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EXECUTIVE SUMMARY

This Initial Transportation Asset Management Plan (TAMP) documents and organizes the existing asset management practices at the Kansas Department of Transportation (KDOT) to optimize investment in highway assets, while providing an overview of the improvement actions needed to both increase the asset management maturity of the agency and meet 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, along with proposed processes to ensure that progress is made towards compliance with federal asset management regulations. The TAMP is intended to be a single source of information on KDOT’s assets, and a planning tool to use in maintaining assets in a state of good repair, towards achieving the national performance goals.

KDOT’S ASSETS

The Kansas transportation system comprises a variety of physical assets. Bridges and pavements are the most significant assets on the system based on asset value and operational, maintenance, and renewal costs. In Kansas, the National Highway System (NHS) is made up of 12,603 lane miles and 2,825 bridges covering the entire state. Additional assets on the State Highway System (but not NHS) are 12,575 pavement lane miles and 2,521 bridges. Accounting for highways that are both NHS and SHS, the total system includes 25,178 lane miles and 5,346 bridges mostly owned and maintained by KDOT, but with some portions under the purview of the Kansas Turnpike Authority (KTA) and other local entities (cities and counties).

<table>
<thead>
<tr>
<th>ASSETS COVERED IN TAMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Pavement In Lane Miles</td>
</tr>
<tr>
<td>NHS 12,603</td>
</tr>
<tr>
<td>Total Bridges</td>
</tr>
<tr>
<td>NHS 2,825</td>
</tr>
</tbody>
</table>
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 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 requirements are for no more than 5% of pavement in poor condition, KDOT has less than 1% of pavements (NHS and non-NHS) in poor condition.

Similarly, KDOT bridges on the NHS and SHS are generally in good condition. KDOT uses the same bridge condition performance measures as specified under federal rules in 23 CFR 490 Subpart D and with the federal requirements specifying that the percent of bridge deck area in poor condition remains below 10%, KDOT’s bridge inventory currently meets the federal standard.

LIFE CYCLE PLANNING

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

To promote a comprehensive evaluation of alternatives, KDOT conducts different LCP scenarios using pavement condition and financial data, modeling tools, and information from experts. The scenarios compare pavement performance for the annual funding KDOT is expected to receive over a 20-year period.

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 successfully implemented the Pontis bridge management system more than 15 years ago, and has been using AASHTOWare Bridge Management (BrM) 5.2.1 for the last four years. KDOT is currently implementing AASHTOWare BrM 5.3, which has life cycle planning capability. After completion of the bridge management system upgrade, KDOT bridge asset managers will be able to forecast changes in condition over time, and estimate life cycle costs for individual bridges and for the whole highway network.

MANAGING ASSET RISKS

KDOT began implementing the fundamentals of best practice risk management by identifying a preliminary set of reasonable and manageable risks for the transportation system. This initial process resulted in a risk register with prioritized risks. The top five risk are presented below.

<table>
<thead>
<tr>
<th>ID</th>
<th>RISK</th>
<th>IMPACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Deferred maintenance</td>
<td>Increased deterioration rate of roadways and bridges; increased cost to maintain roads/bridges; wear and tear on vehicles.</td>
</tr>
<tr>
<td>2</td>
<td>Inability to retain and attract workforce</td>
<td>Shortages of engineers due in part to lower salary and lack of design work; understaffed offices and field shops; employee burnout; overreliance on consultants</td>
</tr>
<tr>
<td>3</td>
<td>Reduction in state funding</td>
<td>Inability to match federal funding; system deterioration; less flexibility in spending decisions; increased safety risk to traveling public; fewer preservation, modernization, and expansion projects</td>
</tr>
<tr>
<td>4</td>
<td>Loss of institutional knowledge through retirements, attrition</td>
<td>Lack of continuity and institutional knowledge, leading to greater likelihood of errors; greater workload/more responsibility placed on fewer staff</td>
</tr>
<tr>
<td>5</td>
<td>Funding uncertainty</td>
<td>Less flexibility in spending decisions; fewer road, bridge, maintenance, preservation projects; inability to plan for long term</td>
</tr>
</tbody>
</table>
Moving forward, KDOT is primed for a more formal risk management process towards enhanced risk-based asset management, following federal and international risk management standards which employ a five-step process:

![Five-step process diagram]

**FINANCIAL PLANNING & INVESTMENT STRATEGIES**

**Where does Kansas highway funding come from?**

KDOT relies on five funding sources to finance asset management and other programs that support asset preservation for all highways. KDOT’s funding sources are:

- Federal Highway Trust Fund
- State motor fuel taxes
- State motor vehicle registration fees
- State sales and compensating use tax
- Other state miscellaneous revenues

These funds contribute to the State Highway Fund (SHF), with FY2017 revenues estimated at about $1.5 billion. The Kansas Turnpike Authority also funds highway asset investments on their responsibility of 236 miles of turnpike, as well as a few partnerships with KDOT and local entities, contributing 7% of the total available funding in FY2017 taking the total to $1.7 billion.
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

Funding projections show that about $10 billion in SHF would be available for investment for the duration of the TAMP (a ten-year period), representing an average annual revenue of $1.0 billion per year, assuming no new legislation is passed during this period.
Investment and Performance Scenarios

KDOT’s pavement management system can estimate investment needs to achieve a specified target performance, as well as the inverse – estimating future performance based on a specified budget. This scenario analysis generates output that informs performance and funding gap analyses to identify the system’s investment needs. Sample output is shown below (for illustration purposes).

Investment and performance scenarios will be determined for KDOT’s bridge assets once the upgrade of the BMS is complete. This system will also support the selection of investment strategies for KDOT’s bridge assets.

CONTINUOUS IMPROVEMENT

Two major improvement actions towards developing the final KDOT TAMP are the completion of the BMS upgrade and development of lifecycle planning scenarios for both pavements and bridges. Funding projections and lifecycle planning scenarios will be combined with risk management outputs and an
assessment of any future performance gaps to identify investment strategies and inform the prioritization of asset-related investments to maintain KDOT’s bridge and pavement assets in a state of good repair.

The following actions have been identified to increase KDOT’s asset management maturity and develop a final TAMP that is in compliance with the FTA Final Rule:

- Report asset performance using federal measures
- Include strategies to close or address performance gaps
- Fully implement bridge management decision support capability.
- Enhance bridge lifecycle strategies to minimize the lifecycle costs while achieving the 23 U.S.C. 150(d) performance targets for asset condition
- Continue development of the comprehensive risk management process
- Include a ten-year estimated cost to implement the investment strategies by State fiscal year and work type
- Address how anticipated available funding to implement strategies and estimated cost of future work types are associated with the investment strategies being considered
- Determine the investment needed on an annual basis to maintain the value of pavement and bridge assets.
- Establish investment scenarios based on the results of performance gap analyses, life-cycle planning, risk management, and projections of anticipated funding and estimated cost of future work.
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INTRODUCTION

The purpose of this plan is to document how transportation asset management is applied at KDOT to optimize investments in highway assets.

Serving a statewide population of almost 3 million, the Kansas transportation system includes over 140,000 miles of public roadways and almost 25,000 bridges, among other assets. Road miles in the 82,000 square-mile state are 90% rural, supporting the movement of people and goods, and economic growth within and beyond the state. While the entire system is important for connecting Kansans, the network of highways that comprise the National Highway System (NHS) and the State Highway System (SHS) are of greater importance to nationwide mobility, defense, and economic development. Figure 1-1 is a map of the SHS in Kansas, showing the portions that are part of the NHS.

The Kansas NHS includes 12,603 lane miles of roadways and 2,825 bridges while the SHS comprises 25,007 lane miles and 5,112 bridges. Accounting for highways that are both NHS and SHS, the total system includes 25,178 lane miles and 5,346 bridges. This includes portions owned and managed by other stakeholders, such as the Kansas Turnpike and the City Connecting Links (highways within city limits), including portions not on the SHS (non-state NHS).

This Initial Transportation Asset Management Plan (TAMP) documents and organizes the existing asset management practices at the Kansas Department of Transportation (KDOT), while providing an overview of the improvement actions needed to both meet federal requirements and increase the asset management maturity level of the agency.
1.1 WHAT IS ASSET MANAGEMENT?

Asset management, as defined in Section 23 United States Code of Federal Regulations (23 U.S. CFR 515.5), is "a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based on quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the life cycle of the assets at minimum practicable cost."

In simpler terms, asset management allows an agency to develop a comprehensive understanding of what assets they have, the condition they are in, and the actions or investments required to maintain desired performance levels. While the main purpose of asset management is to maintain infrastructure at acceptable performance levels at minimum practical cost, many of the major benefits come from the asset management planning process itself. Knowledge of assets and their condition enables KDOT to predict how they deteriorate and to manage risks to meet performance standards — thereby enabling analysis of alternatives to prioritize and optimize life-cycle activities. Ultimately, this allows KDOT to effectively manage assets, operate in a financially sustainable manner while justifying funding requirements to maintain levels of service, and improve transparency in investment decisions.

1.2 WHY IMPLEMENT ASSET MANAGEMENT?

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

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

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 the department currently follows in addition to any proposed processes to ensure that KDOT progresses towards achieving national goals and can maintain assets in a state of good repair. The TAMP is intended to be a single source of information on KDOT’s assets, and a planning tool for KDOT to use in meeting federal requirements by documenting current system condition, establishing performance targets, analyzing life cycle costs, evaluating long-term expenditure and funding forecasts as well as financial constraints, managing risks, identifying deviations from the desired system performance, and developing strategies to address any performance gaps.

While federal regulations require only the inclusion of NHS pavement and bridge assets, KDOT has chosen to include all pavement and bridge assets on the SHS in the scope of the plan, in addition to NHS assets within the jurisdiction of other transportation agencies in the state. This TAMP covers the total of 25,178 lane miles and 5,346 bridges which includes NHS assets (12,603 pavement lane-miles and 2,825 bridges) and other SHS assets that are not on the NHS (12,575 pavement lane miles and 2,521 bridges).

### ASSETS COVERED IN TAMP

<table>
<thead>
<tr>
<th>Total Pavement</th>
<th>25,178</th>
</tr>
</thead>
<tbody>
<tr>
<td>NHS</td>
<td>12,603</td>
</tr>
<tr>
<td>Non-NHS</td>
<td>12,575</td>
</tr>
<tr>
<td>Total Bridges</td>
<td>5,346</td>
</tr>
<tr>
<td>NHS</td>
<td>2,825</td>
</tr>
<tr>
<td>Non-NHS</td>
<td>2,287</td>
</tr>
</tbody>
</table>
Figure 1-2 shows a map of the roadways included in this TAMP, identifying segments that are owned by other entities besides KDOT. All routes shown are on the SHS, except those shown in red, which are non-state portions of the NHS. Routes shown in color are NHS routes, and those in grey are non-NHS routes that are also on the SHS. As shown, the Kansas Turnpike Authority (KTA) is responsible for a portion of the interstate on the NHS, while other smaller portions are the responsibility of local entities (e.g. cities and counties).

Figure 1-3 Highway Examples for each Pavement Asset Category

Pavement assets covered in this TAMP are referred to by NHS and SHS. The NHS is further broken down into (i) Interstate-NHS (IS-NHS); (ii) Non-Interstate NHS (Non-IS NHS); and (iii) NHS assets that are not owned or maintained by KDOT (Non-State NHS). Since the SHS includes most, but not all, NHS assets, the fourth category of pavement assets will be referred to as Other SHS. Bridge assets covered in the TAMP will simply be referred to as NHS bridges and Non-NHS bridges. Figure 1-3 shows some examples of highways in the state that fall in these categories.
This TAMP includes the minimum requirements as specified in 23 CFR 515 for an initial TAMP and describes the processes that will be used to develop the fully-compliant, risk-based asset management plan. The sections are organized as presented below. Beyond these federally-mandated initial iterations, 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 Chapters 4 through 7.

Per federal regulations, this initial TAMP describes KDOT’s processes for developing a comprehensive risk-based TAMP. At the end of each chapter (beginning at Chapter 3), a summary of the gaps in KDOT’s process are identified with an outlined improvement plan towards developing the final TAMP. Chapter 8 provides a summary of these improvement plans.
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 this TAMP.

KDOT’s existing business practices incorporate several fundamental concepts of effective infrastructure management – particularly in the management of pavement and bridge assets. Different strategic documents detailing the department’s mission and vision statements, strategic goals, and objectives emphasize asset management principles and show a commitment to preservation of major transportation assets through sustained condition improvements. Documents include: Geographical Information System Strategic Plan (emphasizing quality data and data-driven decisions); Long-Range Transportation Plan (with preservation as a primary guiding principle); and Strategic Management Plan (with highway maintenance as a key management goal). Each contains key initiatives that support best practice asset management.

While the KDOT mission is simply “to provide a statewide transportation system to meet the needs of the state,” the strategic and management goals include themes that embody the major principles of asset management, such as preserving the condition of the SHS and using technology to improve operational efficiency and effectiveness. KDOT has shown a commitment to preservation of its major transportation assets through these guiding documents and other investments which have led to sustained improvements in pavement condition (See Figure 2-1 on the following page).

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. KDOT has continued to develop several tools that enable progress in asset management. KDOT is well-positioned for improved, effective asset management and through this plan and process, the federal regulations provide an opportunity to hone the agency’s asset management maturity.

![Figure 2-1: Positive Results of the Pavement Management System on Pavement Condition](image)

### 2.1 KDOT ASSET MANAGEMENT GOVERNANCE

To guide the development of KDOT’s federally-compliant TAMP and the improvement of asset management efforts, five 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. Below, Figure 2-2 summarizes the groups, responsibilities, and membership.
Figure 2-2 KDOT Asset Management Governance

### Executive Committee
- Secretary of Transportation
- State Transportation Engineer
- Director of Planning & Development
- Director of Operations
- Director of Engineering
- Director of Finance
- Kansas Turnpike Authority CEO

### Steering Committee
- State Transportation Engineer
- Director of Planning & Development
- Director of Operations
- Bureau Chief of Program & Project Management
- Assistant Bureau Chief of Program & Project Management
- Debt Investment Manager (Office of Finance & Budget)
- KTA Director of Engineering
- KTA Director of Finance

### Working Group
- Bureau Chief of Construction & Materials
- Bureau Chief of Structures & Geotechnical Services
- Bureau Chief of Local Projects
- Bureau Chief of Maintenance
- Assistant Bureau Chief Construction & Materials
- Assistant Bureau Chief of Local Projects
- Pavement Management Engineer
- Bridge Management Engineer
- Preservation / Inspection Engineer
- District Engineers (6)
- Asset Management Manager
- Asset Management Associate

### Project Management Team
- TAM / TAMP point of contact
- Drives and coordinates TAM activities

### Coordinating Committee
- External stakeholder coordination
2.2 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.
2. Enhance investment decision making and programming with risk management principles.
3. Meet or exceed minimum performance standards and the long-term state of good repair for bridge and pavement assets.
4. Enhance the culture of asset management and preservation at KDOT 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.
7. Deliver an improved customer experience on KDOT’s roads and bridges.
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

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. Federal requirements (23 CFR 515) mandate that this TAMP includes, at a minimum, all pavements and bridges on the National Highway System (NHS). In Kansas, the NHS includes assets managed by KDOT, the Kansas Turnpike Authority (KTA), and local governments throughout the state.

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

The NHS consists of 12,603 lane-miles of pavement and 2,825 bridges comprising a total of 31,278,463 square feet of bridge deck. The non-NHS system covered in this TAMP includes 12,575 lane-miles of pavement and 2,521 bridges comprising 16,235,708 square feet of bridge deck. Table 3-1 provides a detailed summary of pavement lane miles and total number of bridges covered in this TAMP.

Table 3-1 Asset Portfolio Summary

<table>
<thead>
<tr>
<th>Pavements (Lane-Miles)</th>
<th>Category</th>
<th>Quantity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interstate NHS</td>
<td>3,700</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-Interstate NHS</td>
<td>8,732</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-State NHS</td>
<td>171</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subtotal NHS</td>
<td>12,603</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other SHS</td>
<td>12,575</td>
<td></td>
</tr>
</tbody>
</table>

| Bridges (Number) | NHS             | 2,825    | 5,346  |
| Other SHS       | 2,521           |          |        |

1 Highway Performance Monitoring System 2016
3.2 PAVEMENT ASSET PORTFOLIO

3.2.1 INVENTORY SUMMARY

The Kansas SHS (including NHS) is approximately 25,000\(^2\) lane miles, owned and managed by multiple stakeholders. The key stakeholders of the public road system include the Kansas state DOT, counties, towns and municipalities, and the KTA. The NHS represents about 50 percent (12,603 lane miles) of the SHS and makes up about 4 percent of the Kansas public roads system.

Even though the NHS is only a fraction of the public road system, it carries approximately 49 percent 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 owns and maintains most of the NHS pavement inventory. Figure 3-1 shows the different categories of pavement assets and Table 3-2 contains KDOT's pavement asset register summarizing the distribution of the pavement inventory among the key stakeholders.

Table 3-2 NHS and SHS Pavement Asset Summary

<table>
<thead>
<tr>
<th>Pavement Categories</th>
<th>KDOT Maintained</th>
<th>KTA Maintained</th>
<th>Other* Maintained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lane Miles</td>
<td>%</td>
<td>Lane Miles</td>
</tr>
<tr>
<td>NHS (Required by Federal Rules)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interstate NHS</td>
<td>2,785</td>
<td>75</td>
<td>915</td>
</tr>
<tr>
<td>Non-Interstate NHS</td>
<td>8,430</td>
<td>97</td>
<td>-</td>
</tr>
<tr>
<td>Total NHS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHS (Not Required by Federal Rules)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other SHS</td>
<td>12,575</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Other includes counties, towns, townships, and municipalities.

\(^2\) The pavement management system contains data for segment length and width. To convert to an estimate of lane-miles, it was assumed that the average lane width is 12 ft. (3.7 m).
3.2.2 PAVEMENT DATA MANAGEMENT

Asset management is founded on asset data – data that describes the inventory and condition of an asset at a point in time. KDOT gathers and manages pavement data using automated and manual means and has gathered and maintained pavement data for the entire SHS since 1983.

KDOT’s pavement asset inventory is comprehensive and reflects the different pavement types used across the state of Kansas. The data collection and management processes have evolved since 1983 to an automated process, to address both KDOT lifecycle planning needs and federal requirements. The original methodologies were based on sampling the pavement and were subjective rating assessments. Today, KDOT uses an automated pavement condition data collection system that allows most of the pavement condition data to be collected over almost the entire state highway system at highway speeds. Although this system is not perfect, it does allow for systematic, consistent, repeatable, objective collection of pavement surface data. The van used to collect this data is shown in Figure 3-2. The Kansas Pavement Data Quality Management Plan (under development) will provide more details on what the van collects and how it turns that into the data KDOT uses.

Figure 3-3 illustrates the evolution of pavement roughness data collection procedures since 1983. In addition to this, the collection of cracking data has been automated since 2013. Joint distresses are still collected manually.

Figure 3-3 Continued Data Collection Automation Since 1983
Pavement condition data is complete for three of the four metrics required by the federal Performance Management rules (PM2)\(^3\):

- International Roughness Index (IRI)
- Faulting
- Rutting

Extensive histories for cracking data are also available, though the way those metrics were collected are currently not consistent with the PM2 rules. Cracking data was collected manually using visual surveys until 2012, but has been collected using automated techniques since. Additionally, KDOT has pavement performance prediction models for distresses, as well as state-based Markov Transition Matrices for their condition indexes to address Part 23 CFR 515.5 of the federal rules. By the end of 2019, data collection practices (including cracking data) will be evolved to be consistent with the PM2 rules with the implementation of software to support the process.

Figure 3-4 shows the percentage of pavements (by centerline miles of surveyed pavements) for each of the four pavement surface types using 2016 data. The current collection methodology for pavement condition data has been designed to capture all the distress types expected with these pavement types.

![Figure 3-4 Distribution of the SHS by Pavement Surface Types](https://www.federalregister.gov/documents/2017/01/18/2017-00550/national-performance-management-measures-assessing-pavement-condition-for-the-national-highway)

3.2.3 PAVEMENT CONDITION SUMMARY

PERFORMANCE MEASURES

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

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

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

KDOT tracks pavement performance using condition metrics such as IRI, rutting, faulting, and cracking. As discussed above, these metrics are in accordance with the PM2 Pavement requirements, though KDOT must reconcile cracking data with the PM2 rules in the Final TAMP.

KDOT uses three performance levels in reporting pavement condition. They include percent Good pavements (PL1), percent Fair pavements (PL2), and percent of Deteriorated pavement (PL3 - which can be classified as Poor). KDOT’s existing definitions for good and poor pavement are not completely aligned with the federal measures. While KDOT will respond to the federal requirements in the Final TAMP using the federal measures, the Department will continue to use these existing performance measures to drive decisions ensuring that the national goals and minimum condition requirements are met.

KDOT is required to establish performance targets, regardless of ownership, for the full extent of the NHS (interstate and non-interstate), and to meet the minimum condition requirements for the Interstate System. The goals established are based on expected available funding (which also serve as constrained performance targets) for the pavement program. The targets or condition goals help KDOT to undertake performance gap analysis.
Interstate pavement condition goals established in 2001 by KDOT are at a higher standard than those required by the federal PM2 rules. The PM2 rule for Interstate Pavement condition is "no more than 5 percent in Poor condition," compared to KDOT’s more stringent measure of "no more than 3 percent in Deteriorated (Poor) condition." Going forward, these targets (and the performance against those targets) will be calibrated to align with federal requirements for KDOT and non-KDOT pavement.
PAVEMENT ASSET PERFORMANCE

The 2016 pavement condition shows that KDOT has achieved or exceeded the minimum requirements stipulated in the federal rules for Interstate pavements.

This section provides an overview of KDOT’s pavement performance trends using existing performance metrics. Based on KDOT’s existing metrics and measures, pavements are generally in good condition due to the consistent investment in pavement preservation and rehabilitation since pavement management began in earnest in the 1980’s.

The percentage of good, fair and poor pavements on the Interstate system do not include data for the 239 centerline miles (CLM) of pavements managed by the Kansas Turnpike Authority (KTA) because not all data elements for estimating the PLs are collected on those pavements. To better understand how comparable the conditions are between the KTA maintained pavements and the non-KTA pavements, comparisons were performed with the IRI and rutting. The results showed that the KTA maintained pavements are in comparable condition to the KDOT-maintained pavements, depending on the metrics and road categories compared.

Figure 3-5 shows the trend in the percent of pavement surface in Good (PL1) condition for the years between 2000 and 2016 for Interstate-NHS, non-Interstate NHS, and other SHS pavements. Similarly, Figure 3-6 shows the percent of pavement surface in Poor (PL3) condition for the years between 2007 and 2016 compared across the three pavement types. As shown, KDOT pavement performance meets the established goals.

Federal rules for performance measures also require KDOT to report pavements in good/poor condition, but these rules use different pavement condition data, have different means of aggregating the data, and will force KDOT to report using a different chart and measure. For the final TAMP, KDOT will compute pavement condition following these new rules for data collected from 2013 through the present. That will allow KDOT to show the trends of both methods over the same period to gain a better understanding of the prescribed federal method.
Figure 3-5 Pavement Surface in Good Condition for the SHS

Figure 3-6 Pavement Surface in Poor Condition for the SHS
3.3 BRIDGE ASSET PORTFOLIO

3.3.1 INVENTORY SUMMARY

The state of Kansas has a total of 24,883 bridges, of which 2,825 carry the NHS and are subject to federal requirements for the TAMP. Most of these are owned and maintained by KDOT, which owns a total of 5,112 bridges including those that are not on the NHS. Of the 234 NHS bridges not owned by KDOT, 218 are owned by the KTA, and the remaining 14 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 3-7 shows the bridge categories included in the TAMP and Table 3-3 summarizes the Kansas bridge population as of the end of 2016. The table also shows the number of bridges in each condition category.

Table 3-3 Kansas Bridge Asset Summary

<table>
<thead>
<tr>
<th>State-owned</th>
<th>National Highway System</th>
<th>TOTAL</th>
<th>Total Deck Area (sq. ft.)</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>2,591</td>
<td>28,533,964</td>
<td>2,105</td>
<td>473</td>
<td>13</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>234</td>
<td>2,744,499</td>
<td>160</td>
<td>73</td>
<td>1</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>2,521</td>
<td>16,235,708</td>
<td>1,905</td>
<td>600</td>
<td>16</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>19,537</td>
<td>43,498,318</td>
<td>9,474</td>
<td>8,672</td>
<td>1,391</td>
</tr>
<tr>
<td>NHS Total</td>
<td></td>
<td>2,825</td>
<td>31,278,463</td>
<td>2,265</td>
<td>546</td>
<td>14</td>
</tr>
<tr>
<td>Non-NHS Total</td>
<td></td>
<td>2,521</td>
<td>16,235,708</td>
<td>1,905</td>
<td>600</td>
<td>16</td>
</tr>
<tr>
<td>Kansas Total</td>
<td></td>
<td>24,883</td>
<td>91,012,489</td>
<td>13,644</td>
<td>9,818</td>
<td>1,421</td>
</tr>
</tbody>
</table>

In this TAMP, separate statistics are reported for the NHS and the SHS; the former is to satisfy federal requirements, while the latter is to satisfy KDOT internal management purposes. Bridges that are not on the NHS and not state-owned are not covered by this TAMP, but may be covered by local government planning processes.
3.3.2 BRIDGE DATA MANAGEMENT

KDOT maintains a bridge inspection program which exceeds National Bridge Inspection Standards, and which provides all data necessary for asset performance management. The department is implementing AASHTOWare Bridge Management release 5.3 to manage its inventory and inspection data, and anticipates an upgrade to enable functions supporting life-cycle planning, risk analysis, and investment planning to comply with 23 CFR 515.17. This upgrade should be operational by June 2019.

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.

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. 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. All bridges on the Kansas Turnpike and the 14 non-state bridges on the NHS are also inspected by KDOT.

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

<table>
<thead>
<tr>
<th>POOR</th>
<th>FAIR</th>
<th>GOOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Rehabilitation or Replacement | Preservation | Routine Maintenance
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

KDOT has specified a target of 5% for the maximum percentage of deck area on bridges in Poor condition and a target of 70% for the minimum percentage of deck area on bridges in Good condition.

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 have a long life ahead of them.

**BRIDGE ASSET PERFORMANCE**

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

Figure 3-8 and Figure 3-9 illustrate the historical condition for KDOT’s bridge assets. As shown, the percentage of bridge deck in poor condition has reduced over time, showing improvement in this measure. Both the NHS and the SHS inventory satisfy the bridge performance targets established. Federal laws specify certain sanctions that apply to states whose percent Poor on NHS bridges exceeds 10%. KDOT currently meets this criterion.

However, the percent of bridge deck area in good condition has been declining over time. There is a significant risk that NHS and/or SHS bridges may fail to meet this target within the next 10 years. Typically, the way to mitigate this risk is to increase the allocation of funding to preservation activities, which reverse or slow the deterioration of bridge condition and extend bridge life.
Figure 3-8 Bridge Condition Trends on NHS

Figure 3-9 Bridge Condition Trends on SHS
3.4 DEMAND ANALYSIS

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

3.4.1 POPULATION TRENDS

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

3.4.2 STATEWIDE MILES TRAVELED

Figure 3-10 shows the annual vehicle mileage in Kansas from 1947 to 2015. As shown, there has generally been a consistent increase in vehicle miles traveled (VMT) throughout the state. Similarly, Figure 3-11 shows a consistent increase in the daily vehicle miles traveled (DVMT) on the state highway system.

![Figure 3-10 Annual Vehicle Mileage from 1947 to 2016](image)
With over 50% of statewide DVMT occurring on the SHS in 2016, continued increases in vehicular travel throughout the state can be correlated to increased travel on the SHS. This will continue to impact bridge and pavement asset condition and increase demand for assets in good condition.

### 3.4.3 ECONOMIC INDICATORS OF TRAVEL DEMAND

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

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

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

**PROCESS**

- Data & Management Systems (23 CFR 515.7(g))

**GAP**

- Bridge management system does not fully comply with the requirements of 23 CFR 515.17.

---

**IMPROVEMENT PLAN**

**Planned Action(s):**

- Upgrade the bridge management system to include deterioration modeling and performance analysis.
- Assess asset performance using federal required metrics; i.e., convert KDOT measures into PM2 (23 CFR 490 Subpart B & C) measures.

**Timeline:** June 2019

**Owner(s):** Pavement and Bridge Working Group, Key External Stakeholders
4 LIFE CYCLE PLANNING

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

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

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

4.1 PAVEMENT LIFE CYCLE PLANNING

KDOT has five categories of routes (Class A through E). Interstate NHS routes and most non-IS NHS routes are categorized within classes A through C and usually receive higher priority, while Class D and E routes are considered less critical. This priority ranking approach forms the foundation of what is considered risk-based prioritization to support minimization of life cycle cost. It allows KDOT to address pavement locations with higher criticality in terms of safety and the degree of impact on the traveling public. Once these high-risk locations are addressed, KDOT uses optimization to select the next potential list of investments. In the optimization phase, all routes compete on the same playing field using system performance and cost effectiveness as driving variables. The following sections describe the key elements that support KDOT’s LCP approach for pavement assets. See Figure 4-1 for a map showing route classification.

- **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
DATA COLLECTION

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

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

4.1.2 TOOLS AND MODELING TECHNIQUES

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

The KDOT PMS is equipped with modeling capabilities that use several predictive equations to estimate different variables. The PMS uses condition data and predictive equations to estimate pavement-related individual distresses and composite measures. For example, the prediction models estimate the drop (reduction) in distress due to heavy rehabilitation action, distress level at one year after the rehabilitation action, and distress levels at each subsequent year after the rehabilitation action. Figure 4-2 shows an example of the modeling output.

![Figure 4-2 Behavior of Pavement Performance (Distress) after a Rehabilitation Action](image)

The estimation of design life serves an important purpose in the LCP process. The estimated design life measures the expected time elapsed from the last heavy rehabilitation action to the time it reaches an established threshold level of distress.
Deterioration models used in KDOT pavement management were originally derived from expert opinion through a modified Delphi process. Later, these models were 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.

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

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

4.1.3 TREATMENT OPTIONS AND COSTS

KDOT’s deterioration models were also developed to show the change in condition of pavements based on applying treatments. The models started based on expert opinion and were updated to data driven models as adequate data became available over several years of pavement data collection. These models compute the expected change in condition based on the type of treatment applied. Some treatments result in a reset to very good pavement conditions, other actions may provide some improvement but not a complete reset.

KDOT uses a mix of treatment options to address pavement needs. Within the PMS, treatments are assigned an equivalent thickness of asphalt and a work type. The equivalent thickness for the treatment is the means to allow all treatments to be modeled and compared for consideration. The work type is assigned based on the treatment being non-structural (N), light (L), or heavy (H) improvement. The work type and existing condition of the pavement determine the combination of treatment options that KDOT applies to address a deficiency.
The process is a combination of selection rules enforced in the NOS and experts' knowledge. The NOS recommends a set of feasible actions for KDOT to consider in developing work plans. However, senior managers make the final investment decision after careful consideration of engineering recommendations and inputs from the field staff.

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

Table 4-1 presents the types of treatments and associated costs that KDOT uses in addressing pavement deficiencies. The unit costs provided are real project numbers and as shown, can vary widely depending on the amount and extent of work performed on the pavement class. KDOT considers the cost effectiveness of each treatment type in selecting the treatments that make up the work types.

**Table 4-1 Pavement Treatment Options, Costs, and Work Types**

<table>
<thead>
<tr>
<th>Pavement Classes</th>
<th>Treatment Option</th>
<th>Cost (per unit measure)</th>
<th>Work Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interstate Pavements</td>
<td>Chip Seal</td>
<td>$28,000 / lane mile</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Overlay 1.5”</td>
<td>$40,000 / lane mile (2004)</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Patching Full Depth</td>
<td>$3,000 / lane mile</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>New Concrete</td>
<td>$1,500,000 / lane mile</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Bonded Wearing Surface</td>
<td>$51,000 / lane mile</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Mill 1.5” Overlay 1.5”</td>
<td>$118,000 / lane mile</td>
<td>L</td>
</tr>
<tr>
<td>Non-Interstate Pavements</td>
<td>Chip Seal</td>
<td>$20,000 / lane mile</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Overlay 1.5”</td>
<td>$48,500 / lane mile</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Patching Full Depth</td>
<td>$146,000 / lane mile</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>New Concrete</td>
<td>$1,320,000 / lane mile</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Bonded Wearing Surface</td>
<td>$57,500 / lane mile</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Mill 1.5” Overlay 1.5”</td>
<td>$81,500 / lane mile</td>
<td>L</td>
</tr>
</tbody>
</table>
4.1.4 LCP SCENARIOS

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

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

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

The worst-first scenario is only presented to illustrate the importance of asset management pertaining to the efficient use of limited resources. KDOT does not pursue this investment scenario because it is costly and does not allow KDOT to achieve system goals. The scenario prioritizes pavements requiring reconstruction or heavy rehabilitation (i.e., poor pavements), allocating remaining funding to lighter treatments that target fair pavements. In other words, this approach does not consider pavement preservation as a priority for investment.

The second scenario representing the current approach or maintain steady state, analyzes pavement performance assuming a perpetual service life using the existing investment approach. A steady-state analysis determines the minimum cost set of treatments that returns the pavement to the previous year’s condition. Put another way, the amount of work put in each year equals the amount of deterioration each year. When the work and deterioration are in balance for a minimum cost, steady state is achieved.

The output of a steady state run is the distribution of pavement conditions in the steady state cycle. This distribution becomes a requirement for transition optimization runs. Having this constraint in place greatly reduces the chance that the set of treatments applied in one year will result in a much costlier set of treatments needed in future years. The scenario considers a combination of maintenance, preservation, heavy rehabilitation, and reconstruction work types.
After developing the steady state constraints, the NOS is run based on the current condition and the previously described parameters. The system is asked to work out a plan to transition from the current set of pavement conditions to a **desired state of good repair** for the pavement asset. It incorporates the deterioration models, evaluates different mixes of work types, and provides an optimal (cost-effective) strategy for treating the pavements as a system.

Investments in this third scenario are driven by KDOT’s pavement performance targets and national goals. In asset management, this scenario is considered the best practice. It prioritizes investments that enable KDOT to achieve established performance targets or meet minimum pavement condition requirements and determines the level of funding required to achieve the desired state of good repair in each analysis year. This scenario helps KDOT to communicate the investment gaps between current investment levels and required investment levels to achieve the desired state of good repair with decision makers and other stakeholders. This process also supports pavement performance gap analysis, which is a requirement of the federal rules.

KDOT’s PMS will be used to develop the lifecycle planning scenarios to show the funding needed and projected performance in each case. Figure 4-3 is an illustration of the expected output.
4.2 BRIDGE LIFE CYCLE PLANNING

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

4.2.1 DATA COLLECTION

As a key ingredient in its life cycle planning strategy, KDOT was an early adopter of a process known as element inspection. Each bridge is subdivided into elements, such as those shown in Figure 4-4, 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 spotting problems before they become serious, when it is inexpensive to solve them. It also has enabled the agency to amass a rich database that can support research and development of improved management tools.

![Figure 4-4 Element Composition of a Bridge – Each Part Receives a Separate Condition Rating](image)

4.2.2 TOOLS AND MODELING TECHNIQUES

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

KDOT successfully implemented the Pontis bridge management system more than 15 years ago and has been using AASHTOWare Bridge Management (BrM) 5.2.1 for the last four years. BrM is one of the
AASHTOWare products published by the American Association of State Highway and Transportation Officials (AASHTO).

KDOT is currently implementing BrM 5.3, which has life cycle planning capability. National research sponsored in part by KDOT has shown significant value in preventive maintenance and preservation to extend the lifespan of expensive bridges and save costs in the long term. With bridges in some cases more than 120 years old, life extension is essential for keeping Kansas’ highway network in service.

Using its extensive data on bridge element conditions, KDOT computes a bridge condition measure known as the Bridge Health Index, where a new bridge has a score of 100 and a fully deteriorated bridge has a score of zero. After KDOT completes the implementation of the latest version of AASHTOWare, KDOT bridge asset managers will be able to forecast changes in condition over time, changes which can vary dramatically from one bridge to another.

Figure 4-5 shows a common pattern. 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.

Figure 4-5 Life Extension from Bridge Preservation (Typical Example)

Consistent past financial support by elected leaders for the bridge preservation program has led to a bridge inventory that is, overall, in very good condition. Analysis tools now being implemented by KDOT
(presented in Table 4-2) 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 in 2019, 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

### Table 4-2 New Tools to be Adopted at KDOT Over the Next Year

<table>
<thead>
<tr>
<th>Tools</th>
<th>Features and Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deterioration models</td>
<td>Models that forecast future deterioration rates for bridge elements, to enable KDOT to anticipate and optimize preservation work. KDOT continues to develop materials and coatings that can protect bridges from deterioration so they will last longer. With more than 20 years of bridge element inspection data, KDOT is in a good position to build statistical models of deterioration suitable for the AASHTOWare BMS.</td>
</tr>
<tr>
<td>Action effectiveness models</td>
<td>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.</td>
</tr>
<tr>
<td>Cost analysis</td>
<td>Analysis to accurately estimate future preservation costs and to help improve productivity and efficiency of workers and materials. In preparation for the 2010-2020 capital program KDOT had developed a set of cost models for its (then) Pontis system, which it now is planning to update in preparation for a future capital program.</td>
</tr>
<tr>
<td>Economic models</td>
<td>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.</td>
</tr>
<tr>
<td>Investment strategies</td>
<td>Tools to estimate total network level costs for alternative policies and levels of investment, to support the establishment and achievement of condition targets as well as accomplish safety and mobility goals of the state and federal governments.</td>
</tr>
</tbody>
</table>
4.2.3 TREATMENT OPTIONS AND COSTS

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

Figure 4-6 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.

Figure 4-6 Examples of Bridge Preservation Opportunities

These are the types of activities that make up a preservation program to minimize life-cycle costs, maximize safety, and avoid disruptions to the movement of people and goods on the highway network. When KDOT’s bridge management system is fully implemented in 2019, the agency will be able to accurately identify and program preservation projects over a one to five-year time frame, and forecast budgetary needs for the five- to ten-year timeframe, ensuring that the bridge inventory remains in a state of good repair over the long term. To accomplish this goal, KDOT will develop models of deterioration, treatment cost, and effectiveness over the next year.
SUMMARY – LIFE CYCLE PLANNING

**PROCESS**
Life Cycle Planning Analysis (23 CFR 515.7(b))

**GAP**

- Does not model deterioration for NHS / SHS bridges
- Does not include management strategies to minimize life cycle costs for bridges while achieving 23 U.S.C.150(d) performance targets

**IMPROVEMENT PLAN**

**Planned Action(s):**

- Upgrade Bridge Management System (BrM) to incorporate lifecycle cost analysis
- Conduct LCP scenarios and identify investment strategies that support the achievement of national condition goals, and performance targets while focusing on preservation, risk management, and minimizing life cycle cost

**Timeline:** June 2019

**Owner(s):** Pavement, Bridge, and Finance Working Group
5 RISK MANAGEMENT

Having conducted preliminary risk management steps, KDOT is primed for a more formal risk management process towards enhanced risk-based asset management.

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 a risk 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 5-1 is an adaptation of the ISO risk management process that includes FHWA’s asset management Final Rule requirements, which illustrates the process that KDOT will follow to ensure robust risk management.

![The Risk Management Process](image)

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.

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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).

Risk identification 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.

Risk analysis 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.

Risk evaluation compares the likelihood of a risk event occurring against the consequence of the event, and uses the level determined to prioritize the risks.

Manage 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.

Communicate and consult, and monitor and review 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.
5.1.1 RISK MANAGEMENT AT KDOT

KDOT began implementing the fundamentals of best practice risk management in February 2017 by identifying a preliminary set of reasonable and manageable risks for the KDOT transportation system. As a first step to refining this list and eventually developing a comprehensive risk register, a steering committee was formed in April 2017 to review the preliminary list. The steering committee’s resulting risk register was distributed to a selection of KDOT employees, to provide their input on impacts and mitigation strategies and to identify any additional risks (Risk Identification). In the end, 27 risks to providing a reliable, safe, and efficient transportation system were compiled. An Advisory Committee of executive leaders representing KDOT and KTA prioritized the list of risks identified using a survey on which respondents scored the likelihood and consequence of each risk from 1 to 5 (Risk Analysis and Evaluation). Definitions of likelihood and consequence were left to the discretion of the survey respondent. Nonetheless, the result of this risk assessment process is the risk register provided in Table 5-1, where the higher the priority score, the higher the risk. Note that the table is sorted in order of priority score.

<table>
<thead>
<tr>
<th>ID</th>
<th>RISK</th>
<th>CATEGORY</th>
<th>IMPACT</th>
<th>LIKELIHOOD</th>
<th>CONSEQUENCE</th>
<th>PRIORITY</th>
<th>MITIGATION</th>
</tr>
</thead>
</table>
| 1  | Deferred maintenance | System/Internal Risk | • Increased deterioration rate of roadways and bridges  
• Increased cost to maintain roads/bridges  
• Wear and tear on vehicles | 4.2 | 3.8 | 15.9 | • 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 |
<table>
<thead>
<tr>
<th>ID</th>
<th>RISK</th>
<th>CATEGORY</th>
<th>IMPACT</th>
<th>LIKELIHOOD</th>
<th>CONSEQUENCE</th>
<th>PRIORITY</th>
<th>MITIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Inability to retain and attract workforce</td>
<td>System/Internal Risk</td>
<td>• Chronic shortages of engineers</td>
<td>4.3</td>
<td>3.7</td>
<td>15.5</td>
<td>• Enhance salary structure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Understaffed offices and field shops</td>
<td></td>
<td></td>
<td></td>
<td>• Develop annual salary increases based on performance</td>
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<td></td>
<td></td>
<td></td>
<td>• Decreased morale</td>
<td></td>
<td></td>
<td></td>
<td>• Promote work-life balance</td>
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<td></td>
<td></td>
<td></td>
<td>• Employee burnout</td>
<td></td>
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<td>• Above market benefit package</td>
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<td></td>
<td></td>
<td></td>
<td>• Inability to carry out agency’s mission</td>
<td></td>
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<td>• Increase schedule flexibility and perquisites</td>
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<td></td>
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<td></td>
<td>• Overreliance on consultants</td>
<td></td>
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<tr>
<td>3</td>
<td>Reduction in state funding</td>
<td>Financial Risk</td>
<td>• Inability to match federal funding</td>
<td>4.0</td>
<td>3.8</td>
<td>15.4</td>
<td>• Rely on prioritization process</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Fewer projects</td>
<td></td>
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<td>• Engage state legislative leaders and governor’s office</td>
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<td></td>
<td></td>
<td></td>
<td>• Fewer contractors available due to lack of work</td>
<td></td>
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<td></td>
<td>• Work with advocates and/or potential allies</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• System deterioration</td>
<td></td>
<td></td>
<td></td>
<td>• Fund preservation work first</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Less flexibility in spending decisions</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>• Negative impacts to customer satisfaction</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>• Increased safety risk to traveling public</td>
<td></td>
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<td></td>
<td></td>
<td>• Increased costs to motorists</td>
<td></td>
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<td>ID</td>
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<tr>
<td>4</td>
<td>Loss of institutional knowledge through retirements, attrition</td>
<td>System/Internal Risk</td>
<td>• Lack of continuity and institutional knowledge, leading to greater likelihood of errors&lt;br&gt;• Greater workload/more responsibility placed on fewer staff; inability of field offices to do basic work</td>
<td>4.3</td>
<td>3.5</td>
<td>15.2</td>
<td>• Institute succession planning strategies&lt;br&gt;• Cross-train staff&lt;br&gt;• Reinforce mentoring program&lt;br&gt;• Enhance salary structure&lt;br&gt;• Enhance non-salary job benefits&lt;br&gt;• Create education/training program</td>
</tr>
<tr>
<td>5</td>
<td>Funding uncertainty</td>
<td>Financial Risk</td>
<td>• Less flexibility in spending decisions&lt;br&gt;• Inefficient use of staff and resources&lt;br&gt;• Fewer road, bridge, maintenance, preservation projects&lt;br&gt;• Fewer contractors available&lt;br&gt;• Negative impacts to customer satisfaction&lt;br&gt;• Right-of-way acquisition complications&lt;br&gt;• Inability to plan for long term</td>
<td>4.1</td>
<td>3.4</td>
<td>14.0</td>
<td>• Be conservative in funding estimates for cash flow&lt;br&gt;• Communicate potential impact with public (including cost and program effectiveness)&lt;br&gt;• Engage legislative leaders and governor’s office</td>
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<tr>
<td>ID</td>
<td>RISK</td>
<td>CATEGORY</td>
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<tr>
<td>6</td>
<td>Loss of public confidence in agency</td>
<td>System/Internal Risk</td>
<td>• Loss of adequate funding</td>
<td>3.5</td>
<td>3.6</td>
<td>12.5</td>
<td>• Retain experienced staff</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Complicates relationships with external partners/stakeholders</td>
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<td>• Transparency</td>
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<td>• Pushing legislative agenda becomes more difficult</td>
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<td></td>
<td>• Host Local Consultation meetings</td>
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<td></td>
<td></td>
<td></td>
<td>• Unwillingness of public to support new highway spending</td>
<td></td>
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<td></td>
<td>• Well-developed communication strategy</td>
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<td></td>
<td></td>
<td>• Provide honest, accurate and timely information to stakeholders and public</td>
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<td></td>
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<td>• Follow through on commitments</td>
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<td></td>
<td></td>
<td>• Strengthen and/or reaffirm partnerships</td>
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<tr>
<td>7</td>
<td>Increased allowable truck weights</td>
<td>External Risk</td>
<td>• Local infrastructure failure</td>
<td>3.6</td>
<td>3.0</td>
<td>10.9</td>
<td>• Increase bridge staff</td>
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<td></td>
<td></td>
<td></td>
<td>• Load postings and restrictions</td>
<td></td>
<td></td>
<td></td>
<td>• Identify heavy freight corridors</td>
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<td></td>
<td></td>
<td></td>
<td>• Additional non-programmed costs</td>
<td></td>
<td></td>
<td></td>
<td>• Change design to handle heavier loads</td>
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<td></td>
<td></td>
<td></td>
<td>• Reduced pavement and bridge life</td>
<td></td>
<td></td>
<td></td>
<td>• Increase preservation activities</td>
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<td></td>
<td></td>
<td>• Increased pavement distress</td>
<td></td>
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<td></td>
<td></td>
<td>• Increase in initial construction costs</td>
<td></td>
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<td>ID</td>
<td>RISK</td>
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</tr>
</tbody>
</table>
| 8  | Reduction in federal funding| Financial Risk     | • System deterioration  
• Fewer miles/bridges can be built/preserved  
• Less flexibility in spending decisions | 3.2       | 3.4         | 10.9     | • Engage congressional delegation  
• Appeal to FHWA regarding project eligibility  
• Refine project selection process  
• Assess alternative procurement strategies such as PPP projects |
| 9  | Increased freight traffic   | External Risk      | • Reduced pavement and bridge life  
• Additional non-programmed costs  
• Increased congestion and traffic conflicts  
• Shortage of truck parking  
• Increase in vehicle/train collisions | 3.7       | 2.9         | 10.8     | • Increase bridge staff  
• Increase evaluation of at-grade rail crossings  
• Increase preservation activities  
• Promote private development of more truck plazas  
• Work with locals on finding parking during the short-term closures  
• Expand Truck Parking Information Management System |
<table>
<thead>
<tr>
<th>ID</th>
<th>RISK</th>
<th>CATEGORY</th>
<th>IMPACT</th>
<th>LIKELIHOOD</th>
<th>CONSEQUENCE</th>
<th>PRIORITY</th>
<th>MITIGATION</th>
</tr>
</thead>
</table>
| 10 | Reduced quality construction materials | External Risk | • Reduced performance and service life  
• Inefficient expenditure of tax dollars  
• Negative impacts to customer satisfaction  
• Increased safety risk to employees and traveling public | 2.9       | 3.2         | 9.3      | • 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 inspection and inspection staff  
• Increase requirements for contractor QC/QA |
| 11 | Extreme individual natural events | External Risk | • Damaged infrastructure  
• Temporary loss of system functionality  
• Additional non-programmed costs  
• Route closure  
• Stretches capabilities of field staff  
• Increased safety risk to employees and traveling public  
• Negative economic impact | 2.9       | 3.1         | 9.1      | • Maintain emergency response plans  
• Follow established inspection practices  
• Coordinate with local entities  
• Have an emergency fund  
• Have adequate amount of materials on hand  
• Excellent communication with staff, stakeholders, and partners  
• Back-up systems  
• Training |
<table>
<thead>
<tr>
<th>ID</th>
<th>RISK</th>
<th>CATEGORY</th>
<th>IMPACT</th>
<th>LIKELIHOOD</th>
<th>CONSEQUENCE</th>
<th>PRIORITY</th>
<th>MITIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Inflation</td>
<td>Financial Risk</td>
<td>• Smaller program without increased funding</td>
<td>3.1</td>
<td>2.9</td>
<td>9.0</td>
<td>• Focus on preservation first</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Fewer road, bridge, maintenance, preservation projects lead to system</td>
<td></td>
<td></td>
<td></td>
<td>• Evaluate funding sources</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>deterioration</td>
<td></td>
<td></td>
<td></td>
<td>• Build inflation into 10-year funding program</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Decreased buying power</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>13</td>
<td>Lack of contractor availability</td>
<td>Financial Risk</td>
<td>• Inability to plan for long term</td>
<td>2.9</td>
<td>3.1</td>
<td>9.0</td>
<td>• Adjust project letting schedule in accordance with contractor availability</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Reduced capacity to accomplish work</td>
<td></td>
<td></td>
<td></td>
<td>• Understand demand on contracting industry beyond the state (consider a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Higher bid prices</td>
<td></td>
<td></td>
<td></td>
<td>“regional” approach to procurement)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Potential delays in project letting</td>
<td></td>
<td></td>
<td></td>
<td>• Advise contracting industry on program (funding and certainty) as early</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Lack of innovative construction practices</td>
<td></td>
<td></td>
<td></td>
<td>as possible</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Reduced competition at bid lettings causes higher prices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID</td>
<td>RISK</td>
<td>CATEGORY</td>
<td>IMPACT</td>
<td>LIKELIHOOD</td>
<td>CONSEQUENCE</td>
<td>PRIORITY</td>
<td>MITIGATION</td>
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<td>----------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 14 | Terrorism and IT infrastructure failure       | External Risk | • Data corruption  
• Confidential data theft  
• Inability to complete program  
• Inability to optimize investment  
• Disruption of services  
• Loss of agency credibility | 2.7        | 3.2          | 8.8       | • 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  
• Complete Construction Management System replacement  
• Maintain strong, dedicated IT support  
• Update disaster recovery and business continuity plans |
| 15 | Change in state/federal leadership/priorities | External Risk | • Change in funding levels  
• Change in staffing levels  
• Change in KDOT leadership  
• Potential loss of internal and external support  
• Loss of credibility | 2.8        | 3.1          | 8.8       | • Tell KDOT story through performance measures, safety, past accomplishments  
• Encourage flexibility through clear, honest communication |
<table>
<thead>
<tr>
<th>ID</th>
<th>RISK</th>
<th>CATEGORY</th>
<th>IMPACT</th>
<th>LIKELIHOOD</th>
<th>CONSEQUENCE</th>
<th>PRIORITY</th>
<th>MITIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Bridge failure</td>
<td>External Risk</td>
<td>• Temporary loss of system functionality</td>
<td>2.3</td>
<td>3.7</td>
<td>8.6</td>
<td>• Maintain emergency response plans</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Loss of life</td>
<td></td>
<td></td>
<td></td>
<td>• Maintain or improve data collection</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Additional non-programmed costs</td>
<td></td>
<td></td>
<td></td>
<td>• Follow established inspection practices</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Increased safety risk to employees and traveling public</td>
<td></td>
<td></td>
<td></td>
<td>• Maintain appropriate emergency fund levels</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Negative impact due to interruption in transportation of goods</td>
<td></td>
<td></td>
<td></td>
<td>• Reprioritize projects if funds are limited</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Apply appropriate funding for bridge rehabilitation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Work with local governments in advance to develop prescribed detour routes</td>
</tr>
<tr>
<td>17</td>
<td>Autonomous and highly-automated vehicles</td>
<td>External Risk</td>
<td>• Could require different design standards</td>
<td>3.2</td>
<td>2.6</td>
<td>8.3</td>
<td>• Understand expectations of KDOT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Vulnerable to IT terrorism</td>
<td></td>
<td></td>
<td></td>
<td>• Monitor progress of lead states</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Increased agency costs</td>
<td></td>
<td></td>
<td></td>
<td>• Involvement on national automated vehicle committees</td>
</tr>
<tr>
<td>ID</td>
<td>RISK</td>
<td>CATEGORY</td>
<td>IMPACT</td>
<td>LIKELIHOOD</td>
<td>CONSEQUENCE</td>
<td>PRIORITY</td>
<td>MITIGATION</td>
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<td>------------</td>
</tr>
</tbody>
</table>
| 18 | Bridge damage caused by vehicle impacts | External Risk | - Temporary loss of system functionality  
- Additional non-programmed costs  
- Damaged infrastructure  
- Negative impacts to customer satisfaction  
- Increased safety risk to employees and traveling public  
- Potential litigation risk | 2.9 | 2.9 | 8.2 | - Maintain emergency response plans  
- Follow established practices and policies  
- Interoperable communication between KDOT and first responders  
- Training |
| 19 | Federal requirements may hinder preservation projects | System/Internal Risk | - Dollars will not stretch as far under federal guidelines and requirements | 3.0 | 2.8 | 8.2 | - Partner with local FHWA to achieve workable solutions |
| 20 | Alternative fuel vehicles – electric, fuel cell, CNG | Financial Risk | - Current fuel tax would not apply, resulting in decreased revenue to State Highway Fund | 3.0 | 2.7 | 8.1 | - Engage legislative leaders |
| 21 | Bridge damage due to scour | External Risk | - Temporary loss of system functionality  
- Additional non-programmed costs  
- Route closure | 2.7 | 2.8 | 7.8 | - Maintain emergency response plans  
- Enact established inspection policy  
- Proper design and engineering practice |
<table>
<thead>
<tr>
<th>ID</th>
<th>RISK</th>
<th>CATEGORY</th>
<th>IMPACT</th>
<th>LIKELIHOOD</th>
<th>CONSEQUENCE</th>
<th>PRIORITY</th>
<th>MITIGATION</th>
</tr>
</thead>
</table>
| 22 | Lack of continuity of operations in a disaster or major workplace | System/Internal Risk | • Loss of productivity  
• Delays in construction and design projects and payments  
• Disruption of internal communication | 2.6 | 3.0 | 7.8 | • Strong, up-to-date Continuity of Operations Plans (COOP)  
• Ensure employees are well-informed about the COOP and its importance |
| 23 | Sinkholes emerge under or near roadway | External Risk | • Temporary loss of system functionality  
• Additional non-programmed costs  
• Loss of life, personal injury | 2.5 | 3.1 | 7.7 | • Maintain emergency response plans  
• Proper design and engineering practices  
• Identify and monitor at-risk locations  
• Eliminate route  
• Mine grouting |
| 24 | Reduced flexibility with federal funding | Financial Risk | • Changed project priorities  
• Potential reduction in planned projects  
• Potential increase in project costs | 2.7 | 2.8 | 7.5 | • Coordinate with AASHTO and FHWA to plan for changes  
• Engage congressional delegation  
• Refine project selection process |
| 25 | Climate change | External Risk | • Assets require more frequent preservation/maintenance actions  
• Reduced service life of roads, bridges  
• Additional non-programmed costs | 2.6 | 2.5 | 6.6 | • Maintain/increase frequency of preservation actions  
• Maintain emergency response plans |
<table>
<thead>
<tr>
<th>ID</th>
<th>RISK</th>
<th>CATEGORY</th>
<th>IMPACT</th>
<th>LIKELIHOOD</th>
<th>CONSEQUENCE</th>
<th>PRIORITY</th>
<th>MITIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>Terrorism/Vandalism/Sabotage</td>
<td>External Risk</td>
<td>• Damaged infrastructure</td>
<td>2.1</td>
<td>3.0</td>
<td>6.3</td>
<td>• Maintain emergency response plans</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Temporary loss of system functionality</td>
<td></td>
<td></td>
<td></td>
<td>• Maintain appropriate emergency fund levels</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Additional non-programmed costs</td>
<td></td>
<td></td>
<td></td>
<td>• Reprioritize projects if funds are limited</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Negative impacts to customer satisfaction</td>
<td></td>
<td></td>
<td></td>
<td>• Training</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Increased safety risk to employees and traveling public</td>
<td></td>
<td></td>
<td></td>
<td>• Identify vulnerabilities, develop plans, policies to minimize risks</td>
</tr>
<tr>
<td>27</td>
<td>Significant increase in federal funding</td>
<td>Financial Risk</td>
<td>• Inability to match federal funding</td>
<td>2.1</td>
<td>2.7</td>
<td>5.8</td>
<td>• Increase design and construction staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Increased need for federally-eligible projects</td>
<td></td>
<td></td>
<td></td>
<td>• Ensure there is a pipeline of projects ready to go</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Increased workload in field offices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Need for more trained staff and consultants to handle the influx of project work</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.2 ENHANCING RISK MANAGEMENT AT KDOT

While risk management is not new to KDOT, there are opportunities to strengthen and to establish more structure around the process.

The following sections describe the process that will be followed to complete a comprehensive risk management process at KDOT beyond the existing risk register, and develop a risk management plan. While the goal is to follow the FHWA/ISO process outlined in Figure 5-1, KDOT’s implementation will be agile in nature, with frequent reassessment of the process and redesign as necessary.

5.2.1 STEP 1: ESTABLISH THE CONTEXT

To begin, KDOT will develop a risk management framework by establishing an understanding of the organization’s context looking at the factors listed in Figure 5-2.

The next step will be to convene the risk management team. This team will consist of members of the different governance groups defined in Section 2.1, led by the project management team. Out of this team, KDOT will identify the person(s) responsible for developing, implementing, and maintaining the risk management framework and products, identify risk owners who will be accountable for risk response and treatments, and identifying the responsibilities of others throughout the organization as it pertains to this process. Risk owners will be assigned following the general structure defined in the NCHRP Guide for Managing Risk Across the Enterprise as shown in Figure 5-3.

With a team assembled, KDOT will define a risk management policy that outlines linkages with KDOT’s strategic goals and asset management objectives, formalizes the accountabilities for managing risk, and demonstrates an organizational commitment to managing risk.

Additional steps that will inform the risk management policy to establish the context for risk management include:

Figure 5-2 Factors to Evaluate to Establish the Context for Risk Management
• **Establishing the scope of the risk management process:** determine the types of risk to be included and the level of detail desired
• **Refine risk criteria:** determine how the significance of risk will be evaluated (e.g., levels of likelihood, how risks will be prioritized, etc.)
• **Identify the organization’s risk appetite:** determine how much risk KDOT is willing to accept

![Image](473x718 to 540x755)

![Image](72x276 to 106x288)

**STEP 2: RISK IDENTIFICATION**

KDOT will refine the preliminary risk register by using a more structured method to identify risks. As shown in Table 5-1, risks were grouped in three categories: (i) system/internal risks; (ii) financial risks; and (iii) external risks. Risk categorization allows for focused thinking about the potential impacts to KDOT’s asset management objectives. Alternative categories could include organizational risks, asset performance risks, safety risks. The KDOT risk management team will refine the categories and provide an opportunity (through a workshop) for a wider selection of staff to brainstorm potential risks to be managed.

**STEP 3: RISK ANALYSIS**

The objective of risk analysis is to understand the causes and effects of the risks identified and consider the probability of their occurrence. In the preliminary risk process, KDOT conducted the risk analysis by

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**Figure 5-3 NCHRP 08-93 Risk Management Levels**

**5.2.2 STEP 2: RISK IDENTIFICATION**

**5.2.3 STEP 3: RISK ANALYSIS**
using a risk prioritization survey. In enhancing the process, the existing risk analysis will be maintained with stronger definitions of likelihood and consequences. While likelihood can be quantified by using a five-point scale structure as shown in Table 5-2, determining risk consequence involves combining information about estimated or calculated effects, history and experience. Descriptions of the levels of consequence depends on the risk categories agreed, as shown in Table 5-3. Once convened, the KDOT risk management team will refine the definitions of likelihood below to suit the KDOT context, and establish consequence levels based on the refined list of categories.

Table 5-2 Risk Likelihood Levels

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Qualitative Description</th>
<th>Probability of Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost Certain (5)</td>
<td>Expected to occur in most circumstances</td>
<td>At least one every year</td>
</tr>
<tr>
<td>Probable (4)</td>
<td>Will probably occur in most circumstances</td>
<td>Approximately one every year</td>
</tr>
<tr>
<td>Possible (3)</td>
<td>Might occur at some time</td>
<td>One every three years</td>
</tr>
<tr>
<td>Rare (2)</td>
<td>Could occur at some time</td>
<td>One every 5-10 years</td>
</tr>
<tr>
<td>Exceptionally Rare (1)</td>
<td>May occur only in exceptional circumstances</td>
<td>More than 10 years</td>
</tr>
</tbody>
</table>

Table 5-3 Examples of Risk Consequence Levels

<table>
<thead>
<tr>
<th>Consequence</th>
<th>Safety</th>
<th>Reputational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe (5)</td>
<td>Several deaths and/or numerous severe injuries</td>
<td>Public investigation; international coverage; may result in management changes</td>
</tr>
<tr>
<td>Major (4)</td>
<td>Low number of deaths and/or severe injuries</td>
<td>Loss of confidence; national publicity; public agitation for action</td>
</tr>
<tr>
<td>Moderate (3)</td>
<td>Minor injury and possible serious injury</td>
<td>Public community discussion; broad negative media coverage</td>
</tr>
<tr>
<td>Minor (2)</td>
<td>Possible minor injury</td>
<td>Minor community interest; local media coverage</td>
</tr>
<tr>
<td>Insignificant (1)</td>
<td>No injury</td>
<td>No community concern; individual interest only</td>
</tr>
</tbody>
</table>

5.2.4 STEP 4: RISK EVALUATION

Risk levels are represented in the form of a risk rating matrix that combines likelihood and consequence as shown in Table 5-4. The risk management team will define risk levels based on this comparison of likelihood and consequence and use the levels to prioritize the risks based on the criteria defined in the risk management framework to identify potential risk response options. Risk levels and response options
will be in alignment with the risk management policy and the defined risk appetite/tolerance that informed the risk management framework.

Table 5-4 Example Risk Rating Matrix

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Insignificant</td>
</tr>
<tr>
<td>Almost Certain</td>
<td>L</td>
</tr>
<tr>
<td>Probable</td>
<td>L</td>
</tr>
<tr>
<td>Possible</td>
<td>L</td>
</tr>
<tr>
<td>Rare</td>
<td>L</td>
</tr>
<tr>
<td>Exceptionally Rare</td>
<td>L</td>
</tr>
</tbody>
</table>

L: Low (acceptable) risk; M: Moderate risk; H: High (unacceptable) risk

5.2.5 STEP 5: MANAGING RISKS

There are several response options to manage risks (see Figure 5-4). For each risk, the calculated level and the selected response option will inform the mitigation strategy (defined and approved by the Executive Committee). Based on the resulting levels, the KDOT risk management team will select response options for each risk and develop risk response plans, including mitigation (treatment) plans for those that fall to the top of the priority list.

Treatment of risks can result in residual risk, that is, the secondary risks introduced after an initial risk is treated. Residual risks will be monitored and managed following the same process.

Ultimately, a refined risk register will be used to summarize KDOT’s risks, the analysis process, and the response option. Risk registers will also identify risk owners accountable for monitoring and managing the risks they are assigned. The risk register will be updated on...
a quarterly basis with the convening of the risk management team to ensure continuous management of risks. It will be important to track the progress of risk responses to learn lessons to apply to other potential risks, identify newly emerging risks and generally ensure that risks related to the asset management process are appropriately managed.

**5.2.6 STEP 6: COMMUNICATION AND CONSULTATION**

In the risk management process, communication with internal and external stakeholders should be consistent throughout all stages. KDOT will document the risk management framework, process, and risk register in a risk management plan for asset management. After each quarterly update of the risk register, it will be distributed to internal and external stakeholders as needed to ensure consistent communication and opportunities for dialogue.

A dashboard on the KDOT website (either internal only or public) is being considered to communicate risk, which would contain information such as new risks for the period, risks mitigated during the period, highest risks, etc.

**5.2.7 STEP 7: MONITORING AND REVIEW**

On a biennial basis, the risk management team will review the framework and process to ensure that KDOT’s risk management is effective. In addition, the team will measure how risks are being addressed and the effectiveness of outcomes against a set of risk performance indicators to be defined.

**5.3 INTEGRATION WITH OTHER RISK-RELATED PROGRAMS**

It will be important to integrate these improvements to KDOT’s risk management process with other existing programs that inherently consider risk management principles. Table 5-5 lists these programs.

**Table 5-5 Other Risk-Related Programs**

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge Inspection Program</td>
<td>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.</td>
</tr>
<tr>
<td>Program</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Highway Safety Improvement Program</td>
<td>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.</td>
</tr>
<tr>
<td>Kansas Response Plan</td>
<td>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.</td>
</tr>
</tbody>
</table>

5.4 23 CFR PART 667 ANALYSIS

Federal asset management rules include a requirement to conduct “statewide evaluations to determine if there are reasonable alternatives to roads, highways, and bridges that have required repair and reconstruction activities on two or more occasions due to emergency events.” 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:

1. Reduce the need for federal funds to be expended on emergency repair and reconstruction activities;
2. Better protect public safety and health and the human and natural environment; and
3. Meet transportation needs as described in the relevant and

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5 23 CFR Part 667
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 will follow the process documented in Figure 5-5 which will be carried out by the central office, following a similar exercise that occurred after the fatal 2003 flash flooding incident at Jacob’s Creek on the Kansas Turnpike.

**SUMMARY – RISK MANAGEMENT**

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>IMPROVEMENT PLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Management Analysis (23 CFR 515.7(c))</td>
<td>Planned Action(s):</td>
</tr>
<tr>
<td></td>
<td>• Revisit the preliminary risk events to confirm, revise, or identify additional potential events.</td>
</tr>
<tr>
<td></td>
<td>• Reevaluate the likelihood and consequence elements for each risk event.</td>
</tr>
<tr>
<td></td>
<td>• Analyze and evaluate risk events.</td>
</tr>
<tr>
<td></td>
<td>• Develop mitigation strategies for groups of risk events.</td>
</tr>
<tr>
<td></td>
<td>• Assign risks to owners and develop monitoring procedures.</td>
</tr>
<tr>
<td></td>
<td>• Complete 23 CFR 667 evaluation.</td>
</tr>
</tbody>
</table>

**Timeline:** June 2019

**Owner(s):** Risk Workgroup, Key External Stakeholders

• Does not include a mitigation plan for addressing the top-priority risks that involve potentially negative consequences

• Does not include an approach for monitoring top priority risks

• Does not include a summary of the results of the 23 CFR Part 667 evaluations of facilities in the State repeatedly damaged by emergency events, including at a minimum the results relating to NHS pavements and bridges
6 FINANCIAL PLANNING

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

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

6.1 FUNDING SOURCES

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

1. Federal Highway Trust Fund
2. State sources:
   a. Motor fuel taxes
   b. Motor vehicle registration fees
   c. Sales and compensating use tax
   d. Other miscellaneous revenues

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

6.1.1 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.

### 6.1.2 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 constitutes most of the SHF and is generated through the following sources:

**MOTOR FUEL TAXES:** Motor fuel tax has been one of the most reliable sources of revenue for highway funding. Funds from motor fuel taxes benefit SHS, City, and County projects. Current rates include 24 cents a gallon for gasoline and other fuels (e.g., gasohol) and 26 cents a gallon for diesel. Proceeds from this source are distributed between the SHF and Special City and County Highway Funds. The SHF receives about two-thirds (66.37 percent) of the revenue generated through this tax while the Special City and County Highway Fund receives approximately one-third (33.63 percent). 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 percent of state tax proceeds to be deposited into the SHF in FY 2016. The current sales and compensating use tax rate is 6.5 percent. Since this source is not protected for NHS or SHS use by state legislation, portions have recently been transferred out for other statewide uses. This funding source is not dedicated to transportation uses, and therefore may be redirected at the discretion of the Kansas Legislature.

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

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6 KDOT, Research and Revenue Analysis Historical Tax Rates from 1925 to Present.
6.1.3 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 are under the jurisdiction of local entities and counties. KDOT has limited management authority over the use of this fund.

6.1.4 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 revenue from this source was approximately $119 million in FY 2017 – a decrease of about 3 percent below FY 2016 revenue. KDOT does not have administrative authority over this fund; however, statutory mandates allow KDOT and KTA to partner in several activities to improve efficiency in the use of resources that impact the overall performance of the NHS. An example of this is the reconstruction of the US-54/Kellogg KTA interchange, which is a joint effort between KDOT, KTA, and the city of Wichita.

6.1.5 HISTORICAL FUNDING BY SOURCE

Figure 6-1 shows the funding available for NHS/SHS investments from all categories of SHF sources for FY2017 and KTA. Total FY2017 funding, from all sources, was approximately $1.7 billion, before transfers and including bond proceeds. This was a decrease of 14 percent from the previous year’s revenue. As shown, the state sales and compensating tax and federal funding provide the highest contributions to available funding for highway asset investments.

Table 6-1 shows the historical funding by sources of the SHF and non-KDOT funds available for NHS investments (excluding KTA). In general, revenues from the state motor fuel tax and registration fees have remained constant over the years.

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7 KTA FY 2017 Annual Report
Revenues from other sources have seen significant fluctuations such as the sales and compensating use tax, which saw a jump in revenues between 2013 and 2014.

**Table 6-1 Actual Total State Highway Funds Cashflow (FY 2011 to FY 2017)**

<table>
<thead>
<tr>
<th>Fund Types and Sources</th>
<th>Actual Total Funds (Millions $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Funds</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>614</td>
</tr>
<tr>
<td>2016</td>
<td>548</td>
</tr>
<tr>
<td>2017</td>
<td>287</td>
</tr>
<tr>
<td>Total State Funds</td>
<td>1,162</td>
</tr>
<tr>
<td>Motor Fuel Taxes</td>
<td>231</td>
</tr>
<tr>
<td>2015</td>
<td>231</td>
</tr>
<tr>
<td>2016</td>
<td>231</td>
</tr>
<tr>
<td>2017</td>
<td>231</td>
</tr>
<tr>
<td>Vehicle Registration Fees</td>
<td>167</td>
</tr>
<tr>
<td>Sales and Compensating Use Tax*</td>
<td>295</td>
</tr>
<tr>
<td>Other**</td>
<td>95</td>
</tr>
<tr>
<td>Transfers Out</td>
<td>(297)</td>
</tr>
<tr>
<td>Local Funds*</td>
<td>50</td>
</tr>
</tbody>
</table>

KTA historical available funding is comparable to Table 6-1 only for FY 2015 to 2017 because the authority operated on a different fiscal year prior to 2015. KTA’s revenues for the three comparable years are shown in Table 6-2.

Federal funds are invested towards improvements in both NHS and non-NHS roadways. Figure 6-2 shows the proportions of annual federal funding distributed between NHS and non-NHS projects.
6.2 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 below:

**Preservation:** Preservation of assets is the underlying principle of KDOT’s investment decision making. It is the principal focus of asset management and the primary priority of T-WORKS and the Long-Range Transportation Plan. Preservation activities have direct impacts on the short- and long-term performance of the SHS and support the efficient use of limited resources.

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

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

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

**Operations (fixed costs or overhead):** This program includes funding regular maintenance (e.g., snow removal), servicing KDOT’s debts, and inter-agency 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 6-3 shows the average distribution over the last seven years with 41% of funding going towards expansion projects and 37% going towards preservation projects. Figure 6-4 provides a view of this distribution by fiscal year,
showing that the proportion of funding towards preservation projects has consistently increased while the proportion of expansion project investments have continuously decreased. Note that much of the expansion expenditure in 2011 and 2012 includes funding from the American Recovery and Reinvestment Act (ARRA) federal grant, while expansion expenditure in 2016 and beyond includes KDOT’s Gateway project, the first major design-build project.

Figure 6-3 Average Historical Funding Distribution in KDOT Core Programs (2011-2017)

Figure 6-4 Historical Funding Distribution in KDOT Core Programs by Fiscal Year
6.3 ESTIMATED COST AND FUNDING LEVELS

6.3.1 PROJECTED FUNDING NEEDS

This section presents the projected annual cost of work needed to preserve or improve performance of the NHS and other SHS. KDOT estimates the cost associated with making progress towards the achievement of performance targets for the SHS (which includes the NHS) as well as meeting federal minimum condition requirements for NHS bridges and Interstate-NHS pavements. Cost is estimated through a needs assessment process. The needs assessment process involves the use of analytical tools, engineering judgment, and inputs from key stakeholders. KDOT estimated an expenditure of $77 million was needed in FY 2017 to maintain the state bridge system at the minimum acceptable condition level. KDOT’s actual expenditure on bridges in FY 2017 was approximately $100 million.

Similar estimated costs needed to maintain the minimum acceptable conditions for pavements included $83 million for interstate highways and $242 million for non-interstate highways. However, the Department actual expenditure in FY 2017 was $137 and $332 million for interstate highways and non-interstate highways, respectively. These estimates and actual expenditures show the level of uncertainty in dealing with future projections to maintain assets.

In early 2018, a Senate Bill 285 was introduced (replaced by House Bill 391) proposing the establishment of a joint legislative transportation vision task force to evaluate and report on the SHF and the state highway transportation system. If this bill is enacted, the work of the transportation task force will provide additional information to the needs assessment and funding estimation process.

In the Final TAMP, KDOT will identify the work types and associated cost for each fiscal year needed to implement investment strategies to achieve its goals and to manage performance expectation. The analysis will be done to cover a 10-year period. The estimated cost will include a variety of program categories with preservation as a priority. KDOT will draw upon information generated through the life cycle planning scenarios to address the costs of implementing the investment strategies by work type.

6.3.2 ESTIMATED FUNDING AND SOURCES

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

Over its 10-year period (2010 to 2020), the T-WORKS program is expected to allocate about $17 billion to transportation programs (including rail, aviation, and transit), which will benefit state and local highways across Kansas. Specifically, funding for highway preservation is expected to reach approximately $3.1 billion over the 10-year period. Also, T-WORKS promised a minimum of $8 million to be invested in each county.

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across Kansas. Since its enactment, T-WORKS has seen many Legislative mandates amending different aspects of the program. Similar amendments also raised the sales and compensating use tax rate from 6.15 percent to 6.5 percent in 2015, although the portion dedicated to the SHF remained the same.

Table 6-3 shows the projected revenue from each of KDOT’s funding sources and KTA. The table shows that about $10 billion in funding would be available for investment for the duration of the TAMP, representing an average annual revenue of $1 billion assuming no new legislation is passed during this period. KDOT funding cashflows project funding at all levels through 2021 but can only project state funding beyond that date. The projections shown in the table assume constant funding at the historical average level for federal and local funding. These projections also assume that transfers out of the SHF will continue at about $500 million for years 2022 to 2027.

Table 6-3 Projected Funding Available (by Fiscal Year)

<table>
<thead>
<tr>
<th>Funding Type</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal</td>
<td>347</td>
<td>406</td>
<td>405</td>
<td>390</td>
<td>418</td>
<td>418</td>
<td>418</td>
<td>418</td>
<td>418</td>
<td>418</td>
<td>4,055</td>
</tr>
<tr>
<td>State</td>
<td>767</td>
<td>719</td>
<td>510</td>
<td>510</td>
<td>594</td>
<td>605</td>
<td>615</td>
<td>626</td>
<td>638</td>
<td>649</td>
<td>6,233</td>
</tr>
<tr>
<td>Local</td>
<td>19</td>
<td>26</td>
<td>19</td>
<td>19</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>252</td>
</tr>
<tr>
<td>TOTAL SHF</td>
<td>1,133</td>
<td>1,151</td>
<td>934</td>
<td>919</td>
<td>1,040</td>
<td>1,051</td>
<td>1,061</td>
<td>1,072</td>
<td>1,084</td>
<td>1,095</td>
<td>10,540</td>
</tr>
<tr>
<td>KTA*</td>
<td>125</td>
<td>132</td>
<td>140</td>
<td>148</td>
<td>156</td>
<td>165</td>
<td>174</td>
<td>184</td>
<td>194</td>
<td>205</td>
<td>125</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,258</td>
<td>1,283</td>
<td>1,074</td>
<td>1,067</td>
<td>1,196</td>
<td>1,216</td>
<td>1,235</td>
<td>1,256</td>
<td>1,278</td>
<td>1,300</td>
<td>10,665</td>
</tr>
</tbody>
</table>

*Based on average increase in revenue (6%) over the last three years

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

As previously mentioned, SB 285/HB 391 is one source of uncertainty KDOT must address when projecting future funds that will be available for investments. If passed, this bill can influence the way transportation infrastructure is funded in KDOT. The transportation task force is expected to evaluate current transportation funding in Kansas to determine whether it is sufficient to not only maintain the transportation system in its current state, but also to ensure that it serves the future transportation needs of Kansas residents. The recommendations from the joint task force may have significant impact on the level of funding KDOT receives in the next decade, considering the T-WORKS program is almost in its final years.

In estimating future funding levels, KDOT will also consider uncertainties surrounding federal authorizations. Though beyond the purview of state legislation, KDOT will continue to address these uncertainties and associated risks in a progressive manner. To this end, the LCP scenarios discussed in Section 4.1.4 will include consideration of different funding scenarios for transportation investments and
the associated performance. In particular, the desired state of good repair scenario will explore the expected performance with: (i) current funding levels; (ii) reduced funding; (iii) additional funding. The funding gap analysis will determine what level of funding is required to maintain KDOT assets above the minimum desired performance level. This analysis will also determine the investment levels needed to maintain the value of KDOT’s roadway assets.

6.4 ASSET VALUATION

KDOT values assets on the SHS (which includes a larger portion of the NHS, but excludes NHS assets owned by KTA and other stakeholders of the NHS) using the “modified approach,” which is recognized by Generally Accepted Accounting Principles (GAAP) in Government Accounting Standards Board (GASB) Statement 34. The modified approach, which is an alternative to the historic cost approach, measures the “fair value” of infrastructure assets based on existing conditions. The historic cost approach applies depreciation to the original cost over the life of the asset, which could render the value of the asset to reach zero in the future.

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

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

The initial capitalization for assets is done using current replacement cost and applying a price-level index to deflate the cost to the estimated construction year. Any additional inventory added through new construction is capitalized and reported at historical cost. As of June 30, 2017, the beginning balance of infrastructure value was approximately $11.3 billion, while the net increase was estimated as $3 million. KDOT estimates the current SHS asset value to be approximately $11.6 billion⁹ (made up of roadways value of $9.2 billion and bridges value of $2.4 billion).

In the Final TAMP, KDOT will estimate the annual investments by work types needed to maintain the value of SHS assets for the duration of the TAMP. This process will draw on output from the life cycle planning, risk management, and investment strategy determination processes, as well as work types that have already been programmed in the system.

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SUMMARY – FINANCIAL PLANNING

**PROCESS**

Financial Plan Development (23 CFR 515.7(d))

**GAP**

- Does not include 10-year estimated cost to implement investment strategies by State fiscal year and work type
- Summary asset valuation does not separate NHS assets from non-NHS assets
- Does not include investment needed on an annual basis to maintain value of pavement and bridge assets

**IMPROVEMENT PLAN**

**Planned Action(s):**

- Estimate 10-year cost, by State fiscal year and work type, to implement the investment strategies drawing upon information from life cycle planning
- Conduct three financial scenarios to estimate funding levels (federal and state sources) that are expected to be available for duration of TAMP
- Estimate asset value for NHS and non-NHS pavement and bridge assets
- Develop annual investments needed to maintain value of assets, drawing upon information from scenarios in life cycle planning and investment strategies process

**Timeline:** June 2019

**Owner(s):** Pavement, Bridge, and Finance Working Group
7 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 KDOT’s targets for asset condition and system performance at a minimum practicable cost.

7.1 PERFORMANCE GAP ANALYSIS

State DOTs are required to establish a process for conducting a gap analysis, evaluating any gaps between current and target condition and suggesting strategies to close the gaps.

KDOT has established condition targets for the pavement and bridge programs that help facilitate the performance gap analysis process.

For pavements, condition data, deterioration models, action options with costs and change in deterioration, and either a budget or targets are provided into the NOS system for analysis. The system can generate pavement performance based on available budget, or a minimum budget based on target performance. It also recommends the actions to apply, where, and when. The gap analysis will be driven by the LCP scenarios described in Sections 4.1.4 and 6.3.2, and while results will be reported using the federal performance measures, internal resources will be managed using KDOT performance measures, which consider additional asset characteristics.

For bridges, estimated needs will be based on condition and deterioration models. Since KDOT’s performance goals are more stringent than the federal condition requirements, there are no performance gaps, primarily a result of strong historical funding. However, gaps may appear in future years due to potential funding risks.

"... 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)
7.2 IDENTIFYING AND SELECTING INVESTMENT STRATEGIES

For KDOT, preservation of the highway system is a top priority. Investments are developed and identified following a “top-down” approach, which emphasizes the use of management systems to assess the effect of different investment scenarios on system performance. This method ensures that short- and long-term allocation decisions are based on the results of performance gap analyses, life-cycle planning, risk management, and projections of anticipated funding and estimated cost of future work. Figure 7-1 below summarizes how each process, described in previous chapters, informs investment prioritization.

**Figure 7-1 Using Asset Management Processes to Inform Investment Prioritization**

Since performance gaps do not currently exist, KDOT’s investment strategies are based on maintaining asset condition at a steady-state, and managing and/or mitigating asset performance decline. For pavements, candidate projects are identified using the PMS/NOS, while for bridges, candidate investments are currently identified based on measured condition and engineering judgment. With the expected upgrade of the BMS (AASHTOWare BrM 5.3), bridge investment project identification will eventually be based on deterioration models and the built-in, life-cycle planning capabilities.
7.2.1 PAVEMENT INVESTMENT STRATEGIES

KDOT’s pavement investment strategy is a three-tiered approach that provides an emphasis on locations on the state highway system that need immediate investment, while meeting system performance goals (optimization) and allowing routine maintenance as a final line of defense.

The first tier employs an objective data-driven application called the Priority Formula (see Figure 7-2), which drives the prioritization of preservation work. The formula combines attributes with weighting factors and adjustment factors to determine a needs-based score for each section of pavement. Attributes include data about the network section, such as road geometry, crash rate, and pavement condition; weights are the relative importance of each attribute; and adjustment factors amplify or diminish the attribute. For example, narrow shoulders become more critical on routes with high posted speeds. The score is the accumulated need for all the attributes. The higher the score, the more likely a section will receive a major rehabilitation or reconstruction.

Figure 7-2 Pavement Priority Formula
For the second tier, the NOS uses pavement condition, investment history, available funding, target performance, and scheduled investments to identify candidate project mileage for each district and candidate project locations for a three-year period. At the district level, logical projects are developed from the sections identified by the NOS/PMS and then reviewed by senior leadership before being considered as final investments.

The third tier of pavement investment at KDOT involves identifying routine maintenance at highway locations that are not identified through the first or second tier processes.

### 7.2.2 BRIDGE INVESTMENT STRATEGIES

Bridge investment decisions also begin with the assessment of asset condition. Figure 7-3 shows typical investment actions for each condition rating level. These actions can be grouped in two main categories of investment strategies: maintenance repair and replacement. Strategies are selected on a case-by-case basis by combining an understanding of the bridge component condition with engineering judgement. Replacement candidate projects, when identified, are subject to prioritization based on safety concerns, traffic considerations, and District input, in addition to asset condition.

Once the upgrade to the BMS is complete, KDOT will be equipped to incorporate lifecycle planning strategies and funding scenarios into the bridge investment strategy selection process.

**Figure 7-3 Bridge Investment Strategies**

<table>
<thead>
<tr>
<th>RATING</th>
<th>TYPICAL ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>No Action Needed.</td>
</tr>
<tr>
<td></td>
<td>Polymer Overlay to seal the Deck</td>
</tr>
<tr>
<td></td>
<td>Paint (no section loss in the steel members)</td>
</tr>
<tr>
<td></td>
<td>Expansion Joint Repairs</td>
</tr>
<tr>
<td>Fair</td>
<td>Replacement of Concrete Overlay</td>
</tr>
<tr>
<td></td>
<td>Paint (some section loss in the steel members)</td>
</tr>
<tr>
<td></td>
<td>Expansion Joint Repairs</td>
</tr>
<tr>
<td></td>
<td>Major Patching Replacement of Concrete Overlay</td>
</tr>
<tr>
<td></td>
<td>Possible Re-deck candidate</td>
</tr>
<tr>
<td></td>
<td>May be load posted for legal load trucks</td>
</tr>
<tr>
<td>Deteriorated</td>
<td>Replacement Candidate</td>
</tr>
<tr>
<td></td>
<td>Re-deck Candidate</td>
</tr>
<tr>
<td></td>
<td>(Programmed for replacement – on watch list)</td>
</tr>
<tr>
<td></td>
<td>Replacement Candidate</td>
</tr>
<tr>
<td></td>
<td>May be load posted less than legal loads trucks</td>
</tr>
</tbody>
</table>

### 7.2.3 CROSS-ASSET INVESTMENT PRIORITIZATION

While KDOT does not conduct a formal systematic cross-asset resource allocation process, tradeoff analyses are performed if needed. Once fully developed, the risk management process, specifically risks related to bridge and pavement condition, will be integrated into the investment strategy selection process.
SUMMARY - INVESTMENT STRATEGIES

**PROCESS**

**Performance Gap Analysis (23 CFR 515.7(a))**

**GAP**

- Pavement gap analysis is not based on federal measures
- Does not include alternative strategies to address identified gaps; this may change once federal measures are implemented

**IMPROVEMENT PLAN**

Planned Action(s):
- Affirm performance targets for pavements and bridges with external stakeholders
- Perform gap analysis for NHS assets using federal measures for funding scenarios (see Investment Strategies chapter)
- Develop alternative strategies to address gaps (if any) and minimize cost
- Identify deficiencies that may hinder KDOT’s progress toward achieving SOGR
- Include results in Investment Strategies chapter

**Timeline:** June 2019

**Owner(s):** Pavement and Bridge Working Group, Key External Stakeholders

**PROCESS**

**Investment Strategies (23 CFR 515.7(e) and 515.9(f))**

**GAP**

- Does not include a methodology for bridge investment strategies that collectively make or support progress toward achieving KDOT targets for asset condition and performance of the NHS in accordance with 23 U.S.C. 150(d); and achieving the national goals identified in 23 U.S.C. 150(b)
- Does not address how anticipated available funding and estimated cost of future work types, LCP, or performance gap analysis processes are associated with bridge investment strategies
- Does not address how the results of risk management influence the investment strategies

**IMPROVEMENT PLAN**

Planned Action(s):
- Use financial projections to develop financially-constrained bridge investment strategies to make progress toward achievement of performance targets
- Describe how results from LCP and gap analysis processes influence selection of bridge investment strategies
- Describe how results from risk analysis influence selection of bridge and pavement investment strategies

**Timeline:** June 2019

**Owner(s):** Pavement and Bridge Working Group, Key External Stakeholders
## 8 OPPORTUNITIES FOR IMPROVEMENT

Based on the current state of KDOT’s asset management practice and the gaps identified in relation to the federal regulations, the following opportunities for improvement have been identified to bring KDOT into compliance by the completion of the Phase II Final TAMP:

<table>
<thead>
<tr>
<th>Process</th>
<th>Identified Gap in Required Elements</th>
<th>Improvement Plan (Actions, Timeline, and Owner)</th>
</tr>
</thead>
</table>
| Use of best available data and bridge and pavement management systems to develop TAMP (23 CFR 515.7(g)) | • Bridge management system does not fully comply with the requirements of 23 CFR 515.17.            | Planned Action(s):  
  • Upgrade the bridge management system to include deterioration modeling and performance analysis.  
  • Assess asset performance using federal required metrics; i.e., convert KDOT measures into PM2 (23 CFR 490 Subpart B & C) measures.  
  
  Timeline:  
  June 2019  
  Owner(s):  
  Pavement and Bridge Working Group, Key External Stakeholders |
| Lifecycle Planning Analysis (23 CFR 515.7(b))                          | • Does not model deterioration for NHS/SHS bridges.  
  • Does not include management strategies to minimize the lifecycle costs while achieving the 23 U.S.C. 150(d) performance targets for asset condition. | Planned Action(s):  
  • Upgrade Bridge Management System (BrM) to incorporate lifecycle cost analysis.  
  • Conduct LCP scenarios and identify investment strategies that support the achievement of national condition goals, and performance targets while focusing on preservation, risk management, and minimizing lifecycle cost.  
  
  Timeline:  
  June 2019  
  Owner(s):  
  Pavement, Bridge, and Finance Working Group |
| Risk Management Analysis (23 CFR 515.7(c))                              | • Does not include a mitigation plan for addressing the top-priority risks that involve potentially negative consequences. | Planned Action(s):  
  • Revisit the preliminary risk events to confirm, revise, or identify additional potential events. |
<table>
<thead>
<tr>
<th>Process</th>
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<th>Improvement Plan (Actions, Timeline, and Owner)</th>
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<tbody>
<tr>
<td></td>
<td>• Does not include an approach for monitoring top priority risks.</td>
<td>• Reevaluate the likelihood and consequence elements for each risk event.</td>
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<td></td>
<td>• Does not include a summary of the results of the 23 CFR Part 667 evaluations of facilities in the state repeatedly damaged by emergency events, including at a minimum the results relating to NHS pavements and bridges.</td>
<td>• Analyze and evaluate risk events.</td>
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<td>• Reevaluate the likelihood and consequence elements for each risk event.</td>
<td>• Develop mitigation strategies for groups of risk events.</td>
</tr>
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<td>• Analyze and evaluate risk events.</td>
<td>• Assign risks to owners and develop monitoring procedures.</td>
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<td>• Develop mitigation strategies for groups of risk events.</td>
<td>• Complete 23 CFR 667 evaluation.</td>
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<td>• Assign risks to owners and develop monitoring procedures.</td>
<td><strong>Timeline:</strong> June 2019</td>
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<td></td>
<td>• Complete 23 CFR 667 evaluation.</td>
<td><strong>Owner(s):</strong> Risk Workgroup, Key External Stakeholders</td>
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<td><strong>Planned Action(s):</strong></td>
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<td></td>
<td>• Estimate the ten-year cost, by state fiscal year and work type, to implement the investment strategies drawing on information from the life cycle planning.</td>
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<td></td>
<td>• Conduct three financial scenarios to estimate funding levels (federal and state sources) that are expected to be available for the duration of the TAMP.</td>
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<tr>
<td></td>
<td>• Estimate asset value for NHS and non-NHS pavement and bridge assets.</td>
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<td></td>
<td>• Develop annual investments needed to maintain the value of assets, drawing on information from the scenarios in the life cycle plan and investment strategies process.</td>
<td><strong>Timeline:</strong> June 2019</td>
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<td><strong>Owner(s):</strong> Pavement, Bridge, and Finance Working Group</td>
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<tr>
<td>Financial Plan Development (23 CFR 515.7(d))</td>
<td>• Does not include a ten-year estimated cost to implement the investment strategies by state fiscal year and work type.</td>
<td><strong>Planned Action(s):</strong></td>
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<td></td>
<td>• The summary asset valuation in the Initial TAMP does not separate NHS assets from non-NHS assets.</td>
<td>• Affirm performance targets for pavements and bridges in collaboration with external stakeholders.</td>
</tr>
<tr>
<td></td>
<td>• Does not include the investment needed on an annual basis to maintain the value of pavement and bridge assets.</td>
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|         | implements the federal measures.   | • Perform gap analysis for NHS assets using federal measures for the three funding scenarios documented in the Investment Strategies chapter.  
• Develop alternative strategies to address gaps (if any) and minimize cost.  
• Identify deficiencies that may hinder KDOT’s progress toward achieving state of good repair.  
• Include the results in the Investment Strategies Chapter.  |
|         |                                    | **Timeline:**  
June 2019  
**Owner(s):**  
Pavement and Bridge Working Group, Key External Stakeholders |
| **Investment Strategies (23 CFR 515.7(e) and 515.9(f))** | • Does not include a methodology for bridge investment strategies that collectively make or support progress toward achieving KDOT targets for asset condition and performance of the NHS in accordance with 23 U.S.C. 150(d); and achieving the national goals identified in 23 U.S.C. 150(b)  
• Does not address how anticipated available funding and estimated cost of future work types, LCP, or performance gap analysis processes are associated with bridge investment strategies  
• Does not address how the results of risk management influence the investment strategies | **Planned Action(s):**  
• Use financial projections to develop financially-constrained bridge investment strategies to make progress toward achievement of performance targets  
• Describe how results from LCP and gap analysis processes influence selection of bridge investment strategies  
• Describe how results from risk analysis influence selection of bridge and pavement investment strategies  |
|         |                                    | **Timeline:**  
June 2019  
**Owner(s):**  
Pavement and Bridge Working Group, Key External Stakeholders |