Kansas
Department of Transportation

# Transportation Asset Management Plan

JUNE 2019

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# EXECUTIVE SUMMARY

This risk-based Transportation Asset Management Plan (TAMP) documents and organizes the existing asset management practices at the Kansas Department of Transportation (KDOT) to enhance strategic investment in highway assets, while meeting federal requirements.

This document establishes KDOT's objectives for managing the asset base to deliver a defined level of service in the most effective and cost-efficient way, and summarizes how KDOT's assets are managed throughout their life cycle. It documents the processes KDOT currently follows to manage assets to ensure that progress is made towards improved asset preservation and compliance with federal performance-based planning initiatives. The TAMP is intended to be a single source of information on KDOT's assets, and a planning tool to use in maintaining assets in a state of good repair, towards achieving the national performance goals.

## KDOT'S Assets

The Kansas transportation system comprises a variety of physical assets. Bridges and pavements are the most significant assets on the system based on asset value and operational, maintenance, and renewal costs. In Kansas, the National Highway System (NHS) is made up of 12,618 lane miles and 2,830 bridges covering the entire state. Additional assets on the State Highway System (but not NHS) include 12,575 pavement lane miles and 2,521 bridges. Accounting for highways that are both NHS and SHS, the total system includes 25,193 lane miles and 5,351 bridges mostly owned and maintained by KDOT, but with some portions under the purview of the Kansas Turnpike Authority (KTA) and other local entities (cities and counties).

### ASSET CONDITION OVERVIEW

KDOT has shown a commitment to preservation of its major transportation assets through historical investments that have contributed to sustained improvements in pavement condition. Beginning in the 1980s, the Department has had a pavement management process which incorporates clearly defined, systematic, and consistent procedures using quantitative factors

**Kansas National & State Highway System**

25,193

Lane-miles of roadways

5,351

Bridges

$32.2 billion

Total replacement cost

to identify and prioritize preservation project selection. Current condition of both bridge and pavement assets continues to reflect the Department's commitment to effective asset management.

Based on KDOT's existing metrics and measures, pavement condition has achieved or exceeded the minimum requirements stipulated in the federal rules for interstate pavements. While federal regulations require that no more than 5% of pavement is in poor condition, KDOT has less than 1% of pavements in poor condition in all categories.

Similarly, KDOT bridges on the NHS and SHS are generally in good condition. With federal requirements specifying that the percent of bridge deck area in poor condition remains below 10%, KDOT's bridge inventory currently meets the federal standard.

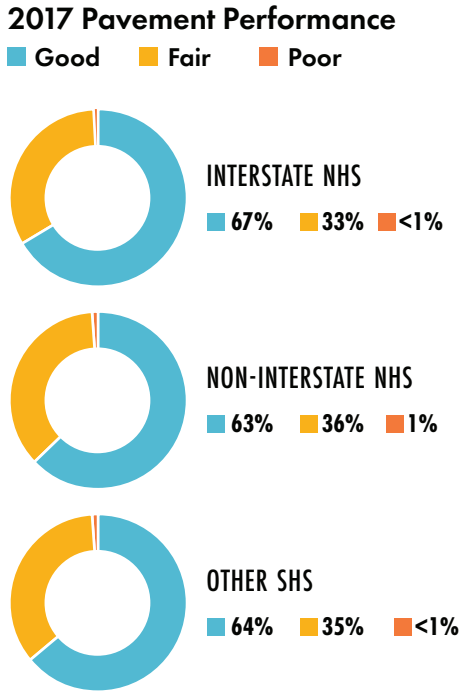
## Life Cycle Planning

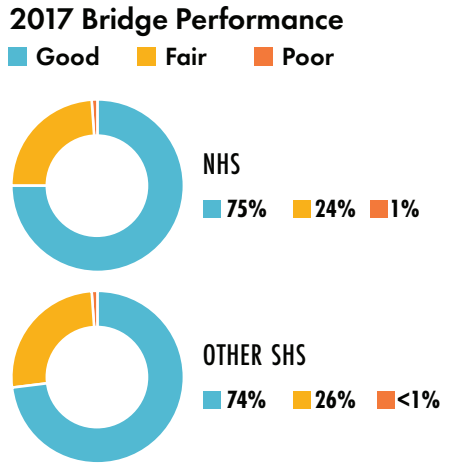
KDOT has forward-looking policies and procedures to effectively support life cycle planning (LCP), which require logical rules, high-quality data, modeling tools, and sound methods to help analyze and evaluate the long-term cost of different scenarios. The primary focus of LCP is to identify investment strategies that minimize cost, address risks, and support the maintenance of highway transportation assets in a State of Good Repair.

### PAVEMENT LCP

KDOT's pavement management system (PMS) contains most of the data and models to provide performance-based decision support, including current and historical condition, performance targets, deterioration models, post treatment condition models, and treatment costs. To promote a comprehensive evaluation of alternatives, KDOT conducts different LCP scenarios using pavement condition and financial data, modeling tools, and information from experts. The scenarios compare pavement performance for the annual funding KDOT is expected to receive over a 20-year period. For this TAMP, three preservation strategies were explored:

- **Worst first:** prioritizes pavements requiring reconstruction or heavy rehabilitation
- **Maintain steady state:** determines the minimum cost set of treatments that returns the pavement to the previous year's condition



- **Desired state of good repair:** a balanced approach to maintain performance, spreading the types of actions so that different pavements are regularly receiving structural condition improvements as well as improvements to surface conditions

### BRIDGE LCP

KDOT officials have been leading a national effort to develop state-of-the-art databases and tools to support the planning of bridge preservation. KDOT is currently implementing and configuring AASHTOWare Bridge Management Software (BrM) version 6.0, which has life cycle planning capability. While BrM configuration is on-going, KDOT developed scenarios to compare the potential impact of different investment levels on bridge asset performance. Once configuration is complete, KDOT will be able to run more accurate scenarios to evaluate LCP analysis for Kansas' NHS and Other SHS bridges. The preliminary scenarios explored for this TAMP are:

- **Historically Representative:** considers preservation investment at a level representative of historical actuals

- **Increased Investment:** considers preservation investment at a level higher than has been historically available

## Managing Asset Risks

KDOT adopted the International Organization for Standardization (ISO) risk management framework, which is arguably the foremost standard on risk management (ISO 31000), to ensure robust risk management. Each step in this process and the underpinning framework sets the foundation for ensuring that information about risks is effectively used to inform decision making towards meeting an organization's objectives. This process resulted in a risk register with prioritized risks in seven categories. The top five risks are presented below in order of priority.

*Risk Management Process*


*Highest Priority Risks (in Order of Priority)*

| RISK | IMPACT |
|---|---|
| 1 **Deferred maintenance** *Asset Performance* | Increased deterioration rate of roadways and bridges; Increased cost to maintain roads/bridges; Wear and tear on vehicles |
| 2 **Loss of institutional knowledge through retirements and attrition; inexperienced staff due to lack of retention** *Workforce/Organizational* | Chronic shortages of engineers; Understaffed offices and field shops; inability of field offices to do basic work; Inability to carry out agency's mission; Overreliance on consultants; Lack of continuity and institutional knowledge, leading to greater likelihood of errors; Greater workload/more responsibility placed on fewer staff; decreased morale; employee burnout |
| 3 **Inadequate/ uncertain state and federal funding** *Financial/Economic* | Inability to match federal funding; Fewer road, bridge, maintenance, preservation projects; fewer contractors available due to lack of work; System deterioration; Less flexibility in spending decisions; Negative impacts to customer satisfaction; Increased safety risk and cost to traveling public; Inefficient use of staff and resources; fewer contractors available |
| 4 **Increased freight traffic** *External/Reputational* | Reduced pavement and bridge life; Additional non-programmed costs; Increased congestion and traffic conflicts; Shortage of truck parking; Increase in vehicle/train collisions |
| 5 **Interruptions or slowdowns in the procurement process** *Business Operations* | Reduced opportunity to have competitive advantage; Vendors not wanting to work with KDOT; Loss of staff due to procurement processes; Process too complex for KDOT to be nimble – inability to leverage opportunities |

## Financial Planning and Investment Strategies

### WHERE DOES KANSAS HIGHWAY FUNDING COME FROM?

KDOT relies on five funding sources to finance asset management and other programs that support asset preservation for all highways. These funds include both federal and state sources:

- Federal Highway Trust Fund
- State sources, including motor fuel taxes, motor vehicle registration fees, sales and compensating use tax, and other miscellaneous revenues

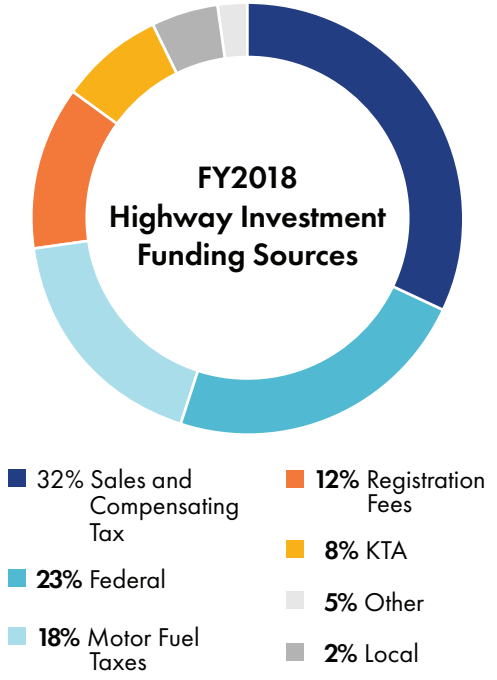
Funds contribute to the State Highway Fund (SHF), with FY2018 revenues estimated at about $1.8 billion, before transfers and including bond proceeds. The Kansas Turnpike Authority also funds highway asset investments on their responsibility of turnpike, through user tolls as well as a few partnerships with KDOT and local entities, contributing 8% of the total available funding in FY2018.

### FUNDING USES

Funding is allocated through four core programs, in addition to operations funding, which directly or indirectly impact bridge and pavement performance:

- **Preservation.** Includes projects that support maintaining assets above minimum condition such as roadway repair, overlays, and reconstruction; and bridge repair, replacement and rehabilitation; and roadway striping.
- **Modernization.** Includes projects to upgrade highway system to meet current standards and codes to improve system performance and safety like adding shoulders, flattening hills, straightening curves, and improving intersections.
- **Expansion.** Includes projects such as addition of roadway lanes, building interchanges, and providing passing lines to improve traffic flow and reliability.
- **Local Construction.** Includes projects to improve county and city roads (including those roads that are on the NHS). This is a combination of federal, state, and local funding.

*FY2018 highway investment available funding by source*



- **Operations (fixed costs or overhead).** Includes regular maintenance (e.g., snow removal), serving KDOT's debts, supporting salaries, administrative cost, and operating costs.

## FUNDING PROJECTIONS

Funding projections show that about $11.6 billion in SHF would be available for investment for the duration of the TAMP (a ten-year period), representing an average annual revenue of $1.2 billion per year, assuming no new legislation is passed during this period.

The 2018 Joint Legislative Transportation Vision Task Force evaluated current transportation funding in Kansas to determine whether it is sufficient to not only maintain the transportation system in its current state, but also to ensure that it serves the future transportation needs of Kansas residents. The Task Force made several key observations with policy and legislation recommendations, including the following recommendations addressing funding issues and transportation needs:

- Provide $500 million to fund highway preservation annually;
- Provide $500 million to complete delayed T-WORKS modernization and expansion projects in four years;
- Continue and restore local programs such as the Kansas Local Bridge Improvement Program
- Increase funding for Local Governments to maintain city connection links;
- Explore new revenue sources such as fees for alternative fueled vehicles or oversized vehicles, expanded tolling, or fees based on vehicle miles traveled.

Out of all available resources, KDOT is estimating that about $500 million will be available for pavement and bridge preservation funding for the duration of the TAMP.

*Projected funding available for pavement and bridge preservation*

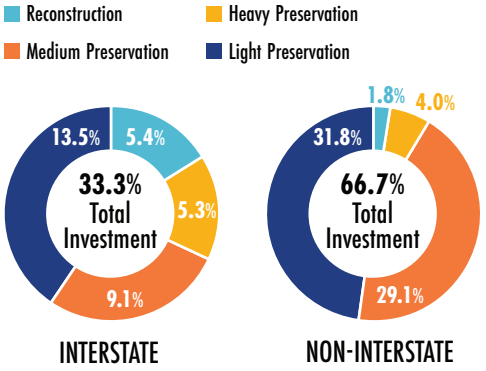
| | ESTIMATED TOTAL FUNDS (MILLIONS $) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
| Pavement | 375 | 375 | 375 | 375 | 375 | 375 | 375 | 375 | 375 | 375 |
| Bridge | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 125 |
| **Total** | **500** | **500** | **500** | **500** | **500** | **500** | **500** | **500** | **500** | **500** |

## FUNDING NEEDS & INVESTMENT STRATEGIES

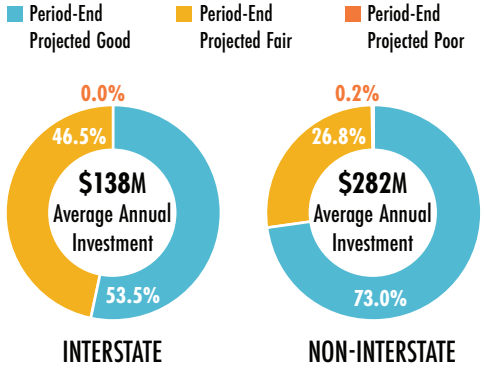
At KDOT, investment project selection generally follows a bottom-up approach with the employment of a multi-phased development process for both pavements and bridges, culminating in the strategic investment selections presented in the Statewide Transportation Improvement Program (STIP). With improvements to asset management tools and processes in developing this TAMP, KDOT's identification of investment needs, strategies and projects can be enhanced if analysis outputs are effectively incorporated. With these analyses, investment strategies can be recommended based on projected funding, an understanding of risk outcomes, and knowledge of any performance gaps that may be created.

Based on the PMS analysis, KDOT has selected the **balanced approach** as the recommended investment strategy for pavement assets. This investment strategy achieves a state of good repair with the smallest performance and funding gap over the projection period, with an average annual investment of $420 million.

### Pavement Balanced Approach Investment Allocations




### Pavement Balanced Approach Scenario Summary




For bridges, both strategies explored allow KDOT to meet the selected two-year performance targets, but performance gaps are projected for both the four-year target and the long-term state of good repair (SGR). With increased funding, the SGR goal for percent of bridge deck in poor condition is met, but not the goal for percent in good condition. This demonstrates that the current funding level for bridge preservation investment is insufficient to maintain bridges in a state of good repair.

The recommended investment strategy for bridges is to continue with the **previously planned investments** in the short-term, while improvements are completed to allow for more accurate analysis and more informed investment decisions, with the completion of the BrM implementation and configuration process over the next year.

## Continuous Improvement

Based on the current state of KDOT's asset management practice and the analyses documented in this TAMP, the following opportunities for improvement have been identified to enhance TAM practice for increased benefit realization:

- Upgrade the bridge management system to enable more accurate life cycle planning;
- Revisit bridge LCP scenarios and identify investment strategies that support the achievement of national condition goals, and performance targets while focusing on preservation, risk management, and minimizing life cycle cost;
- Identify strategies to close the projected long-term performance gaps for bridge assets;
- Evaluate realigning pavement work types to Federal work types to reduce complications in future consistency determinations;
- Establish and document a Standard Operating Procedure for pavement and bridge management to conduct scenario analyses systematically in future TAMPs and to capture institutional knowledge;
- Evaluate cross-asset resource allocation methodologies to improve tradeoff analyses between pavements and bridges;
- Collaborate with other states and federal agencies to improve and clarify the rules, regulations, and guidance around pavement and bridge management and their documentation in the TAMP.

KDOT will continue to implement planned enhancements to the TAM process, with consideration of additional opportunities to further improve asset management maturity. This TAMP will be updated every four years, or with significant changes in the processes or recommendations documented, as required by Federal regulations.

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# CHAPTER 1 INTRODUCTION

The purpose of this risk-based Transportation Asset Management Plan (TAMP) is to document how transportation asset management is applied at KDOT to enhance investments in highway assets.

Each day, over 50 million miles are driven on highways in Kansas. The major highways in the state are divided into two main categories: those designated as part of the National Highway System (NHS) and those non-NHS highways that are designated as part of the State Highway System (SHS). Accounting for overlap between the NHS and SHS, altogether, this system includes 25,193 lanes-miles of pavement and 5,351 bridges.

The Kansas Department of Transportation (KDOT) is required to develop a Transportation Asset Management Plan (TAMP) for the NHS system pavements and bridges. KDOT has chosen to include other state-maintained highways in the TAMP as well.

The Kansas NHS includes 12,618 lane-miles of roadways and 2,830 bridges. Maintenance for NHS roadways is shared by KDOT, the Kansas Turnpike Authority (KTA) and several local entities. The non-NHS highways are maintained by KDOT and include 12,575 lane-miles of pavement and 2,521 bridges. Altogether, this asset base is valued at $32.2 billion, in 2018 dollars (as of June 2018). **Figure 1** is a map of the SHS in Kansas, showing the portions that are part of the NHS and those that are not (non-NHS). Note that light gray lines are county boundaries.

This TAMP documents and organizes the asset management practices at KDOT, documenting a ten-year life cycle and financial planning process to maintain NHS and SHS bridges and pavements in a state of good repair (SGR).

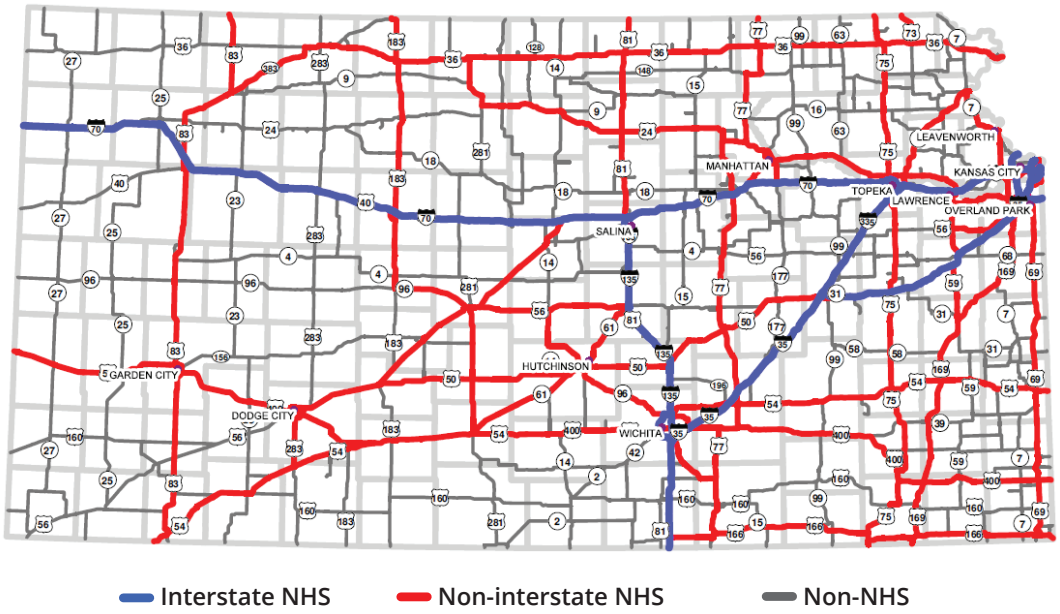
**Kansas National & State Highway System**

25,193
Lane-miles of roadways

5,351
Bridges

$32.2 billion
Total replacement cost

**FIGURE 1** *Kansas highways map*




## 1.1 What is Asset Management?

Asset management, as defined in Section 23 United States Code of Federal Regulations (23 U.S. CFR 515.5), is "a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based on 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."

In simpler terms, asset management allows an agency to develop a comprehensive understanding of what assets they have, the condition they are in, and the actions or investments required to maintain desired performance levels. While the main purpose of asset management is to maintain infrastructure at acceptable performance levels at minimum practical cost, many of the major benefits come from the asset management planning process itself. Knowledge of assets and their condition enables KDOT to predict how they deteriorate and to manage risks to meet performance standards — thereby enabling analysis of alternatives to prioritize and

**ASSET MANAGEMENT IS ABOUT ...**

**Doing the right amount of work at the right time to deliver the right service level for the right cost.**

optimize life cycle activities. Ultimately, this allows KDOT to effectively manage assets, operate in a financially sustainable manner while justifying funding requirements to maintain levels of service, and improve transparency in investment decisions.

## 1.2 Why Implement Asset Management?

KDOT has statutory responsibility to coordinate planning, development, and operation of various modes and systems of transportation in the state. With increasing traffic, aging infrastructure, and limited funding availability, it is important for KDOT, working with other infrastructure owners in the state, to systematically manage these assets to maintain them at or above minimum performance standards. Strategic management of infrastructure assets combines engineering knowledge with economic principles to ensure that the best investment decisions are made for sustained asset performance while minimizing costs, maximizing performance, and managing risks.

In 2012, the Moving Ahead for Progress in the 21st Century Act (MAP-21) became the first national highway legislation to formally introduce a performance-based program towards the goal of systematically improving the condition of transportation infrastructure. MAP-21 introduced requirements for states to develop a risk-based asset management plan for pavement and bridge assets on the National Highway System (NHS). Federal regulations (23 CFR 515) established a two-phase process that states must use to develop its asset management plan. In the first phase, states were required to develop an initial TAMP detailing processes that were followed to develop a fully-compliant TAMP in the second phase.

## 1.3 The KDOT TAMP

> This TAMP establishes objectives for managing the asset base to deliver a defined level of service in the most effective and cost-efficient way.

This document summarizes how KDOT's assets are managed throughout their life cycle. The TAMP documents KDOT's ten-year analysis and investment strategies to ensure progress towards achieving the national goals and maintaining assets in a state of good repair. The TAMP is intended to be a single source of information on KDOT's assets, and a planning tool for KDOT to use in meeting federal requirements by documenting current system condition, establishing

### TAMP CONTENT REQUIREMENTS

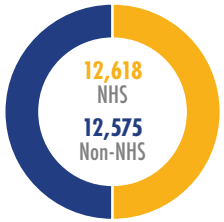
- Summary listing and condition description of the NHS pavements and bridges
- NHS pavement and bridge condition targets
- Asset management objectives and measures
- Performance gap analysis
- Risk analysis
- Life cycle planning
- 10-year financial plan
- Developing investment strategies

performance targets, analyzing life cycle costs, evaluating long-term expenditure, funding forecasts, and financial constraints, managing risks, identifying deviations from the desired system performance, and developing strategies to address any performance gaps.

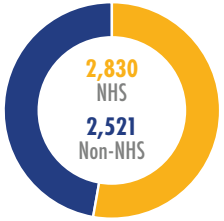
While federal regulations require only the inclusion of NHS pavement and bridge assets, KDOT has chosen to include all pavement and bridge assets on the SHS in the scope of the plan, in addition to NHS assets within the jurisdiction of other transportation agencies in the state. This TAMP covers the total of 25,193 lane miles and 5,351 bridges which includes NHS assets (12,618 pavement lane-miles and 2,830 bridges) and other SHS assets that are not on the NHS (12,575 pavement lane miles and 2,521 bridges).

Figure 2 shows a map of the roadways included in this TAMP, identifying segments that are maintained by other entities besides KDOT. All routes shown are on the SHS, except those shown in pink, which are non-state portions of the NHS. Routes shown in color are NHS routes, and those in grey are non-NHS routes that are also on the SHS. As shown, the Kansas Turnpike Authority (KTA) is responsible for a portion of the interstate on the NHS, while other smaller portions are the responsibility of local entities (e.g. cities and counties).

## Assets Included in the TAMP

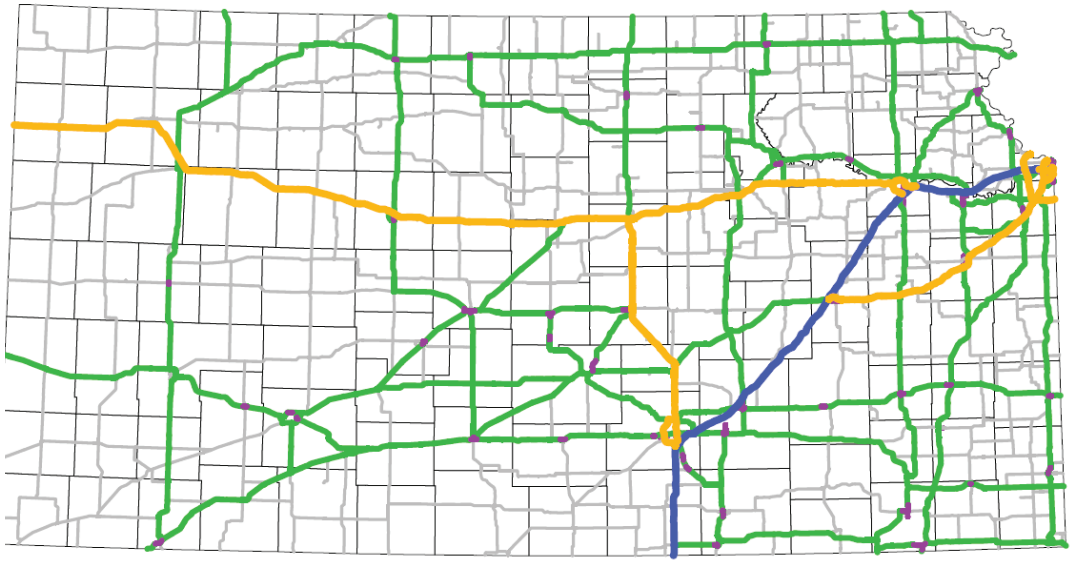



**25,193**
**Total Pavement in Lane-Miles**
*(centerline miles x number of lanes)*




**5,351**
**Total Bridges**

**FIGURE 2** *Kansas NHS by maintenance responsibility*



Pavement assets covered in this TAMP are referred to as NHS and Other SHS. The NHS is further broken down into the following categories:

- Interstate-NHS (IS-NHS);
- Non-Interstate NHS (Non-IS NHS); and
- NHS assets that are not owned or maintained by KDOT (Non-State NHS).

Bridge assets covered in the TAMP will simply be referred to as NHS bridges and Other SHS bridges. **Figure 3** shows some examples of highways in the state that fall in these categories.

This TAMP includes the minimum requirements as specified in 23 CFR 515 for a final TAMP. **Table 1** summarizes the organization of the different sections to meet Federal requirements. Beyond this federally-mandated content, the KDOT TAMP will evolve over time with changes in the state of the system or in any of the inputs to the processes described in **Chapter 4** through **Chapter 7**.

**FIGURE 3** *Highway examples for each pavement asset category*


**TABLE 1** *TAMP Section Organization*

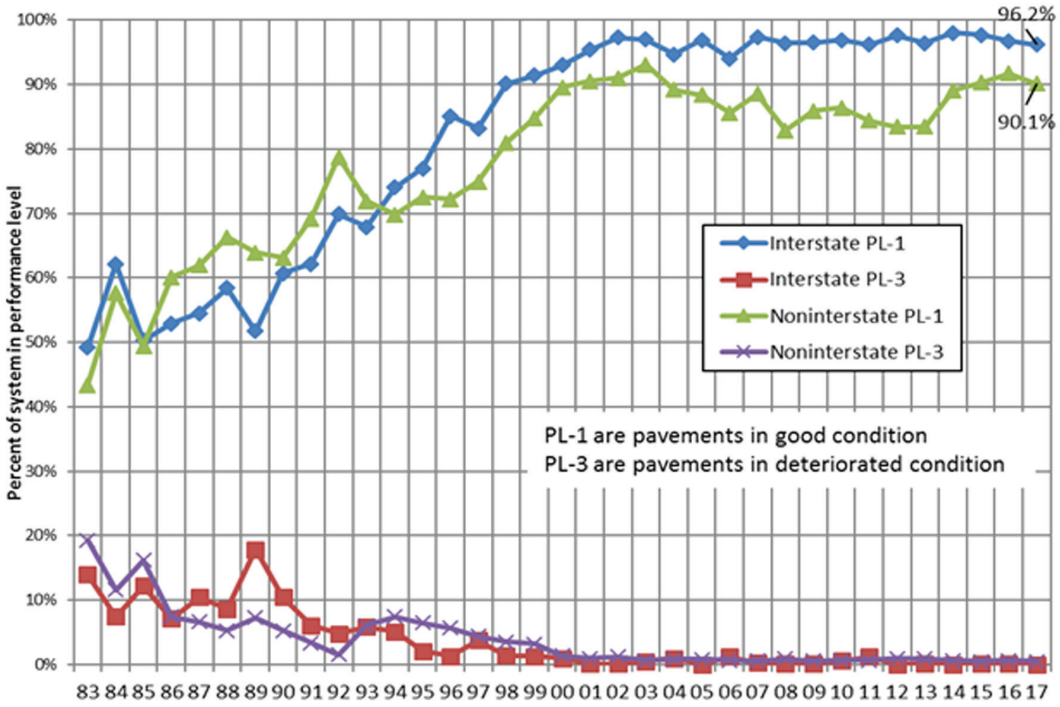
| TAMP CHAPTER | | TAMP REQUIREMENT |
|---|---|---|
| Chapter 1 | Introduction | |
| Chapter 2 | Asset Management at KDOT | ✓ Asset Management Objectives |
| Chapter 3 | State of the System | ✓ Performance Measures and Targets<br>✓ NHS Pavement and Bridge Inventory and Conditions<br>✓ Data Availability and Management Systems |
| Chapter 4 | Life Cycle Planning | ✓ Life Cycle Planning |
| Chapter 5 | Risk Management Plan | ✓ Risk Analysis and Management and Part 667 Analysis |
| Chapter 6 | Financial Planning | ✓ Ten-year Financial Plan |
| Chapter 7 | Investment Strategies | ✓ Performance Gap Analysis<br>✓ Investment Strategies |
| Chapter 8 | Opportunities for Improvement | ✓ Future Actions to Improve Processes |

# CHAPTER 2 ASSET MANAGEMENT AT KDOT

KDOT's asset management journey began with pavement preservation, and has expanded to other highway assets. KDOT is well positioned for continued asset management improvement through the TAMP process.

KDOT's existing business practices incorporate several fundamental concepts of effective infrastructure management — particularly in the management of pavement and bridge assets. Different strategic documents detailing the Department's mission and vision statements, strategic goals, and objectives (e.g. Long-Range Transportation Plan, Strategic Management Plan, etc.) emphasize asset management principles and show a commitment to the preservation of major transportation assets through sustained condition improvements. While the KDOT mission is simply "to provide a statewide transportation system to meet the needs of the state," the strategic and management goals include themes that embody the major principles of asset management, such as preserving the condition of the SHS and using technology to improve operational efficiency and effectiveness. KDOT has shown a commitment to preservation of its major transportation assets through these guiding documents and other investments which have led to sustained improvements in pavement condition (**Figure 4**). Note that this historical data shows condition using the former calculation methodology.

**FIGURE 4** *Positive results of the pavement management system on pavement condition*



In the 1980s, faced with the inability to robustly defend project selection, KDOT embarked on the pursuit of more sophisticated decision making. At the same time, state legislative direction defined expectations for decision making that was quantitative, repeatable and reproducible. This resulted in the creation of the Office of Project Selection, an executive group called the Project Review Committee, and a Preservation Project Development Committee.

While the original focus was on construction project selection, this maturity in investment decision making led to the development of a pavement management process which similarly incorporated clearly defined, systematic, and consistent procedures using quantitative factors to generate reproducible, transparent results. With commitment from senior management at KDOT, early success of the pavement management process resulted in improved pavement condition and increased credibility of the asset management process. Since then, KDOT has continued to develop several tools that enable progress in asset management, and is well-positioned for improved, effective asset management.

In 2018, a Joint Legislative Transportation Vision Task Force was assembled to evaluate the status of the Kansas transportation system, concluding in several findings that emphasized the need for increased investments in the transportation system, especially in system maintenance and preservation. Task Force recommendations covered funding, policy, and legislative changes to fully fund preservation, invest in future transportation needs, encourage the use of alternative delivery and financing methods, and give local governments more tools to meet their needs. Of particular note in the Task Force recommendations were the identified need for $500 million in highway preservation funding annually, and a recommendation to explore new revenue sources, such as fees based on vehicle miles traveled. In combination with the Task Force's push to improve transportation asset health, this TAMP and the asset management process provide an opportunity to hone KDOT's asset management maturity for better infrastructure.

## 2.1 KDOT Asset Management Governance

To guide the development of KDOT's federally-compliant TAMP and the improvement of asset management efforts, four groups have been defined, each with a different purpose and focus. This governance structure adds a cross-functional layer to KDOT's existing organizational structure to manage and inform the asset management planning process and the development of this TAMP. **Figure 5** summarizes the groups, responsibilities, and membership.

**FIGURE 5** *KDOT asset management governance*

## 2.2 KDOT Asset Management Policy

In November 2018, the KDOT TAM Steering Committee formulated an asset management policy to demonstrate the agency's commitment to formally prioritizing and implementing asset management practice. The policy makes five commitments in alignment with the KDOT mission to provide a statewide transportation system to meet the needs of the state. The commitments are to:

- Take a holistic approach to managing assets across the entire highway network and KDOT divisions, towards optimized resource allocation across assets and decision making;
- Make investment decisions that maintain asset health, as defined in the transportation asset management plan (TAMP), driven by asset data and analysis, including considerations of whole life cycle cost analysis and risk management, as documented in the TAMP;
- Continuously measure the effectiveness of asset management practice and prioritize continuous improvement and training of people, processes, and tools;
- Collaborate and coordinate with the Kansas Turnpike Authority and metropolitan planning organizations (MPOs), sharing TAM processes and inviting their participation in relevant discussions and decisions;
- Maintain and implement the objectives highlighted in the TAMP and update the TAMP every four years, per current Federal regulations, or as needed.

The full policy document is provided in **Appendix A**.

## 2.3 KDOT Asset Management Objectives

While the main goal for asset management planning is to achieve and sustain a desired state of good repair over an asset's life cycle at minimum cost, asset management objectives provide a clearer and more direct focus for the asset management planning process and for this TAMP itself. KDOT's asset management objectives are tied to its strategic guiding principles described in the Strategic Management Plan and Long-Range Transportation Plan, and each emphasizes a different, but important aspect of asset management. This TAMP seeks to achieve the objectives listed below, ultimately improving the maturity of asset management planning at the Department.

KDOT's asset management objectives are to:

1. Maximize benefits while minimizing costs of asset preservation investments, based on existing funding availability.
2. Enhance investment decision making and programming with risk management principles.
3. Meet or exceed minimum performance standards and the long-term state of good repair for bridge and pavement assets, with adequate funding.
4. Enhance the culture of asset management and preservation for Kansas roads and bridges by developing resource capacity and institutionalizing roles and responsibilities.
5. Foster transparency and communication of asset management benefits, including tracking and reporting asset performance, financial sustainability, and risk profile.
6. Support business continuity and succession planning by documenting effective asset management processes and by promoting knowledge transfer.

KDOT's asset management objectives are also considered in the context of achieving the national goals for highway surface transportation identified in 23 USC 150(b) as presented in Table 2.

**TABLE 2** *KDOT's asset management objectives in relation to the national goals*

| NATIONAL GOAL | KDOT TAM OBJECTIVES | RELATIONSHIP TO THE TAMP |
|---|---|---|
| Safety | 1 2 3 5 | KDOT's TAMP includes a risk management plan that identifies risks (including safety risks) and proposes mitigation action. |
| Infrastructure Condition | 1 2 3 4 5 | Maintaining and improving the condition of pavements and bridges are key elements of the KDOT's TAMP. |
| Congestion Reduction and System Reliability | 1 3 5 | KDOT's data-driven investment decisions to improve existing highways and bridges are intended to maximize asset performance including road network availability and reliable travel times. |
| Freight Movement and Economic Vitality | 1 2 3 6 | Maintaining highways and bridges at performance target levels strengthens the Kansas highway network and supports Kansas economic development. |
| Environmental sustainability | 1 2 5 | KDOT's TAMP includes life cycle strategies to optimize maintenance work in the highway network, reducing impacts to natural and historic resources. |
| Reduced Project Delivery Delays | 4 5 6 | KDOT's TAMP documents effective asset management processes to support asset-related planning and project delivery. |

# CHAPTER 3 STATE OF THE SYSTEM

> The asset management process begins with a defined understanding of existing asset inventory, condition and maintenance effort, which informs subsequent asset management processes.

## 3.1 Asset Portfolio Summary

Bridges and pavements are the most significant assets on the Kansas highway transportation system based on asset value and operational, maintenance, and renewal costs. Federal requirements (23 CFR 515) mandate that this TAMP includes, at a minimum, all pavements and bridges on the National Highway System (NHS). In Kansas, the NHS includes assets managed by KDOT, the Kansas Turnpike Authority (KTA), and local entities throughout the state.

KDOT is including non-NHS assets on the State Highway System (SHS) in addition to the NHS assets required for this TAMP. In this document, pavements are categorized by Interstate NHS, Non-Interstate NHS, Non-State NHS, and Other SHS and bridges are categorized as NHS and Other SHS (i.e. non-NHS).

The NHS consists of 12,618 lane-miles of pavement and 2,830 bridges comprising a total of 31,801,554 square feet of bridge deck. The non-NHS (Other SHS) system covered in this TAMP includes 12,575 lane-miles of pavement and 2,521 bridges comprising 16,363,525 square feet of bridge deck. **Table 3** provides a summary of pavement lane miles and total number of bridges covered in this TAMP.

**TABLE 3** *Asset portfolio summary*

| CATEGORY | QUANTITY |
|---|---|
| **Pavements** (*Lane Miles*) | |
| Interstate NHS (including KTA) | 3,714 |
| Non-Interstate NHS | 8,733 |
| Non-State NHS | 171 |
| Subtotal NHS | **12,618** |
| Other SHS | 12,575 |
| Total | **25,193** |
| **Bridges** (*Number*) | |
| NHS | 2,830 |
| Other SHS | 2,521 |
| Total | **5,351** |

## 3.2 Pavement Asset Portfolio

### 3.2.1 Inventory Summary

The Kansas SHS (including NHS) is approximately 25,000 lane miles,[1] owned and managed by multiple stakeholders. Key stakeholders include KDOT, counties, towns and municipalities, and the KTA. The NHS represents about 50% (12,618 lane miles) of the SHS and makes up about 4% of the Kansas public roads system.

Even though the NHS is only a fraction of the public road system, it carries approximately 50% of the daily vehicle-miles traveled in Kansas. The NHS pavement inventory is owned and/or maintained by KDOT, KTA, and other local governments. However, KDOT collects, owns and maintains most of the NHS pavement inventory. Figure 6 shows the different categories of pavement assets and Table 4 contains KDOT's pavement asset register summarizing the maintenance responsibility of the pavement inventory among the key stakeholders. It is important to note that KDOT shares maintenance responsibility for a small portion of the Interstate NHS roadway owned by KTA. Table 5 shows a breakdown of other NHS owners.

**TABLE 4** *2017 NHS and SHS pavement asset summary*

| PAVEMENT CATEGORIES | | KDOT | KTA | OTHER* |
|---|---|---|---|---|
| Interstate NHS | Lane miles | 2,785 | 929 | — |
| | Percent | 75% | 25% | |
| Non-interstate NHS | Lane miles | 8,733 | — | 171 |
| | Percent | 98% | — | 2% |
| Total NHS | Lane miles | | 12,618 | |
| Other SHS | Lane miles | 12,575 | | |

**Other includes counties, towns, townships, and municipalities including Overland Park, Topeka, Wichita, Augusta, Chanute, Coffeyville, Independence, Ottawa, Emporia, and Kansas City. ^This includes some KTA-owned roadway miles maintained by KDOT through a contract maintenance program.*

**FIGURE 6** *Pavement asset categories and lengths*

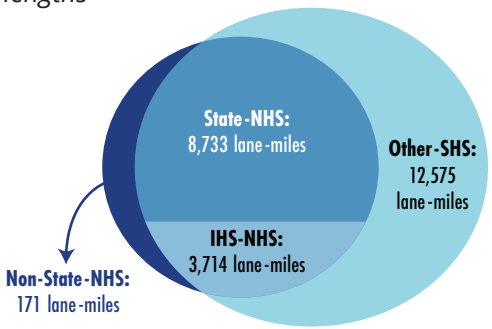



**TABLE 5** *Breakdown of other NHS owners in Kansas*

| OTHER NHS OWNERS | LANE MILES OWNED/ MAINTAINED |
|---|---|
| Augusta | 8.99 |
| Chanute | 3.24 |
| Coffeyville | 4.81 |
| Emporia | 3.42 |
| Independence | 8.88 |
| Kansas City | 14.72 |
| Ottawa | 14.90 |
| Overland Park | 35.33 |
| Topeka | 49.48 |
| Wichita | 27.18 |
| Total | 170.95 |

*1. The pavement management system contains data for segment length and width. To convert to an estimate of lane-miles, it was assumed that the average lane width is 12 ft. (3.7 m).*

### 3.2.2 Pavement Data Management

Asset management is a data-driven process — data that describes the inventory and condition of an asset at a point in time. KDOT gathers and manages pavement data using automated and manual means and has gathered and maintained pavement data for the entire SHS since 1983, including data from other NHS owners.

KDOT's pavement asset inventory is comprehensive, reflecting the different pavement asset categories and subgroups across the state of Kansas. The data collection and management processes have evolved since 1983 to an automated process, to address both KDOT life cycle planning needs and federal requirements. The original methodologies were based on sampling the pavement and were subjective rating assessments. Today, KDOT uses an automated pavement condition data collection system that allows most of the pavement condition data to be collected over almost the entire state highway system at highway speeds.

The van used to collect this data, shown in **Figure 7**, allows for systematic, consistent, repeatable, objective collection of pavement surface data. The Kansas Pavement Data Quality Management Plan provides more details on what the van collects and how it turns that into the data KDOT uses. **Figure 8** illustrates the evolution of pavement roughness data collection procedures since 1983. In addition to this, the collection of cracking data has been automated since 2013. Joint distresses are still collected manually.

**FIGURE 8** *Continued data collection automation since 1983*


Pavement condition data is complete for three of the four distresses required by the federal Performance Management rules (PM2):

- ★ International Roughness Index (IRI)
- ★ Faulting
- ★ Rutting

**FIGURE 7** *KDOT pavement data collection van*

The PM2 rules provide a timeline for State DOTs to collect data and implement these distresses in assessing and reporting pavement performance. The "complete distress and IRI" data collection cycles are 2018 and 2020 calendar years for Interstate and non-Interstate pavements, respectively. KDOT currently has extensive histories for cracking data, though the data collection procedures are not consistent with the PM2 rules. Cracking data was collected manually using visual surveys until 2012, but has been collected using automated techniques since. Additionally, KDOT has pavement performance prediction models for IRI, faulting, and rutting distresses using state-based Markov Transition Matrices for their condition indexes to address Part 23 CFR 515.5 of the federal rules. By the end of 2020, KDOT's data collection practices (including cracking data) will evolve to be consistent with the PM2 rules with the implementation of processes to support pavement cracking modeling. **Figure 9** shows the percentage of pavements (by centerline miles of surveyed pavements) for each of the four pavement subgroups based on surface types. The current collection methodology for pavement condition data has been designed to capture all the distress types expected with these pavement types.

### 3.2.3 Pavement Condition Summary

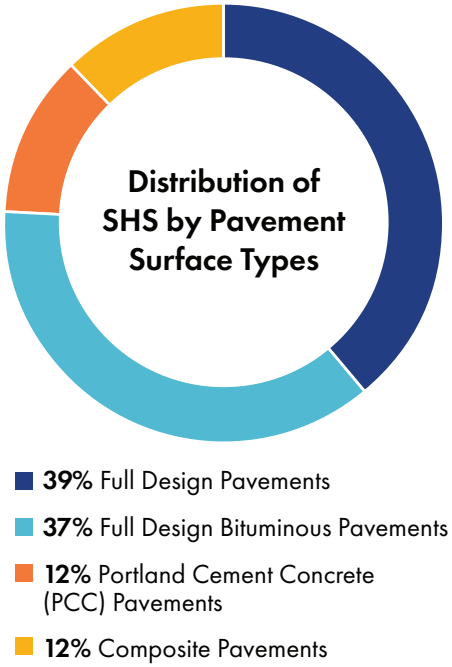
#### PERFORMANCE MEASURES

Federal Requirements (23 CFR 490.307) for Pavement Condition Assessment include four performance measures:

- Percent of pavements of the Interstate System in Good condition;
- Percent of pavements of the Interstate System in Poor condition;
- Percent of pavements of the non-Interstate NHS in Good condition; and
- Percent of pavements of the non-Interstate NHS in Poor condition.

The performance measures are to be computed from four condition metrics — International Roughness Index (IRI), rutting, faulting, and cracking percent. Pavement inventory data elements required are total through lane miles, and surface type. Present serviceability rating (PSR) is allowed as an alternative measure for specific locations where posted speed limits are less than 40mph. However, the percentage of the NHS in this category is not significant so KDOT will not be using PSR.

**FIGURE 9** *Distribution of the SHS by pavement surface types*




#### PM2 FOR PAVEMENT

- 4 federally required performance measures
- 4 condition metrics to compute performance measures
- 2 required data elements for pavement inventory
- 1 alternate performance measure

Internally, KDOT uses three performance measures in assessing and reporting pavement performance. They include percent Good pavements (PL1), percent Fair pavements (PL2), and percent of Deteriorated pavement (PL3 — which can be classified as Poor). These measures take into consideration condition metrics such as IRI, rutting, faulting, and cracking. As discussed above, these existing performance metrics align with the PM2 Pavement requirements, with minimum variations in thresholds. KDOT has established that these differences would not have a significant impact on the overall network performance measures. KDOT will continue to collect and report pavement data using the Highway Performance Monitoring System (HPMS) standards, while continuing to base pavement performance measures on the internal metrics. The Department will continue to use these internal metrics and measures to drive decisions ensuring that the Department achieves or exceeds the national goals and minimum condition requirements.

KDOT is required to establish performance targets, regardless of ownership, for the full extent of the NHS (interstate and non-interstate), and to meet the minimum condition requirements for the Interstate System. The goals established are based on expected available funding (which also serve as constrained performance targets) for the pavement program. The targets or condition goals help KDOT to undertake a performance gap analysis. KDOT's two- and four-year pavement performance targets established in 2018 are shown in Table 6.

Interstate pavement condition goals established in 2001 by KDOT are at a higher standard than those required by the federal PM2 rules. The PM2 rule for Interstate Pavement condition is "no more than 5% in Poor condition," compared to KDOT's more stringent measure of "no more than 3% in Deteriorated (Poor) condition" or the targets set.

**TABLE 6** *Pavement two- and four-year performance targets (established in 2018)*

| TARGET | 2-YEAR | 4-YEAR |
|---|---|---|
| **Interstate NHS** | | |
| Good | 65.0% | 65.0% |
| Poor | 0.5% | 0.5% |

| TARGET | 2-YEAR | 4-YEAR |
|---|---|---|
| **Non-interstate NHS** | | |
| Good | 55.0% | 55.0% |
| Poor | 1.5% | 1.5% |

### PL1 — GOOD

Segments that are smooth and exhibit few, if any, surface defects

### PL2 — FAIR

Segments that appear to require routine maintenance to correct moderate surface defects.

### PL3 — POOR

Segments that appear to require rehabilitation action beyond routine maintenance at the time of the survey

## PAVEMENT ASSET PERFORMANCE

> The 2017 pavement condition shows that KDOT has achieved or exceeded the minimum requirements stipulated in the federal rules for Interstate pavements.

Historically, KDOT's pavements have generally been in good condition due to the consistent investment in pavement preservation and rehabilitation since pavement management began in the 1980s. **Figure 10** shows the trend in the percent of pavement surface in Good (PL1) condition for the years between 2000 and 2016 for Interstate-NHS, non-Interstate NHS, and other SHS pavements. Similarly, **Figure 11** shows the percent of pavement surface in Poor (PL3) condition for the years between 2000 and 2016 compared across the three pavement types. For the KDOT internal measures, the percentage of good, fair, and poor pavements on the Interstate system does not include data for the portions managed by the Kansas Turnpike Authority (KTA) because not all data elements for estimating the PLs are collected on those pavements; however, this does include local NHS portions. To better understand how comparable the conditions are between the KTA maintained pavements and the non-KTA pavements, comparisons were performed with the IRI and rutting. The results showed that the KTA maintained pavements are in comparable condition to the KDOT-maintained pavements, depending on the metrics and road categories compared.

When converted to the federal metrics for pavement performance, KDOT's pavement performance changes, but remains above the established thresholds. As shown to the right, the percent of pavement in good and poor condition (including KTA and local pavement) is within the targets in **Table 6**.

**FIGURE 10** *Pavement surface in good condition for the SHS*

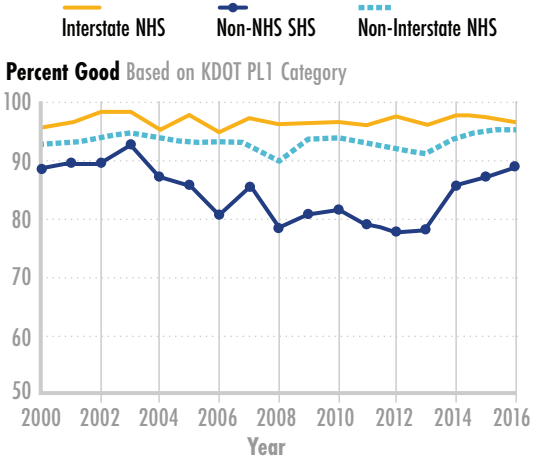
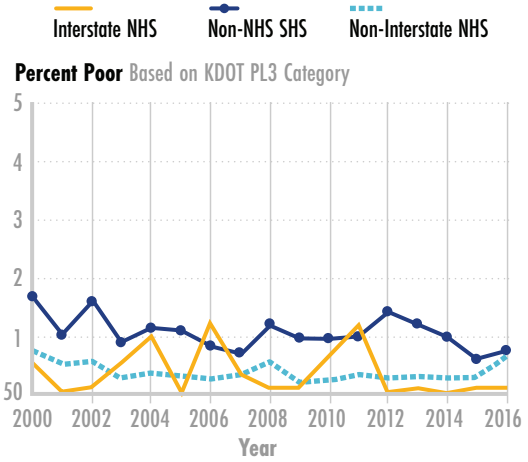
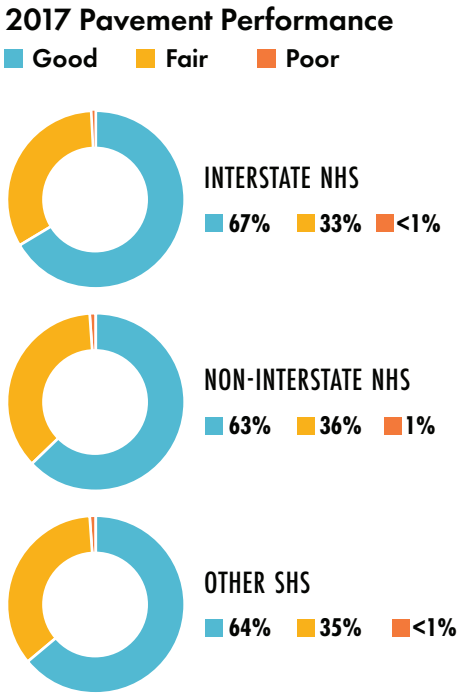



**FIGURE 11** *Pavement surface in poor condition for the SHS*



As mentioned in **Chapter 2**, a Joint Legislative Transportation Vision Task Force was assembled in 2018 to evaluate the status of the Kansas transportation system. During Task Force sessions, the concept of pavement health was introduced, reinforcing KDOT's desire to maintain pavement performance beyond surface condition. Pavement health goes beyond surface condition by incorporating a measure of a pavement's structural condition. It considers the amount (in mile-years) by which pavement life is extended with treatment interventions to counteract declining pavement condition due to normal wear and tear. It is calculated by multiplying the number of miles treated with the estimated number of years added due to that treatment, based on KDOT's experience with that treatment under similar previous conditions. An important distinction to make between the performance measures, which are surface-based, and pavement health, is that virtually all actions improve the surface conditions, but some surface actions hide pavement structural issues below. Thus surface conditions and an indicator of structural health investment are both necessary components to define the state of good repair.

For KDOT, maintaining pavement assets in a state of good repair means keeping them in a condition that meets or exceeds both the federal and state performance requirements and performance targets at both the asset-specific and overall network levels. Beyond the Federal minimum performance thresholds and the Federally-required targets, KDOT's state of good repair is the point at which pavement life is gained at (or higher than) the rate that it is being lost. In other words, pavement assets are in a state of good repair when performance indicates steady-state pavement health, measured in mile-years. In recent years, the surface condition measures have remained steady, but preservation actions have not sufficiently replenished pavement life on the system. If this continues, a rapid degradation may occur that will require "heavier" (more costly) treatments. By continuing to report surface condition and adding a component of pavement health where the overall pavement life is gained at (or higher than) the rate that it is being lost, KDOT can manage pavements to remain in a state of good repair.

**PAVEMENT STATE OF GOOD REPAIR**

**KDOT's pavements are in a state of good repair when pavement life is gained at (or higher than) the rate at which it is being lost. That is, when performance indicates steady-state pavement health, measured in mile-years.**

## 3.3 Bridge Asset Portfolio

### 3.3.1 Inventory Summary

The state of Kansas has a total of 24,786 bridges, of which 2,830 carry the NHS and are subject to federal requirements for the TAMP. Most of these are maintained by KDOT, which owns a total of 5,121 bridges, of which 2,600 are on the NHS. KTA owns 215 of the remaining 230 NHS bridges and 15 are owned by local governments. The largest bridge in Kansas is a 680,596-square foot

structure carrying the southbound lanes of Interstate 135 in Wichita, locally known as the Canal Route. Figure 12 shows the bridge categories included in the TAMP, Table 7 summarizes the Kansas bridge population as of the end of 2017, and Table 8 shows the breakdown of bridge inventory and condition by other NHS owners. Each table also shows the number of bridges in each condition category.

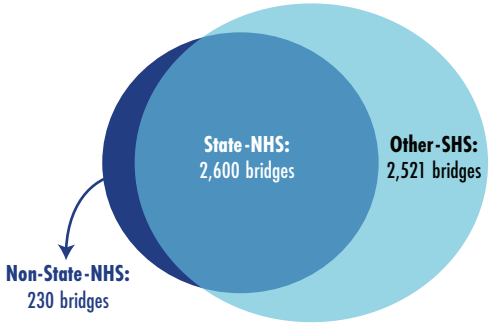
**TABLE 7** *2017 Kansas bridge asset summary with condition (deck area percent shown in parentheses)*

| OWNERSHIP | TOTAL DECK AREA | TOTAL NUMBER | GOOD | FAIR | POOR |
|---|---|---|---|---|---|
| State NHS | 29,068,365 sq. ft. | 2,600 | 2096 (75%) | 491 (23%) | 3 (2%) |
| Non-State NHS | 2,733,189 sq. ft. | 230 | 161 (75%) | 69 (25%) | — |
| NHS Total | 31,801,554 sq. ft. | 2,830 | 2,257 (75%) | 560 (24%) | 13 (1%) |
| Other SHS | 16,363,525 sq. ft. | 2,521 | 1,894 (74%) | 613 (26%) | 14 (<1%) |
| **TAMP Total** | **48,165,079 sq. ft.** | **5,351** | **4,151 (75%)** | **1,173 (24%)** | **27 (1%)** |

**TABLE 8** *2017 Non-state NHS bridge asset summary by ownership (deck area percent shown in parentheses)*

| OWNERSHIP | TOTAL DECK AREA | TOTAL | GOOD | FAIR | POOR |
|---|---|---|---|---|---|
| KTA | 2,324,826 sq. ft. | 215 | 151 (72%) | 64 (28%) | — |
| Wichita Airport Authority | 26,005 sq. ft. | 2 | 2 (100%) | — | — |
| Cities | | | | | |
| Overland Park | 34,257 sq. ft. | 3 | 3 (100%) | — | — |
| Wichita | 47,359 sq. ft. | 4 | 2 (47%) | 2 (53%) | — |
| Topeka | 244,997 sq. ft. | 2 | 2 (100%) | — | — |

**FIGURE 12** *Bridge asset categories*



| OWNERSHIP | TOTAL DECK AREA | TOTAL | GOOD | FAIR | POOR |
|---|---|---|---|---|---|
| Counties | | | | | |
| Montgomery | 11,805 sq. ft. | 2 | — | 2 (100%) | — |
| Shawnee | 2,075 sq. ft. | 1 | — | 1 (100%) | — |
| Wyandotte | 41,864 sq. ft. | 1 | 1 (100%) | — | — |
| **Total Non-state NHS** | **2,733,189 sq. ft.** | **230** | **161 (75%)** | **69 (25%)** | **—** |

Non-state NHS bridge owners submit bridge inspection data to KDOT's Bureau of Local Projects. KDOT then submits all bridge data to the Federal Highway Administration (FHWA) via the National Bridge Inventory. In this TAMP, separate statistics are reported for the NHS and other SHS bridges; the former is to satisfy federal requirements, while the latter is to satisfy KDOT internal management purposes. Bridges that are not on the NHS and not state-owned are not covered by this TAMP, but may be covered by local government planning processes.

### 3.3.2 Bridge Data Management

KDOT maintains a bridge inspection program which exceeds National Bridge Inspection Standards (NBIS), and provides all data necessary for asset performance management. The Department is transitioning to use AASHTOWare Bridge Management Software (BrM) release 6.0 to manage its inventory and inspection data, and its functions support life cycle planning, risk analysis, and investment planning in compliance with 23 CFR 515.17.

Bridges that qualify for the National Bridge Inventory (NBI) must have clear spans of at least 20 feet along the roadway centerline. KDOT and local agencies follow FHWA NBI standards for inspecting Kansas bridges. These bridges are inspected at least every 24 months, but inspection frequencies increase if the bridge is in poor condition.

In addition, KDOT inspects smaller bridges of more than 10 feet in clear span but less than 20 feet at least every four years, although these are not reported to the federal government and are not included in this TAMP. Most bridge inspections are conducted by KDOT personnel,

except for bridges requiring specialized equipment or crews. This includes all bridges on the Kansas Turnpike. The KDOT Bureau of Local Projects only completes an element level inspection on the 15 non-state bridges on the NHS; the local authorities are still responsible for routine inspections.

### 3.3.3 Bridge Condition Summary

#### PERFORMANCE MEASURES

KDOT uses the same bridge condition performance measures as specified under federal rules in 23 CFR 490 Subpart D. These are based on bridge condition assessments conducted by certified bridge inspectors per federal training and quality assurance procedures.

The condition of bridges and culverts is assessed on a scale of 0 to 9, where 0 is the worst condition and 9 is the best condition. Separate assessments are made for decks, superstructures, substructures, and culverts; the lowest of these is used as the overall condition rating for the bridge. For the purposes of performance management and this TAMP, bridges with a rating of 4 or less are denoted Poor, and those with a rating of 7 or better are denoted Good. All others are Fair.

Two performance measures are reported from this information, as established by the FHWA:

- ★ **Percent Good.** The deck area (in square feet) of all bridges in Good condition, divided by the total deck area of the inventory
- ★ **Percent Poor.** The deck area of all bridges in Poor condition, divided by the total deck area of the inventory

All bridges deteriorate over time under the influence of traffic and weather. Bridges in Poor condition may still be safe and serviceable, but require closer monitoring, may have restricted usage, and are often programmed for rehabilitation or replacement if funding is available. Bridges in Fair condition are often programmed for preservation actions to extend their useful lives and to slow or reverse their physical deterioration. In general, most bridges in Good condition are up-to-date on their preservation and maintenance requirements and can be expected to serve the public for many more years.

KDOT's two- and four-year bridge performance targets established in 2018 are shown in Table 9.

**Element-Based Condition Assessment Scale**


**TABLE 9** *NHS bridge two- and four-year performance targets (established in 2018)*

| TARGET | 2-YEAR | 4-YEAR |
|---|---|---|
| Good | 70.0% | 70.0% |
| Poor | 3.0% | 3.0% |

## BRIDGE ASSET PERFORMANCE

Kansas bridges on the NHS and SHS are in generally good condition. Bridge performance exceeds the targets established.

Like pavements, maintaining bridge assets in a state of good repair means keeping them in a condition that meets or exceeds both the federal and state performance requirements and/or targets. More specifically, KDOT's bridges are in a state of good repair when the percent of bridge deck area in good condition is at or greater than 80%, and percent in poor condition is no greater than 1%.

**Figure 13** and **Figure 14** illustrate the historical condition for KDOT's bridge assets. As shown, the percentage of bridge deck in both good and poor condition has reduced over time, showing improvement in the measure for poor, but a decline in good. Federal laws specify certain sanctions that apply to states whose percent Poor on NHS bridges exceeds 10%. The State's current percentage of NHS bridges in poor condition is well below this threshold. Generally, both the NHS and the SHS inventory satisfy the two- and four-year bridge performance targets established; however, bridges are not in a state of good repair.

**FIGURE 13** *Percentage good deck area on NHS and SHS*

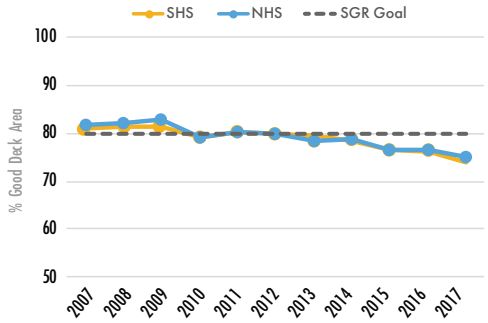
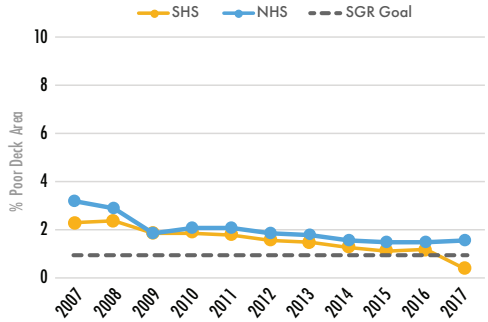
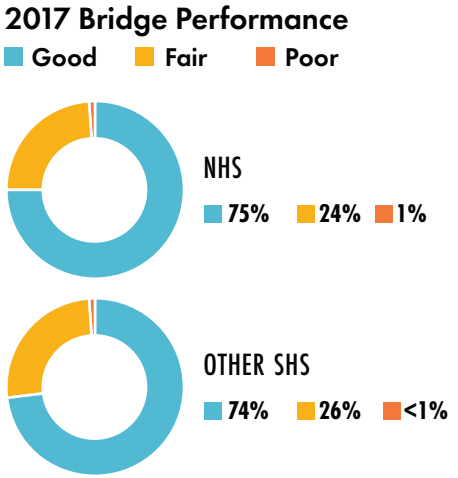



**FIGURE 14** *Percentage poor deck area on NHS and SHS*




There is a significant risk that NHS and/or SHS bridges may fail to meet the target for bridges in good condition within the next 10 years. Typically, the way to mitigate this risk is to increase the allocation of funding to preservation activities, which will reverse or slow the deterioration of bridge condition and extend bridge life. The life cycle planning analysis detailed in **Chapter 4** demonstrates KDOT's options for managing this decline and improving performance towards a state of good repair.




### BRIDGE STATE OF GOOD REPAIR

KDOT's bridges are in a state of good repair when the percent of bridge deck area in good condition is at or greater than 80%, and percent in poor condition is no greater than 1%.

## Demand Analysis

Over the time horizon for this TAMP, the demand for and use of the Kansas highway system may be influenced by continued changes in population demographics, heavy vehicle type and number, and other factors. Changing demand will affect how KDOT will utilize this TAMP and continue to implement asset management principles.

### 3.3.4 Population Trends

Population forecasts project that Kansas' population will increase from 2.9 to 3.5 million in the next 50 years, growing 22% by 2064, which represents a low percent annual population growth of about 0.4%. In addition, population forecasts show a continuation of the sizeable shift from rural to metropolitan areas that has marked the past few decades of growth in Kansas. Communities in Johnson County around Kansas City are some of the fastest-growing in the United States. This expected population growth and shift from rural to urban will have a direct bearing on transportation systems, and will impact transportation needs and resource allocation in the future.

### 3.3.5 Statewide Miles Traveled

Figure 15 shows the total annual vehicle mileage in Kansas from 1947 to 2015. As shown, there has generally been a consistent increase in vehicle miles traveled (VMT) throughout the state. Similarly, Figure 16 shows a consistent increase in the daily vehicle miles traveled (DVMT) on the state highway system.

**FIGURE 15** *Annual vehicle mileage from 1947 to 2017*

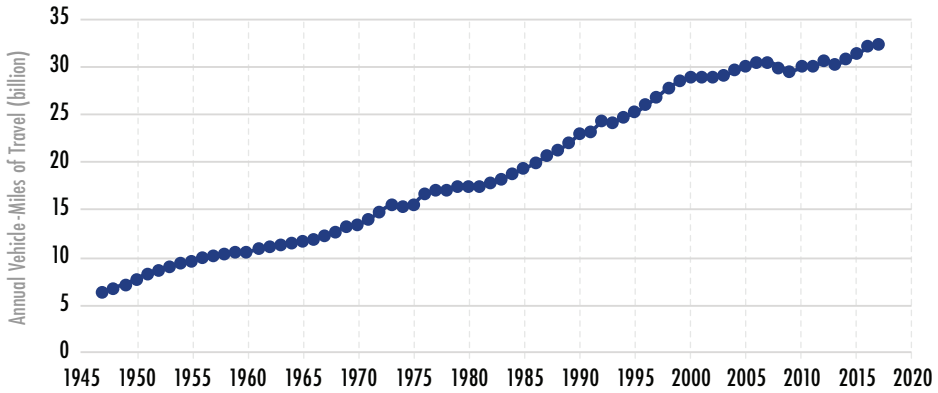
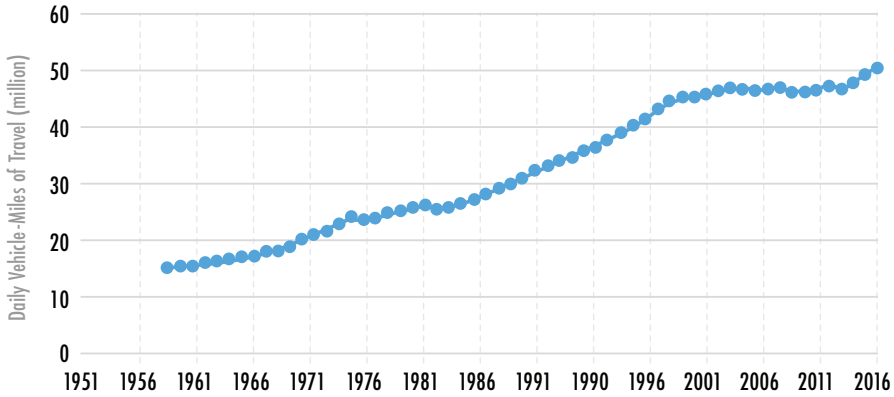


**FIGURE 16** *Kansas SHS daily vehicle miles traveled from 1958 to 2016*




With over 50% of statewide DVMT occurring on the SHS in 2016, continued increases in vehicular travel throughout the state can be correlated to increased travel on the SHS. This will continue to impact bridge and pavement asset condition and increase demand for assets in good condition.

### 3.3.6 Economic Indicators of Travel Demand

A thriving economy creates more demand for transportation throughout all sectors. For example, high employment rates translate into more trips as people commute, shop, and play. As of December 2017, the unemployment rate in Kansas was 3.4%, which is less than the United States rate of 4.1% and reflects a decrease of 0.9% since the December 2016 rate. Unemployment in Kansas has consistently declined since 2010, indicating that people have continued to become employed which results in increased travel.

Freight trends must also be considered when addressing economic impacts on future transportation needs. In the 2017 Kansas Freight Plan, it was indicated that truck tonnage on Kansas roads is forecast to increase by about 34% between 2014 and 2040. With truck miles of travel making up about 15% (in 2015) of total vehicle miles of travel in the state, this projected increase in truck travel will have a substantial impact on roadway condition.

Ultimately, indicator trends suggest that travel on roadways in Kansas, including the NHS and Other SHS, will continue to grow and it is critical that KDOT pursues asset management principles to manage transportation infrastructure to continue to support the dynamic demand.

# CHAPTER 4 LIFE CYCLE PLANNING

> "A process to estimate the cost of managing an asset class, or asset sub-group, over its whole life with consideration for minimizing cost while preserving or improving the condition" (23 CFR 515.5)

Life cycle planning (LCP) is an approach to managing transportation assets over their whole life, from the time each asset goes into service after construction to the time it is retired or replaced. KDOT has forward-looking policies and procedures to effectively support LCP, which require logical rules, complete high-quality data, modeling tools, and sound methods to help analyze and evaluate the long-term cost of different scenarios. The primary focus of LCP is to identify investment strategies that minimize cost, address risks, and support the maintenance of highway transportation assets in a state of good repair. FHWA requires that state DOTs establish a process for conducting LCP at the network level for NHS pavements and bridges.

**THE LCP PROCESS MUST INCLUDE**

- **Targets for asset condition**
- **Identification of deterioration models**
- **Potential work types across the whole life with their relative unit cost**
- **Strategy for managing assets by minimizing its life cycle costs**

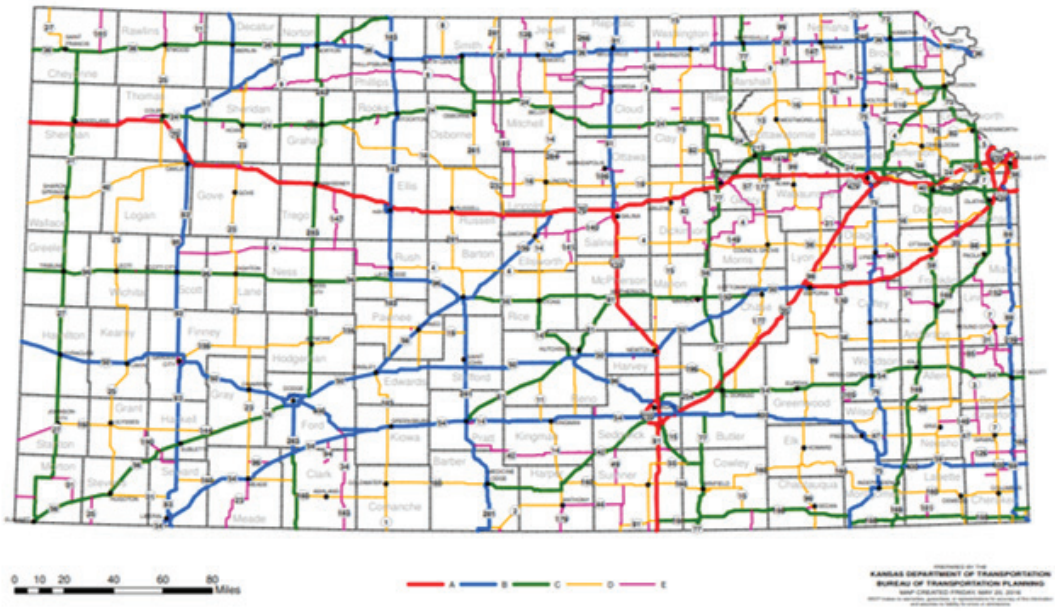
## 4.1 Pavement Life Cycle Planning

KDOT has five categories of routes (**Table 10**). Interstate NHS routes and most non-IS NHS routes are categorized within classes A through C and usually receive higher priority, while Class D and E routes are considered less critical. This priority ranking approach forms the foundation of what is considered risk-based prioritization to support minimization of life cycle cost. It allows KDOT to address pavement locations with higher criticality in terms of safety and the degree of impact on the traveling public. Once these high-risk locations are addressed, KDOT uses optimization to select the next potential list of investments. In the optimization phase, all routes compete on the same playing field using system performance and cost effectiveness as driving variables. The following sections describe the key elements that support KDOT's LCP approach for pavement assets. See **Figure 17** for a map showing route classification.

**TABLE 10** *Route Classifications*

| CLASSIFICATIONS | |
|---|---|
| Class A | IHS, including the Kansas Turnpike |
| Class B | Highways that serve the most important statewide and interstate travel corridors |
| Class C | Routes closely integrated with Class A and B routes to service all parts of the State |
| Class D | Routes that serve small urban areas and provide intercounty travel |
| Class E | Routes that serve small urban areas and provide intercounty travel |

**FIGURE 17** *KDOT route classification system map*



### 4.1.1 Data Collection

Life cycle planning is a data-driven process requiring condition data on assets (i.e. Roughness and Rutting), expected changes in system demands and needs (i.e. traffic growth and traffic composition), available budget for pavements, as well as treatment history and associated costs. Although many data elements about the pavement can be collected, the important elements are those that either provide information about conditions that impact users or information that impacts KDOT's ability to make good cost-effective decisions. The user impact elements include roughness, faulting, and rutting (a safety issue). The cost elements include the user impacts plus cracking and joint distress. KDOT has collected and used this type of information for more than 30 years. The uses were not only to predict and plan for future needs but also to communicate the performance. While data collection policy is generally underpinned by the statewide GIS Strategic Plan, a Data Quality Management Plan completed in 2018 documents specific data collection criteria, policy, and guidelines for KDOT's pavement data collection.

KDOT updates pavement condition data housed and managed within the state's pavement management system (PMS) annually in the spring. This condition data forms the backbone of KDOT's LCP approach. The purpose of the data is to feed into the pavement Network Optimization System (NOS), and to support the pavement needs assessment and the selection of pavement projects. The NOS recommends work types for each district alongside candidate project locations. Currently, the PMS tracks historic treatments; however, there is a gap to link the average cost of treatment per unit measure to the historical treatment. Where cost data exists, there is a level of variability in the data that requires expert judgment to make the data useful. Like many state DOTs, KDOT counts on expert knowledge to inform the decision-making process when there is a data gap. KDOT continues to gather useful data to support LCP and to help develop cost-efficient investment strategies for the long-term benefit of the taxpayer.

### 4.1.2 Tools and Modeling Techniques

LCP relies on predictive analytical techniques to establish and understand the relationships between performance outcomes and funding levels.

The KDOT PMS is equipped with modeling capabilities that use several predictive equations to estimate different variables. The PMS uses condition data and predictive equations to estimate pavement-related individual distresses and composite measures. For example, the prediction models estimate the drop (reduction) in distress due to heavy rehabilitation action, distress level at one year after the rehabilitation action, and distress levels at each subsequent year after the rehabilitation action. Figure 18 shows an example of the modeling output.

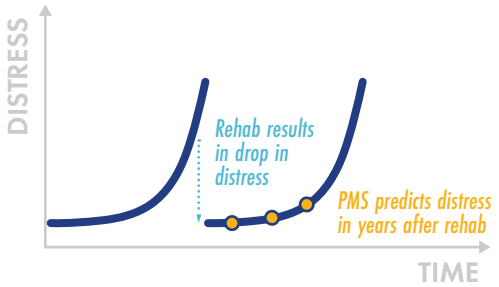
The estimation of design life serves an important purpose in the LCP process. The estimated design life measures the expected time elapsed from the last heavy rehabilitation action to the time it reaches an established threshold level of distress.

Deterioration models used in KDOT pavement management were originally derived from expert opinion through a modified Delphi process. These models were subsequently revised based on historic time-series pavement condition data. The deterioration models predict the next year's pavement condition under routine maintenance. Using the performance output from one cycle of the model as the input to the next year allows for stepwise, multiple year predictions of future performance.

**KDOT PMS MODELS PREDICT...**

- Rutting and transverse cracking for flexible pavements
- Faulting and joint distress for rigid pavements
- Roughness and design life for flexible and rigid pavements

**FIGURE 18** *Behavior of pavement performance (distress) after a rehabilitation action*



Similarly, KDOT estimates composite measures such as the percent of pavement miles in the three PL categories discussed in **Section 3.2.3**. Pavement assets deteriorate at different rates depending on different variables and characteristics such as pavement classification, location, present condition state, environmental conditions, etc. For example, Interstate-NHS pavements are built with stronger base and extra thickness than other pavements. Hence, the deterioration rate of Interstate-NHS pavements in each period will be different from other categories of pavements with similar starting conditions and usage history. The current deterioration models consider this differentiation and other important variables in predicting future condition and performance of pavement assets. In addition to these measurable variables, KDOT draws upon the knowledge base of its experts to make informed decisions on the output of the tools and modeling techniques.

As KDOT is concerned about the condition of the entire state highway network, it follows that the NOS part of pavement management incorporates the whole network which is made up of pavements in varied states of age, condition, and construction standards. A narrow focus on the life cycle pavement sections in isolation would fail to encompass the decisions required to create a continuous (both over time and across the network) system to meet Kansas' needs. The pavement management system combines the current condition, target condition, deterioration models, post treatment condition models, and treatment costs to generate strategies for the amount and type of work and associated costs. KDOT uses a somewhat unique methodology that generates an optimized solution to meet future condition targets with a minimum cost and a set of conditions that allows the system to be maintained perpetually.

### 4.1.3 Treatment Options and Cost

KDOT's deterioration models compute the expected change in condition based on the type of treatment applied. Some treatments result in a reset to very good pavement conditions, other actions may provide some improvement but not a complete reset.

KDOT uses a mix of treatment options to address pavement needs. Within the PMS, treatments are assigned an equivalent thickness of asphalt and a work type. The equivalent thickness for the treatment is the means to allow all treatments to be modeled and compared for consideration. The work type and existing condition of the pavement determine the combination of treatment options that KDOT applies to address a deficiency.

The process is a combination of selection rules enforced in the NOS and experts' knowledge. The NOS recommends a set of feasible actions for KDOT to consider in developing work plans. However, senior managers make the final investment decision after careful consideration of engineering recommendations and inputs from the field staff.

Treatments can change pavement condition, but at a real cost. Just as different treatment options have different expected results, they also have different expected costs. KDOT first used bid tabulations to compute treatment costs (combining bid items into treatments). Eventually, a less complicated process to determine treatment unit costs was developed using historic project costs. Historic treatment unit costs also allowed for better incorporation of maintenance preparation costs. Unit costs under both the bid tabulations and historic treatment costs varied based on the pavement condition prior to the treatment. Thus, the additional costs due to poorer pavement condition was captured and added to the treatment costs.

Table 11 presents the types of treatments and associated costs that KDOT uses in addressing pavement deficiencies. The unit costs provided come from actual projects and as shown, can vary widely depending on the amount and extent of work performed on the pavement class. KDOT considers the cost effectiveness of each treatment type in selecting the treatments that make up the work types.

**TABLE 11** *Pavement treatment options, costs, and work types*

| TREATMENT OPTION | COST PER LANE MILE | | WORK TYPE |
|---|---|---|---|
| | Interstate pavements | Non-interstate pavements | |
| Chip seal | $28,000 | $20,000 | Preservation |
| Overlay 1.5" | $40,000 (2004) | $48,500 | Preservation |
| Patching full depth | $78,000 | $146,000 | Preventive Maintenance |
| New concrete | $1,500,000 | $1,320,200 | Reconstruction |
| Bonded wearing surface | $51,000 | $57,500 | Preservation |
| Mill 1.5", Overlay 1.5" | $118,000 | $81,500 | Rehabilitation |
| Extensive patching, overlay 3" | $135,000 | $140,000 | Heavy Preservation |

### 4.1.4 Pavement LCP Scenarios

> The primary objective of KDOT's LCP approach is to identify investment strategies that minimize the life cycle cost of maintaining pavement assets in a state of good repair for the available or expected funding.

LCP enables KDOT to analyze and evaluate different long-term scenarios and the impact on cost/funding needs, performance, risk, and agency and national goals. Through the LCP process, KDOT identifies potential risks associated with each investment scenario and prioritizes the most cost-efficient investments that effectively target potential risks and manage customer expectations. With current pavement condition, performance targets, deterioration models, post treatment condition models, and treatment costs, a good pavement management system has most of what it needs to provide performance-based decision support for treatment strategies across a pavement network.

To promote a comprehensive evaluation of alternatives, KDOT conducts different LCP scenarios using data (pavement condition and funding availability), modeling tools, and information from experts. The scenarios compare pavement performance for the annual funding KDOT is expected to receive. Each scenario is conducted with the assumption that pavement assets have a perpetual service life; however, expected service life of 20 years is assumed for analysis involving new construction/major rehabilitation.

Although the PMS output is at the network level, analysis is done by road categories, of which there are about 23 in total. Road categories are defined based on highway type (interstate versus non-interstate), asset subgroup (asphalt, concrete, etc.), width, and traffic levels. Once appropriate work types and treatments are applied, results are aggregated to provide interstate and non-interstate performance summaries. Since KDOT's investment decisions are blind to whether a pavement is on the NHS or not, the following scenario summaries present results broken down into only two categories: interstate and non-interstate.

**KDOT PAVEMENT LCP SCENARIOS**

- Worst first
- Steady state
- Desired state of good repair

## WORST-FIRST LCP SCENARIO

The **worst-first scenario** is only presented to illustrate the importance of asset management pertaining to the efficient use of limited resources. The model primarily addresses poor pavements with reconstruction as the main strategy. Table 12 summarizes the funding allocation between pavement categories and treatment types.

**TABLE 12** *Worst-First Scenario Funding Allocation*

| PAVEMENT CATEGORY | RECONSTRUCTION | HEAVY PRESERVATION | MEDIUM PRESERVATION | LIGHT PRESERVATION |
|---|---|---|---|---|
| Interstate | 33.4% | 0.0% | 0.0% | 0.0% |
| Non-Interstate | 66.6% | 0.0% | 0.0% | 0.0% |

Figure 19 and Figure 20 show the output performance. As shown, in this scenario pavements in poor condition are eliminated in exchange for more miles falling out of the good category.

KDOT does not pursue this investment scenario because it is costly and does not allow system goals to be achieved. The scenario prioritizes pavements requiring reconstruction or heavy rehabilitation (i.e., poor pavements), allocating remaining funding to lighter treatments that target fair pavements. In other words, this approach does not consider pavement preservation as a priority for investment.

## STEADY-STATE LCP SCENARIO

The second scenario representing the current approach, or **steady state**, analyzes pavement performance assuming a perpetual service life using the existing investment approach. A steady-state analysis determines the minimum cost set of treatments that returns the pavement to the previous year's condition. Put another way, the amount of work put in each year equals the amount of deterioration each year. The scenario considers a combination of maintenance, preservation, heavy rehabilitation, and reconstruction work types. When the work and deterioration are in balance for a minimum cost, steady state is achieved. Table 13 summarizes the funding allocation between pavement categories and treatment types used in this scenario.

**FIGURE 19** *Worst-First Scenario Pavement Percent Good Output*

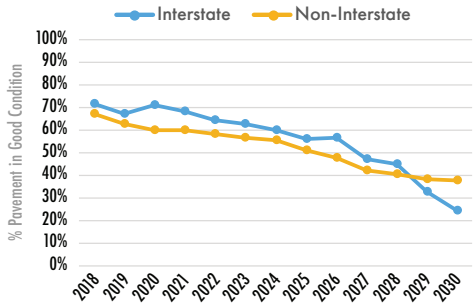



**FIGURE 20** *Worst-First Scenario Pavement Percent Poor Output*

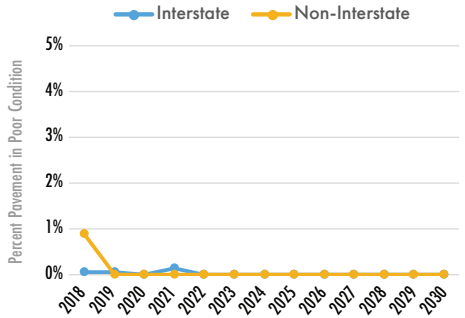


**TABLE 13** *Steady-State Scenario Funding Allocation*

| PAVEMENT CATEGORY | RECONSTRUCTION | HEAVY PRESERVATION | MEDIUM PRESERVATION | LIGHT PRESERVATION | TOTAL |
|---|---|---|---|---|---|
| Interstate | 0.9% | 2.7% | 2.9% | 5.8% | **12.3%** |
| Non-Interstate | 77.5% | 1.4% | 1.5% | 7.3% | **87.7%** |

The pavement performance output is summarized in **Figure 21** and **Figure 22** which show that the pavement surface conditions are held relatively constant over the scenario period. In this scenario, miles and costs continue to rise since the only pavements being addressed are those about to fall to fair condition and those reaching the poor category requiring expensive reconstruction to limit the percent poor.

## DESIRED STATE OF GOOD REPAIR (SGR) LCP SCENARIO

After developing the steady state constraints, the NOS is run based on the current condition and the previously described parameters. The system is asked to generate a plan to transition from the current set of pavement conditions to a **desired state of good repair** (SGR) for the pavement asset.

This scenario presents a balanced approach to maintain performance, spreading the types of actions so that different pavements are regularly receiving structural condition improvements as well as improvements to surface conditions. In some respects, this scenario is a recognition that only basing pavement investment decisions on surface conditions will have long-term detrimental impacts. In other words, repeated light treatments on the same location will eventually have diminishing benefits. **Table 14** summarizes the funding allocation between pavement categories and treatment types used in this scenario.

**TABLE 14** SGR *Scenario Funding Allocation*

| PAVEMENT CATEGORY | RECONSTRUCTION | HEAVY PRESERVATION | MEDIUM PRESERVATION | LIGHT PRESERVATION | TOTAL |
|---|---|---|---|---|---|
| Interstate | 5.4% | 5.3% | 9.1% | 13.5% | **33.3%** |
| Non-Interstate | 1.8% | 4.0% | 29.1% | 31.8% | **66.7%** |

**FIGURE 21** *Steady-State Scenario Pavement Percent Good Output*

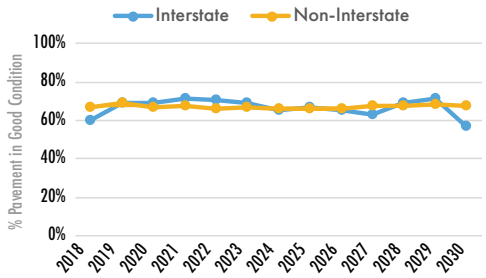
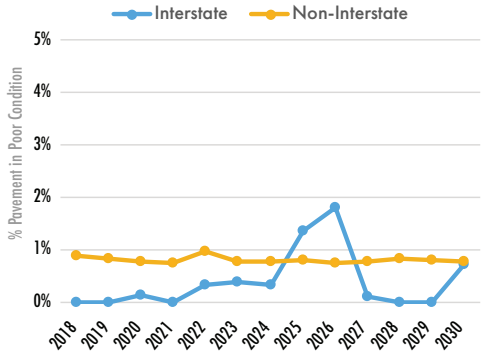



**FIGURE 22** *Steady-State Scenario Pavement Percent Poor Output*



Investments in this third scenario are driven by KDOT's two- and four-year pavement performance targets as well as the national goals. This scenario prioritizes investments that enable KDOT to achieve the established performance targets or meet minimum pavement condition requirements and determines the level of funding required to achieve the desired state of good repair in each analysis year. For this, the NOS incorporates the deterioration models, evaluates different mixes of work types, and provides an optimal (cost-effective) strategy for treating the pavements as a system. This scenario helps KDOT communicate the investment gaps between current investment levels and required investment levels to achieve the desired state of good repair with decision makers and other stakeholders. The pavement performance output is summarized in Figure 23 and Figure 24.

**FIGURE 23** *SGR Scenario Pavement Percent Good Output*

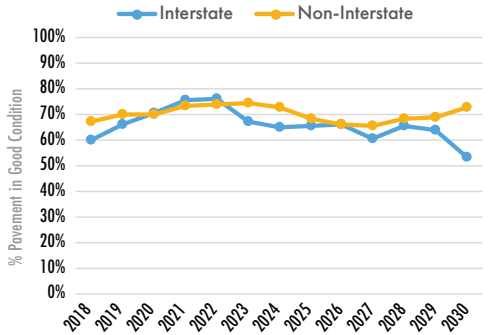
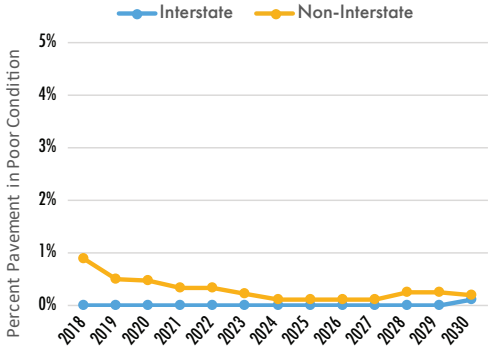



**FIGURE 24** *SGR Scenario Pavement Percent Poor Output*



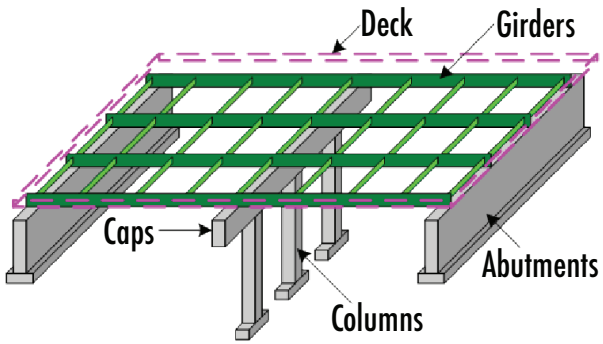

## 4.2 Bridge Life Cycle Planning

> KDOT is currently implementing a state-of-the-art system for developing and evaluating bridge preservation projects based on safety, mobility, risk, and life cycle cost.

### 4.2.1 Data Collection

As a key ingredient in its life cycle planning strategy, KDOT was an early adopter of a process known as element-level inspection. Each bridge is subdivided into elements, such as those shown in Figure 25, having unique profiles for deterioration and costs. Trained inspectors note early signs of distress on each element during regular inspections. The classification of defects is standardized so changes in condition can be tracked over time. This gives KDOT a way of identifying problems before they become serious, when it is inexpensive to solve them. It also has enabled the agency to amass a rich database that can support research and development of improved management tools.

**FIGURE 25** *Element composition of a bridge: each part receives a separate condition rating*



### 4.2.2 Tools and Modeling Techniques

KDOT officials have been leading a national effort to develop state-of-the-art databases and tools to support the planning of bridge preservation.

KDOT has implemented AASHTOWare Bridge Management Release 6.0 (BrM) to support bridge LCP, and continues to enhance configuration of the system to more closely match Kansas state parameters. While still in progress, BrM has been used to generate LCP scenario outputs to support the development of this TAMP, with caveats. Full implementation and configuration of the system is expected to be completed by June 2020.

The Department has been gathering the bridge inventory and condition data required for BrM since the mid-1990s, starting with BrM's predecessor system, Pontis. BrM is already being used to generate STIP projects by means of a priority-setting formula.

In 2018, KDOT developed models for bridge element deterioration, metrics for treatment cost and effectiveness, and decision rules suitable for BrM implementation. Because bridges have a long lifespan that can exceed 100 years, BrM uses deterioration models that can estimate long-term conditions over 100 years or longer, accounting for the significant uncertainty in those forecasts. Decisions made in the STIP today about the preservation of bridges can have long-term consequences and, if optimized, can significantly reduce the long-term costs of keeping bridges in service. Deterioration models were developed using recent historical bridge inspection data to ensure that forecasts are a realistic fit to Kansas weather and traffic.

When BrM implementation is fully completed in June 2020, the LCP scenario analysis performed under multiple alternatives of replacement, rehabilitation, preservation, and maintenance will be used in place of, or in conjunction with, the existing priority formula to enable the Department to select bridge projects that minimize long-term costs while satisfying safety and mobility goals.

With BrM fully functional, KDOT will be able to use its bridge management system to determine an optimal funding level for preservation at the network level for a 10-year or longer timeframe as needed by decision makers; to select work candidates and STIP items at the bridge and project level; to forecast future network conditions under fiscal constraints; and to establish and track condition targets. With this KDOT will have a state-of-the-practice capability to conduct asset management planning for bridges over the long term.

**AASHTOWare Bridge Management software is a BMS solution focusing on the complete bridge management cycle — including inspection, inventory data collection, and analysis. The software recommends an optimal preservation policy, predicts needs and performance measures, and develops projects to include in agency capital plans.**

Figure 26 shows a common pattern of long-term cost analysis that KDOT can develop using BrM. If an agency were to allow a bridge to deteriorate with no maintenance throughout its life, the bridge in the figure would have a lifespan of 60 years before it must be replaced. However, if a well-designed preservation program is undertaken, that same bridge can be made to last as long as 100 years. Over the long term, the preservation strategy is significantly less expensive.

Consistent past financial support by elected leaders for the bridge preservation program has led to a bridge inventory that is, overall, in very good condition. Analysis tools now being implemented by KDOT (presented in Table 15) will enable the agency to sustain safe and serviceable infrastructure into the future if the preservation program is consistently funded.

When these models are fully operational, KDOT will be able to estimate life cycle costs for individual bridges and for the whole highway network. That capability will allow KDOT to:

- Generate and compare preservation alternatives to select those which are most cost-effective
- Estimate the return on investment of such activities
- Optimize available near-term funding as far as possible to ensure safe and reliable service, and to minimize long-term costs

**FIGURE 26** *Life extension from bridge preservation (typical example)*

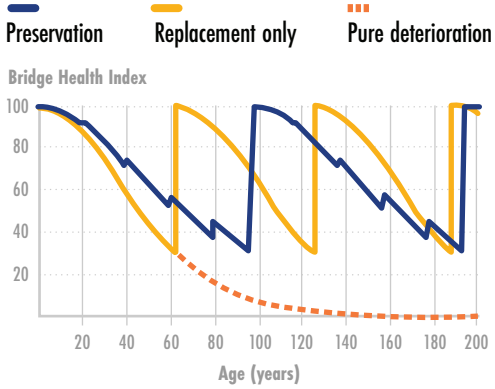



**TABLE 15** *New tools to be adopted at KDOT over the next year*

| TREATMENT OPTION | FEATURES & BENEFITS |
|---|---|
| Action effectiveness models | Models measuring the ability of KDOT preservation activities to improve bridge conditions. This information is useful for anticipating future costs as well as for developing improved maintenance methods. |
| Cost analysis | Analysis to accurately estimate future preservation costs and to help improve productivity and efficiency of workers and materials. In preparation for the 2010-2020 capital program KDOT had developed a set of cost models for its (then) Pontis system, which it now is updating in preparation for a future capital program. |
| Economic models | Models to estimate the cost of managing individual bridges, the inventory and relevant subsets of the inventory over their whole life with consideration for minimizing cost while preserving or improving the asset condition. This leads to the ability to quantify the long-term benefit of postponing major expenditures through effective preservation. |
| Investment strategies | Tools to estimate total network level costs for alternative policies and levels of investment, to support the establishment and achievement of condition targets as well as accomplish safety and mobility goals of the state and federal governments. |

### 4.2.3 Treatment Options and Costs

Unlike manufactured assets such as cars and trucks, every bridge is custom-made in its final location, mostly of native materials, and open to weather and traffic throughout its construction and service life. There is considerable variability in lifespan from one bridge to another, for many complex reasons. Trained inspectors revisit each bridge, usually on a biennial basis, to prepare a detailed record of conditions found on each element. The nature of these conditions determines the appropriate preservation treatment and its cost.

Figure 27 presents three examples of Kansas bridges, all in Fair condition. These bridges could provide satisfactory service for years with little or no maintenance. However, all show prime opportunities for relatively inexpensive preservation treatments that could prolong their lives. These are the types of activities that make up a preservation program to minimize life cycle costs, maximize safety, and avoid disruptions to the movement of people and goods on the highway network. When KDOT's bridge management system is fully implemented in 2020, the agency will be able to accurately identify and program preservation projects over a one to five-year time frame, and forecast budgetary needs for the five- to ten-year timeframe, ensuring that the bridge inventory remains in a state of good repair over the long term. To accomplish this goal, KDOT will develop models of treatment cost and effectiveness over the next year.

### 4.2.4 Bridge LCP Scenarios

> The bridge LCP analysis uses KDOT's best available data and systems to identify investment strategies that minimize the life cycle cost of maintaining bridge assets in a state of good repair for the available or expected funding.

While BrM configuration is on-going, KDOT developed scenarios to compare the potential impact of different investment levels on bridge asset performance. In these scenarios, deterioration modeling is at the NBI level, as opposed to element-level. Due to the combination of historical component condition and the use of NBI deterioration, BrM treatment recommendations in all scenarios only include bridge component replacement and rehabilitation as work types. In addition, this analysis uses national average configuration data, in place of KDOT-specific configuration parameters, which are still under development. Once configuration is complete, KDOT will be able to run more accurate scenarios to evaluate LCP analysis for Kansas' NHS and Other SHS bridges, with results that will include other work types. In the interim, the two

**FIGURE 27** *Examples of bridge preservation opportunities*

**BRIDGE DECK**

This bridge deck is sound except for a localized area with cracks and two large spalls. These defects allow water into the concrete, where it can corrode the underlying reinforcing steel. Restoring the waterproofing and wearing surface in this area would protect the deck from corrosion.

**EXPANSION JOINT**

This expansion joint has been damaged by truck traffic, but the rest of the deck is sound. The damaged joint not only provides an uncomfortable ride and potential for crashes, but also allows water to drip onto the steel below, encouraging corrosion. Repair of this expansion joint would help keep water out of the structure and avoid a safety hazard.

**STEEL BEAMS**

The steel beams here show some early signs of rust. The rust is happening because the paint has begun to deteriorate, allowing water to corrode the steel. At this point the rust is merely superficial, but if allowed to continue it will eventually reduce the strength of the beam. Repainting now is far less expensive than repairing the steel later, and will offer 10-20 years of protection from further corrosion.

scenarios summarized below present analysis completed using the best available data with the goal of maintaining bridge performance at current levels (i.e. achieving steady-state).

## HISTORICALLY REPRESENTATIVE INVESTMENT LEVEL

The **historically representative scenario** considers an average annual funding of $160 million which, although slightly higher than the typical range of $120 to $125 million, is representative of KDOT's historical bridge preservation funding levels. To maintain performance as close as possible to current levels, the model primarily recommends replacing bridge components with few rehabilitation treatments. **Table 16** summarizes the funding allocation between bridge categories and treatment types.

**TABLE 16** *Historically Representative Scenario Funding Allocation*

| WORK TYPE | RECONSTRUCTION | REHABILITATION | MAINTENANCE | TOTAL |
|---|---|---|---|---|
| Funding Allocation | 76.4% | 23.4% | 0.2% | 100% |

As shown in the output performance in **Figure 28** and **Figure 29**, this investment level results in declining proportions of bridges in good condition with an increasing percentage of bridges in poor condition.

This demonstrates that the current investment levels are not sufficient to maintain KDOT's bridge performance at current levels. While the percent of bridges in poor condition remain within KDOT's target and Federal minimum requirements, the percent good declines below the established two- and four-year targets. In both cases, KDOT cannot achieve a state of good repair for bridges in the long-term.

### KDOT BRIDGE LCP SCENARIOS

- Historically Representative Investment Level
- Increased Investment Level

**FIGURE 28** *Historically Representative Scenario Bridge Percent Good Output*

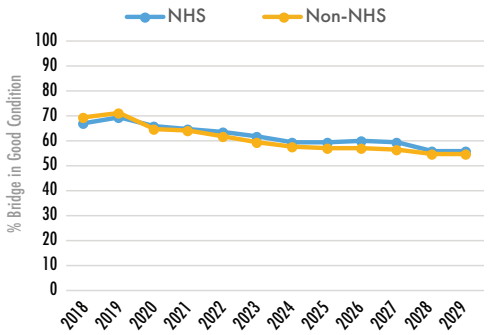
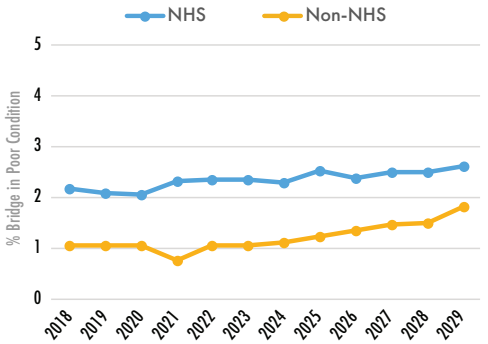



**FIGURE 29** *Historically Representative Scenario Bridge Percent Poor Output*



### INCREASED INVESTMENT LEVEL

The **increased investment scenario** considers an average annual funding of $250 million which exceeds KDOT's historical bridge preservation funding levels. Like the previous scenario, the model primarily recommends replacing bridge components with few rehabilitation treatments to maintain performance as close as possible to current levels. **Table 17** summarizes the funding allocation between bridge categories and treatment types.

**TABLE 17** *Increased Investment Scenario Funding Allocation*

| WORK TYPE | RECONSTRUCTION | REHABILITATION | MAINTENANCE | TOTAL |
|---|---|---|---|---|
| Funding Allocation | 83.9% | 16.0% | 0.1% | 100% |

The results of this scenario are shown in **Figures 30** and **Figure 31**.

As shown, KDOT will be able to maintain bridges in good condition relatively near current conditions, while reducing the percent of bridges in poor condition. In the long-term, this level of funding achieves a state of good repair for bridges as defined by the percent poor (<1%), but not as defined by the percent good (>80%). Nonetheless, the two- and four-year targets and Federal minimum requirements are met for both bridges in poor condition and in good condition. These scenarios make the case for increased investment in bridge preservation at KDOT.

## 4.2.5 Bridge LCP Process Improvements

KDOT is still in the process of configuring BrM 6.0 to be able to inform an improved preservation program. As previously mentioned, full implementation is expected by June 2020, at which point outputs can be incorporated into investment decision making, overall programming, and delivery of the preservation program. Once configuration is complete, KDOT will revisit the LCP analyses documented in this chapter to produce more accurate and representative output. KDOT will then be better able to use this analysis to inform selection of treatments and projects to support improved pavement preservation towards a state of good repair.

**FIGURE 30** *Increased Investment Scenario Bridge Percent Good Output*

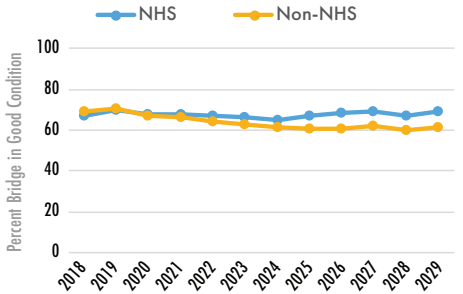
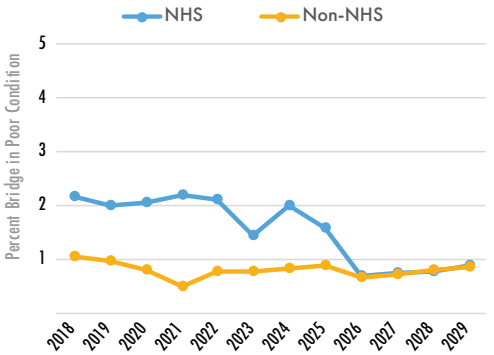



**FIGURE 31** *Increased Investment Scenario Bridge Percent Poor Output*



# CHAPTER 5 RISK MANAGEMENT

KDOT has established and implemented a formal risk management process to support the development of this risk-based asset management plan.

If the purpose of asset management is to ensure that transportation assets remain in acceptable condition, it is important to consider and manage events that may pose risks to this goal. 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)

Effective risk management requires strategic thinking around what risks exist at both the corporate and operational level, and understanding what to do about those risks. The Federal Highway Administration (FHWA) has published a series of reports that explore what risk management is and how it can be applied to transportation asset management. The framework proposed by the FHWA is grounded in the standard established by the International Organization for Standardization (ISO), which is arguably the foremost standard on risk management (ISO 31000).

**Figure 32** is an adaptation of the ISO risk management process that includes FHWA's asset management Final Rule requirements, which illustrates the process that KDOT has followed to ensure robust risk management. Each step in this process and the underpinning framework sets the foundation for ensuring that information about risks is effectively used to inform decision making towards meeting an organization's objectives.

**Establishing the context** involves developing an understanding of the parameters around the risk management process from an internal and external perspective. This step also includes establishment of a risk management policy and a team to develop, implement, and maintain the risk management framework and products (including the risk management plan and risk register).

**WHAT IS RISK?**

**Risk is "the positive or negative effects of uncertainty or variability upon agency objectives." (23 CFR 515.5)**

**FIGURE 32** *The Risk Management Process*[2]


**Identifying Risks** is the process of compiling those effects of uncertainty that can impact the asset management process. Risks can be internal or external, short- or long-term, and enterprise wide or project specific.

**Analyzing Risks** involves understanding the cause of risks, the likelihood of their occurrence, the possible outcomes, and their potential impacts (consequence). Likelihood is a qualitative description of the chance of an event occurring defined by combining information about probability and the agency's historical records and experience, while consequence is a qualitative description of the impact or outcome of a risk event. In this analysis step, both factors are assigned a numerical value to aid in the next step.

**Evaluating Risks** compares the likelihood of a risk event occurring against the consequence of the event, and uses the level determined to prioritize the risks.

**Managing Risks**, the final step in this process, refers to the selection of an action to respond to the risks identified. There are several response options to manage risk and the calculated risk level can inform the selected response option.

**Communicating and Consulting, and Monitoring and Reviewing** are overarching steps in this process that are ongoing throughout the other processes. Communicating and consulting allows for the exchange of information and dialogue with stakeholders to ensure that their

*2. Incorporating Risk Management into Transportation Asset Management Plans. FHWA. (November, 2017)*

varied views are considered, that all participants are aware of their roles and responsibilities, and to ensure transparency and understanding around specific actions in response to risks raised. Continuous reviews will include evaluations to determine if the risk management framework, policy, and process are still appropriate for the organization's context and if (and how) they are followed.

## 5.1 Risk Management at KDOT

> This risk management framework was created by the KDOT TAM Steering Committee, who provide strategic oversight to the overall asset management effort.

In early 2017, KDOT identified a preliminary set of reasonable and manageable risks for the transportation system. In 2019, the TAM Steering Committee established a risk management framework, identifying a governance structure with goals and priorities for risk management, defining the scope of risk management at KDOT, and establishing risk criteria and tolerance levels. This process culminated in a risk management workshop where the Risk Management Team identified and analyzed 35 risks, including ten with high priority.

### 5.1.1 Risk Governance

KDOT's risk governance is grounded in the overall governance structure established to manage the TAM effort (see **Chapter 2**). The same groups are leveraged and hold the following responsibilities for the risk management process:

- The **Project Management Team** coordinates the risk management process as part of TAM efforts, monitoring risk management, developing the risk register, and facilitating risk assessment discussions;
- The **Risk Management Team**, the main group that contributes to the identification and assessment of risks, includes members of the TAM Working Group, adding several staff whose roles, while not directly related to TAM, are critical to enterprise risk management. Responsibility for implementing risk mitigation strategies are assigned to members of this group during the development of the risk register, who serve as the main points of contact for continuous monitoring of their respective risks.

- The **Steering Committee** provides strategic oversight of risk management efforts, while also participating in risk workshops as needed. High priority risks, especially those of an enterprise nature, will be escalated to the Steering Committee for management and monitoring.

### 5.1.2 Risk Goals and Priorities

In managing asset and asset management risks, KDOT is invested in the protection and well-being of the public, its employees and contractors. The priorities of the TAM risk management process are grounded in KDOT's strategic goals, the core commitments in the asset management policy, and the asset management objectives. The goals of the TAM risk management process are to:

- Reduce any risk of harm to stakeholders
- Improve asset management decision making by incorporating risks
- Reduce major risks to maintaining pavement and bridge assets in a state of good repair
- Support achievement of the asset management objectives and performance targets.

### 5.1.3 Scope of Risk Management

The scope of risk management for TAM risks, refers to the types of risk to be managed and the level of detail desired. The scope of TAM risk management at KDOT is defined by (i) levels of risk management; (ii) risk categories included; and (iii) the assets included.

#### RISK LEVELS

Asset and asset management process risks can be managed at different levels. At this time, TAM risks at KDOT will be managed at the enterprise and program levels (see **Figure 33**). By assessing risks at the high level, KDOT can scope the wide level of risks that can potentially threaten the organization. As maturity increases, project/asset and activity level risks may be considered for inclusion in the overall TAM process. In the meantime, general project risks will be managed in the context of each individual project.

### RISK CATEGORIES

KDOT's risks are grouped into the eight categories shown in Table 18. Although many risks can fall in more than one category, this organizing principle allows for more efficient management of risks.

### ASSETS INCLUDED

While Federal regulations require only the inclusion of National Highway System (NHS) pavement and bridge assets, as with this TAMP, KDOT has gone a step further to include State Highway System (SHS) pavements and bridge assets. Both NHS and SHS pavements and bridges are covered in the risk management effort. At this time, risks related to ancillary assets (traffic signals, streetlights, etc.) are not included.

## 5.1.4 Risk Criteria and Appetite

Risk criteria determines how the significance of risks that are identified will be evaluated. KDOT prioritizes risks based on the likelihood of occurrence (L) and the potential consequences (C). Both the likelihood and consequence are defined using a five-point scale as shown in Table 19 and Table 20. These ratings were then combined to determine a risk score for each risk in the KDOT risk register. Risk scores determine how risks will be prioritized (Figure 34).

**FIGURE 33** *NCHRP 08-93 risk management levels*

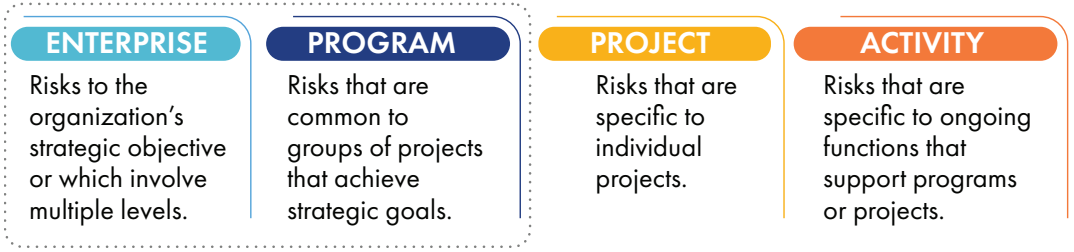



**TABLE 18** *KDOT risk categories*

| CATEGORY | DEFINITION |
|---|---|
| Asset Performance | Risks associated with assets and their failure. Examples include asset data quality, use of asset performance models, etc. |
| Safety | Risks affecting the safety of staff, the public, or other stakeholders (e.g. contractors). |
| Business Operations | Risks due to variability in internal business functions. Examples include inefficiencies in internal processes, lack of agency-wide communication, etc. |
| External/Reputational | Risks caused by external factors, including natural and man-made external threats. Also includes risks having impact on KDOT's external reputation. Examples include political climate, federal/statewide changes, extreme weather of acts of terrorism, etc. |
| Financial/ Economic | Risks affect the financial stability of assets, investments in asset performance, or the Transportation Asset Management program. |
| Information Technology | Risks associated with IT services and tools necessary for TAM. Example include management system implementation, staff ability to use technology tools, etc. |
| Legal & Compliance | Risks related to failure to comply with standards, policies, etc. Also includes the impact of changes in legal requirements. |
| Workforce/ Organizational | Risks related to resourcing, organizational capacity, and other internal enablers. Examples include understaffed roles, lack of departmental coordination, etc. |

**TABLE 19** *Risk likelihood (L) levels*

| RATING | DESCRIPTION |
|---|---|
| **Exceptionally rare** | May occur only in exceptional circumstances |
| **Rare** | Could occur at some point |
| **Possible** | Might occur at some time |
| **Probable** | Will probably occur in most circumstances |
| **Almost certain** | Expected to occur in most circumstances |

**FIGURE 34** *Risk scoring matrix*

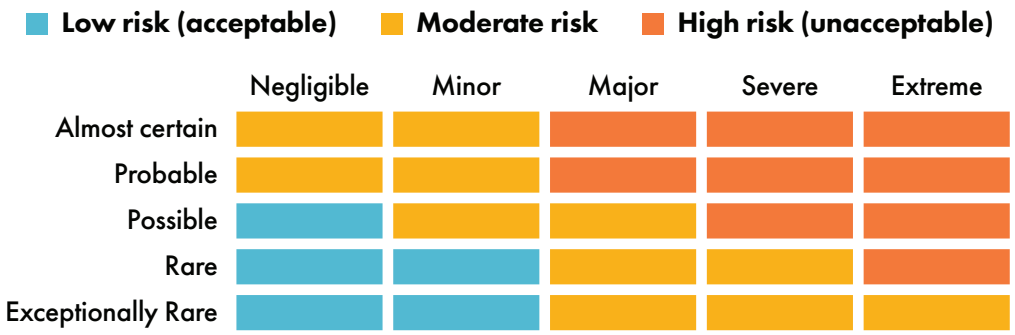


**TABLE 20** *Risk consequence (C) levels*

| | NEGLIGIBLE | MINOR | MAJOR | SEVERE | EXTREME |
|---|---|---|---|---|---|
| **Asset Performance** | Little to no deterioration or damage to assets; short delays and operational slowdowns that go unnoticed | Limited deterioration or damage to assets on highway systems causing short delays and operational slowdowns | Moderate deterioration or damage to assets on highway systems causing some travel disruption; or normal vehicular flow with increased vulnerability | Major deterioration or damage to assets on highway systems causing travel disruptions for an extended time | Permanent damage to assets on multiple highway systems causing significant travel disruptions |
| **Safety** | No injury | Possible minor injury | Minor injury and possible serious injury | Low number of deaths and/or severe injuries | Several deaths and/or numerous severe injuries |
| **Business Operations** | No interruption to business operations | Some slowdown in business operations | Interruptions to business operations in one department | Interruptions to business operations in more than one department | Extended interruption to business operations in more than one department |
| **External/ Reputational** | No community concern; individual interest only | Minor community interest; local media coverage | Public community discussion; broad negative media coverage | Loss of confidence; national publicity; public agitation for action | Public investigation; international coverage; may result in management changes |
| **Financial/ Economic** | Largely adequate financial resources to maintain assets in a minimum acceptable level of condition with no difficulty in justifying requests for funds | Mostly adequate financial resources to maintain assets in a minimum acceptable level of condition with little to no difficulty in justifying requests for funds | Somewhat inadequate financial resources to maintain assets in a minimum acceptable level of condition with limited difficulty in justifying requests for funds. Somewhat confident in level of compliance with asset management provisions of legislation | Largely inadequate financial resources to maintain assets in a minimum acceptable level of condition and considerable difficulty in justifying requests for funds | Lack of financial resources to maintain assets in a minimum acceptable level of condition. Potential risk of penalties or loss of Federal funds |
| **Informational Technology** | No impact on ability to perform asset management functions or make informed decisions | Some impact on ability to perform asset management functions; decisions can be based on some data analyses | Significant impact on ability to perform asset management functions; decisions are based on available raw data (no analysis performed) | Inadequate data available to perform asset management functions or make informed decisions | No data available to perform asset management functions or make informed decisions |
| **Legal/ Compliance** | No legal consequences; compliance with all regulations; or some issues that can be managed by routine procedures | Non-compliance that results in a minor fine or can be managed internally by KDOT legal staff | Results in an issue requiring investigation, or non-compliance with a major fine or other legal action | May result in legal consequences or fines, with some interruption to KDOT operations | Will result in significant legal consequences or fines, or extended interruption to KDOT operations |
| **Workforce/ Organizational** | Does not prevent KDOT from meeting agency objectives | Causes KDOT to meet agency objectives with slight difficulty; operations are interrupted | Causes KDOT to introduce some organizational changes to meet agency objectives and maintain operations | Significant organizational changes required to maintain operations and meet agency objectives | Disrupts KDOT operations and hinders ability to meet agency objectives |

Risk appetite refers to how much risk an organization is willing to accept or how the organization will respond to and manage risks that are evaluated. For KDOT, risk appetite is based on the three priority areas determined from the scoring matrix above, as shown in **Table 21**.

**TABLE 21** *Risk appetite*

| RISK PRIORITY (P) | RESPONSE |
|---|---|
| **High** | Risk cannot be accepted as is; must be prioritized for response |
| **Moderate** | Should be prioritized; may be acceptable with technical review |
| **Low** | Acceptable and/or tolerable without further review |

### 5.1.5 Risk Monitoring and Review

KDOT is committed to the ongoing operation, maintenance, and improvement of its assets. To ensure continuous monitoring, review, and enhancement of risk management, the TAM Steering Committee may make changes and updates to the framework as they see fit for the benefit of the agency. Furthermore, the TAM Project Management Team and the Risk Management Team may also recommend changes, subject to the approval of the Steering Committee.

On a biennial basis, the TAM Project Management Team and the Risk Management Team will revisit the risk register removing, updating, or adding risks as needed.

## 5.2 2019 Risk Register

A two-day risk workshop was held to analyze, evaluate, and develop actions to manage the risks identified. The results of the risk workshop and analysis was a comprehensive risk register. Note that the register (**Table 22**) is sorted in order of priority score and each risk has a responsible party identified which is not documented in the TAMP. The TAM Project Management Team and the KDOT Risk Management Team hold responsibility for implementing the response actions and continuously monitoring risks.

**TABLE 22** *KDOT 2019 risk register*

| ID/RISK/CATEGORY | IMPACT | RESPONSE |
|---|---|---|
| **High Priority** | | |
| 1<br>**Deferred maintenance**<br>*Asset Performance*<br>—<br>Likelihood: 4.22<br>Consequence: 4.06 | • Increased deterioration rate of roadways and bridges<br>• Increased cost to maintain roads/bridges<br>• Wear and tear on vehicles | • Maintain or enhance pavement data collection<br>• Use MEPDG (Mechanistic-Empirical Pavement Design Guide) to prolong asset life<br>• Meet federal eligibilities to use federal funds on light-action preservation projects |
| 2<br>**Loss of institutional knowledge through retirements and attrition; inexperienced staff due to lack of retention**<br>*Workforce/Organizational*<br>—<br>Likelihood: 4.45<br>Consequence: 3.73 | • Chronic shortages of engineers<br>• Understaffed offices and field shops; inability of field offices to do basic work<br>• Inability to carry out agency's mission<br>• Overreliance on consultants<br>• Lack of continuity and institutional knowledge, leading to greater likelihood of errors<br>• Greater workload/more responsibility placed on fewer staff; decreased morale; employee burnout | • Enhance salary structure; develop annual salary increases based on performance<br>• Promote work-life balance<br>• Above market benefit package<br>• Increase schedule flexibility and perquisites<br>• Non-traditional recruitment<br>• Strategic exposure<br>• Internships |
| 3<br>**Inadequate/ uncertain state and federal funding**<br>*Financial/Economic*<br>—<br>Likelihood: 4.09<br>Consequence: 3.52 | • Inability to match federal funding<br>• Fewer road, bridge, maintenance, preservation projects; fewer contractors available due to lack of work<br>• System deterioration<br>• Less flexibility in spending decisions<br>• Negative impacts to customer satisfaction<br>• Increased safety risk and cost to traveling public<br>• Inefficient use of staff and resources; fewer contractors available | • Rely on prioritization process; reprioritize syphoning decisions to maximize funds<br>• Engage state legislative leaders and governor's office<br>• Work with advocates and/or potential allies<br>• Fund preservation work first<br>• Be conservative in funding estimates for cash flow<br>• Communicate potential impact with public (including cost and program effectiveness)<br>• Engage legislative leaders and governor's office |
| 4<br>**Increased freight traffic**<br>*External/Reputational*<br>—<br>Likelihood: 4.03<br>Consequence: 2.90 | • Reduced pavement and bridge life<br>• Additional non-programmed costs<br>• Increased congestion and traffic conflicts<br>• Shortage of truck parking<br>• Increase in vehicle/train collisions | • Increase bridge staff & preservation activities<br>• Increase evaluation of at-grade rail crossings<br>• Promote private development of more truck plazas<br>• Work with locals on finding parking during the short-term closures<br>• Expand Truck Parking Information Management System |

| ID/RISK/CATEGORY | IMPACT | RESPONSE |
|---|---|---|
| 5<br>**Interruptions or slowdowns in the procurement process**<br>*Business Operations*<br>—<br>Likelihood: 3.67<br>Consequence: 3.17 | • Reduced opportunity to have competitive advantage<br>• Vendors not wanting to work with KDOT<br>• Loss of staff due to procurement processes<br>• Process too complex for KDOT to be nimble – inability to leverage opportunities | • Change bulk fuel purchase procedure<br>• Review this risk with the Bureau Chief of Fiscal Services |
| 6<br>**Cybersecurity threats and IT infrastructure failure**<br>*Information Technology*<br>—<br>Likelihood: 3.03<br>Consequence: 3.71 | • Data corruption; confidential data theft<br>• Inability to complete program or optimize investment<br>• Disruption of services<br>• Loss of agency credibility | • Keep strict quality control and quality assurance process in place<br>• Move data storage/application to the Cloud where appropriate (allowing for data security)<br>• Maintain pace with technology standards<br>• Complete K-Hub Project and Construction Management System replacement<br>• Maintain strong, dedicated, qualified IT support staff<br>• Update disaster recovery and business continuity plans<br>• More data storage and application used when appropriate<br>• Continuity of Operations (COOP) plans and disaster recovery |
| 7<br>**Inability to keep pace with technology changes**<br>*Information Technology*<br>—<br>Likelihood: 3.67<br>Consequence: 3.00 | • Increased expenditure requirements<br>• Lack of workforce with skills to manage new technology<br>• Inefficiencies in use of technology to support business operations | • Increase awareness/ commitment for staff training and funding<br>• Complete current upgrade projects<br>• Continued funding for development of new applications/ business models |
| 8<br>**Bridge failure**<br>*Asset Performance*<br>—<br>Likelihood: 2.16<br>Consequence: 4.69 | • Temporary loss of system functionality; interruption in transportation services<br>• Increased safety risk to employees and traveling public; loss of life<br>• Additional non-programmed costs | • Maintain emergency response plans and appropriate emergency fund levels<br>• Maintain or improve data collection and follow established inspection practices<br>• Apply appropriate funding for bridge rehabilitation; reprioritize projects if funds are limited<br>• Work with local governments in advance to develop prescribed detour routes |

| ID/RISK/CATEGORY | IMPACT | RESPONSE |
|---|---|---|
| 9<br>**Increase in fuel prices**<br>*Financial/Economic*<br>—<br>Likelihood: 3.72<br>Consequence: 2.72 | • Increase in construction and material costs | • Reprioritize spending |
| 10<br>**Bridge damage caused by vehicle impacts**<br>*Asset Performance*<br>—<br>Likelihood: 3.33<br>Consequence: 3.33 | • Damaged infrastructure; temporary loss of system functionality<br>• Increased safety risk to employees and traveling public<br>• Potential litigation risk<br>• Additional non-programmed costs<br>• Negative impacts to customer satisfaction | • Maintain emergency response plans<br>• Follow established practices and policies<br>• Interoperable communication between KDOT and first responders<br>• Training |
| **Moderate Priority** | | |
| 11<br>**Safety culture not fully developed**<br>*Safety*<br>—<br>Likelihood: 3.24<br>Consequence: 3.24 | • Unsafe work practices<br>• Increased change of employee injury | • Periodic safety meetings; regular online classes<br>• Safety signs and campaigns |
| 12<br>**Fatal or harmful accident due to poor asset condition**<br>*Legal & Compliance*<br>—<br>Likelihood: 3.34<br>Consequence: 3.13 | • Increased litigation<br>• Lack of public confidence in KDOT | • Continue to look for better asset appraisal methods |
| 13<br>**Lack of performance or reduced service life of maintenance actions**<br>*External/Reputational*<br>—<br>Likelihood: 3.38<br>Consequence: 3.00 | • Increased long-term costs<br>• Loss of public confidence | • Training and education<br>• Pavement measurement evaluation<br>• Research for alternatives |

| ID/RISK/CATEGORY | IMPACT | RESPONSE |
|---|---|---|
| 14<br>**Inflation causing increased expenditure or changes in revenue**<br>*External/Reputational*<br>—<br>Likelihood: 3.49<br>Consequence: 2.86 | • Smaller program without increased funding<br>• Fewer road, bridge, maintenance, preservation projects lead to system deterioration<br>• Increased construction and material costs; decreased buying power | • Focus on preservation first<br>• Evaluate funding sources<br>• Build inflation into 10-year funding program |
| 15<br>**Change in state/federal leadership/ priorities**<br>*Legal & Compliance*<br>—<br>Likelihood: 3.41<br>Consequence: 2.88 | • Change in KDOT leadership priorities<br>• Change in funding or staffing levels<br>• Potential loss of internal and external support<br>• Loss of credibility | • Tell KDOT story through performance measures, safety, past accomplishments<br>• Encourage flexibility through clear, honest communication<br>• Continue to stress importance of good practice to Executive and Legislators<br>• Maintain good communication regarding issues for detrimental changes |
| 16<br>**Loss of public confidence in agency**<br>*External/Reputational*<br>—<br>Likelihood: 3.57<br>Consequence: 2.68 | • Complicates relationships with external partners/ stakeholders<br>• Pushing legislative agenda becomes more difficult<br>• Unwillingness of public to support new highway spending; loss of adequate funding | • Retain experienced staff<br>• Transparency; host local consultation meetings<br>• Well-developed communication strategy<br>• Provide honest, accurate and timely information to stakeholders and public<br>• Follow through on commitments<br>• Strengthen and/or reaffirm partnerships |
| 17<br>**Lack of cross unit understanding**<br>*Business Operations*<br>—<br>Likelihood: 3.57<br>Consequence: 2.68 | • Lack of cooperation between departments that should inform asset management decisions<br>• Inefficient asset management processes<br>• Lack of morale and poor performance due to poor communication between departments | • Active engagement in new employee orientation<br>• Monthly newsletter updating departments on what is occurring in each department<br>• Explore the ability to move staff based on need and availability across different bureaus |
| 18<br>**Bond rating (increase or decrease)**<br>*Financial/Economic*<br>—<br>Likelihood: 3.32<br>Consequence: 2.82 | • Decrease or increase in available funds for construction activities or asset investment | • Reprioritize spending |

| ID/RISK/CATEGORY | IMPACT | RESPONSE |
|---|---|---|
| 19<br>**Failure to follow or inconsistency in applying policies, standards, and processes**<br>*Legal & Compliance*<br>—<br>Likelihood: 2.99<br>Consequence: 3.13 | • Increased errors in asset management processes<br>• Decrease in quality of work | • Continue to provide training to workforce<br>• Inspector General audits of processes |
| 20<br>**Autonomous and highly-automated vehicles**<br>*External/Reputational*<br>—<br>Likelihood: 3.41<br>Consequence: 2.73 | • Could require different design standards<br>• Vulnerable to IT terrorism<br>• Unknown agency costs | • Understand expectations of KDOT<br>• Monitor progress of lead states<br>• Involvement on national automated vehicle committees |
| 21<br>**Lack of continuity of operations in a disaster**<br>*Business Operations*<br>—<br>Likelihood: 2.45<br>Consequence: 3.69 | • Loss of productivity<br>• Delays in construction and design projects and payments<br>• Disruption of internal communication | • Strong, up-to-date Continuity of Operations Plans (COOP)<br>• Ensure employees are well-informed about the COOP and its importance<br>• Make COOP a serious issue and not a part time project |
| 22<br>**Alternative fuel vehicles – electric, fuel cell, CNG**<br>*Financial/Economic*<br>—<br>Likelihood: 3.55<br>Consequence: 2.52 | • Current fuel tax would not apply, resulting in decreased revenue to State Highway Fund | • Engage legislative leaders |
| 23<br>**Reduced quality construction materials**<br>*External/Reputational*<br>—<br>Likelihood: 3.10<br>Consequence: 2.88 | • Reduced performance and service life<br>• Inefficient expenditure of tax dollars<br>• Negative impacts to customer satisfaction<br>• Increased safety risk to employees and traveling public | • Continue to review standards for materials based on in-situ performance<br>• Continue to test materials before using in field and ensure in-situ performance continues to be reflected in updated specifications<br>• Increase inspections and inspection staff<br>• Increase requirements for contractor QC/QA<br>• Research alternative and new materials |

| ID/RISK/CATEGORY | IMPACT | RESPONSE |
|---|---|---|
| 24<br>**Increased allowable truck weights**<br>*Legal/Compliance*<br>—<br>Likelihood: 3.10<br>Consequence: 2.88 | • Increased pavement distress; local infrastructure failure; reduced pavement and bridge life<br>• Load postings and restrictions<br>• Additional non-programmed costs<br>• Increase in initial construction costs | • Increase bridge staff; increase preservation activities<br>• Identify heavy freight corridors<br>• Change design to handle heavier loads<br>• Continue to educate decision makers on impacts to the system |
| 25<br>**Extreme individual natural events causing damage to assets**<br>*External/ Reputational*<br>—<br>Likelihood: 2.60<br>Consequence: 3.44 | • Damaged infrastructure; route closure; temporary loss of system functionality<br>• Additional non-programmed costs; negative economic impact<br>• Stretches capabilities of field staff<br>• Increased safety risk to employees and traveling public | • Maintain emergency response plans; have an emergency fund<br>• Follow established inspection practices<br>• Proper design and engineering practice<br>• Excellent communication with staff, and stakeholders; coordinate with local entities<br>• Have adequate amount of materials on hand<br>• Back-up systems<br>• Training |
| 26<br>**Lack of contractor availability**<br>*Financial/ Economic*<br>—<br>Likelihood: 2.82<br>Consequence: 3.09 | • Inability to plan for long term<br>• Reduced capacity to accomplish work<br>• Potential delays in project letting<br>• Lack of innovative construction practices<br>• Reduced competition at bid lettings causes higher prices | • Adjust project letting schedule in accordance with contractor availability<br>• Understand demand on contracting industry beyond the state (consider a "regional" approach to procurement)<br>• Advise contracting industry on program (funding and certainty) as early as possible<br>• Increase outreach and communication with contracting industries to find out why they are not bidding |
| 27<br>**Poorly written contracts and specifications**<br>*Legal & Compliance*<br>—<br>Likelihood: 2.63<br>Consequence: 3.16 | • Excessive payments on contracts<br>• Poor product delivery to KDOT | • Continue to provide training to workforce<br>• Inspector General audits of processes |

| ID/RISK/CATEGORY | IMPACT | RESPONSE |
|---|---|---|
| 28<br>**Material Shortage**<br>*External/Reputational*<br>—<br>Likelihood: 2.75<br>Consequence: 2.94 | • Delayed project completion<br>• Increased construction costs | • Research alternatives and new products<br>• Stay involved in national association to identify frauds |
| 29<br>**Failure to adhere to federal regulations (Fines, impact on future funding related to quality control, etc.)**<br>*Financial/Economic*<br>—<br>Likelihood: 2.55<br>Consequence: 3.16 | • Compliance fines<br>• Impact on future funding | • Training, monitoring, and review |
| 30<br>**Inadequate communication of asset performance, processes, and decisions**<br>*Asset Performance*<br>—<br>Likelihood: 3.19<br>Consequence: 2.45 | • Inability to explain asset investment decisions<br>• Loss of confidence in decision-making ability | • More interaction at the local level<br>• Increase transparency of decision process and tell the why and what of selections |
| 31<br>**Lack of Diversity**<br>*Workforce/Organizational*<br>—<br>Likelihood: 3.16<br>Consequence: 2.15 | • Increased turnover due to low staff morale | • Non-traditional steps to recruit/including people that look like what you desire to recruit<br>• Recognize and value diversity with an effort to retain (environment where minorities feel welcome/ comfortable/ valued and respected) |
| 32<br>**Terrorism/Vandalism/Sabotage**<br>*External/Reputational*<br>—<br>Likelihood: 2.28<br>Consequence: 2.84 | • Damaged infrastructure; temporary loss of system functionality<br>• Additional non-programmed costs<br>• Negative impacts to customer satisfaction<br>• Increased safety risk to employees and traveling public | • Maintain emergency response plans & appropriate emergency fund levels<br>• Reprioritize projects if funds are limited<br>• Training<br>• Identify vulnerabilities, develop plans, policies to minimize risks |

| ID/RISK/CATEGORY | IMPACT | RESPONSE |
|---|---|---|
| **Low Priority** | | |
| 33<br>**Significant increase in federal funding**<br>*Financial/Economic*<br>—<br>Likelihood: 2.32<br>Consequence: 2.00 | • Increased need for federally-eligible projects<br>• Increased workload in field offices<br>• Inability to match federal funding<br>• Need for more trained staff and consultants to handle the influx of project work | • Increase design and construction staff<br>• Ensure there is a pipeline of projects ready to go |
| 34<br>**Failure to plan for climate change impacts**<br>*External/Reputational*<br>—<br>Likelihood: 2.32<br>Consequence: 2.00 | • Assets may require more frequent preservation/ maintenance actions<br>• Reduced service life of roads, bridges<br>• Additional non-programmed costs | • Maintain/increase frequency of preservation actions<br>• Maintain emergency response plans<br>• Monitor asset performance |
| 35<br>**Sinkholes emerge under or near roadway**<br>*External/Reputational*<br>—<br>Likelihood: 1.00<br>Consequence: 2.00 | • Temporary loss of system functionality<br>• Additional non-programmed costs<br>• Loss of life, personal injury | • Maintain emergency response plans<br>• Proper design and engineering practices<br>• Identify and monitor at-risk locations<br>• Eliminate route<br>• Mine grouting |

## 5.3 Integration with Other Risk-related Programs

It is important to integrate the risk management approach with other existing programs that inherently consider risk management principles. Table 23 describes these programs.

**TABLE 23** *Other risk-related programs*

| PROGRAM | DESCRIPTION |
|---|---|
| **Bridge Inspection Program** | KDOT's bridge inspection program places significant emphasis on risks related to bridge components. While FHWA requires bi-annual inspections, frequency of routine inspections is adjusted as the condition of an element worsens. Inspection frequency can be increased to every 6 months and even to every 3 months in cases of severe deterioration or for structures with elements with a higher risk of failure. In addition, fracture critical structures undergo an additional inspection in the off-year from the required bi-annual inspection. Based on previous bridge risk assessments, structures with span lengths between 10 and 20 feet are inspected with increasing frequency (from four-year intervals to three-month intervals) as the condition decreases. |
| **Highway Safety Improvement Program** | The Highway Safety Improvement Program (HSIP) is a core federal-aid program with the purpose of achieving a significant reduction in traffic fatalities and serious injuries on all public roads, including non-state-owned roads and roads on tribal land. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads with a focus on performance. This program pays attention to high risk roads from a safety perspective. |
| **Kansas Response Plan** | This is an emergency operations plan designed to address all hazards that could affect the state of Kansas. It describes the strategies, assumptions, and mechanisms used to mobilize and coordinate resources to support local emergency management. |

## 5.4 23 CFR Part 667 Analysis

Federal asset management rules include a requirement to 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."[3]

*3. 23 CFR Part 667*

These evaluations are to cover a period beginning January 1, 1997 and ending December 31 of the year before the date of completion of the evaluation. After the initial iteration, the evaluation should be repeated after every emergency event and at least every four years. Reasonable alternatives include options that could partially or fully achieve the following:

- Reduce the need for federal funds to be expended on emergency repair and reconstruction activities;
- Better protect public safety and health and the human and natural environment; and
- Meet transportation needs as described in the relevant and applicable federal, state, local, and tribal plans and programs. Relevant and applicable plans and programs include the Long-Range Statewide Transportation Plan, Statewide Transportation Improvement Plan (STIP), Metropolitan Transportation Plan(s), and Transportation Improvement Program(s) (TIP) that are developed under part 450 of this title.

To meet this requirement, KDOT followed the process documented in **Figure 35** in 2018, finding that there were no locations with two or more emergency response events.

The following locations on the NHS were identified, each with only one event:

- US 59 north of Garnett (Reference Post 110.3 to 110.8)
- US 69 from Milepost 13.86 to 15.66
- Bridge #51 at Reference Post 37.5 West of Neodesha City Limits
- US 169 in Allen County (Milepost 54.5 to 55)
- Multiple bridges on US 400
  - Bridge #79 at Reference Post 396.8
  - Bridge #80 at Reference Post 397.1
  - Bridge #81 at Reference Post 397.4

KDOT will continue to monitor assets, and the risk management team will follow up on any repeatedly damaged assets using the same process.

Compile a list of emergency response events that have occurred since January 1, 1997, including the type of damage that occurred, the road(s), highway(s), or bridge(s) affected, and the cost associated with recovery.

Highlight those road(s), highway(s), or bridge(s) that have had two or more emergency response events.

Convene a discussion with the risk management team and other significant stakeholders to identify reasonable alternatives to those road(s), highway(s), or bridge(s).

Develop mitigation strategies for potential threats at those road(s), highway(s), or bridge(s) identified.

Document the results of the process in a frequent emergency event risk register following the format of the core risk register.

# CHAPTER 6 FINANCIAL PLANNING

> "...a plan spanning 10 years or longer that presents a state DOT's estimates of projected available financial resources and predicted expenditures in major asset categories that can be used to achieve state DOT targets for asset condition during the plan period..." (23 CFR 515.5)

In alignment with the federally-required financial planning approach, KDOT's existing investment programming practice oversees the 10-year transportation programs authorized by the state legislature. Other state statutes require KDOT to annually prepare comprehensive financial reports for all funds for the preceding year. This chapter describes the 10-year program funding sources and uses, and the estimated funds needed to maintain the value of KDOT's transportation assets as well as to manage the performance expectations of Kansans.

**THE FINANCIAL PLANNING PROCESS MUST INCLUDE ...**

- 10-year period analysis
- Sources and uses of funds
- Estimated cost and funding levels
- Asset valuation and needed funds to sustain value

## 6.1 Asset Valuation

In the context of asset management, asset valuation emphasizes the importance of strategic preservation and maintenance investments to maintain the substantial value that is tied up in assets, over the long-term. Historically, agencies have been required to report on the value of assets in their financial statements using the Government Accounting Standards Board Statement No. 34 (GASB-34) "modified approach." For the pavement and bridge assets on the NHS and SHS. KDOT considered this GASB-34 method, as well as a method that uses replacement cost based on unit costs.

### 6.1.1 Modified Approach (GASB-34)

The GASB-34 "modified approach," which is an alternative to the historic cost approach, measures the "fair value" of infrastructure assets based on existing conditions. The historic cost approach applies depreciation to the original cost over the life of the asset, which could render the value of the asset to reach zero in the future.

The "fair value" approach gives a more realistic valuation than the historic cost approach because it takes into consideration the condition of the asset. This approach assumes that infrastructure assets have indefinite life, provided effective strategies are applied to maintain and preserve the condition of the assets.

It is expected that as owners preserve and maintain existing condition or improve asset condition through additional investments, the value of the assets is stabilized or increased. The "modified approach" capitalizes the annual expenditure in those projects that add efficiency or capacity to the highway system. That is, excluding maintenance expenditures that do not extend the expected life of assets. This process allows KDOT to capture any expenditure or work activity that adds value or restores the performance of the asset from the previous year.

The initial capitalization for assets is done using current replacement cost and applying a price-level index to deflate the cost to the estimated construction year. Any additional inventory added through new construction is capitalized and reported at historical cost. As of June 30, 2018, the balance of infrastructure value (total investment in capital assets) was approximately $12 billion. KDOT estimates the current SHS asset value to be approximately $11.9 billion[4] (made up $9.5 billion in roadway value and $2.4 billion in bridge value).

### 6.1.2 Replacement Cost

As described above, the "modified approach" tends to understate the replacement costs of pavements and bridges. As an alternative approach, KDOT also estimates asset value based on current replacement costs.

To estimate the value of pavement assets, KDOT has adopted a replacement cost methodology described in the Highway Economic Requirement System Technical (HERS-ST), which is based on the average cost per lane mile for reconstruction. To estimate the average cost per lane mile, KDOT analyzed 18 pavement reconstruction and replacement project costs in the last eight years.[5] Results of this analysis suggest that average cost per lane mile is $1 million in 2018 dollars. With this method, KDOT's NHS and Other SHS pavement categories are valued at $12.62 billion and $12.58 billion ($2018), respectively.

*4. KDOT Comprehensive Annual Financial Report, 2018.*
*5. Interstate Basic Improvement (IRP) and Non-Interstate Basic Improvement (RIP) projects*

A similar methodology was adopted to estimate the value of bridge assets. The replacement cost approach was based on the average bridge replacement cost per square foot of bridge deck area. Average bridge replacement costs were obtained from KDOT bridge replacement and rehabilitation projects. An estimated average replacement cost of $147 ($2018) per square foot of deck area was used to estimate the asset value of bridge assets for NHS and Other SHS bridges, at $4.67 billion and $2.41 billion ($2018), respectively.

Table 24 summarizes the estimated value for the NHS and other SHS assets that are included in this TAMP. The estimated investment needed to maintain the value of these assets is discussed in the investment strategies section of this document.

**TABLE 24** *Estimated asset value for pavements and bridges*

| ASSET | REPLACEMENT COST* | GASB-34 MODIFIED APPROACH† |
|---|---|---|
| **Pavements** | | |
| **Total NHS** | $12,618,000,000, | — |
| **Other SHS** | $12,575,000,000 | — |
| **Total pavements** | **$25,193,000,000** | **$9,485,705,000** |
| **Bridges** | | |
| **NHS Total** | $4,674,828,438 | — |
| Other SHS Total | $2,405,438,175 | — |
| **Total bridges** | **$7,080,266,613** | **$2,433,990,000** |
| **Total asset value** | **$32,273,266,613** | **$11,919,695,000** |

**2018 dollars;*

*†As of June 2018*

## 6.2 Funding Sources

KDOT relies on five funding categories to finance asset management and other programs that support asset performance. These funds, termed the State Highway Fund (SHF), include both federal and state sources:

- Federal Highway Trust Fund
- State sources, including motor fuel taxes, motor vehicle registration fees, sales and compensating use tax, and other miscellaneous revenues

There are other categories of funding available for NHS investments besides the SHF, such as, Local and Toll Funds, collected and administered by separate entities such as the KTA and local governments. Their use can have potential impact on the performance of the NHS since KTA and some local stakeholders own and manage portions of the NHS. Funding sources are described in detail in the following sections.

### 6.2.1 Federal Funds and Sources

KDOT receives funding from the federal government through congressional allocations. The main sources of this funding are the FHWA, the Federal Transit Administration (FTA), the National Highway Traffic Safety Administration (NHTSA), and the Federal Aviation Administration (FAA). The Federal Highway Trust Fund is the primary source of allocations available for highway use, which is predominantly funded by federal motor fuel taxes.

### 6.2.2 State Funds and Sources

State funds are generated through state taxes and fees. The state legislature establishes these taxes and fees and regulates them over time to compensate for inflation and other prevailing needs and challenges. The Legislature also establishes statutory formulas to distribute proceeds from this fund. The state fund revenue constitutes most of the SHF and is generated through the following sources:

- **Motor fuel taxes.** Motor fuel tax has been one of the most reliable sources of revenue for highway funding. Funds from motor fuel taxes benefit SHS, city, and county projects. Current rates include 24 cents a gallon for gasoline and other fuels (e.g., gasohol) and 26 cents a gallon for diesel. Proceeds from this source are distributed between the SHF

and Special City and County Highway Funds. The SHF receives about two-thirds (66.37%) of the revenue generated through this tax while the Special City and County Highway Fund receives approximately one-third (33.63%). This funding source is dedicated in the state constitution to transportation uses only, and may not be diverted to the general fund.

- **Motor vehicle registration fees.** Proceeds from this source include vehicle registration fees deposited into the SHF. Vehicle registration and title fees are established through legislative mandates. The rates vary by vehicle type and usage ranging from $35 to $1,770 for personal and commercial use trucks. This funding source is also dedicated in the state constitution to transportation uses only, and may not be diverted to the general fund.

- **Sales and compensating use tax.** Historically, the SHF has benefited from deposits from a dedicated portion of the state sales and compensating use tax. In 2015, Senate Bill (SB) 270 authorized approximately 16% of state tax proceeds to be deposited into the SHF in FY 2016. The current sales and compensating use tax rate is 6.5%. Since this source is not protected for NHS or SHS use by state legislation, portions have recently been transferred out for other statewide uses. This funding source is not dedicated to transportation uses, and therefore may be redirected at the discretion of the Kansas Legislature.

- **Other miscellaneous revenues.** The major sources of this revenue category are fees such as driver's license fees. Other fees such as certifications, compliance fees, and sign permits contribute to this category of fund. This funding source also includes proceeds for bonds as part of a debt program that KDOT prudently manages up to a specified debt ceiling. In addition, the State Highway Fund accrues interest which is counted as revenue in this category. This funding source is also not dedicated to transportation uses, and therefore may be redirected at the discretion of the Kansas Legislature.

### 6.2.3 Local Funds and Sources

Local funds are generated through vehicle property taxes, fees paid at registration, and other local sales taxes, which are retained by counties for local projects. These projects have the potential to impact the overall performance of the NHS since portions of the NHS, although minimal, are under the jurisdiction of local entities and counties. KDOT has limited management authority over the use of this fund.

### 6.2.4 KTA Funds and Sources

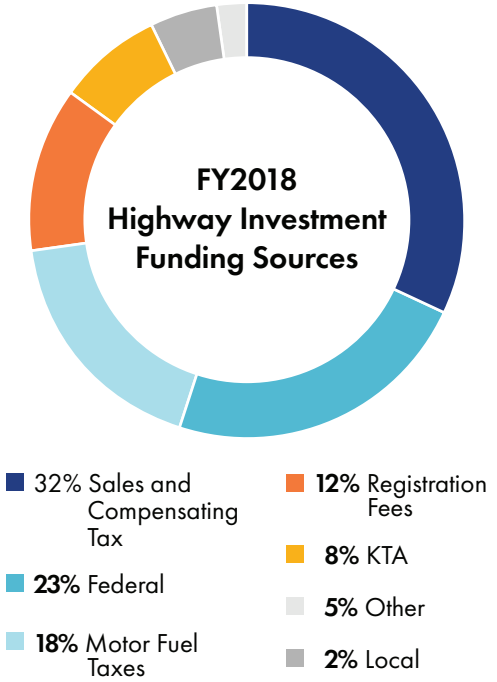
KTA funds are generated through highway tolls, concessionary rentals, and miscellaneous revenue. The KTA, as a separate entity, collects these funds to service KTA debts as well as to maintain, repair, and operate the Kansas Turnpike. The annual operating revenue from this source was approximately $125 million in FY 2018 — an increase of about 5% above FY 2017 revenue. KDOT does not have administrative authority over this fund; however, statutory mandates allow KDOT and KTA to partner in several activities to improve efficiency in the use of resources that impact the overall performance of the NHS. An example of this is the reconstruction of the US-54/Kellogg KTA interchange, which is a joint effort between KDOT, KTA, and the city of Wichita.

### 6.2.5 Historical Funding by Source

Figure 36 shows the funding available for NHS and SHS investments from all categories of SHF sources for FY2018 and KTA. Total FY2018 funding, from all sources, was approximately $1.8 billion, before transfers and including bond proceeds. This amount was almost identical to the previous year's revenue. As shown, the state sales and compensating tax and federal funding provide the highest contributions to available funding for highway asset investments.

Table 25 shows the historical funding by sources of the SHF and non-KDOT funds available for NHS investments (excluding KTA). In general, revenues from the state motor fuel tax and registration fees have remained constant over the years. Revenues from other sources have seen significant fluctuations such as the sales and compensating use tax, which saw a jump in revenues between 2013 and 2014.

**FIGURE 36** *FY2018 highway investment available funding by source*



KTA historical available funding is comparable to Table 25 only for FY 2015 to FY 2018 because the authority operated on a different fiscal year prior to 2015. KTA's revenues for the four comparable years are shown in Figure 37.

**FIGURE 37** *KTA revenues, in millions — FY2015 to FY 2018*


Federal funds are invested towards improvements in both NHS and non-NHS roadways including preservation, expansion, and modernization projects. Figure 38 shows the proportions of annual federal funding distributed between NHS and non-NHS projects.

## 6.3 Funding Uses

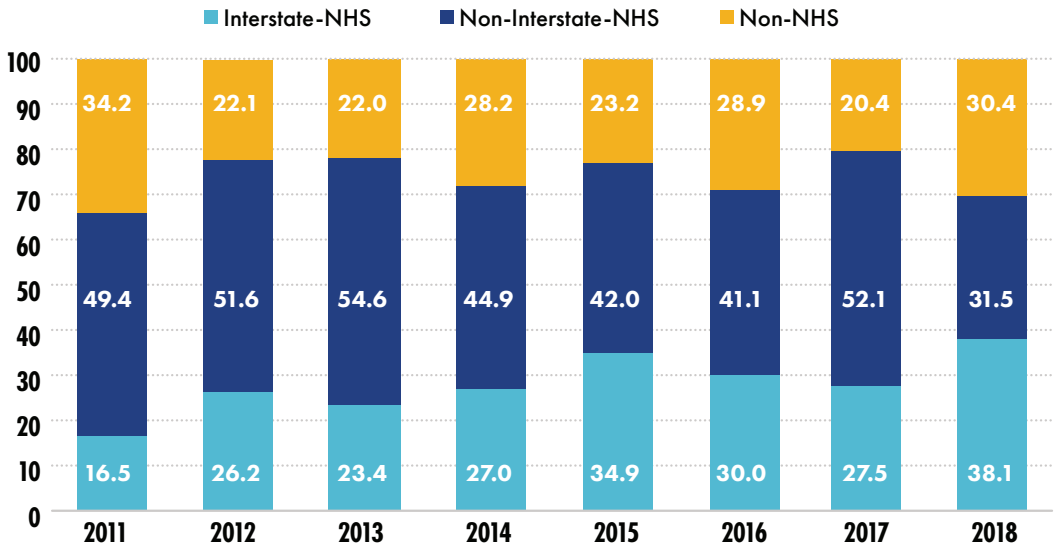
KDOT administers a variety of programs to safely operate and efficiently manage the NHS and the rest of the SHS. Funds are allocated through the SHF and other city and county special funding programs. There are four core KDOT investment programs: preservation, modernization, expansion, and local construction. These four programs, along with operations, support

**TABLE 25** *Actual total state highway funds cashflow (FY 2011 to FY 2018)*

| FUND TYPE | ACTUAL TOTAL FUNDS (MILLIONS $) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| Motor fuel taxes | 287 | 286 | 273 | 291 | 289 | 297 | 302 | 304 |
| Sales & Compensating tax | 293 | 313 | 320 | 485 | 512 | 518 | 515 | 530 |
| Registration fees | 167 | 166 | 187 | 201 | 209 | 204 | 208 | 208 |
| Others* | 36 | 37 | 34 | 35 | 24 | 26 | 23 | 84 |
| Transfers out | (297) | (347) | (119) | (289) | (448) | (547) | (535) | (551) |
| Federal funds | 614 | 461 | 410 | 431 | 413 | 257 | 459 | 375 |
| Local funds | 50 | 19 | 32 | 31 | 41 | 22 | 31 | 26 |
| **Total** | **1,151** | **936** | **1,138** | **1,185** | **1,040** | **776** | **1,001** | **977** |

**Includes transfers in*

**FIGURE 38** *Historical federal funding distribution*



administration and planning activities and fund maintenance and improvement projects to maintain the performance of bridge and pavement assets including those on the NHS. The program categories are described as follows:

- **Preservation.** Preservation of assets is the underlying principle of KDOT's investment decision making, the principal focus of asset management, and the primary priority of the current Kansas transportation program (T-WORKS) and the Long-Range Transportation Plan. Preservation activities have direct impacts on the short- and long-term performance of the SHS and support the efficient use of limited resources.

- **Modernization.** KDOT funds modernization projects to upgrade portions of the SHS to meet current standards and codes. Modernization investments can indirectly impact asset management activities in the long-term by influencing asset inventory, physical conditions, and long-term performance. Modernization projects enable KDOT to improve system performance and safety. However, in the long-term, some types of modernization projects may create potential additional maintenance responsibilities and financial burdens on KDOT.

- **Expansion.** KDOT addresses capacity issues with different strategies, including the addition of roadway lanes, building interchanges, and providing passing lanes. The key goal of capacity investments is to improve traffic flow and reliability; hence, this program investment is not considered asset management. Rather, investments in the Expansion program impact asset inventory and the overall conditions of the SHS and may create additional maintenance responsibilities and financial burdens on KDOT. As such, capacity investments and their outcome are relevant to asset management decision making.

- **Local construction.** Projects to improve county and city roads (including those roads that are on the NHS) are primarily safety-oriented and preservation-related, although some expansion-type projects are included. Funding to support local construction is a combination of federal, state, and local funding.

★ **Operations (fixed costs or overhead).** This program includes funding regular maintenance (e.g., snow removal), servicing KDOT's debts, and interagency fund transfers. Another significant portion of this fund use goes into supporting KDOT's personnel salaries, administrative cost, and operating costs such as utilities and rent.

Without considering operations costs, the highest proportions of funding have historically gone towards preservation and expansion projects, with modernization funding as the lowest. Figure 39 shows the average distribution over the last eight years with 38% of funding going towards preservation projects and 39% going towards expansion projects. Figure 40 provides a view of this distribution by fiscal year, showing that the proportion of funding towards preservation projects has consistently increased while the proportion of expansion project investments have continuously decreased. Note that much of the expansion expenditure in 2011 and 2012 includes funding from the American Recovery and Reinvestment Act (ARRA) federal grant, while expansion expenditure in 2016 and beyond includes KDOT's Gateway project, the first major design-build project.

**FIGURE 39** *Average historical funding distribution in KDOT core programs (2011-2018)*

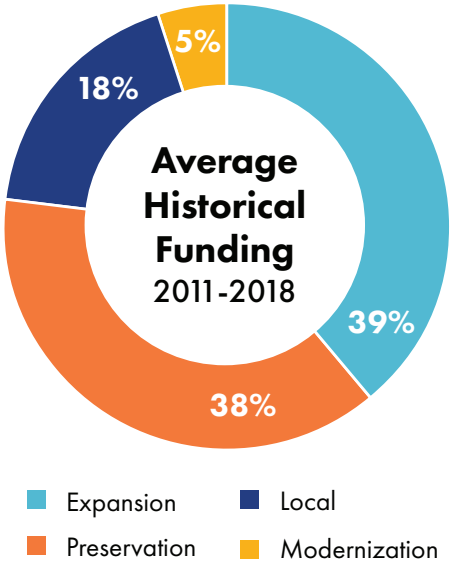
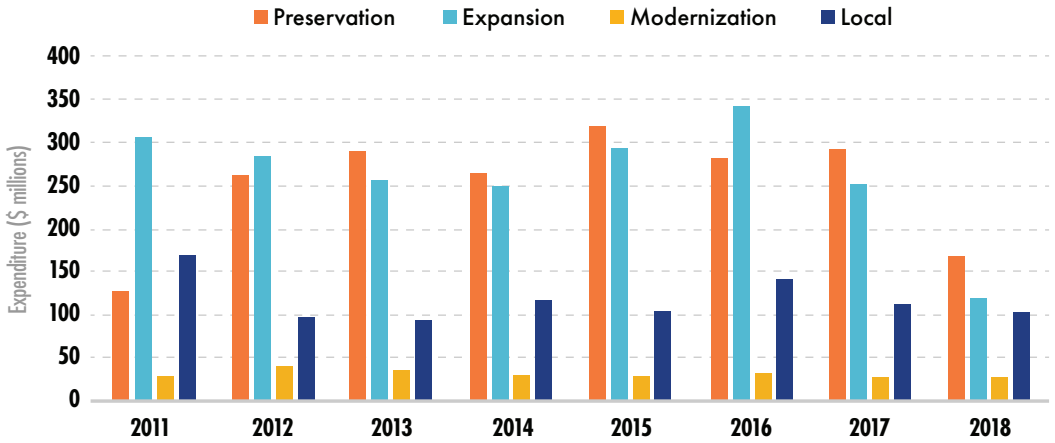



**FIGURE 40** *Historical funding distribution in KDOT core programs by fiscal year*



## 6.4 Estimated Costs and Funding Levels

### 6.4.1 Estimated Funding and Sources

The Kansas state legislature has authorized two funding programs in the past two decades. The most recent is the 2010 Transportation Works for Kansas (T-WORKS) program. Prior to T-WORKS, state legislature enacted the 10-year Comprehensive Transportation Plan (CTP) in 1999. These 10-year funding programs support the creation of jobs through projects that preserve highway infrastructure, modernize and expand highway infrastructure, and provide opportunities for economic development.

Over its 10-year period (2010 to 2020), the T-WORKS program is expected to allocate about $8 billion to transportation programs (including rail, aviation, and transit), which will benefit state and local highways across Kansas. Specifically, funding for highway preservation is expected to reach approximately $3.1 billion over the 10-year period. Also, T-WORKS promised a minimum of $8 million to be invested in each county across Kansas. Since its enactment, T-WORKS has seen many Legislative mandates amending different aspects of the program. Similar amendments also raised the sales and compensating use tax rate from 6.15% to 6.5% in 2015, although the portion dedicated to the SHF remained the same.

Table 26 shows the projected revenue from each of KDOT's funding sources and from KTA.

**TABLE 26** *Projected funding sources (by fiscal year)*

| | ESTIMATED TOTAL FUNDS (MILLIONS $) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
| Federal | 331 | 329 | 335 | 335 | 337 | 343 | 342 | 342 | 342 | 342 |
| State* | 781 | 589 | 594 | 590 | 592 | 593 | 594 | 596 | 597 | 598 |
| Local | 75 | 92 | 89 | 84 | 74 | 68 | 68 | 68 | 68 | 68 |
| **Total SHF** | **1,187** | **1,011** | **1,018** | **1,013** | **1,003** | **1,004** | **1,004** | **1,006** | **1,007** | **1,008** |
| KTA† | 133 | 134 | 135 | 137 | 138 | 140 | 141 | 141 | 141 | 141 |
| **Total** | **1,320** | **1,145** | **1,150** | **1,150** | **1,141** | **1,144** | **1,145** | **1,147** | **1,148** | **1,149** |

**State funding for 2019 includes a bond proceed of $200 million; †KTA projected revenue*

The table shows that about $11.64 billion in funding would be available for investment for the duration of the TAMP, representing an average annual revenue of $1.2 billion assuming no new legislation is passed during this period. KDOT funding cashflows project funding at all levels through 2021 but can only project state funding beyond that date. The projections shown in the table assume constant funding at the historical average level for federal and local funding. These projections also assume that transfers out of the SHF will continue at about $500 million for years 2019 to 2028.

Even at the state level, there is significant uncertainty associated with estimating 10-year funding availability, as evident in several amendments in the T-WORKS program proposed through state House and Senate Bills for the duration of the 10-year program as well as expected changes in future funding from state and federal authorizations. KDOT faces a potential funding risk of being unable to match federal funding, which would require the return of about $100 million in 2021 or 2022.

Following the passing of SB 285/HB 391, the Joint Legislative Transportation Vision Task Force evaluated current transportation funding in Kansas to determine whether it is sufficient to not only maintain the transportation system in its current state, but also to ensure that it serves the future transportation needs of Kansas residents. The Task Force made several key observations with policy and legislation recommendations, including the following recommendations addressing funding issues and transportation needs:

- Provide $500 million to fund highway preservation annually;
- Provide $500 million to complete delayed T-WORKS modernization and expansion projects in four years;
- Continue and restore local programs such as the Kansas Local Bridge Improvement Program
- Increase funding for Local Governments to maintain city connection links;
- Explore new revenue sources such as fees for alternative fueled vehicles or oversized vehicles, expanded tolling, or fees based on vehicle miles traveled

Out of all available resources, KDOT is estimating that about $500 million will be available for pavement and bridge preservation funding for the duration of the TAMP (Table 27).

**TABLE 27** *Projected funding available for pavement and bridge preservation*

| | ESTIMATED TOTAL FUNDS (MILLIONS $) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
| Pavement | 375 | 375 | 375 | 375 | 375 | 375 | 375 | 375 | 375 | 375 |
| Bridge | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 125 |
| Total | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 |

### 6.4.2 Projected Funding Needs

This section presents the projected annual cost of work needed to preserve or improve performance of the NHS and other SHS assets. KDOT estimates the cost associated with making progress towards the achievement of performance targets for the SHS (which includes the NHS) as well as meeting federal minimum condition requirements for NHS bridges and Interstate-NHS pavements. Cost has historically been estimated through a needs assessment process, which involves the use of analytical tools, engineering judgment, and inputs from key stakeholders.

Table 28 and Table 29 present the previously estimated expenditures needed to maintain pavement and bridges at a minimum acceptable condition level with actual amounts spent for the current and prior years. These estimates and actual expenditures show the level of uncertainty in dealing with future projections to maintain assets. As shown, KDOT estimated that an average annual expenditure of $80 million was needed to maintain the state bridge system at the minimum acceptable condition level. Similar estimated costs needed to maintain the minimum acceptable conditions for pavements were $90 million for interstate highways and $238 million for non-interstate highways. In all cases, the actual expenses exceeded the projections.

**TABLE 28** *Historical funding need projections and actuals — pavements ($ millions)*

| | FISCAL YEAR | | | | | |
|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2017 | 2018 | Avg Annual |
| **Interstate highways** | | | | | | |
| Estimated expenditures* | 90 | 93 | 97 | 83 | 87 | 90 |
| Actual expenses | 126 | 144 | 173 | 137 | 36 | 123 |
| **Non-Interstate highways** | | | | | | |
| Estimated expenditures* | 223 | 231 | 241 | 242 | 253 | 238 |
| Actual expenses | 375 | 423 | 391 | 332 | 230 | 350 |

**Estimated need to maintain the system at the minimum acceptable condition level*

**TABLE 29** *Historical funding needs projections and actuals — bridges ($ millions)*

| | FISCAL YEAR | | | | | |
|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2017 | 2018 | Avg Annual |
| Estimated expenditures* | 78 | 81 | 85 | 77 | 81 | 80 |
| Actual expenses | 92 | 129 | 124 | 100 | 56 | 100 |

**Estimated need to maintain the system at the minimum acceptable condition level*

As part of the LCP process discussed in **Chapter 4**, the bridge and pavement scenarios analyzed with the management systems were used to develop estimations of the funding needs to achieve and or maintain a state of good repair (i.e. to implement the investment scenarios). **Table 30** and **Table 31** summarize the projected funding needs for each scenario for both pavements and bridges. The performance and funding gap that these scenarios result in were considered in the selection of recommended investment strategies for both pavements and bridges described in **Chapter 7**.

**TABLE 30** *Pavement LCP Scenario Projected Investment Needs*

| ($MILLIONS) | MODEL-PERIOD TOTAL | AVG ANNUAL |
|---|---|---|
| **Interstate highways** | | |
| Worst-First | 2,191 | 183 |
| Steady-State | 1,600 | 133 |
| Desired SGR (Balanced) | 1,650 | 138 |
| **Non-interstate highways** | | |
| Worst-First | 4,507 | 376 |
| Steady-State | 11,580 | 965 |
| Desired SGR (Balanced) | 3,380 | 282 |

**TABLE 31** *Bridge LCP Scenario Projected Investment Needs*

| ($MILLIONS) | MODEL-PERIOD TOTAL | AVG ANNUAL |
|---|---|---|
| Historically Representative | 1,738 | 158 |
| Increased Investment | 2,674 | 243 |

# CHAPTER 7 GAP ANALYSIS & INVESTMENT STRATEGIES

> Based on asset condition, performance gaps and other analyses, investment strategies are selected to achieve and maintain a desired state of good repair for KDOT's assets.

Establishing investment strategies involves evaluating various funding alternatives to achieve and maintain the desired state of good repair at a minimum practicable cost while managing risks. Per 23 CFR 515, this process must describe how investment strategies are influenced, at a minimum, by:

- Performance gap analysis
- Life cycle planning
- Risk management analysis
- Anticipated available funding and estimated cost of future work

KDOT's investment strategies connect estimated funding needs, funding projections, performance gaps and programming processes to achieve the targets for asset condition and system performance at a minimum practicable cost.

## 7.1 Current Performance Gap Analysis

State DOTs are required to develop a process to analyze and evaluate performance gaps between existing and projected asset condition and performance targets and state of good repair goals. This process will enable KDOT to develop, analyze, and recommend efficient investment strategies to bridge the gaps, if any. The gap analysis process is aided by the understanding of existing conditions, establishment of performance targets, defining a desired State of Good Repair (SGR) for the SHS/NHS pavement and bridge assets, estimation of future funding that is expected to be available, and the projection of future asset performance.

**PERFORMANCE GAP ANALYSIS**

**"...the gaps between the current asset condition and State DOT targets for asset condition, and the gaps in system performance effectiveness that are best addressed by improving the physical assets." (23 CFR 515.5)**

As previously discussed, KDOT has established condition performance targets for pavement and bridge assets in response to the Transportation Performance Management (TPM) reporting requirements. As documented in **Chapter 3**, the existing condition of the NHS assets is summarized in **Table 32** showing a comparison with the established targets.

As shown, KDOT's assets exceed the targets in all cases indicating no performance gap, and satisfy the minimum condition requirements stipulated in the federal rules. This is primarily a result of strong historical funding. However, gaps in performance are likely to appear in future years due to potential funding gaps.

In addition to these two- and four-year performance targets, KDOT has also defined agency-specific SGR for all SHS assets. These definitions align with the national performance goals and are in support of a cost-effective approach to maintaining the long-term performance of SHS assets. The LCP scenario output documented in **Chapter 4** supports the assessment of long-term performance gaps to anticipate potential future gaps, and the identification of corrective investment strategies towards a state of good repair and the achievement of the national performance goals.

**TABLE 32** *Current Performance Gap Summary using Federal Targets (established in 2018)*

| TARGET | 2-YEAR | 4-YEAR | 2017 PERFORMANCE |
|---|---|---|---|
| **Interstate NHS Pavement** | | | |
| Good | 65.0% | 65.0% | 66.7% |
| Poor | 0.5% | 0.5% | 0.3% |
| **Non-interstate NHS Pavement** | | | |
| Good | 55.0% | 55.0% | 62.7% |
| Poor | 1.5% | 1.5% | 1.1% |
| **NHS Bridges** | | | |
| Good | 70.0% | 70.0% | 75.0% |
| Poor | 3.0% | 3.0% | 1.6% |

Before discussing this long-term outlook, the following section highlights some key challenges that can impact KDOT's ability to sustain existing asset conditions, achieve performance targets, and manage customers' expectation for system performance.

## 7.2 Challenges to Long-Term Performance Achievement

KDOT acknowledges several factors that could impact the Department's ability to make progress towards the achievement of the performance targets, sustainment of a long-term SGR, and towards the national goals for the NHS. These factors can be categorized as internal or external impact. The internal factors are those within KDOT's purview to address or manage. The external factors are those inherent in external stakeholders' business processes and are outside KDOT's purview, with limited or no authority for KDOT to manage or address. The following paragraphs characterize the key factors that could impact the NHS assets physical conditions as well as the overall performance of the NHS:

### 7.2.1 The impact of KDOT strategic initiatives

KDOT's investment decisions pertaining to the State highway transportation network are driven by legislative mandates and executive-level strategic initiatives, including, but not limited to, the drive to preserve asset condition, improve mobility and minimize congestion, improve safety, and increase freight movement efficiency. KDOT makes strategic investments in these program areas to manage asset condition for a SGR and to improve the overall performance of the State highway system. The competing goals in these strategic areas require KDOT to adopt strategic decisions to allocate resources among these program areas. Balancing limited resources to achieve these goals simultaneously could impact the Department's ability to achieve performance targets or to meet the national goals for highway physical assets or in any of the system performance areas. To make progress towards performance targets and achieve the national goals concurrently, KDOT would develop balanced-approach investment strategies, employing tradeoff analysis tools and taking into consideration the national and State goals, performance measures, and performance targets. Applying such practices can ensure that TAM investments enable KDOT to make progress towards the achievement of performance targets, to derive maximum benefits for safety, to support expansion and modernization programs and investments for an improved system performance, and vice versa.

### 7.2.2 The impact of anticipated funding gaps

The SHS has performed very well in the past, as evident in **Chapter 3**. This high-level of asset performance is due to the continued financial commitment the State of Kansas has made into the highway transportation system. These historical funding levels may not be available in the future as other system goals begin to compete with asset condition goals and funding is pulled away from bridge and pavement programs, available funds begin to lose value due to inflation, assets begin to deteriorate faster as they age, or asset owners are unable to meet federal funding match to secure the needed funds for maintenance and preservation. These factors can all impact KDOT's ability to sustain existing asset conditions, provide desired levels of system performance for users, and to achieve performance targets. The uncertainty and risks associated with funding gaps are documented in financial, LCP, and risk management chapters. In **Chapter 5**, mitigation strategies to manage the impact of funding gaps have been recommended as part of the risk analysis process.

### 7.2.3 The impact of incongruent performance measures and targets

KDOT has been using performance-based approaches in developing investment strategies for pavements before TAM practice became a federal requirement. Specifically, KDOT has been making data-driven decisions using established performance measures and performance goals as guiding elements for physical assets. These performance management elements have been ingrained in the Department's business processes including analytical tools that support decision analysis. For example, the NOS system uses different levels of pavement performance metrics to track asset condition and to recommend work types for future investments. However, the performance measures and metrics that support the NOS analytical processes are different from the required measures stipulated in the federal rules. These differences in performance measures, condition assessment indicators, and performance goals create an additional step for KDOT in ensuring that they meet the minimum condition requirements specified in the federal rules for the NHS assets. For reporting purposes, KDOT has modified its performance assessment processes to align with the federal requirements but will continue to use existing decision variables to drive investment decisions, such that investments strategies support progress towards the achievement of performance targets and the national goals for the highway system.

### 7.2.4 The impact of external stakeholders' investment approach

The NHS within the State of Kansas is owned by multiple stakeholders, each of which is a separate entity and autonomous. **Chapter 3** discusses the NHS stakeholders and the extent of ownership. These agencies have established business processes that guide investments into the NHS assets. Except for MPOs, these external stakeholders are not subject to the TAM federal requirements. As such, their investment decisions are not necessarily driven by the achievement of the federal condition requirements, performance targets, or the national goals. However, KDOT must ensure that irrespective of the owners of the portion the NHS, each segment is accounted for and meets the federal requirements. This demands that KDOT works with these external stakeholders to establish performance targets that align with the federal requirements, obtain financial documentation for future performance projections, collaborate to ensure that their investments drive physical condition and system performance towards the achievement of performance targets and the national goals. KDOT faces the challenge of influencing the decision processes pertaining to resource allocation of the external stakeholders.

Currently, there are statutory and administrative relationships allowing KDOT and the KTA to collaborate and share resources to improve the performance of the SHS. KDOT will continue to engage the other entities to find working understanding that supports and improves investment decisions for the achievement of the performance targets.

## 7.3 Identifying and Selecting Investment Strategies

### 7.3.1 Existing Processes

At KDOT, selection of investment strategies generally follows a bottom-up approach with employment of a many-phased development process that culminates in the strategic investment selections presented in the Statewide Transportation Improvement Program (STIP). The first phase of the process is identification of available funds and needs. Financing and the specific guidelines associated with said funds comes from the State and Federal legislative levels and the initial departmental list of needs is augmented by the Long-Range Transportation Plan (LRTP) with its high-level goals and broadly identified infrastructure objectives.

Refinement and ranking of the Priority List arises from the input, collaboration and resulting ideas garnered through the local consult process, from the expertise of KDOT staff across the state. Potential projects are further prioritized depending on the KDOT Program and subcategory

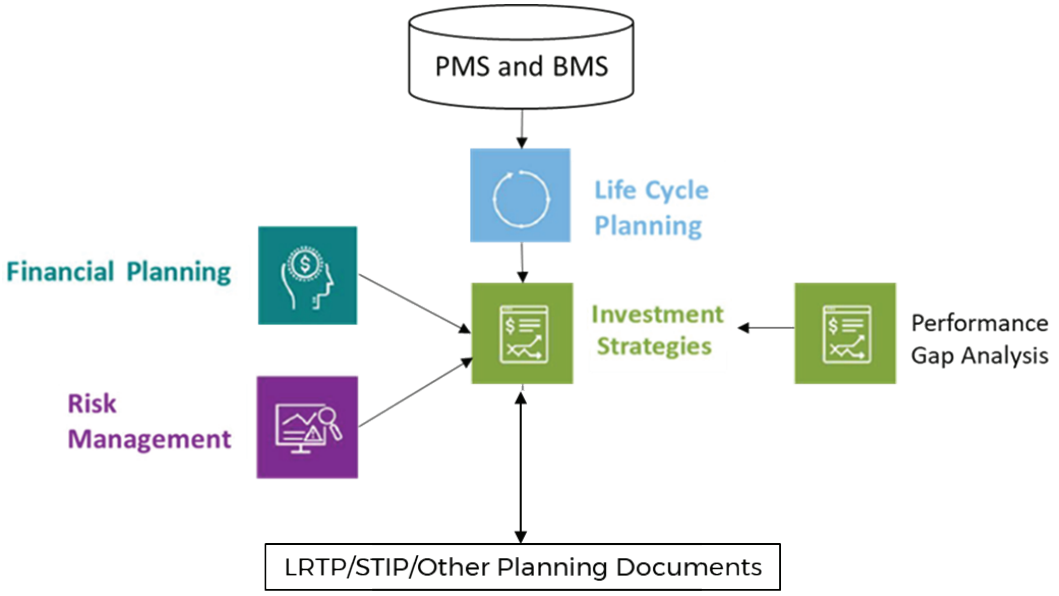
to which they belong and the applicable guidelines, statutes, and policies that apply to each of these programs or/and subcategories. (A discussion of each KDOT Program and subcategory is available in the current STIP.) Together these tools, statutes, policies and guidelines assist KDOT management to arrive at an investment strategy that matches the funding at their disposal. The resulting list of projects is then reflected in the 4-year STIP. The strategic investment strategy is broadly classified by four major investment programs (preservation, modernization, expansion, and local construction), the process for identifying investments considers engineering factors, regional priorities, economic impact, and other criteria identified at the local levels by Local Public Authorities (LPAs) are applied to the selections in the Local Construction program.

Historically, asset data stored in both BrM and the PMS, and the analysis of life cycle costs in the PMS (but not in BrM) have been used to inform identification of needs within certain specific investment subcategories, particularly those related to preservation. Due to the capabilities of the respective management systems to date, pavement project selection has been more mature than bridge project selection, in terms of the incorporation of asset management principles.

### 7.3.2 Incorporating TAM in Investment Decision-Making

With improvements to asset management tools and processes in the process of developing this TAMP, KDOT's identification of investment needs, strategies and projects can be enhanced if analysis outputs are effectively incorporated. With these analyses, investment strategies can be recommended based on projected funding, an understanding of risk outcomes, and knowledge of any performance gaps that may be created. This approach emphasizes the assessment of different investment scenarios on system performance to ensure that selected investment strategies will make or support progress towards improving or preserving asset condition, achieving asset performance targets, achieving and sustaining a SGR, and ultimately, supporting the achievement of the national goals identified in the federal final rules. Figure 41 summarizes this process and the linkage with development of the STIP.

**FIGURE 41** *Using asset management processes to inform investment prioritization*



The investment strategies recommended for KDOT's pavement and bridge assets in this TAMP (described in the sections that follow) will serve as a primary basis for identifying and selecting specific projects, following KDOT's existing processes for project selection. Consideration of cross-asset outcomes and resource allocation across asset groups will be considered in future analysis, as needed.

## RECOMMENDED PAVEMENT INVESTMENT STRATEGY

As documented in **Chapter 4**, KDOT investigated three LCP scenarios for pavements that represent three different investment strategies. **Table 33** below summarizes the required average annual investment and resulting performance at the end of the 12-year projection period. As shown, the Balanced approach results in the best period end performance at a reasonable average annual investment. The steady-state scenario shows a high average annual investment cost to maintain surface conditions because there is an increase in reconstructions towards the end of the model period.

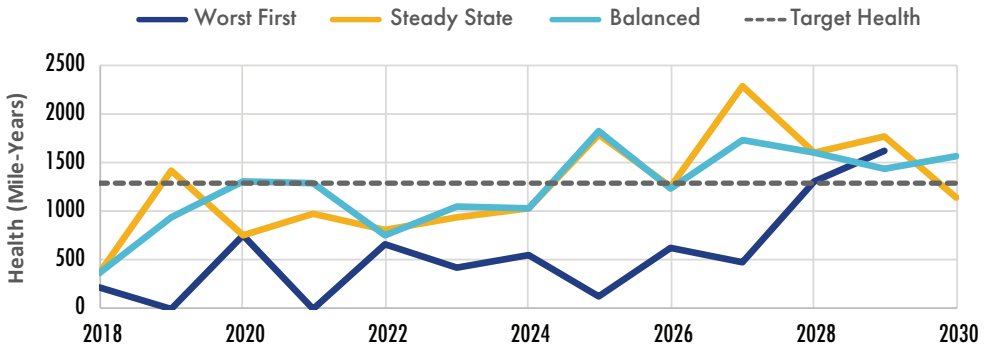
**TABLE 33** *Pavement LCP Scenario Summary*

| SCENARIO | AVERAGE ANNUAL INVESTMENT ($M) | PERIOD END PROJECTED % GOOD | PERIOD END PROJECTED % POOR |
|---|---|---|---|
| **Interstate Highways** | | | |
| Worst-First | 183 | 24.7% | 0.0% |
| Steady-State | 133 | 56.8% | 0.7% |
| Desired SGR (Balanced) | 138 | 53.5% | 0.1% |
| **Non-Interstate Highways** | | | |
| Worst-First | 376 | 37.8% | 0.0% |
| Steady-State | 965 | 67.5% | 0.8% |
| Desired SGR (Balanced) | 282 | 73.0% | 0.2% |

The projected performance gap for each scenario is assessed against KDOT's state of good repair definition, which (as discussed in **Chapter 3**), is the point at which pavement life is gained at (or higher than) the rate that it is being lost. In other words, pavement assets are in a state of good

repair when performance indicates steady-state pavement health, measured in mile-years. As previously stated, pavement health goes beyond surface condition by incorporating a measure of a pavement's structural condition. It considers the amount (in mile-years) by which pavement life is extended with treatment interventions to counteract declining pavement condition due to normal wear and tear. It is calculated by multiplying the number of miles treated with the estimated number of years added due to that treatment, based on KDOT's experience with that treatment under similar previous conditions. **Figure 42** shows the results of each scenario in terms of this measure.

**FIGURE 42** *Pavement Investment Strategy SGR Gap Analysis (Using Pavement Health)*




As shown, while all three scenarios surpass the target pavement health in the long-term, the Desired SGR (Balanced) scenario has the smallest gap over the entire projection period.

Based on this analysis, KDOT has selected the balanced approach as the recommended investment strategy for pavement assets, which will result in no performance gap.

This investment strategy requires an average annual investment of $420 million for pavement preservation ($138 million for interstates and $282 million for non-interstates), with the annual breakdown in work types as shown in **Table 34** and **Table 35**.

**TABLE 34** *Pavement SGR (Balanced) Scenario Projected Annual Funding Need*

| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Interstate** | | | | | | | | | | | | |
| Reconstruction | $0 | $4 | $11 | $79 | $90 | $0 | $21 | $12 | $6 | $13 | $3 | $32 |
| Heavy Preservation | $4 | $60 | $46 | $4 | $19 | $71 | $4 | $5 | $2 | $19 | $7 | $28 |
| Medium Preservation | $62 | $79 | $69 | $7 | $29 | $6 | $87 | $30 | $28 | $12 | $24 | $12 |
| Light Preservation | $25 | $7 | $19 | $19 | $10 | $41 | $68 | $69 | $117 | $108 | $94 | $90 |
| **TOTAL** | **$91** | **$150** | **$145** | **$108** | **$148** | **$117** | **$180** | **$117** | **$154** | **$151** | **$129** | **$161** |
| **Non-Interstate** | | | | | | | | | | | | |
| Reconstruction | $23 | $5 | $16 | $4 | $14 | $19 | $0 | $1 | $1 | $0 | $0 | $6 |
| Heavy Preservation | $53 | $17 | $66 | $0 | $8 | $0 | $0 | $2 | $27 | $20 | $0 | $10 |
| Medium Preservation | $204 | $75 | $71 | $130 | $70 | $100 | $241 | $82 | $90 | $141 | $137 | $136 |
| Light Preservation | $61 | $61 | $70 | $55 | $91 | $93 | $121 | $161 | $256 | $234 | $186 | $225 |
| **TOTAL** | **$340** | **$157** | **$224** | **$189** | **$183** | **$211** | **$362** | **$245** | **$374** | **$395** | **$323** | **$377** |
| **GRAND TOTAL** | **$431** | **$307** | **$369** | **$297** | **$331** | **$328** | **$542** | **$362** | **$527** | **$546** | **$452** | **$538** |

**TABLE 35** *Pavement SGR (Balanced) Scenario Total Period Funding Allocation*

| PAVEMENT CATEGORY | RECONSTRUCTION | HEAVY PRESERVATION | MEDIUM PRESERVATION | LIGHT PRESERVATION | TOTAL |
|---|---|---|---|---|---|
| Interstate | 5.4% | 5.3% | 9.1% | 13.5% | 33.3% |
| Non-Interstate | 1.8% | 4.0% | 29.1% | 31.8% | 66.7% |

KDOT's projected average annual available funding of $375 million over the next two years will result in a funding gap with this recommended scenario. If the Kansas Legislative Task Force recommendation to allocate additional funding to highway preservation is implemented, this funding gap may be alleviated.

## RECOMMENDED BRIDGE INVESTMENT STRATEGY

As documented in **Chapter 4**, KDOT investigated two LCP scenarios for bridges that represent three different investment strategies. **Table 36** below summarizes the required average annual investment and resulting performance at the end of the projection period. As shown, the increased investment scenario results in the best period end performance.

**TABLE 36** *Bridge LCP Scenario Summary*

| SCENARIO | AVERAGE ANNUAL INVESTMENT ($M) | PERIOD END PROJECTED % GOOD | PERIOD END PROJECTED % POOR |
|---|---|---|---|
| **Historically Representative Scenario** | | | |
| NHS Bridges | 158 | 56.20% | 2.60% |
| Non-NHS Bridges | | 55.00% | 1.80% |
| **Increased Investment Scenario** | | | |
| NHS Bridges | 243 | 68.90% | 0.90% |
| Non-NHS Bridges | | 61.40% | 0.90% |

The projected performance gap for each scenario is assessed against KDOT's state of good repair definition, which (as discussed in **Chapter 3**), is when the percent of total bridge deck area (both NHS and Other SHS) in good condition is at or greater than 80%, and percent in poor condition is no greater than 1%. **Figure 43** and **Figure 44** show the results of each scenario in terms of these measures (results are shown for NHS and Non-NHS bridges combined).

**FIGURE 43** *Bridge Investment Strategy Gap Analysis (Using Percent Good)*

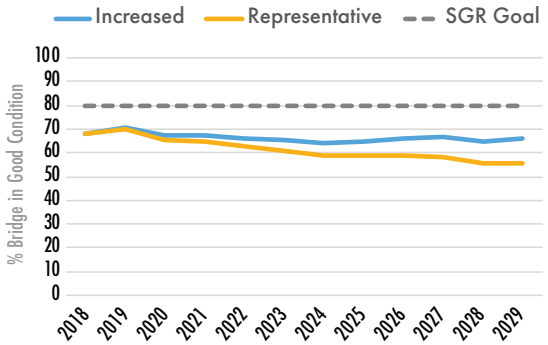
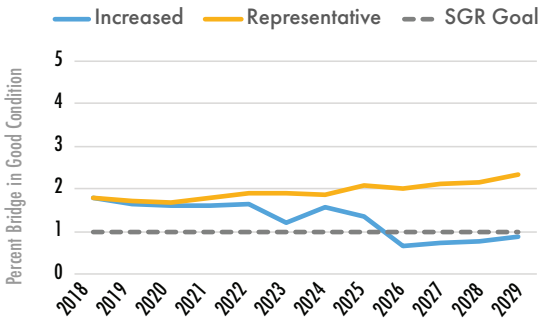



**FIGURE 44** *Bridge Investment Strategy Gap Analysis (Using Percent Poor)*



Both strategies allow KDOT to meet the selected two-year performance targets of 70% good and 3% poor in the short term; however, performance gaps are projected for both the four-year target and the long-term SGR. With increased funding, the SGR goal for percent of bridge deck in poor condition is met, but not the goal for percent in good condition. This demonstrates that current (about $120 million/year) and planned ($125 million/year) funding levels for bridge preservation investment may be insufficient to maintain bridges in a state of good repair, based on this best available data. For the purpose of comparison, **Table 37** shows the estimated annual funding required by work type, to achieve the results of each bridge scenario analysis.

As discussed in **Chapter 4**, this analysis will be refined with the completion of the BrM implementation and configuration process, and will produce more accurate (and potentially different) projections of bridge performance for more informed investment strategies.

The recommended investment strategy for bridges is to continue with the planned investment in bridge preservation ($125M/year) in the short-term, while improvements are completed to allow for more accurate analysis and more informed investment decisions over the next year.

**TABLE 37** *Bridge Investment Scenario Projected Annual Funding Need*

| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Historically Representative Scenario** | | | | | | | | | | | |
| Maintenance | $0.3 | $0.1 | $0.8 | $0.4 | $0.4 | $0.3 | $0.1 | $0.0 | $0.7 | $0.1 | $0.0 |
| Rehabilitation | $15.4 | $7.1 | $76.3 | $56.0 | $59.0 | $26.1 | $31.5 | $24.4 | $42.7 | $39.2 | $29.1 |
| Reconstruction | $144.0 | $150.6 | $82.3 | $101.7 | $99.6 | $133.0 | $118.1 | $130.9 | $116.4 | $120.5 | $130.8 |
| TOTAL | $159.7 | $157.8 | $159.4 | $158.1 | $159.0 | $159.4 | $149.7 | $155.3 | $159.8 | $159.8 | $159.9 |
| **Increased Investment Scenario** | | | | | | | | | | | |
| Maintenance | $0.8 | $0.8 | $0.8 | $0.4 | $0.1 | $0.4 | $0.0 | $0.1 | $0.3 | $0.2 | $0.0 |
| Rehabilitation | $73.1 | $45.9 | $40.7 | $43.0 | $59.5 | $16.4 | $30.7 | $21.2 | $45.4 | $22.0 | $29.7 |
| Reconstruction | $169.7 | $193.9 | $205.3 | $203.5 | $189.8 | $215.8 | $218.9 | $198.1 | $202.7 | $226.8 | $217.7 |
| TOTAL | **$243.6** | **$240.6** | **$246.8** | **$246.9** | **$249.4** | **$232.6** | **$249.6** | **$219.4** | **$248.4** | **$249.0** | **$247.4** |

# CHAPTER 8 CONTINUOUS IMPROVEMENT

> With TAM as an on-going process, this TAMP is a living document to be continuously updated as KDOT improves its asset management practice.

There are several opportunities for improvement in the TAM process that KDOT will consider in order to increase its ability to bring pavement and bridge assets to a state of good repair. Based on the current state of KDOT's asset management practice and the analyses documented in this TAMP, the following opportunities for improvement have been identified to enhance TAM practice for increased benefit realization:

- Upgrade the bridge management system to enable more accurate life cycle planning;
- Revisit bridge LCP scenarios and identify investment strategies that support the achievement of national condition goals, and performance targets while focusing on preservation, risk management, and minimizing life cycle cost;
- Identify strategies to close the projected long-term performance gaps for bridge assets;
- Evaluate realigning pavement work types to Federal work types to reduce complications in future consistency determinations;
- Establish and document a Standard Operating Procedure for pavement and bridge management to conduct scenario analyses systematically in future TAMPs and to capture institutional knowledge;
- Evaluate cross-asset resource allocation methodologies to improve tradeoff analyses between pavements and bridges;
- Collaborate with other states and federal agencies to improve and clarify the rules, regulations, and guidance around pavement and bridge management and their documentation in the TAMP.

KDOT will continue to implement planned enhancements to the TAM process, with consideration of additional opportunities to further improve asset management maturity. This TAMP will be updated every four years, or with significant changes in the processes or recommendations documented, as required by Federal regulations.

# APPENDIX A: TRANSPORTATION ASSET MANAGEMENT POLICY STATEMENT

While the Kansas Department of Transportation (KDOT) has considered asset preservation as a key principle of operation for years, the formal practice of transportation asset management (TAM) has been adopted in accordance with Chapter 23 of the U.S. Code of Federal Regulations Part 119 (National Highway Performance Program) and Part 515 (Asset Management Plans). The purpose of this policy is to establish the fundamental principles that will guide asset management practice throughout KDOT to maintain highway system assets in a state of good repair.

In alignment with the KDOT mission to provide a statewide transportation system to meet the needs of the state, it is the policy and commitment of KDOT to:

- Take a holistic approach to managing assets across the entire highway network and KDOT divisions, towards optimized resource allocation across assets and decision making;
- Make investment decisions that maintain asset health, as defined in the transportation asset management plan (TAMP), driven by asset data and analysis, including considerations of whole life cycle cost analysis and risk management, as documented in the TAMP;
- Continuously measure the effectiveness of asset management practice and prioritize continuous improvement and training of people, processes, and tools;
- Collaborate and coordinate with the Kansas Turnpike Association, sharing TAM processes and inviting KTA's participation in related discussions and decisions;
- Maintain and implement the objectives highlighted in the TAMP and update the TAMP every four years, per current Federal regulations, or as needed.

The Secretary of Transportation for KDOT maintains overall accountability for the implementation of asset management. The Asset Management Steering Committee, chaired by the State Transportation Engineer and the Director of Planning & Development, is responsible for ensuring that KDOT maintains good asset management practice in all aspects of decision making. These groups are further supported by the Asset Management Working Group, Project Management Team, and Coordinating Committee, which includes external stakeholders.

KDOT shall submit asset data, performance reports, and the risk-based TAMP to the Federal Highway Administration (FHWA) as required by federal regulation.

This policy will be circulated to the necessary KDOT departments and made available on the KDOT website.

*Developed by the Asset Management Steering Committee and approved by the State Transportation Engineer and the Secretary of Transportation.*

**State Transportation Engineer**
Date:

**Secretary of Transportation**
Date: