Kansas
Department of Transportation

Transportation Asset Management Plan

DECEMBER 2022

SIGNATURES

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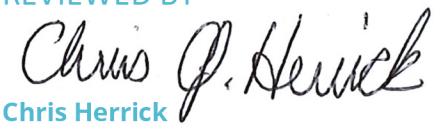

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EXECUTIVE SUMMARY

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 reporting requirements. 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 13,037 lane miles and 2,834 bridges covering the entire state.

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 to identify and prioritize preservation

Kansas National Highway System

13,037
Lane-miles of roadways

2,834
Bridges

$19.1 billion
Total replacement cost

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 Inerstate pavement is in poor condition, KDOT has less than 1.0% (i.e., accounting for rounding errors) of Interstate NHS pavements in poor condition.

Similarly, KDOT bridges on the NHS 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 requirement with only 3% of NHS bridge deck area considered poor.

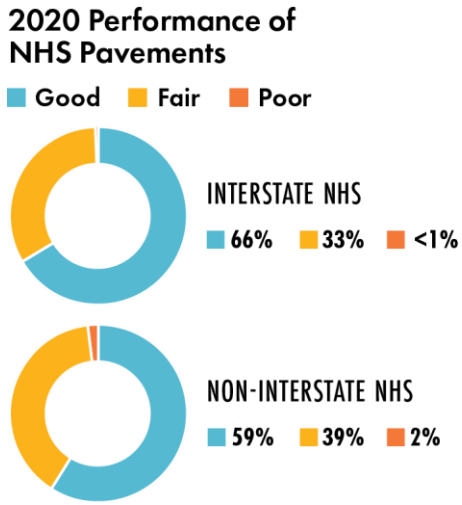
Life Cycle Planning

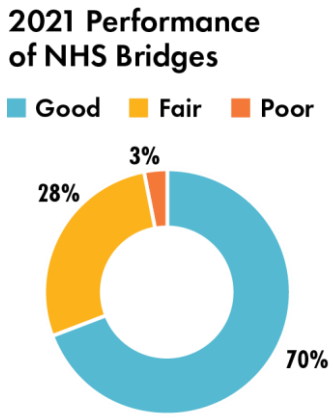
KDOT has forward-looking policies and procedures to effectively support life cycle planning (LCP), which require logical rules, high-quality data, modeling tools, and sound methods to help analyze and evaluate the long-term cost of different scenarios. The primary focus of LCP is to identify cost-effective investment strategies that yield a state of good repair and drive performance towards achieving national goals.

PAVEMENT LCP

KDOT's pavement management system (PMS) is equipped with modeling capabilities and predictive deterioration equations that serves as a performance-based decision support. Pavement condition data is housed in KDOT's PMS and feeds the LCP approach for the entire highway system. To promote a comprehensive evaluation of alternatives, KDOT conducts different LCP scenarios using pavement condition and financial data, modeling tools, and input from experts. The scenarios compare pavement performance for the annual funding KDOT is expected to receive over a 10-year period. For this TAMP, three LCP strategies were explored:

- **Worst first:** prioritizes pavements requiring reconstruction or heavy rehabilitation.
- **Balanced (increased preservation)**: a balanced approach to maintain performance, spreading the types of preservation actions so that different pavements are regularly receiving structural condition improvements.





- **Balanced (increased reconstruction)**: a balanced approach to maintain performance, spreading the types of reconstruction 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 has inhouse, probability-based tools for network forecasting and they configured and implemented AASHTOWare Bridge Management Software (BrM), which has LCP capability. For this TAMP, KDOT developed scenarios to compare the potential impact of different investment levels on bridge asset performance. The scenarios explored for this TAMP are:

- **Baseline Representative:** considers committed projects through 2026 for replacement projects, committed projects through 2025 for rehabilitation projects, and 2023 for preservation projects.
- **Increased Investment:** considers preservation investment at a 10% higher level than has been historically available to account for the possibility of additional funding being provided or construction cost savings.
- **Decreased Investment:** considers preservation investment at a 20% lower level than has been historically available to account for the possibility of reduced funding, inflation, and construction cost increase over time.

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
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
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
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
Lack of contractor availability *Financial/ Economic*	Inability to plan for long term; Reduced capacity to accomplish work; Potential delays in project letting; Lack of innovative construction practices; Reduced competition at bid lettings causes higher prices
Lack of staff leading to an increase in contractor reliance *Workforce/Organizational*	Higher reliance on contractual staff with increased cost

Financial Planning and Investment Strategies

WHERE DOES KANSAS HIGHWAY FUNDING COME FROM?

KDOT relies on several 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

MANAGING RESILIENCE AND EXTREME WEATHER *RISKS*

Climate change introduces extreme weather trends and other events that can present unexpected consequences to transportation infrastructure in the state of Kansas. In particular, KDOT considers the following extreme weather events that have happened in the past or are likely to occur:

- Extreme temapreature variations
- Windstorms
- Increased fires
- Inland flooding

These risks are identified in the risk register with the risk assessed to be moderate. Nonetheless, risk response strategies that will improve resilience and preparedness include:

- Design and engineering practice that emphasizes resilience to damage from extreme weather including interstate designs for higher flooding risks and bridge scour action plans.
- Robust inspection practices (including increased frequency) to identify vulnerable assets at increased risk of damage from extreme weather
- Maintaining emergency response plans (KS Response Plan and State Hazard Mitigation Plan) to support fast-paced recovery actions

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 a potential impact on the performance of the NHS since KTA and some local stakeholders own and manage portions of the NHS.

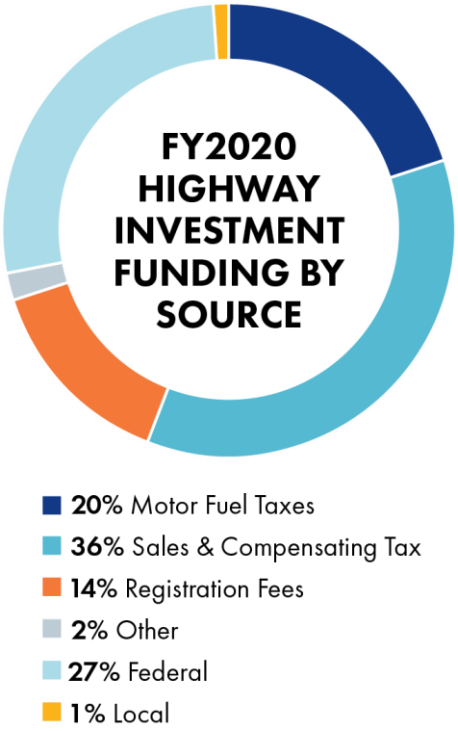
FUNDING USES

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.
- **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

The current funding program, The Eisenhower Legacy Transportation Program (IKE), is expected to provide funding at a level that stabilizes infrastructure decline. This 10-year program will use protected funding sources for preservation work. Over its 10-year period (2020 to 2029), IKE is expected to allocate about $9.9 billion to transportation programs (including rail, aviation, and transit), which would benefit state and local highways across Kansas.



Funding projections show that about $17 billion in State Highway funding would be available for investment for the duration of the TAMP (2022-2031), representing an average annual revenue of $1.7 billion per year. Out of all available resources, KDOT is estimating that an annual funding of about $410 million will be available for the pavement program (all the State Highway System) and $125 million for bridge preservation funding for the duration of the TAMP. This is in addition to an expected $100 million in new construction and reconstruction annually to support preservation investments.

Projected funding available for pavement and bridge preservation

ESTIMATED TOTAL FUNDS (MILLIONS $)										
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Pavement	410	410	410	410	410	410	410	410	410	410
Bridge	125	125	125	125	125	125	125	125	125	125
Total	535	535	535	535	535	535	535	535	535	535

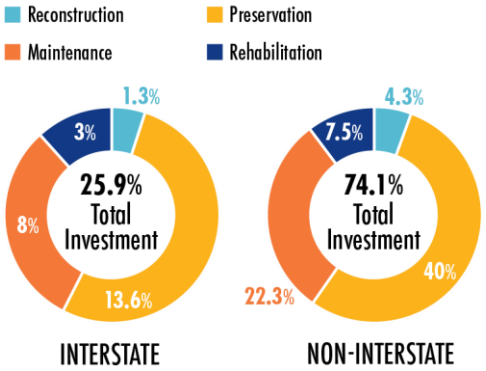
FUNDING NEEDS & INVESTMENT STRATEGIES

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). KDOT continues improving asset management tools and processes as described in this TAMP. Outcomes of these tools and processes are used to recommend investment strategies based on projected funding, understanding of risk outcomes, and knowledge of any performance gaps that may result. 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 state of good repair, and ultimately, supporting the achievement of the national goals identified in the federal final rules.

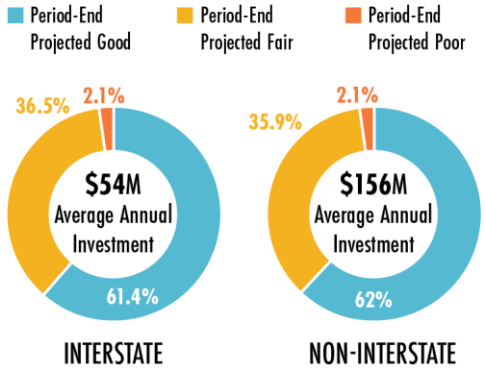
Based on the PMS analysis, KDOT has selected the **balanced approach (with increased preservation)** as the recommended investment philosophy to guide pavement investments for the duration of the

TAMP. This approach assumes an average annual investment of $210 million over the next ten years. This investment strategy is expected to achieve the selected performance targets and will enable KDOT to meet the federal minimum requirement for Interstate NHS while making progress towards the national goals.

Pavement Balanced Approach Investment Allocations



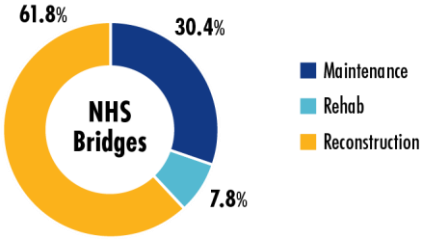
Pavement Balanced Approach Scenario Summary



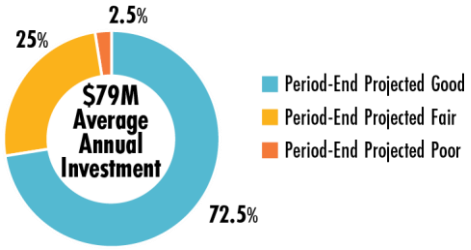
For bridges, both strategies explored allow KDOT to meet the selected two-year performance targets, but performance gaps are projected for both the four-year target and the long-term state of good repair (SGR). With increased funding, the SGR goal for percent of bridge deck in poor condition is met, 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.

Bridge Planned Investment Allocation Summary



Bridge Planned Investment Allocation Summary



Engaging Other NHS Owners

KDOT uses a formal process to engage other NHS owners to ensure these agencies understand Federal asset management regulations, commitments that have been made, impacts on their portions of the NHS, and how they can contribute to ensuring that Kansas' pavement and bridge assets are maintained at acceptable condition levels, to meet national performance goals. This external engagement is intended to guide KDOT in keeping all other NHS owners informed while supporting information gathering and buy-in to improve TAM processes. Altogether there are 49 other entities that own these assets, including KTA and CCLINKS. The engagement strategy is summarized below:

TAMP Overview Workshops	TAM Data Coordination	TAMP Analysis Output & Performance Targets Communication	TAMP Implementation Updates
To introduce the TAMP effort, review objectives, and the engagement plan	To collect asset and finance data from stakeholders and share data as needed.	To share outputs of asset lifecycle analyses and proposed performance targets	To provide updates to stakeholders and obtain input for Annual Consistency Determination and Performance Period Progress Reports
At least every four years	*At least every four years*	*At least every four years*	*Annually in April/May*

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:

- Better utilize the continual upgrades to BrM to improve KDOT's LCP and Investment strategies and utilize BrM within a well rounded, robust bridge management system to support more accurate lifecycle planning ;
- Continue to review the pavement work types and treatment crosswalk to make any improvements as needed to reduce complications in future consistency determinations;
- Acquire a PMS with enhanced capabilities to handle federal metrics and KDOT-specific metrics for analyzing LCP, in developing investment strategies, improving transparent decision making;
- 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; and
- 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 implementing planned enhancements to the TAM process, considering additional opportunities to improve asset management maturity further. In addition, this TAMP will be updated every four years with significant changes in the processes or recommendations documented, as required by Federal regulations.

Contents

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 just the NHS, this system includes 13,037 lanes-miles of pavement and 2,834 bridges.

The Kansas Department of Transportation (KDOT) is required to develop a Transportation Asset Management Plan (TAMP) for the NHS pavements and bridges. The content of this TAMP does not include non-NHS pavements and bridges, unless clearly stated.

Maintenance for NHS roadways is shared by KDOT, the Kansas Turnpike Authority (KTA) and several local entities. This asset base is valued at $19.1 billion, in 2022 dollars. **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, including a ten-year life cycle and financial planning process to maintain NHS pavements and bridges in a state of good repair (SGR)

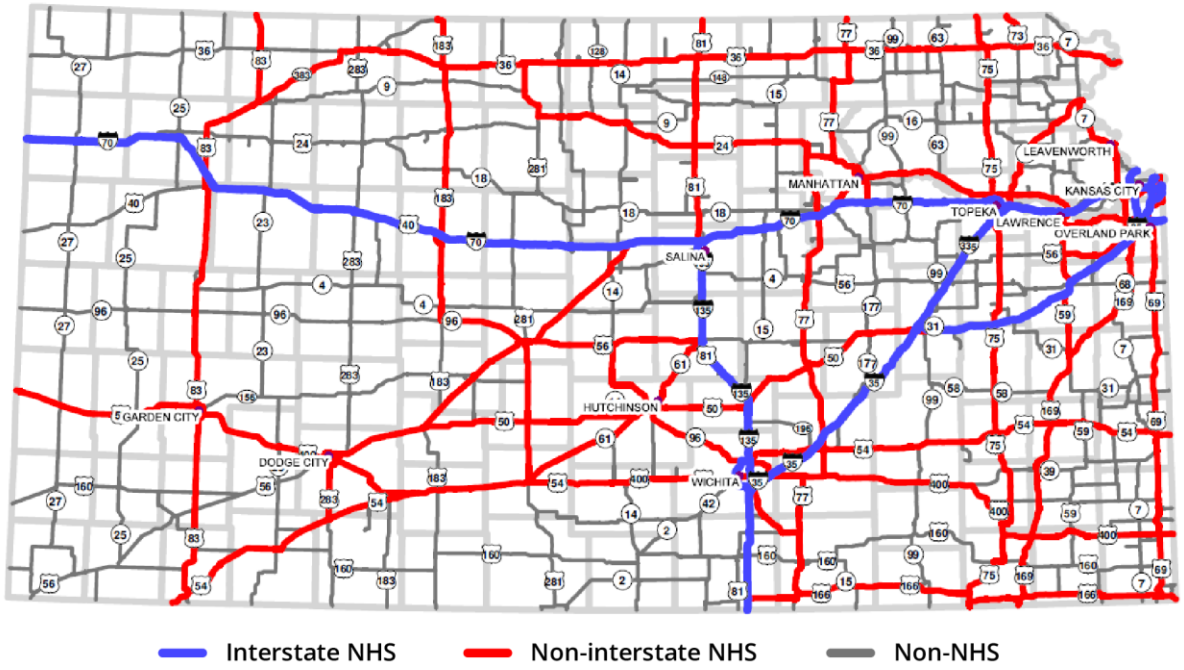
Kansas National Highway System

13,037
Lane-miles of roadways

2,834
Bridges

$19.1 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

ASSET MANAGEMENT IS ABOUT ...

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

predict how they deteriorate and to manage risks to meet performance standards — thereby enabling analysis of alternatives to prioritize and 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 NHS. These requirements were reinforced by the Fixing America Surface Transportation Act (FAST Act) in 2015. States were required to develop a TAMP that was compliant with the Federal regulations (23 CFR 515) in 2018.

In 2021, the Federal TAMP regulations were amended by the Bipartisan Infrastructure Law (BIL) to include a requirement for States to consider extreme weather and resilience within their lifecycle cost and risk management analyses in the TAMP. This 2022 TAMP update is in compliance with the original mandate to update the TAMP every four years and incorporates several new elements to improve asset management practice at KDOT.

TAMP CONTENT REQUIREMENT

- 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

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 philosophies to ensure progress towards achieving the national goals and maintaining assets in a state of good repair. The TAMP is intended to be a 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 performance targets, analyzing life cycle costs, evaluating long-term expenditure, funding forecasts, and financial constraints, addressing risks and resilience, identifying deviations from the desired system performance, and developing strategies to address any performance gaps.

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 and not included in this TAMP. As shown, the Kansas Turnpike Authority (KTA) is responsible for a portion of the interstate on the NHS in blue, while other smaller portions are the responsibility of local entities (e.g. cities and counties).

Assets Included in the TAMP

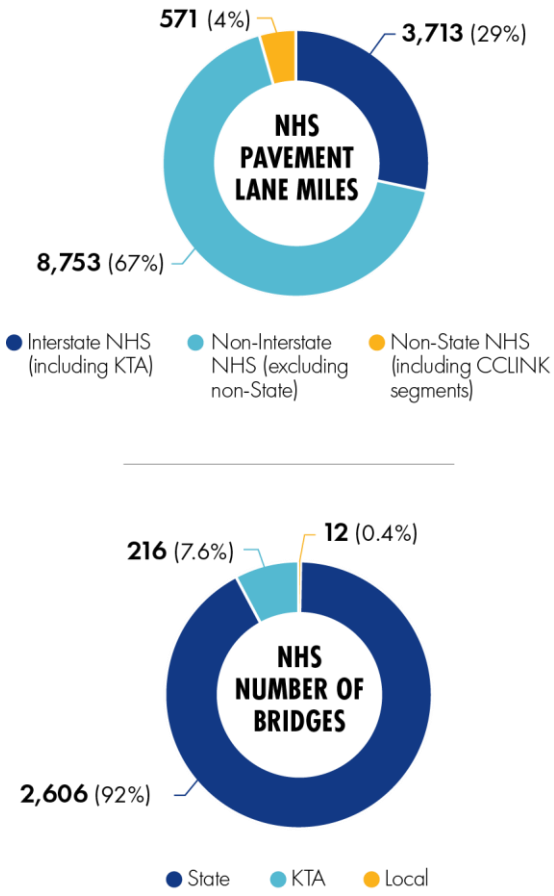
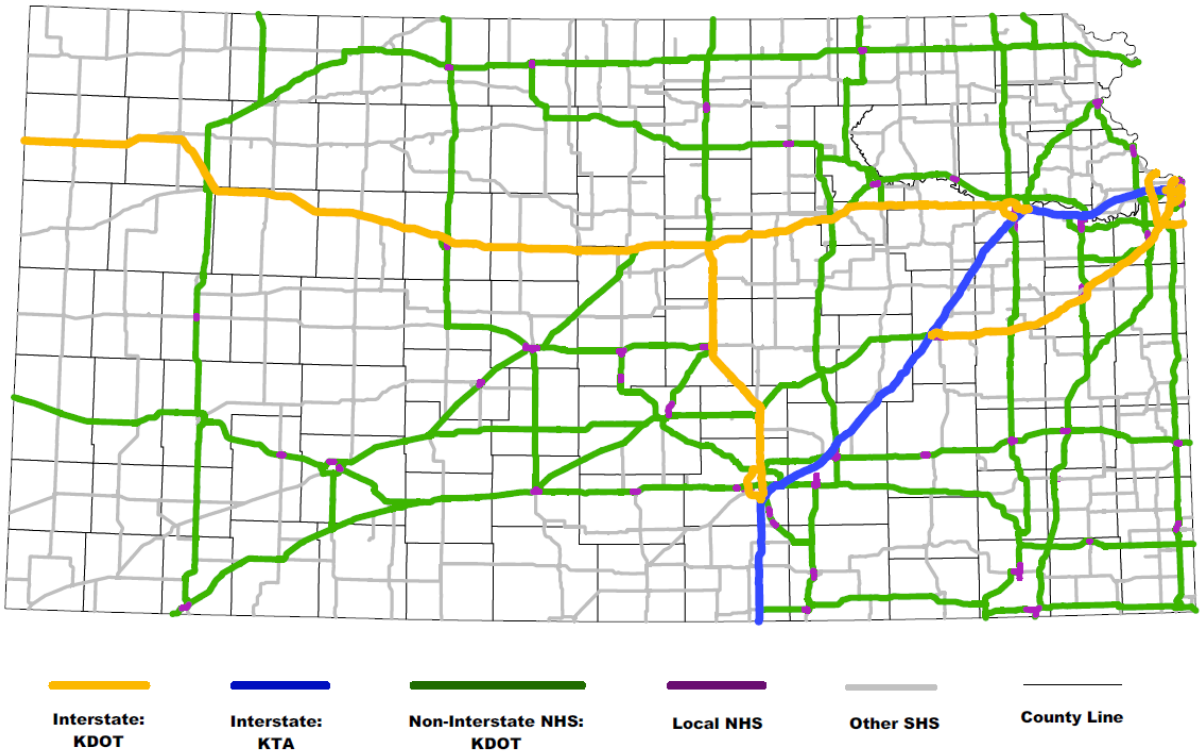


FIGURE 2 Kansas NHS by maintenance responsibility



NHS pavement assets covered in this TAMP are broken down into the following categories:

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

NHS bridge assets covered in the TAMP are referred to as State/KDOT bridges and Non-State bridges (KTA & Local Agencies). **Figure 3** shows some examples of highways in the state that fall in these categories.

FIGURE 3 *Highway examples for each pavement asset category*

Table 1 summarizes the organization of the TAMP showing where Federal requirements, as specified in 23 CFR 515, are met. 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 5 through Chapter 8.

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 ✓ NHS Pavement and Bridge Inventory and Conditions ✓ Data Availability and Management Systems
Chapter 4	Engaging Other NHS Owners	✓ Coordinating data with non-DOT owners of NHS assets
Chapter 5	Life Cycle Planning	✓ Life Cycle Planning
Chapter 6	Risk Management Plan	✓ Risk Analysis and Management and Part 667 Analysis ✓ ExtremeWweather & Resilience Considerations
Chapter 7	Financial Planning	✓ Ten-year Financial Plan
Chapter 8	Investment Strategies	✓ Performance Gap Analysis ✓ Investment Strategies
Chapter 9	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 and planning documents (e.g. Long-Range Transportation Plan, Strategic Management Plan, etc.) detail the Department's mission and vision statements, strategic goals, and objectives emphasizing asset management principles and demonstrating a commitment to the preservation of major transportation assets through sustained condition improvements. While the KDOT mission is "To provide a safe, reliable, innovative statewide transportation system that works for all Kansans today and in the future," the agency goals include themes that embody the major principles of asset management. KDOT has shown a commitment to preservation of its major transportation assets through these guiding documents and other investments which have led to a long history of sustained improvements in pavement condition (**Figure 4**). Note that this historical data shows condition using a calculation methodology different from the federal performance measures. In 2018, KDOT adopted new performance measures and targets for pavement infrastructure system condition, in alignment with federal regulations. **Figure 5** shows the trends in the last several years, using the new measures.

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

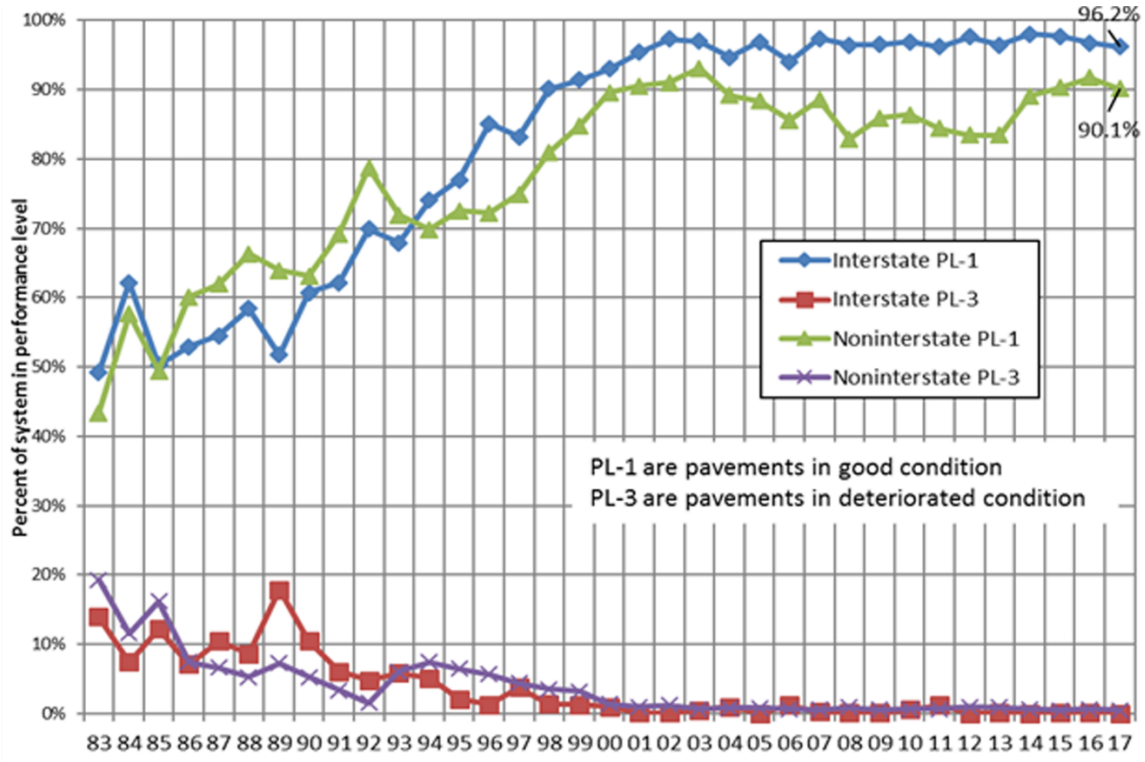
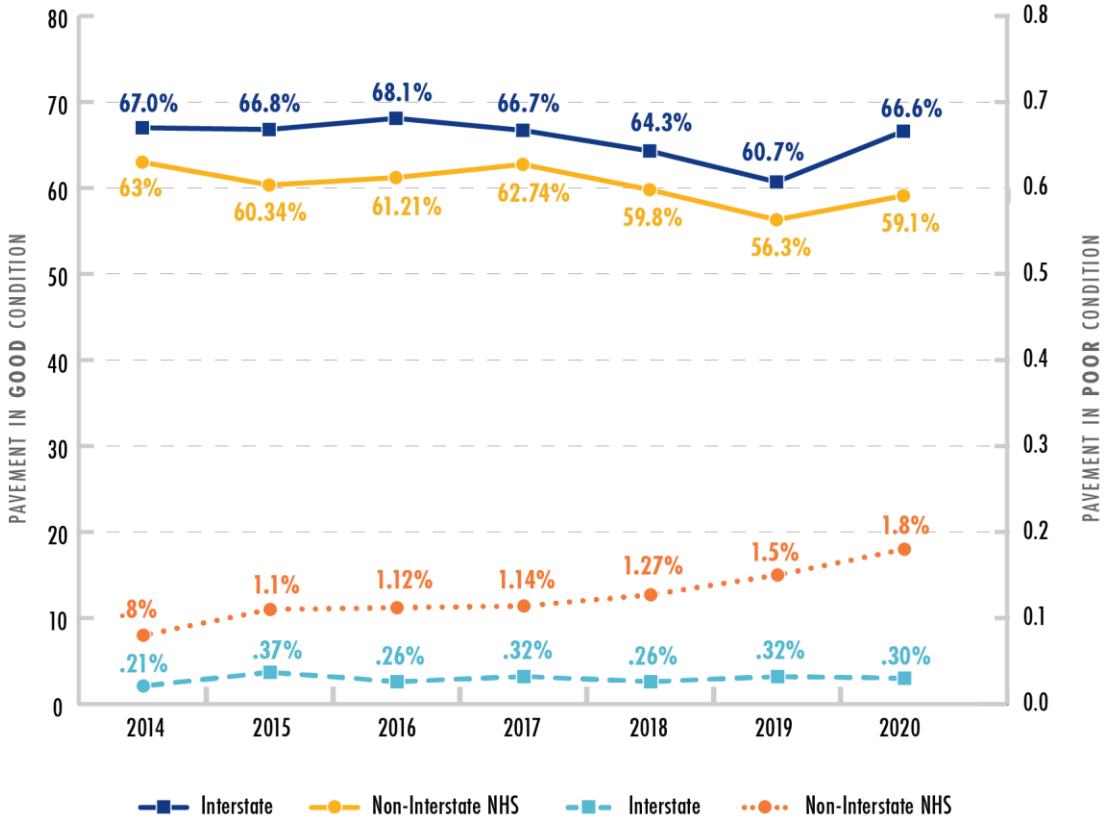


FIGURE 5 *Recent pavement condition data using current measures*



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 provided an opportunity to hone KDOT's asset management maturity for better infrastructure.

Since then, KDOT has established the Eisenhower Legacy Transportation Program (IKE), a rolling ten-year investment program that addresses transportation needs across the state. With about $5 billion invested in preservation, IKE demonstrates KDOT's commitment to improving infrastructure performance with flexibility, responsiveness, and accountability. KDOT has also implemented a Performance Measures dashboard which provides up-to-date summaries of agency-wide performance measures including and the FHWA system condition performance measures (PM2) along with the other national performance measures.

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 6** summarizes the groups, responsibilities, and membership.

FIGURE 6 *KDOT asset management governance*

Responsibilities

- Provides strategic oversight to TAM
- Reviews TAMP analyses, results, and contents
- Makes cross-functional area decisions

Members

- State Transportation Engineer
- Director of Planning & Development
- Director of Engineering & Design
- Division Director of Program & Project Management
- Assistant Bureau Chief of Program Management
- Debt Investment Manager (Office of Finance & Budget)

Responsibilities

- Acts as subject matter experts
- Provides technical input to TAM and analysis

Members

- Bureau Chief of Construction & Materials
- Assistant Bureau Chief of Construction & Materials
- Bureau Chief of Structures & Geotechnical Services
- Bureau Chief of Local Projects
- Bureau Chief of Maintenance
- Pavement Management Engineer
- Bridge Evaluation & Management Engineer
- Bridge Inspection Engineer
- District Engineers (6)
- Asset Management Engineer
- Program Controls Executive

Responsibilities

- Serves as TAM / TAMP point of contact
- Drives and coordinates TAM activities

Members

- Director of Planning & Development
- Asset Management Engineer

Responsibilities

- Coordinates external stakeholder engagements

Members

- MPOs
- KTA Director of Engineering
- KTA Director of Finance
- FHWA
- Other Owners of NHS
- KDOT Communications Director
- Chief of Transportation Planning

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 safe, reliable, innovative statewide transportation system. The commitments are to:

- Take a holistic approach to managing pavement and bridge assets across the entire highway network and KDOT divisions, towards optimized resource allocation across assets and decision making;
- Make investment decisions that maintain pavement and bridge asset health, as defined in the transportation asset management plan (TAMP), driven by 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 pavement and bridge 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	❶ ❷ ❸ ❹	KDOT's TAMP includes a risk management plan that identifies risks (including safety risks) and proposes mitigation action.
Infrastructure Condition	❶ ❷ ❸ ❹ ❺	Maintaining and improving the condition of pavements and bridges are key elements of the KDOT's TAMP.

NATIONAL GOAL	KDOT TAM OBJECTIVES	RELATIONSHIP TO THE 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

Pavements and bridges 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 NHS. In Kansas, the NHS includes assets managed by KDOT, the KTA, and local entities throughout the state. In this document, pavements are categorized by Interstate NHS, Non-Interstate NHS, Non-State NHS, and Bridges are categorized as only NHS.

The NHS consists of 13,037 lane-miles of pavement and 2,834 bridges comprising a total of 34,012,949 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	PERCENT
Pavements (*Lane Miles*)		
Interstate NHS (including KTA)	3,713	36.2
Non-Interstate NHS	8,753	67.1
Non-State NHS	571	4.4
NHS Total	13,037	100
Bridges (*Number*)		
NHS	2,834	
Total	**2,834**	

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

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).\z

represents about 50% (13,037 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 7 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. Figure 8 illustrates the ownership of the NHS by all entities in the state.

TABLE 4 *2020 NHS pavement asset summary*

Ownership	Interstate NHS		Non-Interstate NHS	
	Lane miles	Percent	Lane miles	Percent
KDOT	2,713	73	8,753	94
KTA	1,000	27	—	—
Other*	—	—	571	6
Total NHS	**13,037 lane miles**			

**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 7 *Pavement asset categories and lengths*

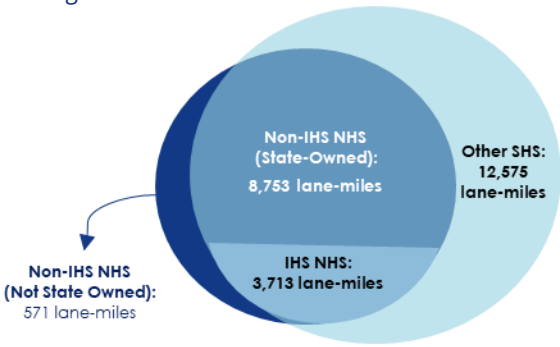
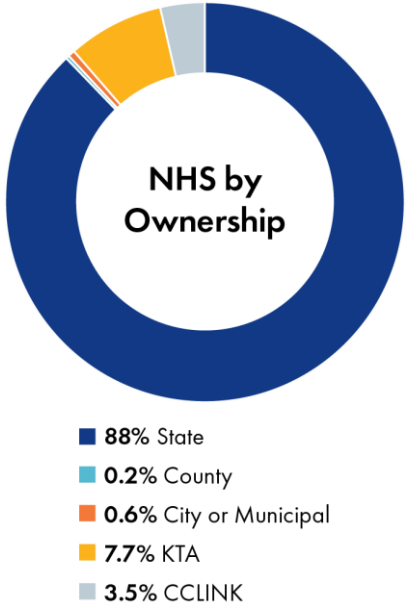


FIGURE 8 *Breakdown of other NHS owners in Kansas*



3.2.2 Pavement Data Management

Asset management is a data-driven process; KDOT relies on high-quality inventory and condition data to make pavement management decisions. The Agency gathers and manages pavement data using automated and manual collection methods and has gathered and maintained information on the entire SHS since 1983, including data from other NHS owners.

The data collection and management processes within the State have evolved since 1983. For all condition metrics, KDOT initially relied on visual pavement surveys conducted by raters to assess pavement condition. However, in response to both KDOT's changing life cycle planning needs and federal requirements, the Agency has shifted from conducting manual distress surveys to relying on a fully automated data collection process.

The current data collection system enables the Agency to collect at highway speeds using a pavement data collection vehicle. KDOT's data collection vehicle, shown in **Figure 9**, provides repeatable and accurate pavement network condition data and is used to report pavement performance metrics on an annual basis. The equipment, personnel, and control procedures used to ensure high-quality data are detailed in the State's Pavement Data Quality Management Plan.

The National Performance Management rules for pavements (PM2) requires condition data to be collected for four distress types:

- International Roughness Index (IRI)
- Faulting
- Rutting
- Cracking Percent

As of 2020, KDOT's data collection practices (including cracking data) is consistent with the PM2 rules. The current collection methodology for pavement condition data has been designed to capture all the distress types expected for each pavement type. **Figure 10** shows the percentage of pavements (by lane miles) based on surface type.

FIGURE 9 *KDOT pavement data collection van*

3.2.3 Pavement Condition Summary

PERFORMANCE MEASURES

The national performance management measures (23 CFR 490.307) for Pavement Condition Assessment include:

- 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 overall performance of the pavement network is computed from the four condition metrics — IRI, rutting, faulting, and cracking percent. Present serviceability rating (PSR) is allowed as an alternative measure for specific locations where posted speed limits are less than or equal to 40 mph. However, the percentage of the NHS in this category is not significant so KDOT does not use PSR.

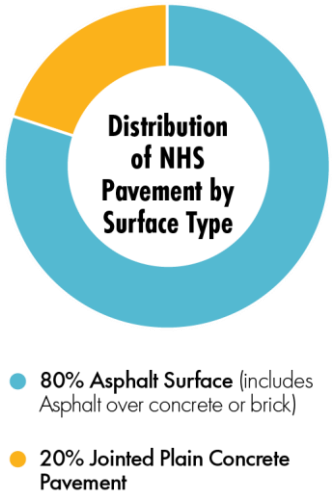
KDOT is required to establish performance targets, regardless of ownership, for the full extent of the NHS (interstate and non-interstate), and to meet the minimum condition requirements for Interstate NHS. The minimum condition requirements state that KDOT shall have no more than 5% of Interstate pavements in Poor condition. The targets established are based on expected funding (which also serve as constrained performance targets) for the pavement program. The targets enable KDOT to make progress towards the national goals - maintaining the highway infrastructure asset system in a state of good repair. KDOT's two- and four-year performance targets are shown in **Table 5**.

TABLE 5 *Two- and Four-Year Pavement Performance Targets for Performance Period 2 (2022-2025)*

TARGET	2-YEAR	4-YEAR
Interstate NHS		
Good	60.0%	61.0%
Poor	0.4%	0.4%

TARGET	2-YEAR	4-YEAR
Non-interstate NHS		
Good	61.0%	61.0%
Poor	1.7%	1.7%

FIGURE 10 *Distribution of the NHS 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

PAVEMENT ASSET PERFORMANCE

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. The 2020 pavement condition shows that KDOT has achieved or exceeded the minimum requirements stipulated in the federal rules for Interstate pavements.

Figure 11 and Figure 12 show the percentage of NHS pavements in Good and Poor condition between 2016 and 2020 based on the HPMS overall condition. The percentage of the network in Good condition has remained over 50% while the percentage of the network in Poor condition has consistently been less than 2% of the overall network. The 2020 pavement condition shows that KDOT has achieved or exceeded the minimum requirements stipulated in the federal rules for Interstate pavements. As shown in Figure 13, the percent of Interstate pavement in poor condition (including KTA) is 1.8%, which is much less than the federal minimum requirement of 5% poor.

FIGURE 11. *Pavement in good condition for the NHS*

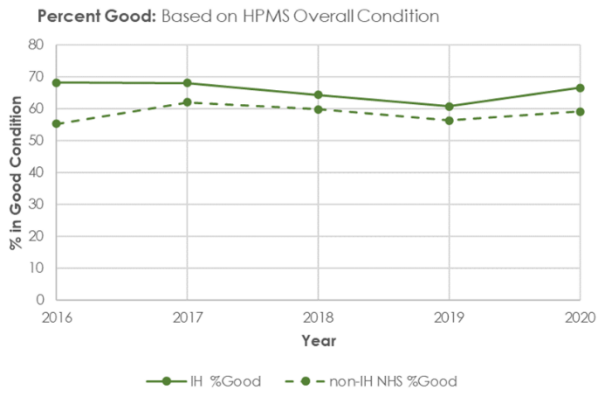
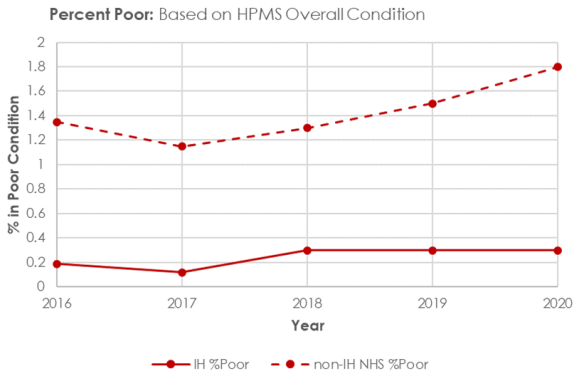
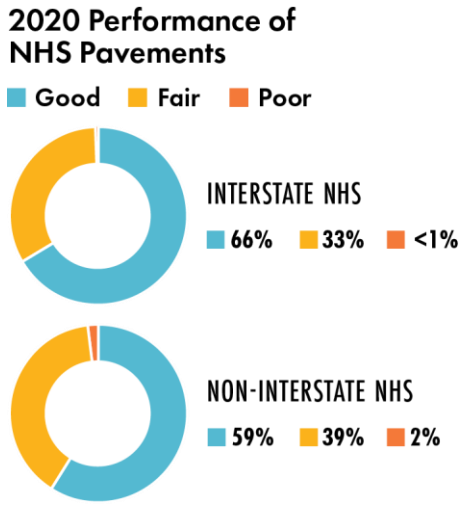


FIGURE 12. *Pavement in poor condition for the NHS*



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 combines the continued investment in

FIGURE 13. *2020 performance of NHS pavement*



PAVEMENT STATE OF GOOD REPAIR

KDOT's pavements are in a state of good repair when Interstate NHS and Non-Interstate NHS Good pavements are at 62% and 63%, respectively.

pavements to maintain or improve the Federal performance metrics and to improve state specific performance related to joint distress and transverse cracking. By incorporating these specific distresses in addition to the Federal measures, KDOT is more holistically managing pavement assets. While joint distress and transverse cracking are not part of the Federal conditions, they are a significant component of pavement condition in Kansas. For this reason, KDOT will continue to report surface condition and monitor and reduce joint distress and transverse cracking distresses through pavement management and preservation activities to remain in a state of good repair.

3.3 Bridge Asset Portfolio

3.3.1 Inventory Summary

The state of Kansas has a total of 24,807 bridges, of which 2,834 carry the NHS and are subject to federal requirements for the TAMP. Most of these are maintained by KDOT, which owns a total of 5,104 bridges, of which 2,606 are on the NHS. KTA owns 216 of the remaining 228 NHS bridges and 12 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 14** shows the bridge categories included in the TAMP, **Table 6** summarizes the Kansas bridge population as of the end of 2021, and

Table 7 shows the breakdown of bridge inventory and condition by other NHS owners. Each table also shows the number of bridges in each condition category.

FIGURE 14 *Bridge asset categories*

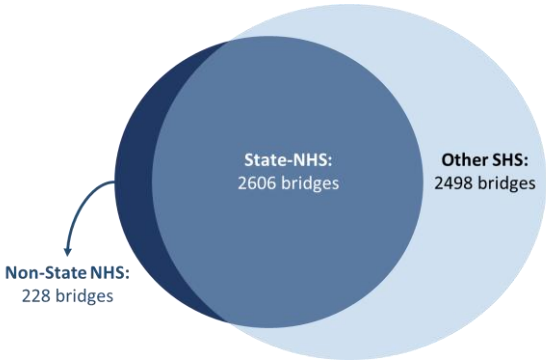


TABLE 6 *2021 Kansas bridge asset summary with condition (deck area percent shown in parentheses)*

OWNERSHIP	TOTAL DECK AREA	TOTAL NUMBER	GOOD	FAIR	POOR
State NHS	31,213,000 sq. ft.	2,606	2,068 (70%)	519 (27%)	19 (3%)
Non-State NHS	2,800,000 sq. ft.	228	167 (79%)	60 (21%)	1 (<1%)
NHS Total	34,013,000 sq. ft.	2,834	2,235 (69%)	579 (28%)	20 (3%)

TABLE 7 *2021 Non-state NHS bridge asset summary by ownership (deck area percent shown in parentheses)*

OWNERSHIP	TOTAL DECK AREA	TOTAL	GOOD	FAIR	POOR
KTA	2,426,000 sq. ft.	216	161 (79%)	54 (20%)	1 (<1%)
Wichita Airport Authority	26,000 sq. ft.	2	2 (100%)	—	—
Cities					
Wichita	47,000 sq. ft.	4	2 (47%)	2 (53%)	—
Topeka	245,000 sq. ft.	2	2 (100%)	—	—
Counties					
Montgomery	12,000 sq. ft.	2	—	2 (100%)	—
Shawnee	2,000 sq. ft.	1	—	1 (100%)	—
Wyandotte	42,000 sq. ft.	1	—	1 (100%)	—
Total Non-state NHS	2,800,000 sq. ft.	228	167 (80%)	60 (20%)	1 (<1%)

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, statistics are only reported for the NHS bridges. 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 uses AASHTOWare Bridge Management Software (BrM) 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 12 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 is assessed on a scale of 0 to 9, where 0 is the worst condition and 9 is the best condition. Separate “component” assessments are made for decks, superstructures, and substructures; 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.

Component-Based Condition Assessment Scale

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 are shown in **Table 8**.

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 greater than 75%, and percent in poor condition is no greater than 2%.

TABLE 8 *Two- and Four-Year Bridge Performance Targets for Performance Period 2 (2022-2025)*

TARGET	2022	2025
Good	72.0%	72.0%
Poor	3.0%	3.0%

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 75%, and percent in poor condition is no greater than 2%.

Figure 16 and Figure 17 illustrate the historical condition for KDOT's bridge assets. As shown, the percentage of bridge deck in good condition has reduced over time and the percentage of poor deck area also decreased through 2018, but from 2018 through 2021 the poor deck area is increasing. 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, the NHS inventory just satisfies the 2022 bridge performance targets established (Figure 15); however, bridges are not in a state of good repair.

FIGURE 16 *Percentage Good Deck Area*

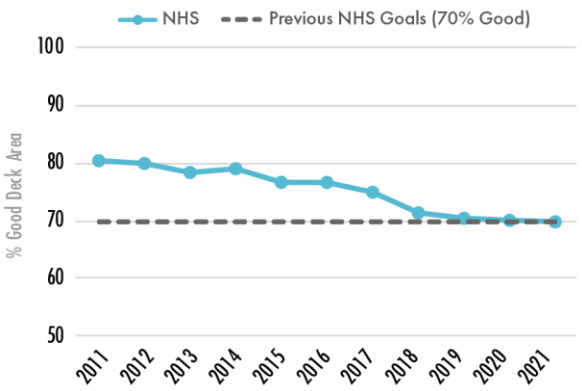
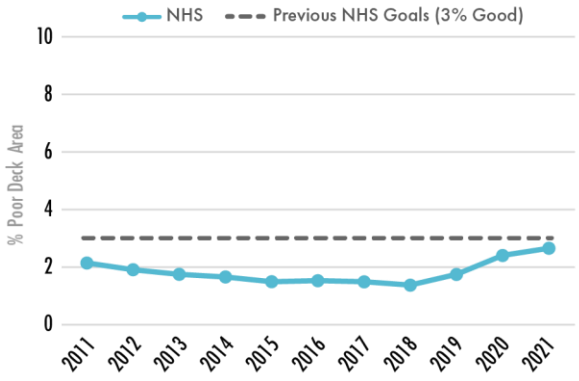
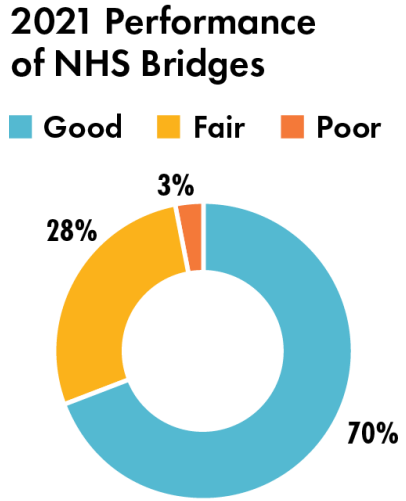


FIGURE 17 *Percentage Poor Deck Area*



Typically, the way to mitigate this is to selectively rehabilitate and reconstruct poor bridges while increasing 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 5 demonstrates KDOT's options for managing this decline and improving performance towards a state of good repair.

FIGURE 15 *2021 Bridge Performance NHS*



CHAPTER 4 ENGAGING OTHER NHS OWNERS

KDOT is engaging other NHS owners to develop a collaborative strategy for data exchange and target setting that satisfies federal requirements.

4.1 Overview

Following federal regulations, KDOT has initiated a formal process to engage other NHS owners to ensure these agencies understand Federal asset management regulations, commitments that have been made, impacts on their portions of the NHS, and how they can contribute to ensuring that Kansas' pavement and bridge assets are maintained at acceptable condition levels, to meet national performance goals.

This external engagement is intended to guide KDOT in keeping all other NHS owners informed while supporting information gathering and buy-in to improve TAM processes.

This section summarizes the federal requirements for collaborating with other NHS owners, identifies the stakeholders and their communications requirements, and specifies the action plan for engagement by identifying the communications.

4.2 Federal Requirements

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

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

FHWA expects State DOTs to coordinate to obtain necessary data from other owners of NHS pavements and bridges. When evaluating whether to certify a State DOT's asset management development processes, FHWA will consider whether the State DOT included a process for obtaining the necessary data

OTHER NHS OWNERS

Is a city, county or other entity (KTA) that owns and/or is responsible for maintenance and upkeep of the Kansas NHS assets included in this TAMP.

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

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

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

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

4.3 Other NHS Ownership

This TAMP covers over 13,000 lane miles of pavement and 2,834 bridges on the NHS (based on 2021 inventory). Of this inventory, over 1,500 lane miles and 231 bridges are not owned by KDOT. Altogether there are 49 other entities that own these assets, including KTA and CCLINKS. **Table 9** summarizes these external stakeholders with their respective pavement and bridge inventory.

TABLE 9 *Kansas NHS External Stakeholder Asset Ownership (2022)*

EXTERNAL OWNERSHIP WITH NHS OWNERSHIP	NUMBER OF BRIDGES	BRIDGE DECK AREA (square feet)	TOTAL PAVEMENT LANE MILES (mi)
1. ARKANSAS CITY	-	-	4.1
2. ATCHISON	-	-	14.5
3. AUGUSTA	-	-	15.7
4. CHANUTE	-	-	6.3
5. CIMARRON	-	-	5.2
6. CLAY CENTER	-	-	3.9
7. COFFEYVILLE	-	-	26.2
8. CONCORDIA	-	-	8.4
9. DERBY	-	-	8.3
10. DODGE CITY	-	-	9.2
11. EL DORADO	-	-	30.5
12. EMPORIA	-	-	19.6
13. EUREKA	-	-	6.6
14. FORT SCOTT	-	-	2.5
15. GREAT BEND	-	-	21.3

EXTERNAL OWNERSHIP WITH NHS OWNERSHIP	NUMBER OF BRIDGES	BRIDGE DECK AREA (square feet)	TOTAL PAVEMENT LANE MILES (mi)
16. HAYS	-	-	14.9
17. HUTCHINSON	-	-	18.9
18. INDEPENDENCE	-	-	19.5
19. IOLA	-	-	6.5
20. KANSAS CITY	-	-	62.7
21. KANSAS TURNPIKE AUTHORITY	216	2,426,000	929
22. KINGMAN	-	-	7.7
23. LARNED	-	-	4.8
24. LAWRENCE	-	-	26.2
25. LEAVENWORTH	-	-	11.3
26. LIBERAL	-	-	11.2
27. LYONS	-	-	14.1
28. MANHATTAN	-	-	11.3
29. MARYSVILLE	-	-	2.8
30. MCPHERSON	-	-	13.7
31. MONTGOMERY COUNTY	2	12,000	-

EXTERNAL OWNERSHIP WITH NHS OWNERSHIP	NUMBER OF BRIDGES	BRIDGE DECK AREA (square feet)	TOTAL PAVEMENT LANE MILES (mi)
32. MULVANE	-	-	6.5
33. OLATHE	-	-	15.8
34. OTTAWA	-	-	14.2
35. PHILLIPSBURG	-	-	4.9
36. PITTSBURG	-	-	4.7
37. PRATT	-	-	9.5
38. SCOTT CITY	-	-	3.7
39. SHAWNEE COUNTY	1	2,000	-
40. SMITH CENTER	-	-	2
41. ST. MARYS	-	-	2.7
42. STERLING	-	-	3.1
43. TOPEKA	2	245,000	31.8
44. UG of City of KCK/WY Co	1	42,000	-
45. WESTWOOD	-	-	3
46. CITY OF WICHITA	4	47,000	43.6
47. WICHITA AIRPORT AUTHORITY	2	26,000	-

EXTERNAL OWNERSHIP WITH NHS OWNERSHIP	NUMBER OF BRIDGES	BRIDGE DECK AREA (square feet)	TOTAL PAVEMENT LANE MILES (mi)
48. WINFIELD	-	-	10
49. YATES CENTER	-	-	7.9
TOTAL	228	2,800,000	1500.3

As shown in the table, KTA is the most important other NHS owner in terms of NHS asset inventory. This agency owns about 95 percent and 87 percent of the locally owned bridges on the NHS (by count and by deck area, respectively) and about 62 percent of the Non-KDOT owned NHS pavement lane miles. This situation provides a reason for a slightly modified engagement strategy. As a result, a two-tiered approach was established for engaging the external as follows:

- Tier 1 includes KTA and all metropolitan planning organizations (MPOs), who are expected to have a higher stake in the decisions KDOT makes related to the NHS
- Tier 2 includes all other agencies

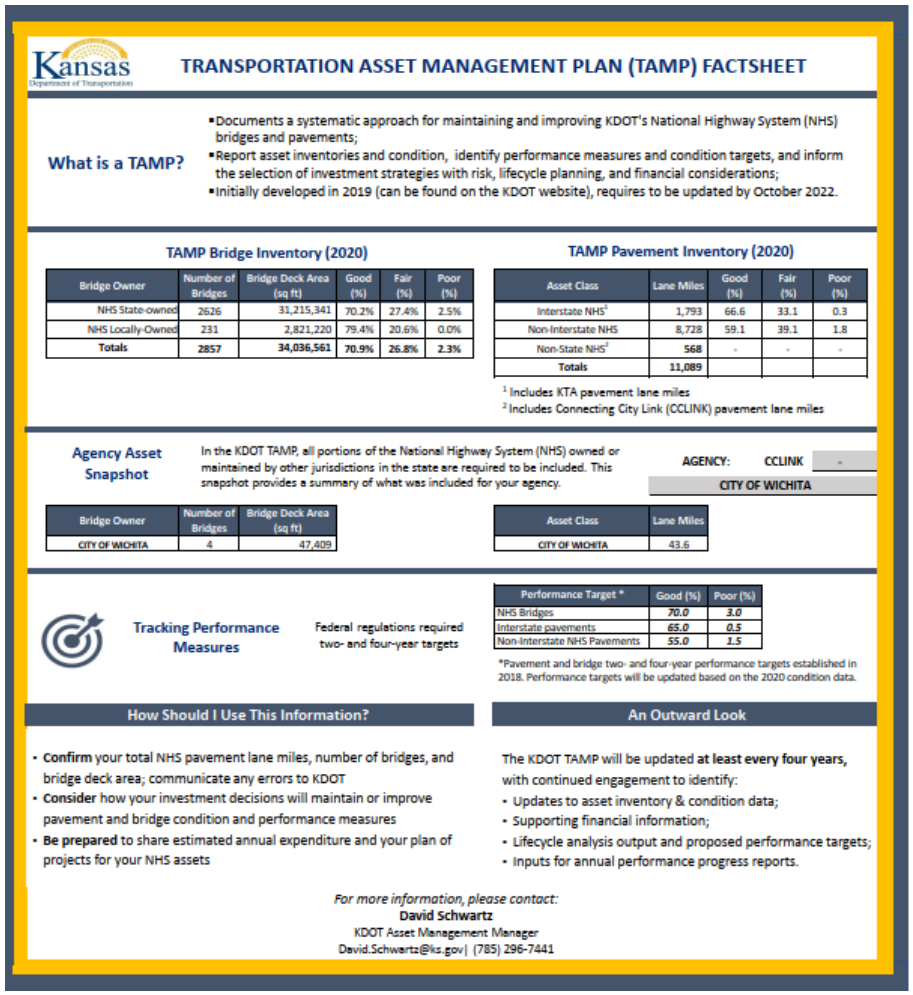
4.4 External Stakeholder Engagement Strategy

For both Tier 1 and Tier 2 other NHS owners, the goal of the initial engagement is to make external stakeholders aware of the TAMP and the analysis used to develop its content and provide information on the recommended investments that would allow the state to maintain NHS assets at or above target condition. In the longer term, engagement can include coordination of funding, projects for the Statewide Transportation Improvement Program (STIP), and the ten-year investment strategy as documented in the TAMP. This engagement plan document focuses on the short-term engagement strategy, primarily through the communicating relevant information with opportunities for stakeholders to provide feedback. Engagement activities described in the plan include:

TAMP Overview Workshops	TAM Data Coordination	TAMP Analysis Output & Performance Targets Communication	TAMP Implementation Updates
To introduce the TAMP effort, review objectives, and the engagement plan	To collect asset and finance data from stakeholders and share data as needed.	To share outputs of asset lifecycle analyses and proposed performance targets	To provide updates to stakeholders and obtain input for Annual Consistency Determination and Performance Period Progress Reports
At least every four years	*At least every four years*	*At least every four years*	*Annually in April/May*

As part of the TAMP Overview Workshop, KDOT distributed a TAMP Factsheet and an Agency Asset Snapshot to each of the NHS owners included in **Table 9**. These one-pager snapshots summarize the NHS ownership and compare it with the total NHS inventory. KDOT expects each agency to confirm the total NHS assets (i.e., bridges and pavements) and identify actions for continued engagement to support TAMP updates. An example is presented in **Figure 18**.

FIGURE 18 *Example of TAMP Factsheet and Agency Snapshot*



Kansas Department of Transportation

TRANSPORTATION ASSET MANAGEMENT PLAN (TAMP) FACTSHEET

What is a TAMP?

- Documents a systematic approach for maintaining and improving KDOT's National Highway System (NHS) bridges and pavements;
- Report asset inventories and condition, identify performance measures and condition targets, and inform the selection of investment strategies with risk, lifecycle planning, and financial considerations;
- Initially developed in 2019 (can be found on the KDOT website), requires to be updated by October 2022.

TAMP Bridge Inventory (2020)

Bridge Owner	Number of Bridges	Bridge Deck Area (sq ft)	Good (%)	Fair (%)	Poor (%)
NHS State-owned	2626	31,215,341	70.2%	27.4%	2.5%
NHS Locally-Owned	231	2,821,220	79.4%	20.6%	0.0%
Totals	**2857**	**34,036,561**	**70.9%**	**26.8%**	**2.3%**

TAMP Pavement Inventory (2020)

Asset Class	Lane Miles	Good (%)	Fair (%)	Poor (%)
Interstate NHS[1]	1,793	66.6	33.1	0.3
Non-Interstate NHS	8,728	59.1	39.1	1.8
Non-State NHS[2]	568	-	-	-
Totals	**11,089**			

[1] Includes KTA pavement lane miles
[2] Includes Connecting City Link (CCLINK) pavement lane miles

Agency Asset Snapshot

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

AGENCY: CCLINK -
CITY OF WICHITA

Bridge Owner	Number of Bridges	Bridge Deck Area (sq ft)
CITY OF WICHITA	4	47,409

Asset Class	Lane Miles
CITY OF WICHITA	43.6

Tracking Performance Measures

Federal regulations required two- and four-year targets

Performance Target *	Good (%)	Poor (%)
NHS Bridges	*70.0*	*3.0*
Interstate pavements	*65.0*	*0.5*
Non-Interstate NHS Pavements	*55.0*	*1.5*

*Pavement and bridge two- and four-year performance targets established in 2018. Performance targets will be updated based on the 2020 condition data.

How Should I Use This Information?

- **Confirm** your total NHS pavement lane miles, number of bridges, and bridge deck area; communicate any errors to KDOT
- **Consider** how your investment decisions will maintain or improve pavement and bridge condition and performance measures
- **Be prepared** to share estimated annual expenditure and your plan of projects for your NHS assets

An Outward Look

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

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

For more information, please contact:
David Schwartz
KDOT Asset Management Manager
David.Schwartz@ks.gov| (785) 296-7441

4.5 Engagement Responsibilities

Responsibility for the KDOT TAMP lies in the Planning and Development Division, under the purview of the Asset Management Manager. While facilitating and implementing this engagement plan is included in that responsibility, it will be important to include other key players to support development of the material/tools for engagement. Table 10 identifies these key players and their responsibilities.

TABLE 10 *Stakeholder Engagement Responsibilities*

Key Player	Responsibility
KDOT Asset Management Manager	★ TAMP Project Manager, overall lead and facilitator ★ Developing communication materials ★ Facilitating workshops and meetings
Bridge Management Engineer (or designate)	★ Obtaining/receiving bridge data or other inputs from stakeholders
Pavement Management Engineer (or designate)	★ Obtaining/receiving pavement data or other inputs from stakeholders
Comprehensive Project Management System (CPMS) Administrator	★ Providing context or content to support project and programming discussions
Local Projects Representative	★ Providing documentation and data related to locally owned projects and facilitating communication with agencies

CHAPTER 5 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

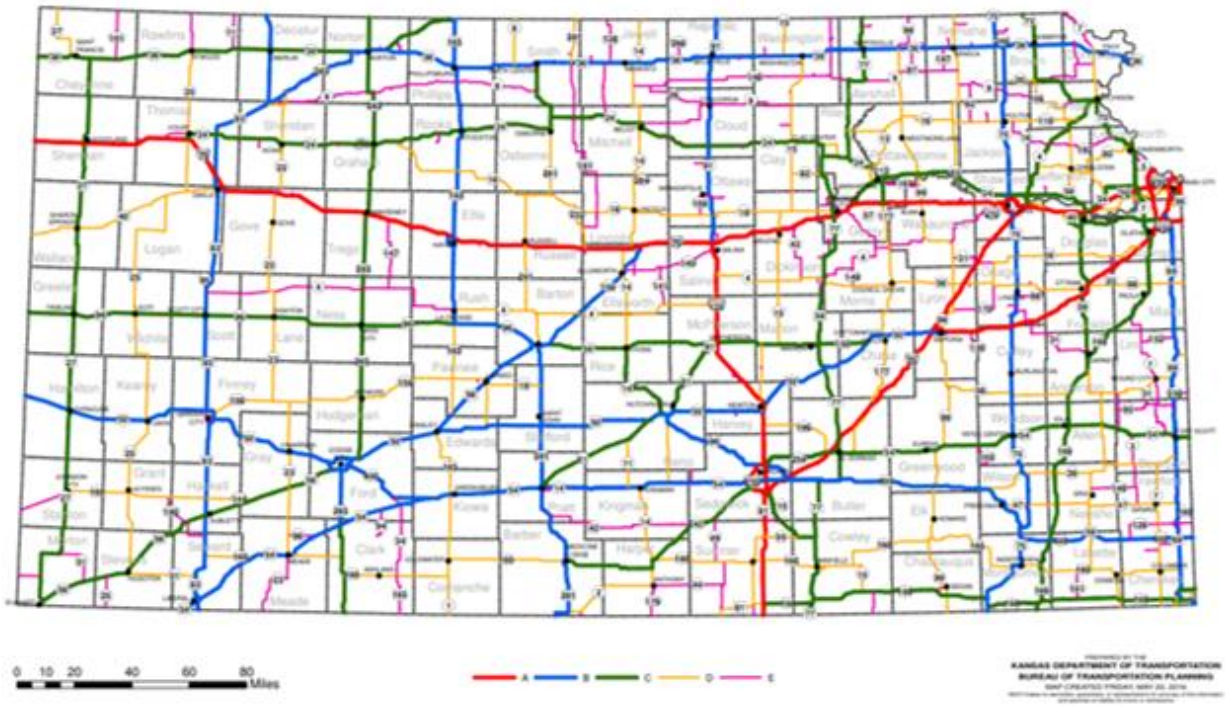
5.1 Pavement Life Cycle Planning

KDOT has five categories of routes (Table 11). Interstate NHS routes and most non-Interstate 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 19 for a map showing route classification.

TABLE 11 *Route Classification*

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 19 *KDOT route classification system map*



5.1.1 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 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 information is used to not only to predict and plan for future needs but also to communicate system performance. While data collection policy is generally

underpinned by the statewide GIS Strategic Plan, KDOT's Data Quality Management Plan 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 PMS and to support the pavement needs assessment and the selection of pavement projects. The PMS and supporting tools are used in recommending work types for each district alongside candidate project locations. 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.

5.1.2 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 and uses several 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 20** shows an example of the modeling output.

The estimation of design life plays an important role in the LCP process. The estimated design life measures the expected time elapsed from the last heavy rehabilitation action to the time a pavement section reaches an established threshold level of distress.

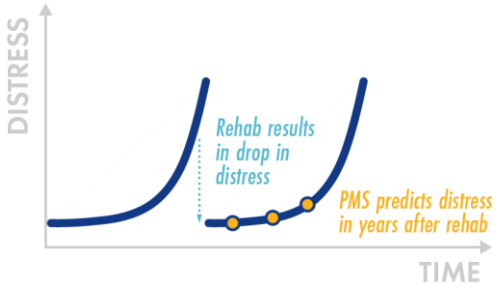
Deterioration models used in KDOT pavement management were originally derived from expert opinion through a modified Delphi process. These models were subsequently revised based on historic time-series pavement condition data. The deterioration models predict the next year's pavement condition under 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

NOTE: KDOT is in the process of acquiring a modern PMS with enhanced capabilities for pavement analysis.

FIGURE 20. *Behavior of pavement performance (distress) after a rehabilitation action*



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 when compared to 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 PMS 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 of 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 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. The Department is currently in the process of acquiring a new PMS to enable improved LCP analysis in the future.

5.1.3 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 treatment types, which can be assigned to the major federal work types. The equivalent thickness for the treatment is a means to allow all treatments to be modeled and compared for consideration. The KDOT work types 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 PMS and experts' knowledge. The PMS 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 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 worse pavement condition was captured and added to the treatment costs.

Table 12 contains the types of treatments and associated costs that KDOT uses in addressing pavement deficiencies. These cost numbers incorporate the rapid increases in construction cost in recent years. The unit costs provided come from actual projects and 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 12 *Pavement treatment options, costs, and work types*

WORK TYPE	TREATMENT TYPES	COST PER LANE MILE	
		Interstate pavements	Non-interstate pavements
Preservation	Chip seal, Overlay 1.5", Bonded Wearing Surface, Extensive patching, overlay 3"	$187,500	$125,000
Maintenance	Patching full depth	$67,500	$45,000
Rehabilitation	Mill 1.5", Overlay 1.5"	$300,000	$200,000
Reconstruction	New concrete/asphalt	$1,125,000	$750,000

5.1.4 Pavement LCP Strategies

> 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 strategies and 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 LCP strategy 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 evaluates different LCP strategies on all State-owned pavements using data (pavement condition and funding availability), modeling tools, and information from experts. The strategies evaluate pavement performance for the annual funding KDOT is expected to receive for the duration of the TAMP.

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 NHS performance summaries. It is important to note that the focus of the analyses discussed in this section is on NHS pavements that are owned by KDOT.

KDOT PAVEMENT LCP STRATEGIES

- Worst first
- Balanced Approach
  - » Increased preservation
  - » Increased reconstruction

Table 13 contains a summary of the three LCP strategies evaluated. A more detailed description of each strategy is provided below. KDOT uses insights from these evaluations to make informed decisions about developing investment strategies that minimize life cycle costs, set targets, and manage asset performance and risk. The results show that at the end of the analysis period and for projected annual funding of $410 million:

- The percent of pavements rated as Poor is expected to increase
- The percent of Interstate pavements rated Good is expected to decline
- More pavement miles receive treatment under the balanced approach (with increased preservation)
- The percent of Non-Interstate NHS rated as Good is expected to improve
- The worst first strategy yields the biggest decline in pavement performance

Even with construction costs rising sharply over the last couple of years, which are not expected to decrease, KDOT is making efficient resource allocation decisions to maintain or slightly improve pavement performance over the next ten years, as depicted in the analysis results.

TABLE 13 *Summary of LCP Strategies*

PERFORMANCE INDICATORS	WORST FIRST	BALANCED APPROACH (INCREASED PRESERVATION)	BALANCED APPROACH (INCREASED RECONSTRUCTION)
SHS Annual Funding (Million$)	410	410	410
Interstate NHS %Good (Baseline = 64.7%)	40.2%	61.4%	52.9%
Interstate NHS %Poor (Baseline = 0.3%)	1.1%	2.1%	2.4%

PERFORMANCE INDICATORS	WORST FIRST	BALANCED APPROACH (INCREASED PRESERVATION)	BALANCED APPROACH (INCREASED RECONSTRUCTION)
Non-Interstate NHS %Good (Baseline=57.4%)	21.3%	62%	60.5%
Non-Interstate NHS %Poor (Baseline=1.5%)	2.1%	2.1%	1.9%
NHS Preservation (Miles/Year)	Majority Recon miles	1,960	1,800
NHS Maintenance (Miles/Year)		650	600
NHS Rehabilitation (Miles/Year)		626	650
NHS Reconstruction (Miles/Year)		10	24
NHS Total Miles Treated/Year	Significantly less	3,246	3,074

The paragraphs that follow present the LCP results broken down into only two categories: interstate and non-interstate NHS.

WORST-FIRST LCP STRATEGY

The **worst-first strategy** is only presented to illustrate the importance of asset management and the efficient use of limited resources. This strategy focuses on treating pavements in Poor condition through reconstruction. This strategy does not prioritize preservation or other treatments used to keep pavements in good condition longer. When the worst-first strategy was applied using current condition data, it decreased the percentage of pavements in Good condition over time, while the percentage of the pavements in Fair and Poor condition increased with time, as depicted in **Figure 21** and **Figure 22**.

KDOT does not plan to implement this investment strategy because it is costly and does not achieve its system goals. The strategy prioritizes pavements requiring reconstruction or heavy rehabilitation (i.e., pavements in Poor condition), allocating the remaining funding to lighter treatments that target fair pavements. In other words, this approach does not consider pavement preservation a priority for investment.

FIGURE 21 *Percentage of Pavement in Good Condition—Worst-First Scenario*

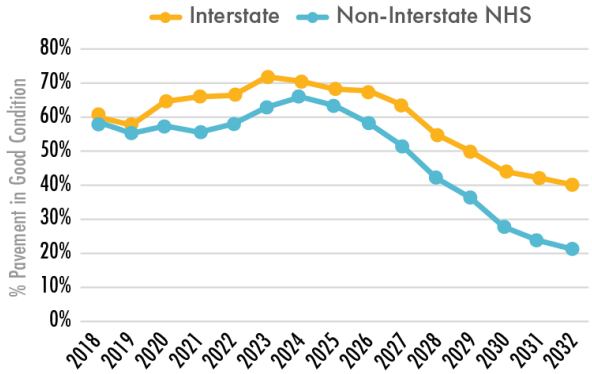
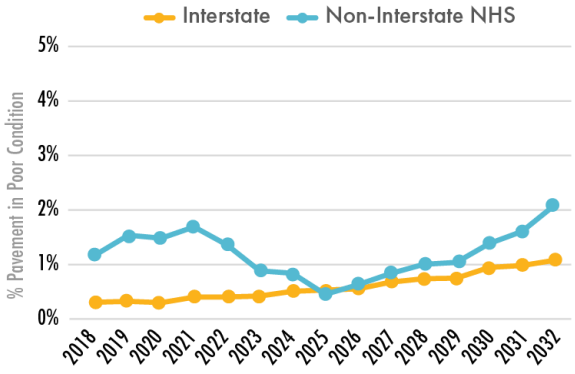


FIGURE 22 *Percentage of Pavement in Poor Condition—Worst-First Scenario*



BALANCED LCP STRATEGY—INCREASED PRESERVATION

The **balanced (increased preservation) strategy** maintains performance, distributing the types of treatment actions taken so that pavements in different condition states are regularly receiving structural condition improvements as well as improvements to surface conditions. In some respects, this scenario acknowledges that only basing pavement investment decisions on surface conditions will have long-term

detrimental impacts. In other words, repeated light treatments, such as maintenance and preservation, will eventually have diminishing benefits. However, on the converse, only focusing on pavements in the worst condition will lead to costly treatments that will not maximize a pavement's life. Therefore, under this approach, KDOT distributed the funding available per year ($410 million for NHS and non-NHS) based on established lane mileage targets, presented above in **Table 13**, for each treatment category.

This strategy enables KDOT to achieve the established performance targets or meet minimum pavement condition requirements by prioritizing a range of treatment types each year. For this, the PMS incorporates the deterioration models, evaluates different mixes of work types, and provides an optimal (cost-effective) investment strategy for treating the pavements as a system. As depicted in **Figure 23** and **Figure 24**, the strategy leads to a stabilization of the percentage of the NHS network in Good condition over time, while the percentage of pavements in Poor condition slightly increases over the analysis period.

FIGURE 23 *Percentage of Pavement in Good Condition— Balanced Approach, Increased Preservation*

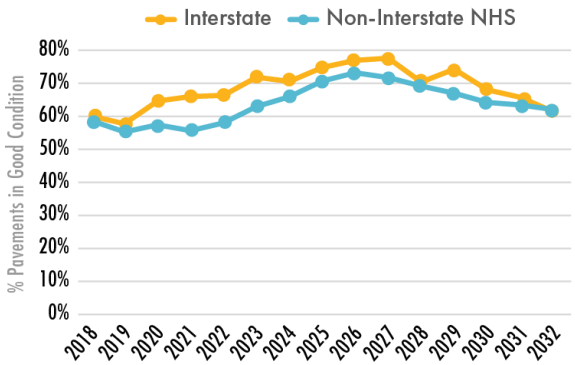
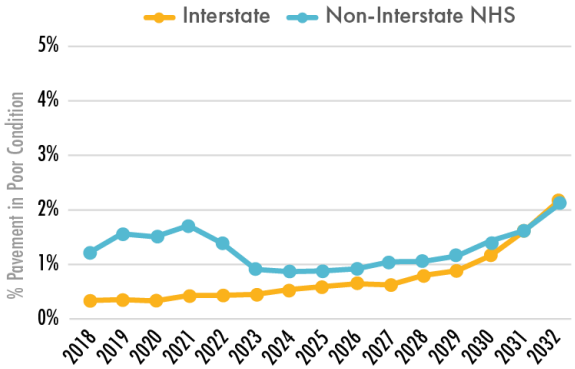


FIGURE 24 *Percentage of Pavement in Poor Condition— Balanced Approach, Increased Preservation*



While the results indicate KDOT will be able to meet the minimum federal requirements for interstate pavements, the increase in the percentage of pavements in Poor condition over time indicates that KDOT may need to continue to increase its overall investment over time or reconsider the treatment targets in each work type category, particularly with regards to the rehabilitation and reconstruction goals.

BALANCED LCP SCENARIO—INCREASED RECONSTRUCTION

Similarly, in this strategy, treatment actions are distributed so that pavements in different condition states are regularly receiving condition improvements. Using this approach, KDOT distributed the funding available per year ($410 million for NHS and non-NHS) based on the lane mileage targets, presented in **Table 13**, for each treatment category.

Like the increased preservation balanced approach, the PMS incorporates the deterioration models, evaluates different mixes of work types, and provides an optimal (cost-effective) strategy for treating the pavements as a system. As depicted in **Figure 25** and **Figure 26**, the strategy leads to a stabilization of the percentage of the NHS network in Good condition over time, while the percentage of pavements in Poor condition slightly increases over the analysis period.

FIGURE 25 *Percentage of Pavement in Good Condition— Balanced Approach, Increased Reconstruction*

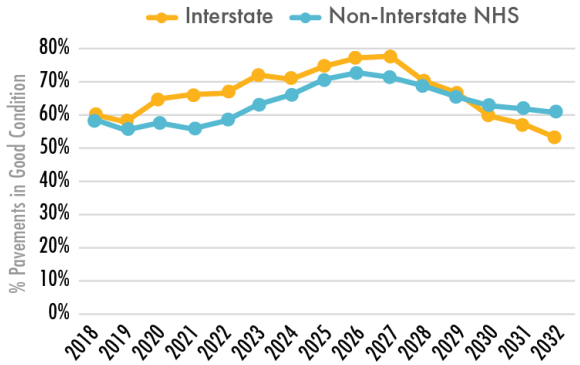
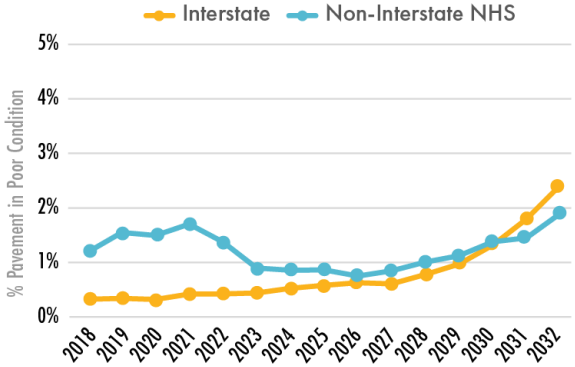


FIGURE 26 *Percentage of Pavement in Poor Condition— Balanced Approach, Increased Reconstruction*



In comparison to the balanced approach with increased preservation targets, the non-interstate NHS shows less change in performance over time than the Interstate NHS; therefore, when looking at the overall trend of the NHS pavement network over time, the percentage of the system in Poor condition remains lower when compared to the preservation-heavy balanced approach. Overall, the LCP scenario enables KDOT to meet the minimum federal requirements for interstate pavements. However, the increase in the percentage of pavements in Poor condition over time, while slight, indicates that KDOT may need to increase its overall pavement investment over time.

5.2 Bridge Life Cycle Planning

KDOT has implemented and is currently configuring AASHTOWare Bridge Management (BrM) for developing and evaluating bridge replacement, rehabilitation, and preservation projects based upon benefit/cost analysis and multi-objective optimization.

5.2.1 Data Collection

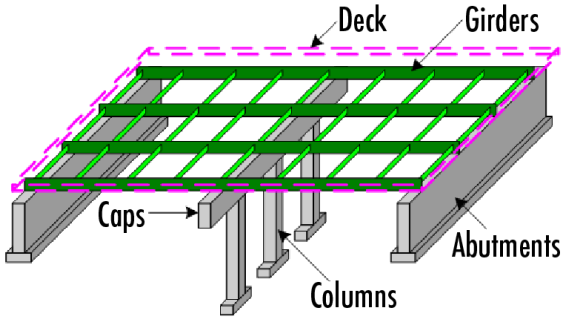
As a key ingredient in its life cycle planning strategy, KDOT was an early adopter of a process known as element-level inspection. Each bridge is subdivided into elements, such as those shown in **Figure 27**, having unique profiles for deterioration and costs. Trained inspectors note early signs of 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.

5.2.2 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 replacement, rehabilitation, and preservation.

KDOT has implemented AASHTOWare Bridge Management Release 6.3 (BrM) to support bridge LCP and continues to enhance configuration of the system to match Kansas DOT parameters more closely. While testing and validation is still in progress, BrM has been used to generate LCP scenario outputs to support the Kansas DOT bridge program. KDOT plans to better utilize the continual upgrades to BrM to improve KDOT's LCP and Investment strategies and utilize BrM within a well-rounded, robust bridge management system to support bridge asset management.

FIGURE 27 *Element composition of a bridge: each part receives a separate condition rating*



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 replacement, rehabilitation, and preservation policy, predicts needs and performance measures, and develops projects to include in agency capital plans.

In 2021, KDOT configured BrM to evaluate treatments and projects and help optimize the bridge program. During the configuration, NBI General Condition Rating (GCR) deterioration modeling was done for structure design types and materials. Network policies were developed including action definitions, project cost, and decision trees with triggers and benefits. KDOT funding allocation and project categories were input. BrM does incremental benefit cost analysis maximizing "Total Utility." Utility criteria used in the initial runs of BrM included condition, risk, and mobility. Testing and validation of the BrM bridge management system software is ongoing and KDOT plans to continue to enhance the configuration and expand use of the software to help 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.

Figure 28 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 and models now being implemented by KDOT (presented in Table 14) 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 28 *Life extension from bridge preservation (typical example)*

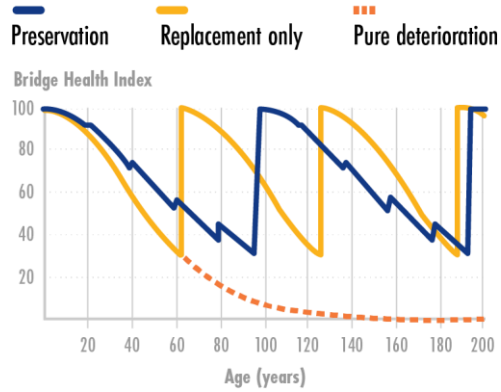


TABLE 14 *New tools being adopted at KDOT*

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 2022-2032 capital program KDOT had developed a set of cost models for use in AASHTOWare BrM.
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	BrM and inhouse tools are used 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.

5.2.3 Treatment Options and Costs

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.

Kansas DOT has categories of bridge work types described in their "Project Selection Criteria.[2]" Bridge program work categories and descriptions are shown in **Table 15** with a crosswalk to the Federal work categories as described in the FHWA Bridge Preservation Guide[3]

[2] *Kansas Department of Transportation Project Selection Criteria.* https://www.ksdot.org/Assets/wwwksdotorg/bureaus/burProgProjMgmt/STIP/Assetsfor2022STIP/3-2022STIP-Project_Selection_Criteria.pdf

[3] *USDOT FHWA Bridge Preservation Guide, Spring 2018.* https://www.fhwa.dot.gov/bridge/preservation/guide/guide.pdf

TABLE 15 *KDOT Bridge Work Type Cross Walk to Federal Work Types*

KANSAS DOT WORK CATEGORY	DESCRIPTION	FEDERAL WORK CATEGORY
Bridge Replacement (PBR)	Replace substandard bridges	Replacement
Bridge Re-Deck and Culvert Rehabilitation (PDR & PCR)	Replace bridge decks on structures where the deck is poor, and the superstructure and substructure are in satisfactory condition. Culvert rehabilitation addresses replacement of culverts less than bridge size that are beyond the scope of a culvert repair project	Rehabilitation
Bridge and Culvert Repair (BSR & BCR)	Bridge and culvert repairs of lesser magnitude than rehabilitation and replacement	Preservation
Bridge Painting (BSP)	Coating structural steel	Preservation
Contract Maintenance	Maintenance activities are performed to offset the effects of weather, deterioration, traffic wear, damage, and vandalism.	Maintenance

Figure 29 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. KDOT is doing testing and validation of the BrM software configuration with the objective 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 achieves a state of good repair over the long term. Table 16 provides a summary of treatments with costs in BrM. Indirect cost ranging from 40-60% is applied to the unit prices, and these values are continually updated to match KDOT's bridge program.

TABLE 16 *Bridge Work Types and Costs*

WORK TYPE	TREATMENT CATEGORY	TREATMENT TYPE	UNIT COST
Maintenance	Strip Seal Repair	Replace Glands	$379/ft
Maintenance	Expansion Joint Replacement	New Expansion Joints	$3,000/ft
Maintenance	Deck Patching	Partial Depth	$480/sq. yd.
Maintenance	Deck Patching	Full Depth	$660/sq. yd.
Preservation	Polymer Overlay	Prep deck and place Polymer overlay	$60/sq. ft.
Preservation	Deck Rigid Overlay	Mill and place PCC overlay	$100/sq. ft
Preservation	Superstructure Preservation	Superstructure preservation includes minor to moderate beam/girder repairs, spalled concrete patches, structural steel paint	$75/sq. ft.

FIGURE 29 *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.

WORK TYPE	TREATMENT CATEGORY	TREATMENT TYPE	UNIT COST
Preservation	Substructure Preservation	Substructure preservation includes minor to moderate pier beam repairs, column and abutment repairs, spalled concrete patches, bridge drainage around abutments	$50/ sq. ft.
Rehabilitation	Deck Replacement	Replace Bridge Deck. Cost depends upon with or without widening	$110/ sq. ft.
Rehabilitation	Superstructure Replacement	Replace Superstructure with or without widening	$150/ sq. ft.
Reconstruction	Span Bridge Replacement	Replace Bridge. Cost depends upon span length and structure type	Varies $125-$225/ sq. ft.
Reconstruction	Bridge-Sized Culvert Replacement	Replace Culvert	$150/ sq. ft.
Construction	New Bridge	New Span Bridge	$110-$200/ sq. ft.
Construction	Bridge-Sized New Culvert	New Culvert	$150/ sq. ft.

5.2.4 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. KDOT uses well-established inhouse spreadsheets that do probability-based network-level forecasting and BrM is going through continual testing and validation to identify more accurate investment strategies.

Using a combination of tools, KDOT has developed scenarios to compare the potential impact of different investment levels on bridge asset performance. In these scenarios, Markov transition probability of NBI GCR is used to deteriorate KDOT's network of NHS bridge deck area, and benefit rules improve deck area condition for replacement and repair projects. Different budgets and strategy can be evaluated with respect to the Federal performance measures over time.

BrM is used to recommend bridge replacement, rehabilitation, and preservation projects using benefit cost analysis and multi-objective optimization. KDOT-specific configuration parameters have been developed and are continually being tested and validated. As BrM is enhanced, 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.

BASELINE REPRESENTATIVE INVESTMENT LEVEL FOR KDOT NHS BRIDGES

The baseline representative scenario for Kansas DOT NHS Bridges considers committed projects through 2026 for replacement projects, committed projects through 2025 for rehabilitation projects, and 2023 for preservation projects. In subsequent years current and anticipated funding levels are used to make condition forecasts. **Table 17** shows the committed and estimated budgets and the average funding provided for replacement, rehabilitation, and preservation projects. Replacement includes complete bridge replacement. Rehabilitation is primarily deck replacements, and preservation includes all other repairs and preservation actions.

KDOT BRIDGE LCP SCENARIOS

- Baseline Representative Investment Level
- 10% Increased Investment Level
- 20% Decreased Investment Level

TABLE 17 *Baseline Representative Scenario Funding for Kansas DOT NHS Bridges By Year and Work Category*

FUNDING YEAR	REPLACEMENT	REHABILITATION	PRESERVATION
2022	$30,895,000	$7,259,000	$20,353,000
2023	$17,749,000	$5,173,000	$24,710,000
2024	$27,600,000	$4,491,000	$21,500,000
2025	$147,840,000	$11,656,000	$21,500,000
2026	$64,177,000	$5,500,000	$21,500,000
2027	$40,000,000	$5,500,000	$25,000,000
2028	$40,000,000	$5,500,000	$25,000,000
2029	$40,000,000	$5,500,000	$25,000,000
2030	$40,000,000	$5,500,000	$25,000,000
2031	$40,000,000	$5,500,000	$ 28,000,000
Average 10-Year Funding	**$48,000,000 (61%)**	**$6,000,000 (8%)**	**$24,000,000 (31%)**

Note: Yellow shaded cells indicate current projected funding level. Orange shaded cells indicate anticipated projected funding level.

Figure 30 and **Figure 31** show the forecast for percent good and percent poor by deck area, respectively for KDOT NHS bridges given the funding shown in **Table 17**.

FIGURE 30 *Baseline Representative Scenario - Percent Good by Deck Area*

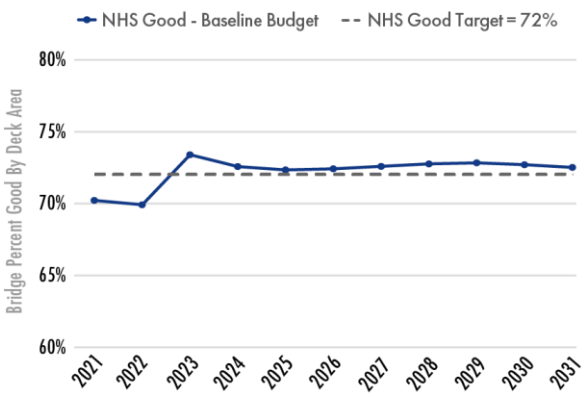
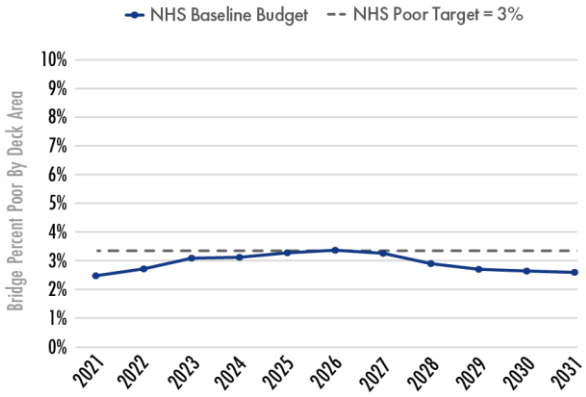


FIGURE 31 *Baseline Representative Scenario - Percent Poor by Deck Area*



Several large deck projects that show benefit in 2023 provide positive movement of the percent good measure. Percent good NHS bridge deck is expected to achieve the 72% Good target in 2023 and maintain the target though 2031. This forecast only includes bridge improvements that are covered by KDOT's priority Bridge Replacement or Set Aside Funding. Bridges are also replaced or repaired under other programs; for example Modernization/Expansion program funding, which will further improve KDOT NHS condition. Percent poor NHS bridge deck area is predicted to move above the target in 2026 and remain above the target until 2027. However, the percent poor is expected to decline steadily from 2028 to through 2031, falling below the target set for poor pecent.

PLUS 10% BUDGET INVESTMENT LEVEL FOR KDOT NHS BRIDGES

A scenario was evaluated given a 10 percent increase in budget dedicated to KDOT NHS bridges following the current program of committed projects. This is to account for the possibility of new money, cost savings, or changes in strategy. The resulting forecasts for percent good and poor by deck area are shown in **Figure 32** and **Figure 33** respectively, along with the baseline budget forecast for comparison. Percent good NHS bridge deck is expected to achieve the 72% Good target in 2023 and maintain the target though 2031. Percent poor NHS bridges are predicted to be greater than the 3% percent poor target from 2023 through 2027, and the poor target is predicted to again be achieved in 2028 and maintained through 2031.

FIGURE 32 *Plus 10 Percent Budget for KDOT NHS Bridges - Percent Good by Deck Area*

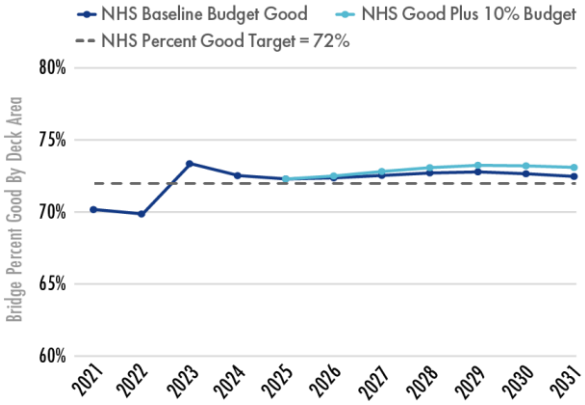
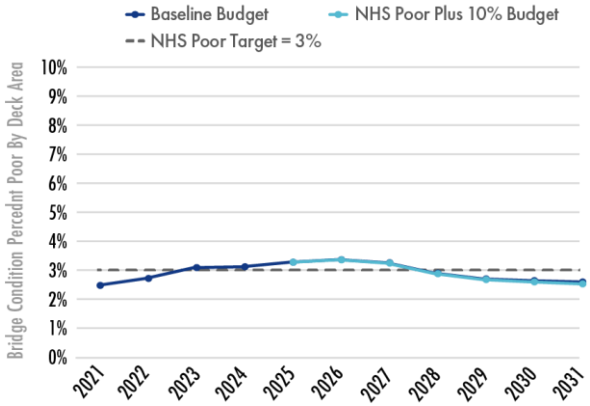


FIGURE 33 *Plus 10 Percent Budget for KDOT NHS Bridges - Percent Poor by Deck Area*



MINUS 20% BUDGET INVESTMENT LEVEL FOR KDOT NHS BRIDGES

A scenario was evaluated given a 20 percent decrease in budget dedicated to KDOT NHS bridges following the current program of committed projects. This is to account for the possibility of project cost increase. The resulting forecasts for percent good and poor by deck area are shown in **Figure 34** and **Figure 35** respectively, along with the baseline budget forecast for comparison. The decreased funding results in KDOT dropping below the percent good target in 2029 and continuing a decline in condition afterwards. Percent poor NHS bridges are predicted greater than the 3% percent poor target from 2023 through 2027, and the poor target is predicted to again be achieved in 2028 and maintained through 2031.

FIGURE 34 *Minus 20 Percent Budget for KDOT NHS Bridges - Percent Good by Deck Area*

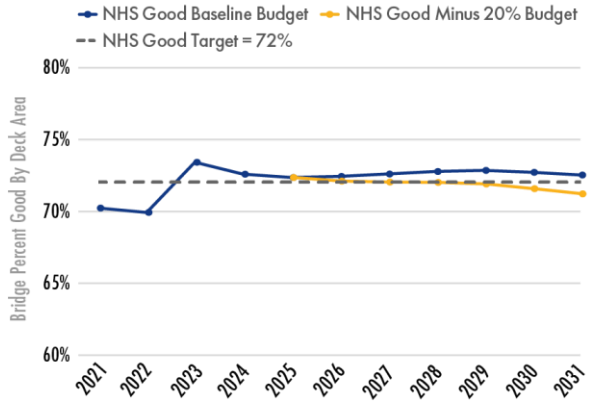
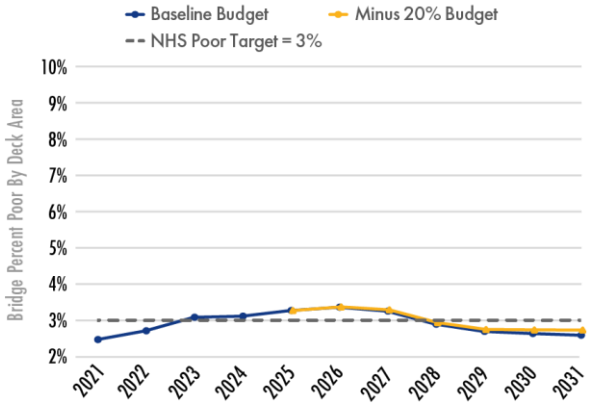


FIGURE 35 *Minus 20 Percent Budget for KDOT NHS Bridges - Percent Poor by Deck Area*



RECOMMENDATIONS FOR BUDGET INVESTMENT LEVEL FOR KDOT NHS BRIDGES

The Baseline scenario, which represents current funding levels, demonstrates that this investment in NHS bridges is sufficient to maintain the two-year and four-year percent good target of 72% good by deck area for KDOT NHS bridges, and maintain the target through 2031. The funding is not sufficient to maintain KDOT's percent poor by deck area for the two-year and four-year percent poor target of 3% poor by deck area, however, it does meet the ten-year target.

CHAPTER 6 RISK MANAGEMENT

KDOT has established and implemented a formal risk management process to support a risk-based asset management process.

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 36 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 36 *The Risk Management Process*

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 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.

6.1 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. For this 2022 TAMP, the risk register has been updated to identify any changes since the previous risk management workshop, with a particular focus on resilience and climate change.

6.1.1 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.

6.1.2 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.

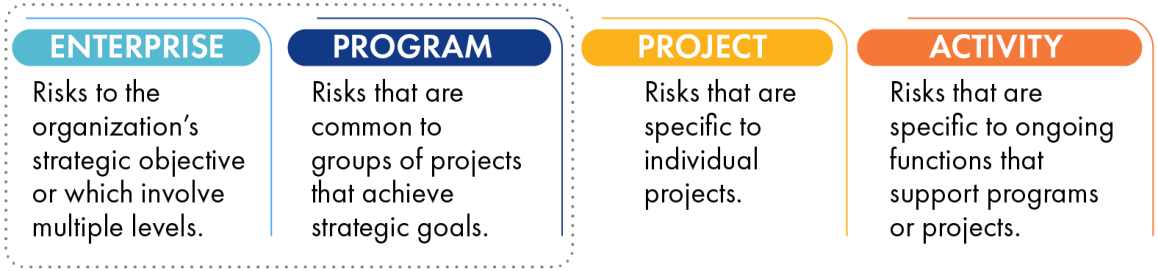
6.1.3 Scope of Risk Management

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 37**). 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.

FIGURE 37 *NCHRP 08-93 risk management levels*



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.

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.

CATEGORY	DEFINITION
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/Organizationa	Risks related to resourcing, organizational capacity, and other internal enablers. Examples include understaffed roles, lack of departmental coordination, etc.

ASSETS INCLUDED

NHS pavement and bridges are considered in the risk management process following Federal regulations. At this time, risks related to ancillary assets (traffic signals, streetlights, etc.) are not included.

6.1.4 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 *38*).

TABLE 19 *Risk likelihood (L) levels*

RATING	DESCRIPTION
Exceptionally rare	May occur only in exceptional circumstances
Rare	Could occur at some point

RATING	DESCRIPTION
Possible	Might occur at some time
Probable	Will probably occur in most circumstances
Almost certain	Expected to occur in most circumstances

FIGURE 38 *Risk scoring matrix*

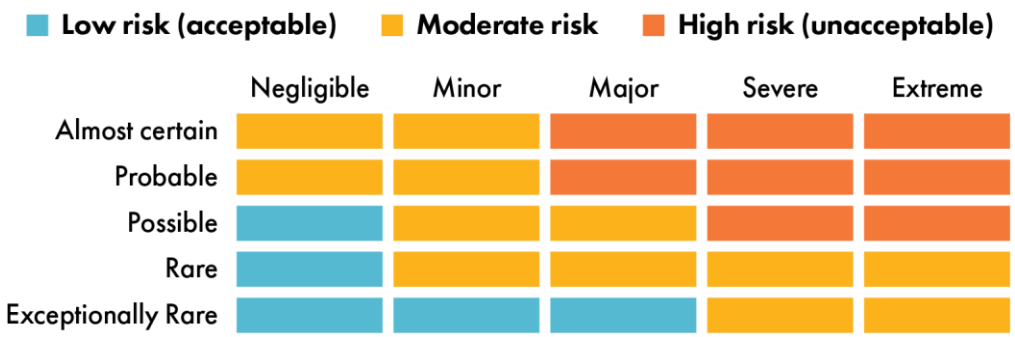


TABLE 20 *Risk consequence (C) levels*

	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

	NEGLIGIBLE	MINOR	MAJOR	SEVERE	EXTREME
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
Information 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

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

6.2 2022 Risk Register

For the 2019 TAMP, a two-day risk workshop was held to analyze, evaluate, and develop actions to manage the risks identified. In 2022, a Risk Management Survey was distributed to internal KDOT stakeholders to seek input in reviewing the existing risk register and introducing any new risks. **Table 22** is an updated comprehensive risk register, sorted in order of priority score based on outcomes of the Risk Management Survey. The TAM Project Management Team and the KDOT Risk Management Team hold responsibility for implementing the response actions and continuously monitoring risks. With a few risks changing in priority, it is of note that there are no low priority risks identified in this update.

TABLE 22 *KDOT 2022 risk register*

ID/RISK/CATEGORY	IMPACT	RESPONSE
High Priority		
1 **Loss of institutional knowledge through retirements and attrition; inexperienced staff due to lack of retention** ***Workforce/Organizational*** — **Likelihood: 4.67** **Consequence: 4.00**	• 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	• Enhance salary structure; develop annual salary increases based on performance • Promote work-life balance • Above market benefit package • Increase schedule flexibility and prerequisites • Non-traditional recruitment • Strategic exposure • Internships

ID/RISK/CATEGORY	IMPACT	RESPONSE
2 **Inadequate/ uncertain state and federal funding** ***Financial/Economic*** — **Likelihood: 3.59** **Consequence: 3.75**	• 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	• Rely on prioritization process; reprioritize syphoning decisions to maximize funds • Engage state legislative leaders and governor's office • Work with advocates and/or potential allies • Fund preservation work first • Be conservative in funding estimates for cash flow • Communicate potential impact with public (including cost and program effectiveness) • Engage legislative leaders and governor's office
3 **Interruptions or slowdowns in the procurement process** ***Business Operations*** — **Likelihood: 3.69** **Consequence: 3.53**	• 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	• Change bulk fuel purchase procedure • Review this risk with the Bureau Chief of Fiscal Services
4 **Lack of contractor availability** ***Financial/ Economic*** — **Likelihood: 3.94** **Consequence: 3.50**	• Inability to plan for long term • Reduced capacity to accomplish work • Potential delays in project letting • Lack of innovative construction practices • Reduced competition at bid lettings causes higher prices	• Adjust project letting schedule in accordance with contractor availability • Understand demand on contracting industry beyond the state (consider a "regional" approach to procurement) • Advise contracting industry on program (funding and certainty) as early as possible • Increase outreach and communication with contracting industries to find out why they are not bidding

ID/RISK/CATEGORY	IMPACT	RESPONSE
5 **Lack of staff leading to an increase in contractor reliance** ***Workforce/Organizational*** — **Likelihood: 4.00** **Consequence: 4.00**	• Higher reliance on contractual staff with increased cost	• Consider offering competitive salaries and benefits to attract necessary hires
6 **Deferred maintenance** ***Asset Performance*** — **Likelihood: 3.82** **Consequence: 3.06**	• Increased deterioration rate of roadways and bridges • Increased cost to maintain roads/bridges • Wear and tear on vehicles	• Maintain or enhance pavement data collection • Use MEPDG (Mechanistic-Empirical Pavement Design Guide) to prolong asset life • Meet federal eligibilities to use federal funds on light-action preservation projects
7 **Increased freight traffic** ***External/Reputational*** — **Likelihood: 4.13** **Consequence: 2.67**	• Reduced pavement and bridge life • Additional non-programmed costs • Increased congestion and traffic conflicts • Shortage of truck parking • Increase in vehicle/train collisions	• Increase bridge staff & preservation activities • Increase evaluation of at-grade rail crossings • Promote private development of more truck plazas • Work with locals on finding parking during the short-term closures • Expand Truck Parking Information Management System
8 **Inability to keep pace with technology changes** ***Information Technology*** — **Likelihood: 3.53** **Consequence: 2.62**	• Increased expenditure requirements • Lack of workforce with skills to manage new technology • Inefficiencies in use of technology to support business operations	• Increase awareness/ commitment for staff training and funding • Complete current upgrade projects • Continued funding for development of new applications/ business models

ID/RISK/CATEGORY	IMPACT	RESPONSE
9 **Bridge failure** ***Asset Performance*** — **Likelihood: 2.61** **Consequence: 4.00**	• Temporary loss of system functionality; interruption in transportation services • Increased safety risk to employees and traveling public; loss of life • Additional non-programmed costs	• Maintain emergency response plans and appropriate emergency fund levels • Maintain or improve data collection and follow established inspection practices • Apply appropriate funding for bridge rehabilitation; reprioritize projects if funds are limited • Work with local governments in advance to develop prescribed detour routes
10 **Increase in fuel prices** ***Financial/Economic*** — **Likelihood: 4.13** **Consequence: 3.07**	• Increase in construction and material costs	• Reprioritize spending
11 **Bridge damage caused by vehicle impacts** ***Asset Performance*** — **Likelihood: 4.11** **Consequence: 3.06**	• Damaged infrastructure; temporary loss of system functionality • Increased safety risk to employees and traveling public • Potential litigation risk • Additional non-programmed costs • Negative impacts to customer satisfaction	• Maintain emergency response plans • Follow established practices and policies • Interoperable communication between KDOT and first responders • Training
12 **Inflation causing increased expenditure or changes in revenue** ***External/Reputational*** — **Likelihood: 4.24** **Consequence: 3.38**	• Smaller program without increased funding • Fewer road, bridge, maintenance, preservation projects lead to system deterioration • Increased construction and material costs; decreased buying power	• Focus on preservation first • Evaluate funding sources • Build inflation into 10-year funding program

ID/RISK/CATEGORY	IMPACT	RESPONSE
13 **Loss of public confidence in agency** ***External/Reputational*** — **Likelihood: 2.75** **Consequence: 3.76**	• Complicates relationships with external partners/stakeholders • Pushing legislative agenda becomes more difficult • Unwillingness of public to support new highway spending; loss of adequate funding	• Retain experienced staff • Transparency; host local consultation meetings • Well-developed communication strategy • Provide honest, accurate and timely information to stakeholders and public • Follow through on commitments • Strengthen and/or reaffirm partnerships
14 **Material Shortage** ***External/Reputational*** **— Likelihood: 3.76** **Consequence: 2.94**	• Delayed project completion • Increased construction costs	• Research alternatives and new products • Stay involved in national association to identify frauds
15 **Cybersecurity threats and IT infrastructure failure** ***Information Technology*** — **Likelihood: 3.44** **Consequence: 4.00**	• Data corruption; confidential data theft • Inability to complete program or optimize investment • Disruption of services • Loss of agency credibility	• Keep strict quality control and quality assurance process in place • Move data storage/application to the Cloud where appropriate (allowing for data security) • Maintain pace with technology standards • Complete K-Hub Project and Construction Management System replacement • Maintain strong, dedicated, qualified IT support staff • Update disaster recovery and business continuity plans • More data storage and application used when appropriate • Continuity of Operations (COOP) plans and disaster recovery

Moderate Priority

ID/RISK/CATEGORY	IMPACT	RESPONSE
16 **Safety culture not fully developed** ***Safety*** — **Likelihood: 2.83** **Consequence: 2.86**	• Unsafe work practices • Increased change of employee injury	• Periodic safety meetings; regular online classes • Safety signs and campaigns
17 **Fatal or harmful accident due to poor asset condition** ***Legal & Compliance*** — **Likelihood: 2.67** **Consequence: 3.38**	• Increased litigation • Lack of public confidence in KDOT	• Continue to look for better asset appraisal methods
18 **Lack of performance or reduced service life of maintenance actions** ***External/Reputational*** — **Likelihood: 3.22** **Consequence: 3.06**	• Increased long-term costs • Loss of public confidence	• Training and education • Pavement measurement evaluation • Research for alternatives
19 **Lack of cross unit understanding** ***Business Operations*** — **Likelihood: 3.38** **Consequence: 3.13**	• Lack of cooperation between departments that should inform asset management decisions • Inefficient asset management processes • Lack of morale and poor performance due to poor communication between departments	• Active engagement in new employee orientation • Monthly newsletter updating departments on what is occurring in each department • Explore the ability to move staff based on need and availability across different bureaus
20 **Bond rating (increase or decrease)** ***Financial/Economic*** — **Likelihood: 2.67** **Consequence: 3.10**	• Decrease or increase in available funds for construction activities or asset investment	• Reprioritize spending

ID/RISK/CATEGORY	IMPACT	RESPONSE
21 **Failure to follow or inconsistency in applying policies, standards, and processes** ***Legal & Compliance*** — **Likelihood: 3.00** **Consequence: 3.00**	• Increased errors in asset management processes • Decrease in quality of work	• Continue to provide training to workforce • Inspector General audits of processes
22 **Lack of continuity of operations in a disaster** ***Business Operations*** — **Likelihood: 2.71** **Consequence: 3.47**	• Loss of productivity • Delays in construction and design projects and payments • Disruption of internal communication	• Strong, up-to-date Continuity of Operations Plans (COOP) • Ensure employees are well-informed about the COOP and its importance • Make COOP a serious issue and not a part time project
23 **Reduced quality construction materials** ***External/Reputational*** — **Likelihood: 2.88** **Consequence: 2.88**	• Reduced performance and service life • Inefficient expenditure of tax dollars • Negative impacts to customer satisfaction • Increased safety risk to employees and traveling public	• Continue to review standards for materials based on in-situ performance • Continue to test materials before using in field and ensure in-situ performance continues to be reflected in updated specifications • Increase inspections and inspection staff • Increase requirements for contractor QC/QA • Research alternative and new materials
24 **Extreme individual natural events causing damage to assets** ***External/ Reputational*** — **Likelihood: 2.88** **Consequence: 2.63**	• Damaged infrastructure; route closure; temporary loss of system functionality • Additional non-programmed costs; negative economic impact • Stretches capabilities of field staff • Increased safety risk to employees and traveling public	• Maintain emergency response plans; have an emergency fund • Follow established inspection practices • Proper design and engineering practice • Excellent communication with staff, and stakeholders; coordinate with local entities • Have adequate amount of materials on hand • Back-up systems • Training

ID/RISK/CATEGORY	IMPACT	RESPONSE
25 **Poorly written contracts and specifications** ***Legal & Compliance*** — **Likelihood: 2.76** **Consequence: 3.00**	• Excessive payments on contracts • Poor product delivery to KDOT	• Continue to provide training to workforce • Inspector General audits of processes
26 **Sinkholes emerge under or near roadway** ***External/Reputational*** — **Likelihood: 2.50** **Consequence: 2.87**	• Temporary loss of system functionality • Additional non-programmed costs • Loss of life, personal injury	• Maintain emergency response plans • Proper design and engineering practices • Identify and monitor at-risk locations • Eliminate route • Mine grouting
27 **Change in state/federal leadership/priorities** ***Legal & Compliance*** — **Likelihood: 3.88** **Consequence: 2.36**	• Change in KDOT leadership priorities • Change in funding or staffing levels • Potential loss of internal and external support • Loss of credibility	• Tell KDOT story through performance measures, safety, past accomplishments • Encourage flexibility through clear, honest communication • Continue to stress importance of good practice to Executive and Legislators • Maintain good communication regarding issues for detrimental changes
28 **Autonomous and highly-automated vehicles** ***External/Reputational*** — **Likelihood: 3.88** **Consequence: 2.00**	• Could require different design standards • Vulnerable to IT terrorism • Unknown agency costs	• Understand expectations of KDOT • Monitor progress of lead states • Involvement on national automated vehicle committees

ID/RISK/CATEGORY	IMPACT	RESPONSE
29 **Alternative fuel vehicles – electric, fuel cell, CNG** ***Financial/Economic*** — **Likelihood: 3.94** **Consequence: 1.92**	• Current fuel tax would not apply, resulting in decreased revenue to State Highway Fund	• Engage legislative leaders
30 **Increased allowable truck weights** ***Legal & Compliance*** — **Likelihood: 3.27** **Consequence: 1.85**	• Increased pavement distress; local infrastructure failure; reduced pavement and bridge life • Load postings and restrictions • Additional non-programmed costs • Increase in initial construction costs	• Increase bridge staff; increase preservation activities • Identify heavy freight corridors • Change design to handle heavier loads • Continue to educate decision makers on impacts to the system
31 **Failure to adhere to federal regulations (Fines, impact on future funding related to quality control, etc.)** ***Financial/Economic*** — **Likelihood: 2.47** **Consequence: 3.36**	• Compliance fines • Impact on future funding	• Training, monitoring, and review
32 **Inadequate communication of asset performance, processes, and decisions** ***Asset Performance*** — **Likelihood: 3.20** **Consequence: 2.29**	• Inability to explain asset investment decisions • Loss of confidence in decision-making ability	• More interaction at the local level • Increase transparency of decision process and tell the why and what of selections

ID/RISK/CATEGORY	IMPACT	RESPONSE
33 **Lack of Diversity** ***Workforce/Organizational*** — **Likelihood: 2.69** **Consequence: 1.94**	• Increased turnover due to low staff morale	• Explore innovative methods to increase and encourage diversity in the recruitment process • Recognize and value diversity with an effort to retain (environment where minorities feel welcome/ comfortable/ valued and respected)
34 **Terrorism/Vandalism/Sabotage** ***External/Reputational*** — **Likelihood: 2.00** **Consequence: 2.73**	• Damaged infrastructure; temporary loss of system functionality • Additional non-programmed costs • Negative impacts to customer satisfaction • Increased safety risk to employees and traveling public	• Maintain emergency response plans & appropriate emergency fund levels • Reprioritize projects if funds are limited • Training • Identify vulnerabilities, develop plans, policies to minimize risks
35 **Significant increase in federal funding** ***Financial/Economic*** — **Likelihood: 2.75** **Consequence: 2.38**	• Increased need for federally-eligible projects • Increased workload in field offices • Inability to match federal funding • Need for more trained staff and consultants to handle the influx of project work	• Increase design and construction staff • Ensure there is a pipeline of projects ready to go
36 **Failure to plan for climate change impacts** ***External/Reputational*** — **Likelihood: 2.50** **Consequence: 2.00**	• Assets may require more frequent preservation/maintenance actions • Reduced service life of roads, bridges • Additional non-programmed costs	• Maintain/increase frequency of preservation actions • Maintain emergency response plans • Monitor asset performance

6.3 Managing Resilience and Extreme Weather Risks

Much like in other parts of the world, climate change introduces extreme weather trends and other events that can present unexpected consequences to transportation infrastructure in the state of Kansas. In particular, KDOT considers the following extreme weather events that have happened in the past or are likely to occur:

- **Extreme temperature variations:** year after year, communities across the world experience higher temperatures during the warmer months and lower temperatures during the winter months. In Kansas, the combination of extreme heat and sever cold has had recent impacts on pavement and bridge infrastructure including faster deteriorating and sometimes buckling pavements and bridge damage from rapid expansion and contraction.
- **Windstorms:** Kansas is known for high wind conditions caused by opposing weather systems that form a center of low air pressure. In 2022, record-breaking high winds have been reported across Kansas with more high wind warnings than usual. Windstorms bring increased potential of damage across infrastructure assets in the state with higher chances of other extreme events like fires.
- **Increased fires:** wildfires in Kansas generally occur in the spring, caused by a combination of dry weather conditions, higher temperatures, and high winds. In recent years, wildfires have extended throughout the year with severe damage and interruption to life in the state. By 2050, the average number of days with wildfire potential is projected to increase from 5 to nearly 30 days a year.4
- **Inland flooding:** floods in Kansas cause millions of dollars in damage to bridge and pavement assets and loss of life. When they occur, they become damaging rapidly and can be extremely dangerous to manage. Following recent climate events in a neighboring state, KDOT is at risk of suffering a "perfect storm" event, an event that combines heavy rainfall with severe snow melt with the ability of widespread flooding. If an event of this nature occurs, it can cause bridge failure that can significantly cripple the mobility in the state.

In the context of this asset management plan, it is important to identify the risks that these events present and consider risk mitigation strategies in the long-term plan. These risks are identified in the risk register above (Risk #24, 26, and 36) with the risk assessed to be moderate. Nonetheless, risk response strategies that will improve resilience and preparedness include:

[4] *States at Risk: America's Preparedness Report Card 2015 (https://reportcard.statesatrisk.org/report-card/kansas)*

- Design and engineering practice that emphasizes resilience to damage from extreme weather including interstate designs for higher flooding risks and bridge scour action plans.
- Robust inspection practices (including increased frequency) to identify vulnerable assets at increased risk of damage from extreme weather
- Maintaining emergency response plans (KS Response Plan and State Hazard Mitigation Plan) to support fast-paced recovery actions

As part of the approach to managing resilience and extreme weather, the KDOT 2020-2045 Long Range Transportation Plan identifies system resilience as a category of external influence that will affect transportation in Kansas. The plan discusses the need for strategic investments "to retrofit aging infrastructure and engineer new assets to withstand the impacts of extreme weather."[5]

6.4 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.

[5] *KDOT 2020-2045 Long Range Transportation Plan, July 2021*

PROGRAM	DESCRIPTION
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.

6.5 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."[6]

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 39**, 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)

FIGURE 39 *Emergency event evaluation 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.

6. 23 CFR Part 667

- 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.

CHAPTER 7 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 program authorized by the State legislature. Other State statutes require KDOT to prepare an annual comprehensive financial report on all funds in the preceding year. This chapter describes the 10-year program funding sources and uses and the estimated funds necessary 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

7.1 Funding Sources

KDOT relies on several funding categories to finance asset management and other programs that support asset performance. 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

The other categories of funding available for NHS investments besides the SHF are Local and Toll Funds, collected and administered by separate entities such as the KTA and local governments. Their use can have a 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.

7.1.1 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.

7.1.2 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 is mostly from 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 the state highway system, city, and county projects. Current rates are 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 starting 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 only 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.

7.1.3 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.

7.1.4 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 FY2021. 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.

7.1.5 Historical Funding by Source

Figure 40 shows the funding available for NHS and SHS investments from all categories of SHF sources for FY2021 and KTA. Total FY2021 funding for the SHF sources was approximately $1.3 billion, after transfers and including bond proceeds. This amount was higher than the previous year's revenue; likely due to the impact of the COVID-19 pandemic in FY2020. As shown, the State sales and compensating tax, motor fuel taxes, and federal funding provide the highest contributions to available funding for highway asset investments.

FIGURE 40. *Available funding by source*

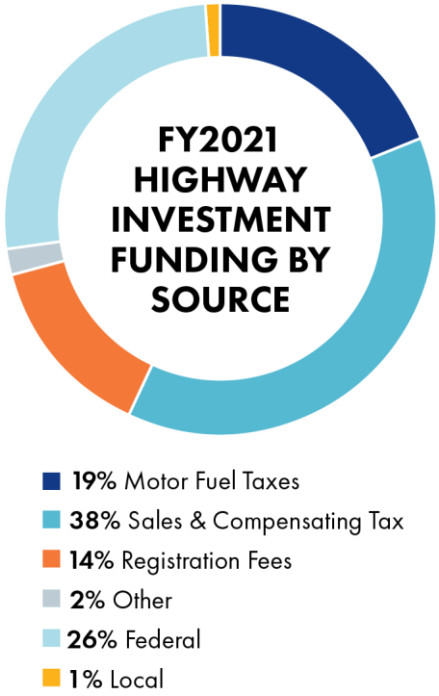


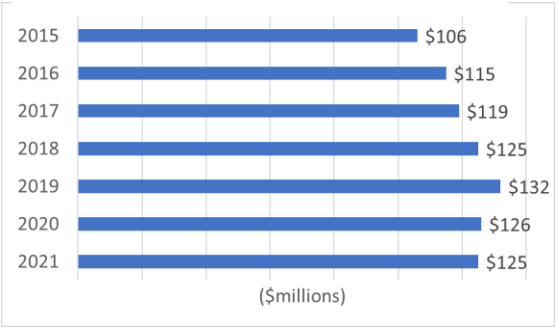
Table 24 shows the historical funding by sources of the SHF and non-KDOT funds (excluding KTA and bonds) available for NHS investments. In general, revenues from the state motor fuel tax and registration fees have remained constant over the years. Revenues from other sources have seen significant fluctuations. For example,sales and compensating use tax saw a jump in revenues between 2013 and 2014. KTA historical operating revenues for the six comparable years are shown in Figure 41.

TABLE 24 *Actual total state highway funds cashflow (FY 2013 to FY 2021)*

FUND TYPE	ACTUAL TOTAL FUNDS (MILLIONS $)								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Motor fuel taxes	273	291	289	297	302	304	307	308	296
Sales & Compensating tax	320	485	512	518	515	530	533	541	602
Registration fees	187	201	209	204	208	208	208	208	223
Others*	34	35	24	26	23	84	27	26	26
Transfers out	(119)	(289)	(448)	(547)	(535)	(551)	(493)	(493)	(314)
Federal funds	410	431	413	257	459	375	331	329	413
Local funds	32	31	41	22	31	26	14	19	14
Total	**1137**	**1185**	**1040**	**777**	**1003**	**976**	**927**	**938**	**1,260**

Includes transfers in

FIGURE 41 *KTA revenues in millions — FY2015 to FY 2021*



7.2 Funding Uses

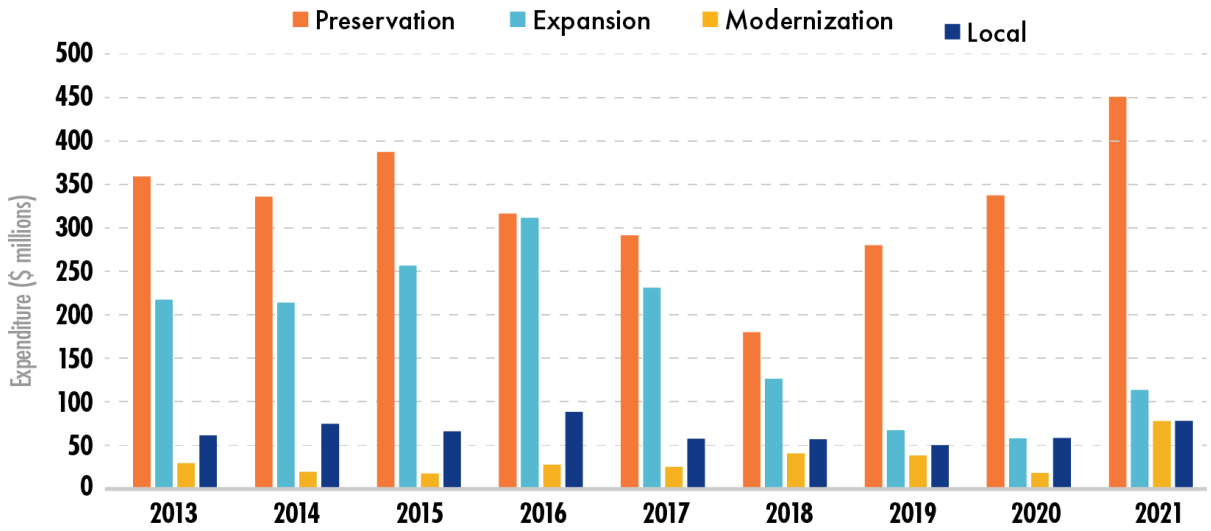
KDOT administers a variety of programs to safely operate and efficiently manage the NHS and the rest of the SHS. Funds are allocated through the SHF and other city and county special funding programs. There are four core KDOT investment programs: preservation, modernization, expansion, and local construction. These four programs, along with operations, support 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 (IKE) 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 42 shows the average distribution over the last eight years with 57% of funding going towards preservation projects and 29% going towards expansion projects. Figure 43 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.

FIGURE 43 *Historical funding distribution in KDOT core programs by fiscal year*



Federal funds are invested towards improvements in both NHS and non-NHS roadways, including preservation, expansion, and modernization projects. Figure 44 shows the proportions of annual federal funding distributed between NHS and non-NHS projects.

FIGURE 42 *Average historical funding distribution in KDOT core programs (2013 - 2021)*

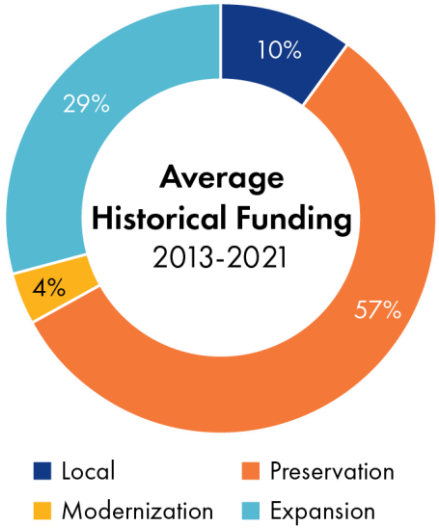
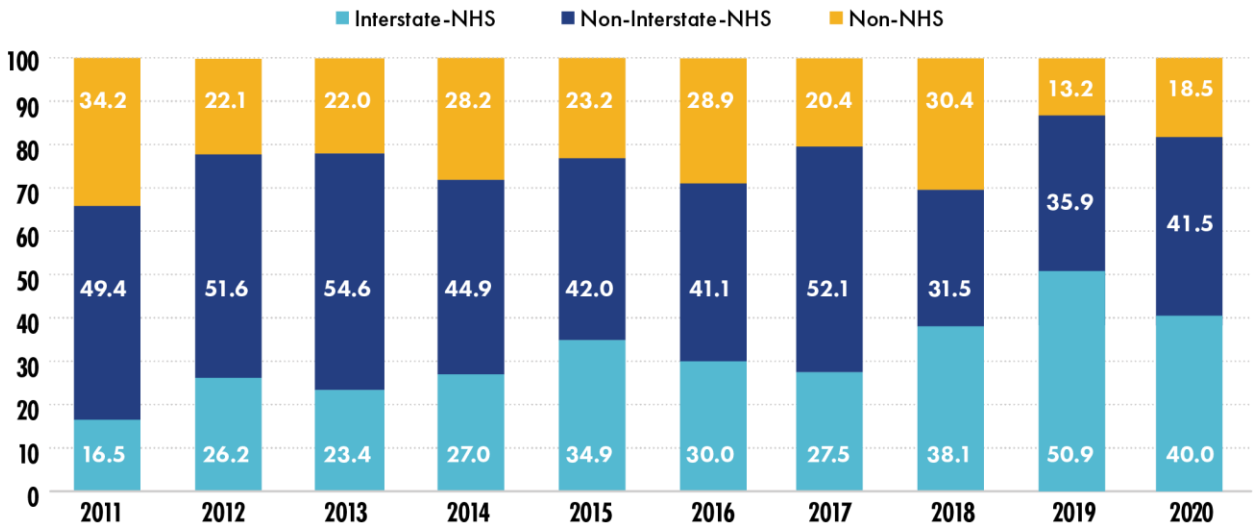


FIGURE 44 *Historical federal funding distribution*



KDOT's core funding programs are aligned with the five Federal work types as shown in **Table 25**.

TABLE 25 *Aligning KDOT Funding Programs to Federal Work Types*

IMPROVEMENT TYPE	FEDERAL WORK TYPE	KDOT PROGRAM CATEGORY
New Construction Roadway	Initial Construction	Expansion, Local Construction
4R - Added Capacity	Reconstruction	Modernization, Expansion, Local Construction, Preservation
4R - No Added Capacity	Reconstruction	Preservation, Modernization, Local Construction, Expansion
4R - Maintenance Resurfacing	Preservation	Preservation, Modernization, Local Construction

IMPROVEMENT TYPE	FEDERAL WORK TYPE	KDOT PROGRAM CATEGORY
4R - Restoration & Rehabilitation	Rehabilitation	Preservation, Modernization, Local Construction, Expansion
Bridge New Construction	Initial Construction	Preservation, Expansion, Local Construction
Bridge Replacement - Added Capacity	Reconstruction	Preservation, Modernization, Expansion, Local Construction
Bridge Replacement - No Added Capacity	Reconstruction	Preservation, Modernization, Local Construction
Bridge Rehabilitation - Added Capacity	Rehabilitation	Preservation, Modernization, Local Construction
Bridge Rehabilitation - No Added Capacity	Rehabilitation	Preservation, Modernization, Local Construction
Bridge Preventive Maintenance	Preservation	Preservation, Local Construction
Bridge Protection	Preservation	Preservation, Local Construction
Bridge Resurfacing	Preservation	Preservation, Modernization, Local Construction

7.3 Estimated Costs and Funding Levels

7.3.1 Estimated Funding and Sources

Through the 1991 Comprehensive Highway Program, the 2000 Comprehensive Transportation Plan, the 2010 Transportation Works for Kansas (T-WORKS), and the 2020 Eisenhower Legacy Transportation Program (IKE), the Kansas state legislature continues to support the creation of jobs through projects that preserve highway infrastructure, modernize, and expand highway infrastructure, and provide

opportunities for economic development. It is important to note that over half of IKE's funding is dedicated to preserving assets, emphasizing KDOT's commitment to preserving existing assets.

The current funding program, IKE, is expected to provide funding at a level that stabilizes infrastructure decline. This 10-year program will use protected funding sources for preservation work. Over its 10-year period (2020 to 2029), IKE is expected to allocate about $9.9 billion to transportation programs (including rail, aviation, and transit), which would benefit state and local highways across Kansas. This level of funding represents an increase of about $1.7 billion over the planned funding for T-WORKS. To date, funding for highway preservation has reached approximately $340.7 million, including $288.4 million for preservation, $40.6 million for expansion, and $11.7 million for modernization[7]. This legislation requires at least $8 million of investment in each county which includes a variety of investments ranging from highway preservation, highway expansion and modernization with direct impact on the performance of the NHS. Currently, the $8 million target has been met in 22 counties across Kansas.

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 $)									
	2021*	2022*	2023	2024	2025	2026	2027	2028	2029	2030
Federal	413	519	487	503	520	546	538	495	469	452
State	834	978	1,080	1,111	1,321	1,320	1,339	1,362	1,184	1,207
Local	14	53	44	37	40	34	24	24	24	24
Total SHF	**1,260**	**1,550**	**1,611**	**1,651**	**1,881**	**1,900**	**1,901**	**1,881**	**1,678**	**1,683**

[7] *Program Overview - KDOT IKE Program (ksdotike.org)*

	ESTIMATED TOTAL FUNDS (MILLIONS $)									
KTA[†]		30	45	22	45	32	58	34	51	44
Total	**1,260**	**1,580**	**1,656**	**1,673**	**1,927**	**1,931**	**1,959**	**1,915**	**1,729**	**1,727**

*[†]KTA projected revenue; *Actual funding*

The table shows that about $17 billion in State Highway funding would be available for investment for the duration of the TAMP (2022-2030), representing an average annual revenue of $1.7 billion assuming no additional funding becomes available during this period.

Even at the State level, there is significant uncertainty associated with estimating 10-year funding availability, as evident in several amendments in past funding programs proposed through State House and Senate Bills. This is a risk that is documented in the risk section and assigned treatment options to minimize the risk.

Out of all available resources, KDOT is estimating that an annual funding of about $410 million will be available for the pavement program (all the State Highway System) and $125 million for bridge preservation funding for the duration of the TAMP (**Table 27**). This is in addition to an expected $100 million in new construction and reconstruction annually to support preservation investments.

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

	ESTIMATED TOTAL FUNDS (MILLIONS $)									
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Pavement	410	410	410	410	410	410	410	410	410	410
Bridge	125	125	125	125	125	125	125	125	125	125
Total SHF	535	535	535	535	535	535	535	535	535	535

7.3.2 Projected Funding Needs

This section presents the projected annual cost of work needed to preserve or improve performance of the NHS assets. KDOT estimates the cost associated with making progress towards the achievement of performance targets for 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.

As part of the LCP process discussed in **Chapter 5**, the bridge and pavement scenarios analyzed with the management systems were used to develop different investment philosophies to achieve and or maintain a state of good repair (i.e. to identify the most efficient and effective investment scenarios for a given funding level). **Table 28** summarizes the projected annual cost for both pavements and bridges. The performance and funding levels that these scenarios result in were considered in the selection of recommended investment strategies for both pavements and bridges described in **Chapter 8**.

TABLE 28 *NHS Pavement and Bridge Projected Funding*

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Pavements										
Interstate NHS	102	87	57	70	74	43	44	24	21	21
Non-Interstate NHS	161	316	102	162	133	161	139	137	165	167
Total NHS Pavements	203	316	159	232	207	204	184	161	186	188
Bridges										
NHS Bridges	59	48	54	181[†]	91	71	71	71	71	74

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
NHS Assets										
NHS Assets	262	364	213	413	298	274	254	231	256	262

† FY 2025 includes the 18th Street Bridge Replacement under Bridge Replacement/Rehabilitation (PBR) program.

7.4 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, KDOT considered both the GASB-34 method as well as the replacement cost method which assesses value based on the estimated cost to replace the entire asset class. A description of each method is provided below.

7.4.1 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 2021, KDOT estimates the current SHS asset value to be approximately $12.2 billion[8] (made up of $9.6 billion in roadway value and $2.6 billion in bridge value).

7.4.2 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 pavement reconstruction and replacement project costs using historical data. Results of this analysis suggest that average cost per lane mile is $1,000,000 for non-IHS roadways and $1,500,000 for IHS roadways in 2022 dollars. With this method, KDOT's NHS pavements are valued at $14.9 billion.

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 following FHWA criteria, which excludes ancillary assets such as slope protection, lighting, and conduits. An estimated average replacement cost of $127 ($2022) per square foot of deck area was used to estimate the asset value of bridge assets for NHS at $4.1 billion.

4. KDOT Annual Comprehensive Financial Report, 2021.

Table 29 summarizes the estimated value for the NHS assets includes 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 29 *Estimated asset value for pavements and bridges*

ASSET	REPLACEMENT COST*	GASB-34 MODIFIED APPROACH
Pavements		
Interstate	$5,569,500,000	-
Non-Interstate NHS	$8,753,000,000	-
Non-State NHS	$571,000,000	
Total NHS	*$14,893,500,000*	*$9,614,718,000*[†]
Bridges		
Total NHS	$4,149,586,000	$2,590,435,000[†]
Total asset value	$19,043,086,000	$12,205,153,0001[†]

[1] *Valuation for assets on the SHS.*

CHAPTER 8 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.

8.1 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 NHS

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)

pavement and bridge assets, estimation of future funding that is expected to be available, and the projection of future asset performance.

As previously discussed, KDOT has established condition performance targets for pavement and bridge assets in response to the Transportation Performance Management (TPM) reporting requirements. The most recent performance of the NHS assets is summarized in **Table 30** showing a comparison with the established performance targets.

TABLE 30 *Current Performance Gap Summary using Federal Targets (established in 2018)*

TARGET	2022 TARGET	2022 REPORTED PERFORMANCE
Interstate NHS Pavement		
Good	65.0%	66.6%[1]
Poor	0.5%	0.3%[1]
Non-interstate NHS Pavement		
Good	55.0%	59.1%[1]
Poor	1.5%	1.8%[1]
NHS Bridges		
Good	70.0%	70.0%
Poor	3.0%	3.0%

[1] *For pavements 2022 reported performance is based on preliminary HPMS data. At the time of the development the HPMS was not yet confirmed.*

As shown in **Table 30**, KDOT met or exceeded the target in the initial performance period (January 2018 to December 2021) in all categories with the exception of the percent poor for non-interstate pavement. Nonetheless, these current conditions 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 5** 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.

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.

8.2 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:

8.2.1 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.

8.2.2 The impact of anticipated funding gaps

Historically, highway funding has been increased to levels that support the attainment of long-term goals. However, historical funding levels may not be available in the future for a number of reasons including:

(i) Competition with other systemwide goals causing funding to be pulled away from bridge and pavement programs. Although IKE legislation dedicates motor fuel tax and parts of sales tax revenue to transportation, changing state leadership priorities could impact this.

(ii) Unprecedented inflation levels in 2022 and the resulting loss in value of the funding provided

(iii) Increased project costs

(iv) Inability to meet federal funding match to secure the needed funds for maintenance and preservation

(v) Increasingly rapid asset deterioration

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 6**, mitigation strategies to manage the impact of funding gaps have been recommended as part of the risk analysis process.

8.2.3 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. The introduction of Federal

performance measures presented the complication of having multiple tools that slice the performance pie in different ways. This has resulted in different performance summary outputs that are not necessarily the perspective considered by KDOT in decision making. Ongoing efforts are focused on implementing tools that provide improved analysis with a comprehensive picture of asset performance. 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.

8.2.4 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 and **Chapter 4** describes KDOT's strategy for engaging them. 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.

8.3 Identifying and Selecting Investment Strategies

At KDOT, the selection of investment strategies generally follows a bottom-up approach with the 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 setting adequate funding levels to maintain the system in good condition. October 2022 marks the two-year point of the IKE, and despite all the challenges faced previously, the program has been able to proceed uninterrupted. IKE continues to emphasize the preservation of the existing state system with funding levels set for preserving existing roadway and bridge infrastructure, allowing KDOT's limited resources to be used efficiently and effectively by being directed at projects with the potential to yield the greatest benefit.

KDOT leadership uses two key tools to develop and execute the transportation program. The 2045 Long Range Transportation Plan (LRTP), which analyzes trends and issues in transportation and provides possible recommendations along with this document (i.e., 2022 KDOT TAMP), which provides a detailed assessment of the current state of the infrastructure, lifecycle planning scenarios, and risk management strategies. Together, these two tools provide information and set the direction and focus of KDOT's investment strategies.

To facilitate program management under IKE, KDOT categorizes road and bridge investments into four core programs Preservation, Modernization, Expansion, and Local Construction. Investments within these major programs are further grouped based upon similar funding sources or project types into more specific groups or subcategories. A list of the programs and respective subcategories can be found in the 2022 KDOT Annual Report Appendix[9].

Identifying investments considers engineering factors, regional priorities, economic impact, and other local criteria specified at the local levels by Local Public Authorities (LPAs). For Preservation investments, engineering factors continue to be the most effective evaluation method. Asset data stored in BrM (e.g., bridge deck condition and/or load ratings) and PMS (e.g., remaining pavement life, rutting, and cracking for roads and join), and the analysis of life cycle costs have been used to inform the identification of

[9] *2022 KDOT Annual Repot Appendix. https://www.ksdot.org/Assets/wwwksdotorg/bureaus/offTransInfo/AnnualReports/2022/2022_APPENDIX_FINAL.pdf*

needs within certain specific investment subcategories. The Preservation program includes larger-scale projects like roadway surfacing rehabilitations, major bridge repairs, full pavement, and bridge replacements to smaller set-aside projects like minor bridge repairs, resurfacing, patching, and seals.

KDOT continues improving asset management tools and processes as described in this TAMP. Outcomes of these tools and processes are used to recommend investment strategies based on projected funding, 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.

The investment strategies recommended for KDOT's pavement and bridge assets in this TAMP (described in the following sections) will serve as a primary basis for identifying and selecting specific projects, following KDOT's existing processes for project selection. Candidate projects selected are based on these investment strategies are recommended for inclusion in the STIP.

RECOMMENDED PAVEMENT INVESTMENT STRATEGY

As documented in **Chapter 5**, KDOT evaluated three LCP strategies for pavements based on the projected annual funding discussed in the financial chapter. These strategies represent the underlying philosophies that guide KDOT's investment development process for the duration of the TAMP. The results of the LCP evaluation indicated that the Balanced approach (with increased preservation) offers the most effective and efficient investment strategy that tend to minimize the long-term cost, optimize performance, address risks, and meet performance goals. Some of the key risks considered in developing the investment strategies are documented in the risk chapter and they include financial uncertainty, the threat of not meeting the federal minimum condition requirements for Interstate NHS, etc. The Balanced approach (with increased preservation) is expected to achieve the selected performance targets and will enable KDOT to meet the federal minimum requirement for Interstate NHS while making progress towards the national goals.

This investment strategy requires an average annual investment of $210 million for NHS pavement preservation ($54 million for interstates and $156 million for non-interstates NHS), with the annual breakdown in work types as shown in **Table 31**.

TABLE 31 *NHS Pavement Investment Strategy*

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Interstate NHS										
Maintenance	$2	$2	$2	$7	$4	$2	$3	$1	$1	$3
Preservation	$53	$17	$37	$42	$37	$27	$28	$17	$19	$9
Rehabilitation	$45	$6	$18	$20	$33	$14	$14	$7	$1	$9
Reconstruction	$2	$62	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL	$102	$87	$57	$69	$74	$43	$45	$25	$21	$21
Non-Interstate NHS										
Maintenance	$4	$3	$8	$14	$9	$15	$8	$13	$7	$8
Preservation	$90	$131	$76	$89	$83	$66	$66	$78	$81	$80
Rehabilitation	$38	$46	$18	$44	$40	$68	$47	$36	$63	$67
Reconstruction	$29	$49	$0	$14	$0	$12	$18	$9	$13	$13
TOTAL	$161	$229	$102	$162	$133	$161	$139	$137	$165	$167
GRAND TOTAL	$263	$316	$159	$231	$207	$204	$184	$162	$186	$188

As a general practice, KDOT makes investment decisions on all infrastructure, irrespective of whether a segment sits on the NHS or not. As such, the numbers presented in **Table 31** above should be considered high-level estimates. **Table 32** below provides a summary of the overarching investment philosophy in terms of proportions of investment for each Federal pavement work type. The projected average annual funding for the entire state highway system ($410 million) tends to stabilize pavement performance in the short term. However, due to increasing construction costs and other factors, KDOT is expected to experience declining conditions on the NHS pavement assets without additional, dedicated funding in the future.

TABLE 32 *NHS Pavement Investment Allocation*

PAVEMENT CATEGORY	MAINTENAC E	PRESERVATIO N	REAHABILITATIO N	RECONSTRUCTIO N	TOTAL
Interstate	1.3%	13.6%	8.0%	3.0%	25.9%
Non-Interstate	4.3%	40.0%	22.3%	7.5%	74.1%
TOTAL	**5.5%**	**53.6%**	**30.2%**	**10.5%**	**100.0%**

RECOMMENDED BRIDGE INVESTMENT STRATEGY

As documented in **Chapter 5**, KDOT investigated three scenarios; a baseline budget representing current and expected funding, a 10% increased NHS bridge budget in outer years, and a 20% decreased NHS bridge budget in outer years. **Table 33** below summarizes the required average annual investment and resulting performance at the end of the 10-year projection period. As shown, the increased investment scenario results in the best period end performance.

TABLE 33 *Bridge LCP Scenario Summary*

SCENARIO	AVERAGE ANNUAL NHS INVESTMENT ($M)	PERIOD END PROJECTED NHS % GOOD	PERIOD END PROJECTED NHS % POOR
Baseline Scenario			
NHS Bridges	79	72.5%	2.60%
Plus 10% Investment Scenario			
NHS Bridges	83	73.1%	2.5%
Minus 20% Investment Scenario			
NHS Bridges	71	71.2%	2.70%

The projected performance gap for each scenario is assessed against KDOT's NHS targets for percent good (72% Good) and percent poor (3% Poor). **Figure 45** and **Figure 46** show the results of each scenario in terms of these measures.

FIGURE 45 *NHS Bridge Investment Strategy Gap Analysis (Using Percent Good)*

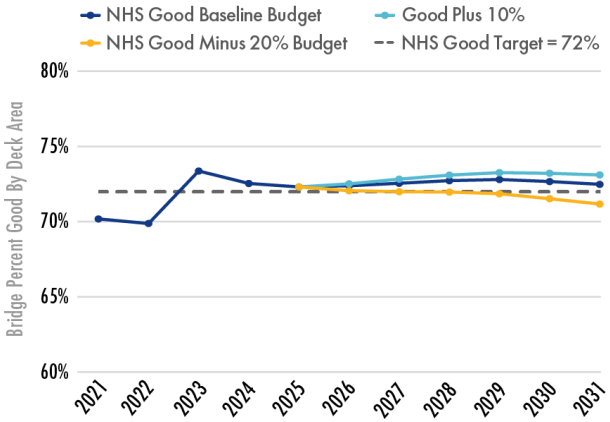
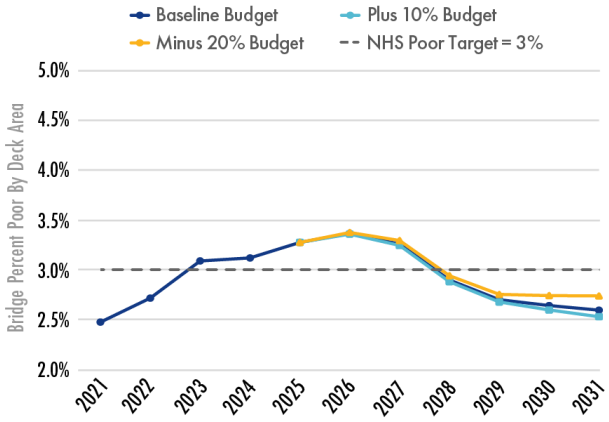


FIGURE 46 *NHS Bridge Investment Strategy Gap Analysis (Using Percent Poor)*



The Baseline and Plus 10% NHS Budget strategies allow KDOT to meet the 72% good target over the ten-year TAMP projection, and the Minus 20 percent budget strategy will not maintain the 72% target for percent good. All three strategies meet the 3% poor target over the ten-year timeframe.

This demonstrates that current (about $79 million/year average) funding levels for NHS bridge preservation investment is sufficient to maintain the NHS good and poor bridge targets based on this best available data. **Table 34** shows the estimated annual funding required by work type, to achieve the results of each bridge scenario analysis.

As discussed in **Chapter 5**, 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. At that time, the bridge SGR target may also be modified to more accurately match expected performance.

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 34 *NHS Bridge Investment Scenario Projected Annual Funding Need*

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Maintenance	$20.3	$24.7	$21.5	$21.5	$21.5	$25	$25	$25	$28	$28
Rehabilitation	$7.3	$5.2	$4.5	$11.7	$5.5	$5.5	$5.5	$5.5	$5.5	$5.5
Reconstruction	$30.9	$17.7	$27.6	$147.8	$64.2	$40	$40	$40	$40	$40
TOTAL	$58.5	$47.6	$53.6	$181.0	$91.2	$70.5	$70.5	$70.5	$73.5	$73.5

The recommended investment strategies for both pavements and bridges not only support the TAM policy and objectives identified in **Chapter 2**, but also support achievement of the national goals identified in 23 USC 150(b). While the primary goal of this TAMP has been to support improved infrastructure condition, the analysis presented here and the resulting investment strategies are expected to inform KDOT's core planning efforts (LRTP, STIP, etc.) to improve safety, congestion, freight movement, environmental sustainability, and to reduce project delivery delays. As with pavements, KDOT makes investment decisions on all bridge infrastructure, irrespective of whether a bridge sits on the NHS or not. As such, the numbers presented in **Table 34** above should be considered high-level estimates.

CHAPTER 9 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:

- Better utilize the continual upgrades to BrM to improve KDOT's LCP and Investment strategies and utilize BrM within a well rounded, robust bridge management system to support more accurate lifecycle planning ;
- Continue to review the pavement work types and treatment crosswalk to make any improvements as needed to reduce complications in future consistency determinations;
- Acquire a PMS with enhanced capabilities to handle Federal metrics and KDOT-specific metrics for analyzing LCP, in developing investment strategies, improving transparent decision making.
- 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.

APPENDIX A: TRANSPORTATION ASSET MANAGEMENT POLICY STATEMENT

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: 3/7/23

Secretary of Transportation

Date: 3/7/2023