information?

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Quartzite Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Quartzite NHS Pavement	7.7	-	89.1	10.9

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Quartzite NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
SB010 1	**SB010 1-000.418-1**	0.418	2.937	2021	RR_3INCH_AC_FR
SB010 1	**SB010 1-000.418-1**	0.418	2.937	2030	MS_1_PASS

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Salt River Pima-Maricopa Indian Community (SRPMIC) Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
SRIC NHS Pavement	0.6	N/A	N/A	N/A

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
SRIC NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Sahuarita Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Sahuarita NHS Pavement	-	-	-	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
SRIC NHS Bridges	2	3,912	100.0	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

San Luis Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
San Luis NHS Pavement	6.9	-	93.8	6.2

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
San Luis NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
U 095 0	**U 095 0-000.000-1**	0.000	0.742	2021	RR_3INCH_AC_FR
U 095	**U 095-000.000-1**	0.000	0.720	2021	RR_3INCH_AC_FR
U 095 0	**U 095 0-000.000-1**	0.000	0.742	2030	MS_1_PASS
U 095	**U 095-000.000-1**	0.000	0.720	2030	MS_1_PASS

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Scottsdale Snapshot (p. 1)

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Scottsdale NHS Pavement	156.8	12.7	82.8	4.5

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Scottsdale NHS Bridges	16	93,008	45.2	54.8	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
07 SCOTTSDALE RD	**07 SCOTTSDALE RD-010.300-1**	10.300	15.573	2024	RR_3INCH_AC_FR

Bridge Project Work Type	Year	Str NO
09638(AZ Deck - Epoxy Overlay, AZ Super - FRP Wrap)	2020	9638
10373(AZ Deck - Epoxy Overlay, AZ Super - FRP Wrap)	2020	10373
10359(AZ Deck - Epoxy Overlay)	2021	10359
09360(AZ Deck - Epoxy Overlay)	2022	9360
10359(AZ Super - Conc Maj Repair)	2022	10359
10373(AZ Sub - Conc Maj Repair)	2022	10373
09754(AZ Deck - Epoxy Overlay)	2023	9754
09360(AZ Super - Conc Maj Repair)	2024	9360
09580(AZ Deck - Epoxy Overlay)	2025	9580
09656(AZ Deck - Epoxy Overlay)	2025	9656

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Scottsdale Snapshot (p. 2)

How Should I Use This Information?

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Sierra Vista Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Sierra Vista NHS Pavement	-	-	-	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Sierra Vista NHS Bridges	4	13,872	55.9	44.1	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Somerton Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Somerton NHS Pavement	10.9	-	100.0	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Somerton NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
U 095 0	**U 095 0-013.568-1**	13.568	19.169	2028	SR_3INCH_AC_MS
U 095	**U 095-011.800-1**	11.800	17.100	2028	SR_3INCH_AC_MS

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
- **Consider** the project recommendations above which will positively impact our statewide efforts to meet performance targets and the long-term state of good repair; if no projects are recommended at this time, consider how your investment decisions will maintain or improve pavement and bridge condition
- **Be prepared** to share estimated annual expenditure and your plan of projects for your NHS assets

An Outward Look

The ADOT TAMP will be updated **at least every four years,** with continued engagement to identify:

- Updates to asset inventory & condition data;
- Supporting financial information and risks;
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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Surprise Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Surprise NHS Pavement	33.9	7.4	92.6	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Surprise NHS Bridges	2	6,186	-	100.0	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
07 BELL RD	**07 BELL RD-015.669-1**	15.669	21.469	2029	SR_3INCH_AC_MS

How Should I Use This Information?

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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Tempe Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Tempe NHS Pavement	66.8	0.9	92.2	6.9

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Tempe NHS Bridges	2	9,400	-	100.0	-

Life Cycle Analysis Project Recommendations

Bridge Project Work Type	Year	Str NO
09378(AZ Deck - Epoxy Overlay)	2020	9378
09379(AZ Deck - Epoxy Overlay, AZ Super - FRP Wrap)	2020	9379
09378(AZ Super - Conc Maj Repair)	2031	9378

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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January 2021 - WSP

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Tucson Snapshot (p. 1)

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Tucson NHS Pavement	129.9	14.2	80.1	5.6

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Tucson NHS Bridges	82	551,480	42.7	57.3	-

Life Cycle Analysis Project Recommendations

Bridge Project Work Type	Year	Str NO
09021(AZ Deck - Epoxy Overlay, AZ Super - FRP Wrap)	2021	9021
09774(AZ Deck - Epoxy Overlay)	2021	9774
10312(AZ Deck - Epoxy Overlay)	2021	10312
08895(AZ Deck - Epoxy Overlay, AZ Super - FRP Wrap)	2022	8895
09774(AZ Sub - Conc Maj Repair)	2022	9774
10398(AZ Deck - Epoxy Overlay)	2023	10398
07629(AZ Deck - Epoxy Overlay)	2024	7629
07630(AZ Deck - Epoxy Overlay)	2024	7630
09814(AZ Deck - Epoxy Overlay)	2024	9814
09974(AZ Deck - Epoxy Overlay)	2024	9974
09858(AZ Deck - Epoxy Overlay)	2027	9858
09858(AZ Super - Conc Maj Repair)	2028	9858
09809(AZ Deck - Epoxy Overlay, AZ Super - FRP Wrap)	2029	9809
09815(AZ Deck - Epoxy Overlay)	2029	9815
10398(AZ Super - Conc Maj Repair)	2029	10398
10447(AZ Deck - Epoxy Overlay, AZ Super - FRP Wrap)	2029	10447

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Tucson Snapshot (p. 2)

Life Cycle Analysis Project Recommendations (cont'd)

Pavement Route	Name	From	To	Year	Treatment
10E AVIATION PKWY	10E AVIATION PKWY-003.089-1	3.089	3.510	2021	RR_1INCH_FR
10E GOLF LINKS EB ON RAMP	10E GOLF LINKS EB ON RAMP-000.000-1	0.000	0.602	2021	RR_3INCH_AC_FR
10E WETMORE RD	10E WETMORE RD-000.000-1	0.000	0.149	2021	RR_3INCH_AC_FR
10N TOOLE AVE	10N TOOLE AVE-000.000-1	0.000	0.278	2021	RR_3INCH_AC_FR
10S CAMPBELL AVE	10S CAMPBELL AVE-021.304-1	21.304	21.565	2021	SR_3INCH_AC_MS
10S GOLF LINKS RD	10S GOLF LINKS RD-000.000-1	0.000	0.999	2021	RR_3INCH_AC_FR
10S TUCSON BLVD	10S TUCSON BLVD-000.067-1	0.067	3.576	2021	SR_3INCH_AC_MS
10W CONGRESS ST	10W CONGRESS ST-000.799-1	0.799	1.359	2021	RR_3INCH_AC_FR
10W WETMORE RD	10W WETMORE RD-002.520-1	2.520	2.870	2021	SR_3INCH_AC_MS
10E GOLF LINKS RD	10E GOLF LINKS RD-000.825-1	0.825	4.679	2022	SR_3INCH_AC_MS
10N STONE AVE	10N STONE AVE-004.526-1	4.526	5.204	2022	SR_3INCH_AC_MS
SB010 2	SB010 2-001.689-1	1.689	2.326	2022	SR_3INCH_AC_MS
10E AVIATION PKWY	10E AVIATION PKWY-003.089-1	3.089	3.510	2029	RR_1INCH_FR
10E GOLF LINKS EB ON RAMP	10E GOLF LINKS EB ON RAMP-000.000-1	0.000	0.602	2029	MS_2_PASS
10E VALENCIA RD	10E VALENCIA RD-000.000-1	0.000	4.449	2029	RR_3INCH_AC_FR
10E VALENCIA RD	10E VALENCIA RD-004.823-1	4.823	7.738	2029	RR_3INCH_AC_FR
10E GOLF LINKS RD	10E GOLF LINKS RD-000.825-1	0.825	4.679	2030	MS_2_PASS
10E WETMORE RD	10E WETMORE RD-000.000-1	0.000	0.149	2030	MS_1_PASS
10N STONE AVE	10N STONE AVE-004.526-1	4.526	5.204	2030	FOG_COAT
10N TOOLE AVE	10N TOOLE AVE-000.000-1	0.000	0.278	2030	MS_1_PASS
10S CAMPBELL AVE	10S CAMPBELL AVE-021.304-1	21.304	21.565	2030	MS_1_PASS
10S GOLF LINKS RD	10S GOLF LINKS RD-000.000-1	0.000	0.999	2030	MS_1_PASS
10S TUCSON BLVD	10S TUCSON BLVD-000.067-1	0.067	3.576	2030	MS_1_PASS
10W CONGRESS ST	10W CONGRESS ST-000.799-1	0.799	1.359	2030	MS_1_PASS
10W WETMORE RD	10W WETMORE RD-002.520-1	2.520	2.870	2030	MS_1_PASS
SB010 2	SB010 2-001.689-1	1.689	2.326	2030	MS_2_PASS

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Tucson Snapshot (p. 3)

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
- **Consider** the project recommendations above which will positively impact our statewide efforts to meet performance targets and the long-term state of good repair; if no projects are recommended at this time, consider how your investment decisions will maintain or improve pavement and bridge condition
- **Be prepared** to share estimated annual expenditure and your plan of projects for your NHS assets

An Outward Look

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Williams Snapshot

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Williams NHS Pavement	1.9	-	100.0	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Williams NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

No LCA Model Recommendations

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Yavapai County Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Yavapai County NHS Pavement	-	-	-	-

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Yavapai County NHS Bridges	1	22,226	-	100.0	-

Life Cycle Analysis Project Recommendations

Bridge Project Work Type	Year	Str NO
11333(AZ Deck - Epoxy Overlay)	2027	11333

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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An Outward Look

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Yuma City Snapshot (p. 1)

What is an Agency Asset Snapshot?

In the ADOT TAMP, all portions of the National Highway System (NHS) owned or maintained by other jurisdictions in the state are required to be included. This snapshot provides a summary of what was included for your agency.

Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Yuma City NHS Pavement	66.7	1.2	96.8	2.0

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Yuma City NHS Bridges	1	42,552	-	100.0	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
14S AVENUE 3 E	14S AVENUE 3 E-011.866-1	11.866	14.877	2021	RR_3INCH_AC_FR
U 095 0	U 095 0-024.206-1	24.206	29.099	2021	RR_0p5INCH_FR
U 095	U 095-023.200-1	23.200	29.077	2021	RR_0p5INCH_FR
SB008 1	SB008 1-006.671-1	6.671	11.073	2022	SR_3INCH_AC_MS
SB008 1	SB008 1-003.825-1	3.825	6.671	2023	RR_3INCH_AC_FR
SB008 1	SB008 1-000.000-1	0.000	3.823	2028	RR_3INCH_AC_FR
14S AVENUE 3 E	14S AVENUE 3 E-011.866-1	11.866	14.877	2030	MS_1_PASS
SB008 1	SB008 1-006.671-1	6.671	11.073	2030	MS_2_PASS
U 095 0	U 095 0-024.206-1	24.206	29.099	2030	RR_3INCH_AC_FR
U 095	U 095-023.200-1	23.200	29.077	2030	RR_3INCH_AC_FR

Bridge Project Work Type	Year	Str NO
10686(AZ Deck - Epoxy Overlay)	2026	10686

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Yuma City Snapshot (p. 2)

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to ADOT
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An Outward Look

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TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP)

Yuma County Snapshot

What is an Agency Asset Snapshot?

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Asset Portfolio Summary (2019)

Pavement Asset Category	Total Lane Miles	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Pavement	1,692	5.7	89.2	4.8
Yuma County NHS Pavement	80.0	N/A	N/A	N/A

Bridge Owner	Number of Bridges	Bridge Deck Area (square feet)	Good (%)	Fair (%)	Poor (%)
Locally-owned NHS Bridges	244	2,312,667	33.0	66.0	1.0
Yuma County NHS Bridges	-	-	-	-	-

Life Cycle Analysis Project Recommendations

Pavement Route	Name	From	To	Year	Treatment
U 095	**U 095-017.100-1**	17.100	23.200	2021	SR_3INCH_AC_MS
U 095 0	**U 095 0-019.169-1**	19.169	24.206	2022	RR_3INCH_AC_FR
U 095	**U 095-006.500-1**	6.500	11.800	2023	SR_3INCH_AC_MS
U 095	**U 095-000.720-1**	0.720	6.500	2024	RR_3INCH_AC_FR
U 095 0	**U 095 0-019.169-1**	19.169	24.206	2030	MS_2_PASS
U 095	**U 095-017.100-1**	17.100	23.200	2030	MS_1_PASS

How Should I Use This Information?

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January 2021 - WSP

TAMP FACTSHEET GLOSSARY

Pavement Terminology

Route Name

- The formal name of route has 32 characters; a simplified and condensed form is used here
- The name of local roads may start with 2-character County code; the main part of state route has 5 characters
- First character will be one of the following:
    - I - Interstate Highway system
    - U - U.S. Highway system
    - S – Arizona Highway System
- The second character may be null or one of the following:
    - A – Alternate
    - B – Business Route
    - L – Loop Route (None in state system at this time)
    - S – Spur
    - T – Truck
    - X – Temporary
    - Y – Wye Leg
- 3rd, 4th, and 5th character will be numbers including zero.
- 5th character will be followed by gap and one of the following-
    - Null – Mainline –Cardinal Direction
    - 0 – Mainline – Non-Cardinal Direction
    - 1 – Frontage – Cardinal Direction
    - 2 – Frontage – Non-Cardinal Direction
- For business routes, above characters may be followed by another number which is the segment number of the business route.
- For State Routes, cardinal direction is the direction of increasing milepost, which is most often from south or west to north or east. However, there are several exceptions.
- For Local Roads, cardinal direction is the primary direction of the roadway as north or east. Non-cardinal direction is therefore always south or west.

From/To Measure

- 1 mile is a perfect mile or 1760 yards
- Roads start at mile 0 and continue without break in measurement or length. For example- one segment of road may end at mile 10 at a city/town/village/intersection; the next segment, if any, will start at mile 10 at same or sometimes at a different city/town/village/intersection.

Pavement Treatments

- SR - Spot Repair
- RR – Remove and Replace
- MS – Micro Surfacing
- Fog Coat – Fog Seal
- FR – Rubberized Friction Course
- AC – Asphaltic Concrete

- SR_ 3INCH_AC_MS = Spot Repair with 3” or more Asphaltic Concrete + Micro Surfacing
- MS_1_PASS = 1 pass or layer Micro Surfacing
- RR_ 3INCH_AC_FR = Remove and Replace 3” Asphaltic Concrete + FR
- RR_0p5INCH_FR = Remove and Replace 0.5” Rubberized Friction Course
- MS_2_PASS = 2 passes or layers Micro Surfacing
- RR_2p5INCH_AC_FR = Remove and replace 2.5” Asphaltic Concrete + FR
- RR_1INCH_FR = Remove and Replace 1” Rubberized Friction Course.

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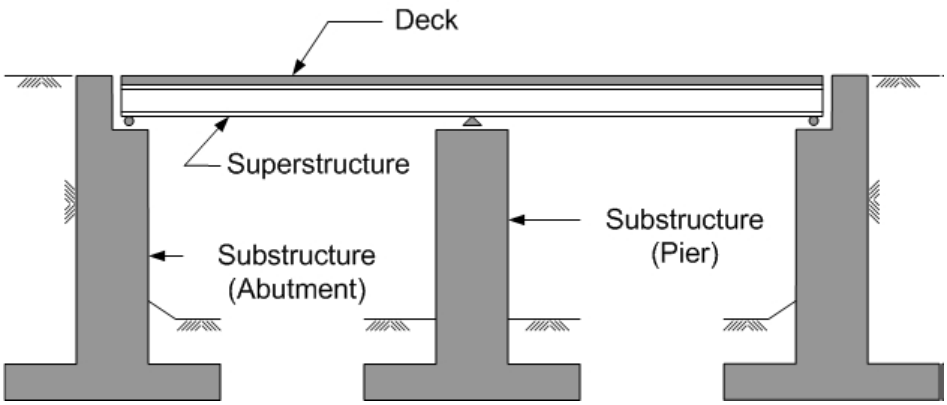
TAMP FACTSHEET GLOSSARY (p.2)

Bridge Terminology

Bridge Identifier & Components

- Str NO – Structure Number: used as an identifier for the bridge in the inspection report which is provided to each local public agency for whom ADOT does bridge inspections

- Deck – Bridge deck
- Super – Bridge superstructure
- Sub – Bridge substructure



Bridge Treatments

- Stl min Repair – Steel Minor Repair
- FRP – Fiber Reinforced Polymer Wrap
- Epoxy overlay
- Polyester overlay
- Conc maj Repair – Concrete Major Repair

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