

# **Transportation Asset Management Plans**

## **Case Study 5 - Financial Planning and Investment Strategies**

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## **Case Study on Financial Planning and Investment Strategies**

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### Case Study Introduction

This case study is one of seven that captures good asset management practices documented in the 2019 transportation asset management plans (TAMPs) required by 23 U.S.C. 119(e). This series distills many of the good practices and presents them in a convenient format for use by other transportation agencies.

The seven case studies are:

#### **Case Study 1: Asset Management Practices and Benefits**

Many of the TAMPs provided comprehensive summaries of their asset management practices and the benefits they received from them. Several examples are highlighted in this case study. These include examples from the DOTs in New Jersey, Pennsylvania, Illinois, and Washington State. These examples illustrate how asset management plans can effectively summarize asset management processes and improvement strategies.

#### **Case Study 2: Linking Asset Management to Planning and Programming**

This case study examines how TAMPs documented linkages to the DOT's long-range plan, the State Transportation Improvement Program (STIP), and state planning and programming practices. Examples are selected from the TAMPs in Missouri, Maine, Utah, Ohio, Wyoming, and Montana.

#### **Case Study 3: Supporting Life-Cycle Planning**

To develop a life cycle plan, one needs to know how assets deteriorate throughout their life cycle. Several TAMPs were notable in documenting how they manage assets with life cycle plans. Included in this case study are examples from the DOTs in Minnesota, Ohio, Tennessee, and New Jersey.

#### **Case Study 4: Managing Risks to Assets**

DOTs embrace risk management to support the long-term performance of assets, and for making risk-based investment tradeoffs. This case study summarizes some of the good risk management practices from Washington State, California, Kansas, South Dakota, Louisiana, Rhode Island, Pennsylvania, Texas, Colorado, and Michigan.

#### **Case Study 5: Developing Financial Plans and Investment Strategies**

The financial plans and investment strategies reflect priorities for allocating scarce resources to achieve their highest asset management objectives. This case study examines how several TAMPs described the clear linkages between their asset management objectives, gaps, risks, and investment strategies. Examples are from Kentucky, Michigan, Washington State, New York State, Utah, Vermont, and Illinois.

#### **Case Study 6: Communicating Asset Management Strategies**

This case study summarizes examples of communicating asset management strategies with key internal and external stakeholders. Examples are cited from the DOTs in Vermont, California, New Jersey, Washington State, Michigan, Ohio, Colorado, and Nebraska.

#### **Case Study 7: Managing Non-Bridge-and-Pavement Assets**

Several State TAMPs included additional assets beyond pavements and bridges. Examples are cited from Minnesota, Connecticut, Utah, and California.

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# Financial Plans and Investment Strategies from the TAMPs

Developing and implementing a 10-year transportation asset management plan that extends the useful life of assets is a challenging task. It entails conducting extensive analyses to develop effective investment strategies and a practical financial plan.

Investment strategies communicate an agency's strategic approach to cost effectively maintain or preserve the assets over the short and long term and to extend their useful lives. A financial plan informs decision makers of funding needed to carry out the investment strategies. It also shows an agency's plan to invest strategically versus adopting a "worst first" approach.

At a summary level the financial planning and investment strategies show:

- How a State's financial plan supports asset management and achieving the DOT's targets for condition and performance and state of good repair (SOGR) goals.
- How a State's investment strategies align with its financial plan.
- How the work types are reflected in the investment strategies.
- How the strategies address high priority asset risks.
- How the investment strategies align with life-cycle planning.

This case study includes examples highlighting practices on financial planning and investment strategies from the TAMPs prepared by Kentucky Transportation Cabinet, Michigan DOT, Washington State DOT, New York State DOT, Utah DOT, Vermont Agency of Transportation, and Illinois DOT.

## Kentucky Transportation Cabinet's Approach

The Kentucky Transportation Cabinet (KYTC) TAMP showed a methodical process that it followed in developing its financial plan. The KYTC's TAMP section on financial planning and investment strategies included the following:

- The projected available revenue for managing the physical condition of the assets included in the TAMP.
- The level of funding needed to meet the bridge and pavement condition targets, to preserve and sustain improved asset conditions, and to maintain these assets in a state of good repair.
- The investment strategies that the KYTC plans to implement, to construct, maintain, preserve, rehabilitate, or replace pavement and bridge assets.
- The asset condition and system performance expected based on the investment strategies selected and reflected in the TAMP.
- The additional resources required to address current or forecasted differences between desired and expected conditions.

The KYTC has a Consensus Forecasting Group (CFG) that "develops annual road fund projections before each upcoming biennial budget legislative session. The CFG reviews revenue sources and analyzes any trends."<sup>1</sup> The group reviews fuel consumption, vehicle registrations and trends in other revenue sources to develop realistic projections for revenue growth for the next two to three years. A similar approach is

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used to project Federal revenues. The CFG continues to monitor actual receipts and compare them to the projections to track shortfalls and surpluses.

### Acknowledgment of Financial Risks

The KYTC in its TAMP addressed the financial risks to achieving the TAMP objectives. It addressed the financial risks due to several factors including “the uncertainty in federal and (to a lesser extent) state road fund revenue, which is compounded by funding uncertainties for major projects, such as the Brent Spence Bridge replacement, that require significant funding beyond traditional revenue streams.” The TAMP acknowledged the need for stakeholder support for asset management activities. It stated that there is a risk of “the possibility that the public and other external stakeholders will not understand and support the Cabinet’s increased focus on preserving existing assets.”<sup>2</sup> The KYTC TAMP was transparent about potential fluctuations in revenue receipts. It included strategies that may be employed in the event of revenue shortfalls.

### Revenue Forecasting and Practical Approaches to Addressing Revenue Reductions and Allocations for TAM Activities

The KYTC TAMP acknowledged there is a likelihood for differences between the revenue projections and actual receipts, and showed an approach to addressing shortfalls. However, any minor revenue fluctuations were not expected to affect the major projects. The TAMP stated that in the fiscal year (FY) 2016 timeframe when revenue reductions had been projected, KYTC delayed some large rehabilitation and reconstruction projects, and instead used available funds for maintenance and preservation activities that addressed safety needs and prevented further deterioration.

The KYTC TAMP stated some of the practical implications of potential revenue shortfalls. It stated that in the event of major shortfalls alternate strategies and/or financial scenarios would be generated addressing the funding gap and presented to the Cabinet leaders. It also stated that because bridge and pavement assets are high value assets, they are among the last to be impacted by minor reductions. Also, in the event of a reduction in funding the “KYTC has given priority to preservation and maintenance of interstate and NHS pavements and bridges,”<sup>3</sup> reflecting the Cabinet’s commitment to asset management.

The KYTC TAMP also discussed other practical aspects to be considered in creating a realistic financial plan. For example, Federal funds come with some restrictions and can be used only for certain types of projects. The TAMP also discussed other financial obligations such as debt servicing and dedicated funds for programs such as the Surface Transportation Program (STP) and Congestion Mitigation and Air Quality Improvement (CMAQ). The KYTC TAMP showed the anticipated revenues along with State funds obligations for debt servicing, routine maintenance (snow and ice, mowing etc.), direct appropriations to other State agencies, and other obligations that have to be addressed in the financial planning process.

Based on the CFG’s projections, the TAMP showed approximately \$5.9 billion of Federal revenues and \$1.27 billion of State road fund revenues being available for the 10 years of the TAMP. The TAMP included detailed information on each of the revenue sources and the different deductions such as debt service, pension obligations, direct appropriations to other agencies, or funding for maintenance activities such as snow and ice control. The TAMP explained how substantial amounts of its revenues were required for such mandatory deductions and the deducted funds were not available to invest in the TAMP assets.

The 10-year TAMP financial plan showed that over the TAMP period, after the deductions for other required expenditures, a total of \$7.2 billion of combined Federal and State road funds were projected

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to be available for bridges, pavements, and other assets, such as pavement markings and culvert repair and maintenance.

### Financial Planning and Investment Strategies Are Aligned to Life-Cycle Planning

The TAMP stated that the pavement and bridge funding allocations were developed based on an analysis of anticipated revenue forecasts and estimates of funding needs for each asset class based on the life-cycle planning (LCP) processes.

The TAMP acknowledged that KYTC is in the early stages of implementing life-cycle strategies for bridges and pavements. It stated that the strategies applied significantly higher priorities to maintenance and preservation work types than the Cabinet had done historically. The TAMP stated that though the Cabinet has identified preferred LCP strategies, it will require time to fully implement its preferred LCP.

### Funding Allocations Address the Work Types

KYTC has categorized and prioritized its roadway network into Interstates, Parkways, and Maintenance Program (MP). The Maintenance Program system is comprised of non-Interstate and Parkway State primary pavement, State secondary pavement, and supplemental pavement. The Parkways category has about 25 percent of the non-Interstate NHS lane-miles while the MP has the remaining 75 percent of the non-Interstate NHS lane-miles. The Cabinet has internal measures to manage and sustain the bridge and pavement assets that it used to develop the investment strategies. The TAMP showed that based on the KYTC's internal measures, the pavements had approximately 32 percent of the Interstate in Poor condition, 32 percent in Fair and 35 percent in Good condition.<sup>4</sup> However, as shown in Table 1, based on FHWA measures the Interstate and non-Interstate NHS have 0 and less than 1 percent Poor respectively.<sup>5</sup> Based on the 2017 Highway Performance Monitoring System submission, KYTC had some pavement segments that were unreported. After including these, the percent Poor based on the FHWA measures for Interstates increased to 1.1 percent. Table 1 shows the existing conditions based on FHWA measures. Based on the FHWA measures, the planned investments indicate that over the 10-year TAMP period KYTC will continue to achieve and sustain less than 5 percent of the Interstate and non-Interstate NHS in Poor condition.

Sub Network	Percent Good	Percent Fair	Percent Poor
Interstate	66.1%	33.8%	0.0%
Non-Interstate NHS	44.8%	54.6%	0.5%
Total	52.2%	47.4%	0.4%

*Table 1: Summary of existing Interstate and non-Interstate NHS pavement conditions per the Federal performance measures. Numbers may not add up due to rounding. Source KYTC June 2019 TAMP*

Based on the KYTC measures, the TAMP showed funding needed and planned allocations for the entire pavement network over the 10-year TAMP period as follows:

- \$4.9 billion was the estimated amount needed to achieve the desired state of good repair for the pavement network (Interstate, Parkway and MP system) over the TAMP period. Of this, 95 percent (\$4.7 billion), 1.1 percent (\$55 million), 3.6 percent (\$178 million) and 0.1 percent (\$6
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million) were estimated to address investments in preservation strategies, rehabilitation, replacement and maintenance activities, respectively, over the 10-year TAMP period.

- A total of \$3.37 billion in Federal and State funds was planned for the entire pavement network to achieve the KYTC condition targets. “Based on the projections the overall interstate condition will remain stable during the TAMP period, KYTC predicts the percent Poor Interstate Pavement will remain below 1 percent.”<sup>6</sup> The TAMP showed that this level of investment would result in reduction in percent Poor in both Interstate and Parkway system but would result in approximately 10 percent decrease in Good pavements and 10 percent increase in Poor pavements by 2028 using the KYTC performance measures.

Years of the TAMP Period	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	10- Year Total
Maintenance Needs	—	—	—	—	—	—	\$2	\$2	\$1	\$1	\$6
Preservation Needs	\$48	\$43	\$81	\$86	\$148	\$214	\$197	\$223	\$254	\$250	\$1,544
Rehabilitation Needs	\$24	\$21	—	—	—	—	—	—	—	—	\$45
Replacement Needs	—	—	—	—	—	—	\$16	—	—	—	\$16
<b>Total Investment Needs</b>	<b>\$72</b>	<b>\$64</b>	<b>\$81</b>	<b>\$86</b>	<b>\$148</b>	<b>\$214</b>	<b>\$215</b>	<b>\$225</b>	<b>\$255</b>	<b>\$251</b>	<b>\$1,611</b>

Table 2: KYTC Interstate Investment Needs- All amounts are in \$ million. \* Source KYTC 2019 TAMP

Table 2 shows the Interstate investment needs for the 10-year TAMP period by work type. The investment needed for maintenance, preservation, rehabilitation and replacement are \$6 million, \$1.544 billion, \$45 million and \$16 million respectively to achieve the KYTC condition targets. This totals to \$1.611 billion.

Years of the TAMP Period	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	10- Year Total
Planned Maintenance	—	—	—	—	—	—	\$2	\$2	\$1	\$1	\$6
Planned Preservation	\$48	\$43	\$81	\$86	\$148	\$139	\$97	\$98	\$104	\$104	\$948
Planned Rehabilitation	\$24	\$21	—	—	—	—	—	—	—	—	\$45
Planned Replacement	—	—	—	—	—	—	\$16	—	—	—	\$16
<b>Total Planned Investments</b>	<b>\$72</b>	<b>\$64</b>	<b>\$81</b>	<b>\$86</b>	<b>\$148</b>	<b>\$139</b>	<b>\$115</b>	<b>\$100</b>	<b>\$105</b>	<b>\$105</b>	<b>\$1,015</b>

Table 3: KYTC Interstate Planned Investment- All amounts are in \$ millions \* Source KYTC 2019 TAMP

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Table 3 shows the planned investment for the KYTC Interstate to achieve the KYTC's internal performance targets for the 10-year TAMP period by year and work type. Though there is a funding gap to achieve the target based on KYTC's internal performance measures, the TAMP showed the total planned investment increasing over the TAMP period from a total planned investment of \$72 million to \$148 million in 2023 and then reducing to approximately \$105 million in 2028. This is an average increase of \$33 million per year over the 2019 investment. The TAMP showed similar detailed information about planned investment for the Parkway and MP System.

The TAMP also included tables showing planned investment and needed investment by year and work type for the 10 years of the TAMP for the bridges. It showed by year and work type the planned funding totaling to \$1.763 billion. This is less than the amount of \$1.8 billion that is needed to achieve a desired state of good repair for all State-owned bridges. The planned investment will result in percent Poor decreasing from 4 to 3 percent, percent Fair decreasing from 47 to 13 percent, and percent Good increasing from 49 to 83 percent over the 10-year TAMP period.

The KYTC TAMP thus provided an example of the alignment between financial planning, investment in life-cycle planning by work types, and the resulting conditions that can be expected over a 10-year period for each of its three roadway networks. Such level of detail provides transparency on the financial planning and investment strategies considered by the Cabinet, along with the assumptions made and the uncertainties considered.

## Michigan DOT Linking TAMP Investment Strategies, Five-year Transportation Program and STIP

The Michigan DOT (MDOT) TAMP linked its goals, use of LCP, financial planning, investment strategies, and achieving its asset management objectives. The TAMP showed the MDOT's process and the resulting 10-year financial plan. It also showed four possible pavement and two possible bridge investment strategies. The TAMP also showed the final pavement and final bridge investment strategies selected by MDOT. Each included the estimated amount by year and by work type. The sections that follow discuss each of the investment strategies included in the MDOT TAMP.

The TAMP showed how MDOT used LCP in its investment strategy development to allocate funds by work type for each year of the TAMP period. It also showed the engagement of MDOT's seven Regions in recommending candidate projects through the DOT's Call for Projects (CFP) process that focuses on addressing preservation and maintenance of bridges and pavements. It showed the alignment between the CFP, the Five-Year Transportation Program that gets approved by the State Transportation Commission (STC), and the STIP. Overall, the MDOT TAMP showed how a DOT used LCP and risk analysis to develop a financial plan that aligns with a selected investment strategy and is part of the DOT's routine activities.

## The Michigan DOT's Revenue Forecasting

The MDOT TAMP explained its risks and assumptions on revenue increases and laid out the background to its computation of revenues for the 10-year financial plan. The TAMP showed a detailed 10-year financial plan that explained the current amounts, sources of revenue, and the funding amounts projected to be available for the TAMP period. This was based on the State gasoline tax increase from 19 to 26.3 cents per gallon and the diesel fuel tax increase from 15 to 26.3 cents per gallon on Jan. 1, 2017. The TAMP financial plan stated that beginning in 2022 State fuel tax rates will be tied to inflation to help remedy the decline in purchasing power of the fuel tax. The plan also explained that additional revenue

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expected from “Registration fees for most cars and trucks increased 20 percent on Jan. 1, 2017. New electric car fees of \$100 per year, and \$30 per year for plug-in hybrid cars, equalize road-user fees for vehicles that use little or no taxed fuel.”<sup>7</sup>

The TAMP stated that, starting in FY 2019, \$150 million in income tax revenues will be appropriated for roads, a funding strategy not seen in most States. The State income tax revenues going to MDOT was expected to increase to \$325 million in FY 2020, and to \$600 million in FY 2021. “The forecasted revenue from FY 2022 to 2028 assumes that \$600 million will be transferred from income tax revenues every year to the Michigan Transportation Fund. These revenues will be distributed to road agencies only under the current Act 51 formula”<sup>8</sup> The TAMP stated that future State revenues are forecasted using a long-range forecasting model managed by MDOT’s Statewide Transportation Planning Division (STPD). This forecasting model is a multi-factor-driven process that addresses other non-income tax revenues that includes vehicle miles of travel, historical revenue trends, fuel prices, number of passenger and commercial vehicles, registration fees, fleet miles per gallon, and other factors.

The financial plan explained the methodology MDOT used for projecting Federal revenue. It stated that based on the past trend of modest increases through FY 2020, increases are assumed to continue through FY 2028, and the plan assumed a 2 percent growth rate through this period. A 1.9 percent inflation rate also was assumed. The inflation rate was used to convert year-of-expenditure dollars to constant (2019) dollars. For the trunkline, the total projected State and Federal revenues were shown in the TAMP based on the year of expenditure and base year (2019) dollars. Based on the projections, the TAMP also showed the summary of the dollar amounts by year of State and Federal funds forecasted to be available for the capital highway program through FY 2028. The plan showed the projected total annual revenues for the 10 years before deductions for other required expenditures to be \$24.21 billion and after deductions for non-capital uses, safety initiatives, and other MDOT responsibilities to be \$14.257 billion. The deductions include legally required transfers to other agencies and debt service as well as deductions for maintenance, administration, and facilities. Also, deductions in Federal-aid funds include allocations for safety, metropolitan planning organizations (MPOs), off-system bridges and other eligible uses. The TAMP stated that “the revenue available for the NHS portion of the trunkline capital program is estimated at almost 85 percent, which is the percent of currently planned highway capital road and bridge program investments that were on the NHS.”<sup>9</sup>

### Michigan DOT’s Link Between Revenue Estimation, Investment Strategy, and Projects

The MDOT TAMP linked financial planning, investment strategies development, and the final selection of projects for the Five-Year Transportation Program. The process of selecting projects starts with estimating the revenues that are forecasted to be available, moves to developing investment strategies, and finally, selecting a fiscally balanced strategy that results in projects becoming part of the Five-Year Transportation Program. MDOT has for many years developed a Five-Year Transportation Program in addition to the STIP and long-range statewide transportation plan. The MDOT TAMP indicated that the Five-Year Transportation Program is an integral component of the department’s input to the STIP and the schedules for the two programs have been synchronized.

The TAMP explained that the MDOT’s regional staffers use the Bridge Condition Forecasting System (BCFS) and the Road Quality Forecasting System (RQFS) along with stakeholder input to develop improvement strategies for roads and bridges. These strategies have a mix of fixes that are short-term, medium-term, and long-term. The treatments range from low-cost preventive maintenance, to scheduled reactive maintenance, to rehabilitation and reconstruction. Following a methodical approach

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that is the CFP, the seven Regions propose a combination of these fixes as candidate projects based on the DOT's risk analysis, life-cycle costs, distress severity, amount of traffic, maintenance costs, the areas the roadways serve, and other factors. The investment strategies shown are aligned to the DOT's SOGR targets and constrained by the funds available for project work. The final list of projects in the Five-Year Transportation Program and STIP reflect the selected investment strategy and shows the corresponding investment amounts for the five work types.

### Role of Life-Cycle Planning in Investment Planning and Allocations

The link between LCP and investment strategies on the Interstate and NHS was articulated in the TAMP. The TAMP stated that investment strategies were developed using anticipated available funding, LCP, financial and performance gap analysis, and the results of the risk analysis. MDOT analyzed four alternative pavement investment strategies and two alternative bridge investment strategies before selecting the preferred pavement and preferred bridge investment strategy. Based on the available funding, analysis of each investment strategy was completed. The TAMP stated that the financial plan, LCP, gap analysis, and risk mitigation strategies were considered when each potential investment strategy was reviewed.

The TAMP stated that,

“Life cycle planning was completed for various investment strategies. MDOT used two network-level pavement models and one bridge model. The life cycle planning identified the amount of work needed by category for each investment strategy.

Financial gap analysis is considered when various investment strategies are compared to determine the most realistic strategy to meet overall goals and objectives. Where funding gaps existed, cross-asset analysis was considered. Agency-level and program-level risks that could impact implementation were considered. .... To develop an investment strategy to reach each goal, MDOT used life cycle analysis that represented the most efficient and effective approach to achieving the asset management objective. A mix of fixes was developed that would produce the desired asset condition. The life cycle analysis constrained the amount of preservation work by year to balance mobility impacts. The desired level of work for this investment objective was compared to the available funding as identified in the 10-year financial plan forecast.”<sup>10</sup>

### Investment Strategies for Pavements and Bridges

The selected investment strategy demonstrated a mix of fixes and investment by work type needed to achieve MDOT's desired asset condition. MDOT compared the projected available funding as detailed in its 10-year financial plan to the amount of work required for the following four scenarios that the TAMP call the alternative strategies before making a final selection. For each alternative strategy, the TAMP presented 10-year periods and the funds projected to be available each year for the NHS pavements, as well as the expected cost of work by year, and work type for each year of the TAMP period.

MDOT selected one preferred investment strategy from the four pavement investment strategy alternatives analyzed and one preferred investment strategy from the two analyzed for bridges. Both were “Constrained Investment” strategies that were based on LCP for the whole life of the asset. The TAMP stated that the selected investment strategy drives project selection for both the Five-Year Transportation Program and the STIP. This preferred investment strategy was implemented within the department through the annual integrated Highway CFP process, which provided the mechanism for project selection. The desired mix of fixes, investment levels, and the funding targets were developed

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for the selected investment strategy through the CFP program. The four pavement investment strategies and the two bridge investment strategies included in the TAMP are discussed below.

### Pavement Investment Strategies

The TAMP showed the Constrained Investment for Pavements as the selected investment strategy. The four pavement investment strategies analyzed were:

1. **Constrained Investment for Pavement:** This alternative strategy was based on the funding forecasted to be available. The TAMP stated that this allowed MDOT to achieve the two-year (midpoint) and four-year (full performance) 23 CFR Part 490 targets for the pavement condition. This investment strategy showed the total revenues projected to be available for NHS pavements, the expected cost of future work, and the expected work needed by work type each year for the 10-year period of the TAMP. The total investment in the constrained-investment strategy for pavements with no funding gap is shown to be \$7.389 billion. The allocations in the TAMP showed \$2.724 billion for rehabilitation, \$3.809 billion for reconstruction, \$857 million for preservation, and zero for initial construction. Similarly, detailed information was included in the TAMP for each of the other three pavement investment strategies.
2. **Achieve the National Minimum Condition Level for Pavement:** The TAMP showed the investment needed to achieve no more than 5 percent Poor for the Interstate to be \$8.3 billion resulting in a funding gap of approximately \$1.794 billion over the 10-year period. The amounts needed to complete expected work on the Interstate by work type as shown in the TAMP were \$3.248 billion for rehabilitation, \$4.780 billion for reconstruction, \$303 million for preservation, and zero for initial construction.
3. **Achieve the Pavement State of Good Repair:** The TAMP showed a need for \$17.8 billion for the 10 years to achieve 95 percent Good/Fair on the Interstate and 85 percent Good/Fair on the non-Interstate NHS pavements based on Remaining Service Life (RSL). The total estimated funding shortfall to achieve this goal was \$10.426 billion over the 10-year TAMP period. The TAMP showed a need of \$7.597 billion for rehabilitation, \$9.042 billion for reconstruction, \$1.175 billion for preservation, and zero for initial construction.
4. **Preserve Current Condition:** The TAMP showed a need of approximately \$15.83 billion to sustain the current condition on Interstate routes of 78.5 percent Good/Fair and 73.6 percent Good/Fair on the non-Interstate NHS pavement based on RSL. The total estimated funding shortfall to achieve this goal was approximately \$8.441 billion over the 10-year TAMP period. The TAMP showed a need of \$5.924 billion for rehabilitation, \$8.872 billion for reconstruction, \$1.034 billion for preservation, and zero for initial construction.

### Bridge Investment Strategies

The TAMP showed the Constrained Investment for Bridges as the selected investment strategy. It included the analysis of the following two alternative bridge investment strategies that were considered:

1. **Constrained Investment for Bridges:** The TAMP stated that there was a large project in construction that will influence the overall State bridge conditions. It stated that achieving the minimum bridge condition level of “no more than 10 percent structurally deficient (or Poor) by deck area on the NHS will be achieved with the completion of a project that is under construction that represents more than 4 percent of the NHS deck area statewide.” With the completion of this project and using constrained investments, the national minimum condition
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level for NHS bridges was expected to be achieved and maintained with the planned \$1.5 billion over the 10-year period. The total projected amount for the NHS bridges was \$1.528 billion.

2. **Bridge State of Good Repair:** The bridge state of good repair goal is 95 percent Good/Fair by deck area on the NHS. The investment strategy to achieve the bridge state of good repair required \$1.851 billion, an estimated funding shortfall of \$323 million over the 10-year TAMP period. The TAMP showed the amounts by work typed needed to achieve a state of good repair. It showed a need for \$735 million for reconstruction, \$420 million for rehabilitation, \$343 million for preservation and \$354 million for work to be done on NHS bridges by bridge authorities and local agencies. An option considered but not adopted was to redirect funds from non-NHS bridges to the NHS but that would result in unacceptable declines in the condition of those assets.

### Condition Gap Resulting from Constrained Investment

In addition to showing the estimated funding gap for different investment strategies, the MDOT TAMP included charts that showed the condition gap for each year of the 10-year TAMP financial plan period resulting from implementing the investment strategy to achieve the state of good repair versus the constrained investment strategy. It showed the condition of Interstate pavements and the percent Good/Fair declining over the 10-year period to approximately 60 percent by 2030 when the constrained investment strategy was applied. Similar charts showed the condition of the non-Interstate pavements also declining over the 10-year period. The MDOT TAMP also included a chart that showed a need for an additional \$32 million of investment annually to achieve the SOGR for bridges of 95 percent Good/Fair based on deck area statewide.

### Washington DOT's Financial Planning and Investment Strategies

The Washington DOT (WSDOT) TAMP showed detailed financial planning done in support of asset management practices. The WSDOT TAMP detailed in the financial plan, the revenue sources, the funding needs, the planned expenditures, and the approach the DOT took to prioritize preservation projects and communicate the importance of funding preservation and related asset management investments. The TAMP emphasized the importance of long-term funding for preservation and stated that WSDOT's preservation investments considered three core principles for all projects: "avoiding future liability, asset use, and life cycle cost."<sup>11</sup>

The TAMP stated the revenue challenges and the funding gap faced by WSDOT. It highlighted the challenge the DOT faced in receiving preservation funding and the potential future impacts to preserving existing assets. The TAMP stated that "while some of the Connecting Washington mobility projects address preservation needs, WSDOT continues to see a trend of underfunding preservation activities when large revenue packages were assembled. This trend can lead to long-term preservation deficits, especially as large revenue packages make future preservation funding less likely."<sup>12</sup> The TAMP highlighted concerns that if this continues, the extent of network deterioration would make its restoration increasingly costly. The TAMP stated that though discussions around increasing taxes and fees for preservation activities have occurred, no such increases have passed the Legislature and the prospect of near-future increases were unknown. It also stated that WSDOT continued to communicate preservation needs as its top priority for any additional funding stream should it become available. The WSDOT TAMP showed the funding gaps by year and work type.

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## WSDOT Monitors Planned Projects by Work Type

The WSDOT tracked expenditures by work type, stating in the TAMP that this allowed it to monitor if planned levels of investments were followed. The TAMP stated that “as part of the department’s asset funding need process, the Bridge and Pavement offices provided estimates of the total 10-year investment needs, based on asset management practices.”<sup>13</sup> These represented the amount of funding required to fully implement lowest life-cycle cost strategies across the statewide network. Per 23 CFR Part 490 performance measures, approximately 1.87 percent of the Interstate and 2.17 percent of the state-maintained non-Interstate NHS is in Poor condition. The 2022 pavement targets that were set based on the 23 CFR Part 490 are to have no more than 4 percent Poor condition for the Interstate and no more than 5 percent Poor condition for the non-Interstate NHS, and 30 Percent of the Interstate and 21 percent of the non-Interstate NHS in Good condition. WSDOT’s 23 CFR Part 490 target and SOGR is to have less than 10 percent of NHS bridges by deck area in Poor condition over the 10-year TAMP period. In 2018, 7.5 percent of WSDOT’s NHS bridges by deck area were in Poor condition as per 23 CFR Part 490.

Years of the TAMP Period	2019	2020	2021	2022	2023	2024-2028	2019-2028
Capital Pavement Preservation Needs (\$ in Millions)	\$ 284	\$ 284	\$ 284	\$ 284	\$ 284	\$ 1,420	\$ 2,840
Total Capital Planned Pavement Preservation Spending (\$ in Millions)	\$ 43	\$ 45	\$ 58	\$ 75	\$ 62	\$ 168	\$ 450
Total Capital Planned Pavement Rehabilitation Spending (\$ in Millions)	\$ 222	\$ 126	\$ 112	\$ 120	\$ 106	\$ 628	\$ 1,314
Total Capital Planned Pavement Replacement Spending (\$ in Millions)	\$ 22	\$ 10	\$ 11	\$ 14	\$ 41	\$ 125	\$ 224
Total Capital Planned Pavement Spending (\$ in Millions)	\$ 286	\$ 181	\$ 181	\$ 209	\$ 209	\$ 921	\$ 1,988
<b>Investment Gap (\$ in Millions)</b>	<b>\$ 2</b>	<b>\$(103)</b>	<b>\$(103)</b>	<b>\$(75)</b>	<b>\$(75)</b>	<b>\$(499)</b>	<b>\$(852)</b>

Table 4: WSDOT 10-Year Pavement Needs and Planned Spending (\$ amounts may not add up because of rounding), Source: WSDOT 2019 TAMP

Table 4 from the WSDOT TAMP showed an investment gap of \$852 million to meet pavement needs over the 10-year period. This assumes an annual pavement backlog of \$40 million.

The WSDOT TAMP included the following:

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- Tables with bridge information by work type similar to that shown for pavements in Table 4. The bridge funding needs totaled \$2.806 billion. The planned spending totaled \$1.954 billion resulting in a shortfall of \$852 million for bridges also over the 10-year TAMP period.
- As levels of expenditures for bridges and pavements were less than needed to fully utilize an ideal lowest life-cycle cost strategy, State bridge and pavement project prioritization were shifted to optimal performance within the current funding environment.
- The TAMP stated that the DOT used a variety of strategies to program projects that might exceed appropriation levels. This approach offset the risk of having projects come in under budget and of leaving additional appropriation on the table. It placed the agency in a position to use any additional funding sources that become available. It also positioned the WSDOT to receive unused funds from other States and/or Federal programs.

The WSDOT TAMP also stated that for the next four years the funding needed to meet condition targets for bridges and pavements would be met. However, beyond that period the conditions of pavements and bridges would drop below targets if funding is not increased. The TAMP stated that WSDOT used the results from life-cycle planning, revenue and financials, and performance scenario analysis as the foundation for setting the direction of its investment strategies. For State-maintained pavements and bridges, the results from these analyses were directly incorporated as part of project prioritization. The investment strategies shown in the TAMP detailed the prioritization to align investment with the estimated funding. For bridge projects, the investments were prioritized based on the following four major investment areas: repairs, replacements, scour, and seismic.

The TAMP also stated that 23 percent of the NHS was locally owned and maintained. To support the local NHS, the WSDOT planned to allocate 41 percent of the 2019 Federal funds to local jurisdictions. WSDOT was working closely with the local jurisdictions that manage the NHS to estimate annual funding needs. The TAMP stated that the projected funding dedicated to the local NHS was not available because no process existed to capture data on how local projects were selected or treatments determined. The TAMP stated that WSDOT was leveraging the current metropolitan planning organization (MPO) engagement framework to obtain baseline funding estimates for the local NHS.

## New York State DOT's Asset Sustainability Index and Funding Gaps

NYSDOT's TAMP discussed the Asset Sustainability Index as a State's measure of the economic sustainability of its assets. In the TAMP, NYSDOT defined the Asset Sustainability Index as "the ratio of actual funding to the funding level necessary to achieve a state of good repair for an asset class."

Although not specifically required by regulations, the Asset Sustainability Index is a forward-looking metric used by Australia, Great Britain, New Zealand, and others, to not just meet current condition targets, but to sustain the asset conditions into the future. The index shows if the funds planned for future years are sufficient to achieve and sustain assets at their targeted conditions over the long-term. The NYSDOT TAMP used the index to show the investment gap and the funding needed to achieve a state of good repair for bridges and pavements in 10 years.

The NYSDOT TAMP discussed sustainability and the focus on asset management principles in developing its investment strategies. In referring to the word "sustainability" the TAMP clarified that "NYSDOT has a formal definition for the concept that includes considerations such as generational equity,

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environmental impacts, and balanced transportation options.” In discussing sustainability in the context of addressing asset investment needs, the NYSDOT TAMP stated that it was

“more narrowly focused on the Asset Sustainability Index defined as an index comparing a given level of resource investment with the underlying asset need.

A basic economic notion behind asset management is the idea that assets deteriorate from use, weather and age. That loss can be quantified as a ‘need’ or amount of asset value lost that needs to be restored so that the asset can continue to function as necessary. That loss is counterbalanced through investment in restoring that asset.”<sup>14</sup>

The TAMP acknowledged that NYSDOT’s assets were currently not in a state of good repair. To develop a set of strategies to achieve the best bridge and pavement conditions 10 years into the future, NYSDOT’s Comprehensive Asset Management/Capital Investment Team investigated different investment and treatment strategies. This effort led to a strategy to “focus on preserving as much of the overall highway and bridge system as possible, to minimize future costs, while also treating assets in the worst conditions where those conditions impact the most travelers”<sup>15</sup> The TAMP stated that this resulted in a focus on preservation and a capital investment program that was made up of 60 percent preservation and 40 percent system renewal (rehabilitation and reconstruction). In 2012, by implementing a stricter asset management approach, focused on preservation and pavement management principles, NYSDOT slowed the increase in Poor pavement in 2018 from the 2011 projected value of 40 percent to an actual 2018 value of only 19 percent. The TAMP also stated that with current funding, even the most efficient investment plan resulted in a widening gap between desired and actual conditions. The TAMP stated that while NYSDOT was investing \$875 million per year, it would require approximately \$2.5 billion annually to bring the NHS State pavements and bridges to a state of good repair in 10 years.

The TAMP stated that when the actual funding for a given asset(s) is sufficient to achieve a state of good repair the Asset Sustainability Index value will be 1.0. It showed the Asset Sustainability Index for NYSDOT’s highways and pavements combined currently to be 0.30. The NYSDOT TAMP showed the total anticipated investment, the funding needed, and the Asset Sustainability Index for the 10-year TAMP financial plan period as follows:

- Bridges: Funding needed is \$1.7 billion, anticipated investment is \$575 million, resulting in an ASI of 0.34.
- Pavements: Funding needed is \$725 million, anticipated investment is \$300 million, resulting in an Asset Sustainability Index of 0.41.

The anticipated funding resulted in an Asset Sustainability Index for State pavements and bridges of 0.35, indicating that the State received and had planned for approximately one-third of the funding from all levels of government needed to achieve a state of good repair.

## Utah DOT’s Pavement Sustainability Index

The Utah Department of Transportation (UDOT) TAMP included what UDOT called the Sustainability Index (SI) to gauge the adequacy of pavement investments to sustain a state of good repair. The TAMP stated that UDOT has been focused on managing its assets with a philosophy of “Good Roads Cost Less” since 1978. UDOT defines the Sustainability Index as: Surface Area Years replaced/Surface Area Years lost. The UDOT TAMP stated that assuming all pavements lose one year of life each year, the selected projects should replace an equivalent amount of pavement life.

It determines the Sustainability Index as follows:

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- The ratio of the work done (planned) to the work required – measured in units of Surface Area Years.
- Considering that all pavements age one year each year, a loss of pavement life can be measured in units of Surface Area Years.
- The different surfacing projects replace different amounts of pavement life, which can be added up in units of Surface Area Years.

The TAMP stated that the Sustainability Index supports UDOT’s long-term vision and pavement management strategy to maintain pavements in a continuous state of good repair. UDOT decision makers use the index as input when selecting a mix of treatments to achieve sustainable pavement conditions.

The TAMP stated that the Sustainability Index enables UDOT to identify pavement life added by each project and make projections. A Sustainability Index value greater than 1.0 indicates improvement in conditions while a value of less than 1.0 indicates a decline. The TAMP stated that UDOT reviews the Sustainability Index annually to ensure adequate funding is allocated to maintain the systems. One of the three pavement investment strategies that UDOT implemented looked at the mix of treatments planned for its five-year pavement program to calculate if the rolling average of the Sustainability Index is 1.0 or greater. The TAMP showed the UDOT’s planned work in future years will result in less “pavement benefit years.” The TAMP showed a declining index starting in 2018. It showed a Sustainability Index of 1.2 in 2017, 1.4 in 2018, 1.1 in 2019, 1.1 in 2020, 0.9 in 2021 and 0.9 in 2022.

The TAMP stated that the agency’s Preserve Infrastructure strategic goal was to achieve 80 percent of mileage in Fair or better condition per the State’s pavement performance measure. The TAMP indicated that UDOT tracks the system to make sure that there is adequate funding allocated to meet its State-set pavement condition targets.

## Vermont Agency of Transportation’s Investment Strategies and Measures for Tracking Useful Life of Assets

The Vermont Agency of Transportation (VTrans) has for many years used an Asset Sustainability Index to measure the impact of past investments. Vermont’s Asset Sustainability Index is similar to New York’s and is explained below. VTrans uses an additional measure called the Asset Consumption Ratio that was included in the TAMP.

The TAMP stated that though Vermont started its focus on Asset Management in 1995, it made changes to its business model in 2006 with the adoption of the “The Road to Affordability” policy.<sup>16</sup> This policy relied on the principles of asset management. It led to lower-cost preventive maintenance treatments that resulted in savings that accumulated over time, increasing the Agency’s financial sustainability.

The VTrans TAMP showed investment needs and planned allocations by four major work types: maintenance, preservation, rehabilitation, and reconstruction. For NHS pavements, preservation included monies spent on maintenance as well as preservation activities. The TAMP stated that in FY 2020, VTrans had approximately 70 percent of the funding needed to maintain a state of good repair. The TAMP stated that in FY 2019 the funding gap was \$250 million. Based on two funding scenarios the TAMP showed an annual funding gap ranging from \$244 million to \$262 million in 2021. The funding gap rose to between \$314 million and \$383 million in 2028.<sup>17</sup>

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### VTrans Sustainability Measures

The VTrans TAMP reported four financial performance measures to evaluate the sustainability of its pavement and bridge assets and to evaluate the overall financial health of its infrastructure.

1. **Pavement Sustainability Index:** This is the ratio of the anticipated available funding for pavements relative to the anticipated annual need to maintain pavements in a state-of-good-repair.
2. **Bridge Sustainability Index:** This is the ratio of the anticipated available funding for bridges relative to the anticipated annual need to maintain bridges in a state-of-good-repair.
3. **Overall Asset Sustainability Index:** This is the ratio of the total anticipated available funding relative to the total anticipated annual operational and asset preservation needs. The Asset Sustainability Index can be computed for any or all assets. The Asset Sustainability Index for pavements only would be the same as the Pavement Sustainability Index and the Asset Sustainability Index for bridges only would be the same as the Bridge Sustainability Index.
4. **Asset Consumption Ratio:** This is a newer measure adopted by VTrans and is the ratio of the current value of the asset to its replacement cost. This provides a “balance sheet” perspective of the impact of the Agency’s investments.

The TAMP stated that VTrans also uses asset valuation to track the return on its investment. VTrans computes current asset value as the current bid price to replace that asset. This means the value for bridges is the sum of the current asset value of each bridge in its class. VTrans has categorized its network into five Customer Service Level (CSL) of roads. The value of each CSL class of pavements is the sum of all 0.1-mile segments in it.

The TAMP explained that the depreciated replacement cost is developed based on depreciable and non-depreciable costs. An example of a non-depreciable cost is the underlying earthworks. The remaining depreciable costs for a segment of pavement were then reduced based on the pavement condition.

A ratio of 1.0 for a Pavement Sustainability Index or a Bridge Sustainability Index indicates that the revenue anticipated will be sufficient to meet the needs of the pavements and bridges respectively. An Asset Sustainability Index of 1.0 indicates sufficiency to meet the needs of all the transportation assets being considered in the computation. VTrans could include other assets such as culverts, stormwater controls, slope stabilization assets, etc. along with bridges and pavements in computing the Asset Sustainability Index.

The TAMP stated that VTrans had been successful in securing funds to address a large amount of its surficial pavements needs. Based on a \$128 million need over the last five years VTrans had a Pavement Sustainability Index ranging between 0.87 and 0.97. The TAMP also stated that the current VTrans Asset Sustainability Index is 0.7. This means that currently VTrans only has 70 percent of the funds needed to maintain the transportation assets in a state of good repair. The TAMP stated that for pavements the long-term need versus future funding levels is concerning.

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Budget Year	2% Budget Growth (million)	Anticipated Need (million)	Infrastructure Gap (million)	ASI
2020	\$600.9	\$853.9	\$253.0	0.7
2021	\$611.6	\$875.8	\$264.2	0.7
2022	\$622.4	\$895.6	\$273.1	0.7
2023	\$640.5	\$925.8	\$285.3	0.69
2024	\$652.0	\$948.9	\$297.0	0.69
2025	\$663.6	\$972.7	\$309.0	0.68
2026	\$682.5	\$995.3	\$312.7	0.69
2027	\$694.8	\$1,020.2	\$325.3	0.68
2028	\$707.3	\$1,045.7	\$338.3	0.68
2029	\$727.1	\$1,071.8	\$344.7	0.68
2030	\$740.3	\$1,098.6	\$358.3	0.67

*Table 5: VTrans Asset Sustainability Index, Source: VTrans 2019 TAMP*

Table 5 shows the projected Asset Sustainability Index trend for the 10-years of the TAMP. The VTrans TAMP stated that the projected annual gap in addressing bridge funding needs was approximately \$52 million. It noted that though the gap decreased due to past increased investments, the bridge needs are expected to climb. VTrans computations also showed that an annual revenue growth of 4.5 percent would be necessary to achieve an Asset Sustainability Index of 1.0 in 20 years.

VTrans identified Asset Sustainability as a way to help the agency make cost-effective pavement and bridge management decisions. It can be used as input to optimize and prioritize preventive maintenance treatment selection and coordinate with a wide range of partners. It communicates that asset management is important and long-term commitment is necessary to achieve the best results.

The Asset Consumption Ratio shows the aged condition of assets. It can be computed on any asset class and is also a measure of the remaining life of that specific asset. The TAMP stated that the Asset Consumption Ratio is used to demonstrate the impact of previous infrastructure investment decisions on the Agency's overall asset value. It provides a "balance sheet" perspective on the impact of past agency investment decisions and can provide insight into where future monies may need to be spent to maintain a minimum asset value. It can be used to determine how balanced each asset's investment plan is over the Agency's entire asset portfolio.

Table 6 shows the Asset Consumption Ratio for Vtrans' bridges by the five CSLs. CSL 1 includes Interstates and divided highways. CSL 2 includes arterial highways, including the non-Interstate NHS. CSL 3 includes State Highway System Regional Corridors. CSL 4 includes State Highway System Local Connectors. CSL 5 includes Town Highways not including any NHS sections.

The TAMP showed the current value of all VTrans bridges to be \$1.59 billion and the replacement value to be \$2.874 billion, resulting in an Asset Consumption Ratio of 55.3 percent. An Asset Consumption Ratio of 55.3 percent indicates that more than 44 percent of the life of all bridges has been consumed.

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CSL Designation	Bridges (Numbers)	Deck Area (sq. ft)	Replacement Value \$ (in millions)	Current Value \$ (in millions)	% Remaining
CSL1	372	3,295,041	\$1,064	\$ 620	58.2%
CSL2	132	1,116,946	\$361	\$ 215	59.6%
CSL3	247	1,102,132	\$325	\$ 182	56.1%
CSL4	330	1,062,173	\$313	\$ 174	55.6%
CSL5	1700	2,747,876	\$811	\$ 399	49.2%
<b>Totals</b>	<b>2781</b>	<b>9,324,168</b>	<b>\$2,874</b>	<b>\$ 1,590</b>	<b>55.3%</b>

*Table 6: VTrans Bridge Asset Valuation, Source: VTrans 2019 TAMP*

The TAMP stated that VTrans intends to continue to use the Asset Sustainability Index and the Asset Consumption Ratio to monitor bridges and pavements annually. Its primary financial goal is to increase or maintain current performance levels by making the “right treatment on the right asset, at the right time.” This strategy was expected to extend each asset’s service life for the minimum practical cost. The TAMP stated that if in the future resources are available, VTrans will continue to explore how to balance transportation investments to meet conflicting enterprise objectives while moving the needle on the Agency’s Asset Sustainability Index toward 1.0.

## Illinois DOT’s Use of Spreadsheet Tool for Analysis

The Illinois Department of Transportation (IDOT) TAMP provided an example of a DOT with developing asset management practices that conducted analysis with simple spreadsheet tools to develop a financial plan and investment strategies for its bridge and pavement assets.

During the process of developing its 2019 TAMP, IDOT took steps to improve its asset management practices. The TAMP stated that historically IDOT had been using a “worst condition first” approach. However, its analysis showed that “programming appropriate treatments throughout the lives of assets will lead to higher performance of the highway system as a whole. As a result of this analysis, IDOT began programming projects in the following five categories: initial construction, maintenance, preservation, rehabilitation, and reconstruction/replacement.”<sup>18</sup>

The IDOT TAMP discussed the process of collaboration between the Bureau of Programming and Office of Finance and Administration to develop a financial plan for the next 10 years. The TAMP stated the following about the alignment between the financial plan, investment strategies, LCP, and maximizing of bridge and pavement conditions:

“Using the financial plan, the current condition of the assets, the mix of treatments recommended by the life-cycle analysis, and the results of the risk analysis, an investment strategy was developed to maximize the condition of NHS pavements and bridges as top priority, and the non-NHS system as funding permits.”<sup>19</sup>

The plan stated that IDOT was in the process of selecting an Enterprise Asset Management System (EAMS) and used an interim spreadsheet tool in the analyses for the 2019 TAMP to satisfy the 23 CFR 515.7 requirements. Using the interim tool, IDOT predicted the pavement conditions for three different funding scenarios and investment strategies. The TAMP showed a total of \$10.3 billion available for pavements and bridges. It stated that if IDOT adopted the recommended investment strategies, the

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targets could be met in the 10-year TAMP period. However, that would necessitate an increase of \$6.0 billion in funding from \$10.3 billion to \$16.3 billion over the period.

### Spreadsheet Tool for Investment Strategy Analysis and Programming Funds

The TAMP discussed the impact of not just the current funding gap on the assets, but also the impact of delayed funding increases and the effect upon future deterioration. The TAMP stated that IDOT would systematically and over time allocate more funds to preservation and maintenance once the supporting business processes are in place. The TAMP stated that IDOT developed a spreadsheet tool that allowed the Office of Planning and Programming to evaluate the impacts of different investment options for both pavements and bridges.

The TAMP stated that the “State of Acceptable Condition for pavements represents a Condition Rating Survey (CRS) value of 5.5 or higher for Interstates and 5.0 for other NHS and non-NHS routes. (IDOT combines the sensor data (rutting, roughness, and faulting) and distress data to determine a CRS value ranging from 1.0 to 9.0, with 9.0 representing a new pavement and 1.0 a failed pavement.) The State of Acceptable Condition for Bridges is set to a minimum National Bridge Inventory (NBI) rating of 5 for all primary components (deck, superstructure, substructure, or culvert) for all bridges, regardless of system. These values were chosen as the State of Acceptable Condition because they represent the lowest values for which preservation activities are effective in extending the life of assets.”<sup>20</sup>

The fund allocation analysis was done iteratively to meet the State of Acceptable Condition targets. The TAMP included a pavement investment strategy that acknowledged existing project commitments and showed a transition to using LCP based on pavement classification (Interstate, other NHS, Non-NHS), pavement conditions, and repair needs. For other scenarios, planned allocations beyond existing project commitments varied to satisfy the State of Acceptable Conditions established for the network. The analysis based on applying the constrained funding scenario on the current pavement condition and backlog resulted in a final strategy to invest heavily in minor and major rehabilitation and allocate the remaining funds to preservation and reconstruction activities.

The TAMP included charts based on the spreadsheet tool that showed the impact of three different funding scenarios on pavement conditions in a 10-year TAMP period. The TAMP stated that if an increase in funding does not begin until after that period, the gap at that point would be \$9.1 billion; in the interim, the condition of the highway system would continue to decline. If inflation and costs related to including ancillary items such as drainage and lighting were also considered, the cost would be between \$13.5 to \$15 billion. The TAMP included similar scenarios for bridges showing the impact of three different funding scenarios on the future condition of the bridges.

Using the spreadsheet tool, IDOT estimated investments and analyzed “investment strategies in which NHS bridge conditions were improved to attain 90 percent of square footage at or above the State of Acceptable Condition, while maintaining NHS pavements at as high a level as possible, and incrementally changing the historic distribution of pavement and bridge funding.”<sup>21</sup> The bridges and pavements on the network were prioritized based on the hierarchy with Interstate, NHS and higher volume assets being given higher priority.

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### Strategic Direction, Process Improvements and Simple Tools

IDOT's EAMS implementation can take up to 36 months, so waiting for its implementation was not an option. Instead, IDOT used the spreadsheet tool and streamlined processes to guide the Districts and other agency personnel on treatment criteria for pavements and activities to perform in order to maximize the life of bridges. The TAMP stated that to enhance IDOT's ability to make performance and data driven investment decisions and help ensure that limited resources are used wisely, it introduced several initiatives.

Following are three of the five initiatives that better use performance data to drive investment decisions and align with national initiatives to promote a transportation asset management (TAM) framework:

- Introduce a systematic process that links investments to performance objectives.
- Emphasize the use of preservation treatments that extend the life of the highway system at a minimum practicable cost.
- Consider agency risks or exposure in setting investment priorities.

Using available tools and introducing initiatives to provide guidance to agency personnel on how to use these tools, IDOT developed its 2019 TAMP in accordance with Federal requirements and continued making improvements in asset management.

The TAMP stated that with funding constraints, cost-effectively using funds to extend the useful lives of assets becomes even more important. The TAMP stated that IDOT made many improvements including programming maintenance and preservation treatments early in the asset's life. It also modified tracking procedures so that it can easily report on funds spent throughout the life cycle by initial construction, maintenance, preservation, rehabilitation, and reconstruction/replacement.

### Collaboration with Districts on Investment Strategy Analysis and Programming Funds

IDOT worked with its Districts and Divisions and used the analysis results of the spreadsheet tools and streamlined processes to develop multiple investment strategies and select a fiscally constrained strategy to implement its asset management plan. Acknowledging the lack of necessary funding to achieve its State of Acceptable Condition levels, IDOT developed a system hierarchy prioritizing the Interstate and NHS pavements and bridges for investments. IDOT established new targets for State of Acceptable Condition level based on this hierarchy with emphasis on system preservation.

The TAMP stated that once investment levels are established, the Office of Planning and Programming works with the Districts to select projects that will enable IDOT to meet its statewide performance objectives. The spreadsheet facilitated the analysis of programming funds for preservation, rehabilitation, and reconstruction at both the State and district levels using deterioration rates and treatment costs. The amounts to be invested in the multi-year period for the different work types were agreed and the Districts selected projects following IDOT guidelines and based on bridge and pavement conditions to match intended investments. The final project list was incorporated into the STIP, presented to the General Assembly, and made public.

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# Funding Implications of Aging Infrastructure and Deferred Investment

Using the spreadsheet tool and conducting iterative and detailed analysis, IDOT showed the investments planned by work types for the 10-year period for NHS and non-NHS assets. The assumptions for distribution of funds between bridges and pavements were also clearly stated in the TAMP. The TAMP noted that the expected service life of pavements is 30 years and nearly 91 percent of the State-maintained network is over 40 years old, and “approximately 44 percent IDOT’s bridges still in service are more than 48 years old, representing a significant level of deferred investment.”<sup>22</sup> The TAMP also stated that the aging infrastructure typically requires “more frequent, and expensive, maintenance and rehabilitation in order to continue to provide acceptable levels of performance.”

In explaining the pavement investment strategy, the TAMP stated that “the final recommended pavement strategy invests heavily in minor and major rehabilitation with the remaining funding allocated to preservation and reconstruction activities.”<sup>23</sup> The investment strategies show IDOT achieving 88 percent State of Acceptable Condition versus its goal of 90 percent for the Interstate pavements. The annual investment planned by work type to achieve these goals were shown by the four work types for the 10-year TAMP period. Because IDOT at the time of the TAMP development did not have a mechanism to separate out preservation and maintenance, the TAMP showed annual planned investments by four work types for the 10-year period: combined preservation and maintenance, rehabilitation, reconstruction, and new construction. The TAMP showed under the constrained budget scenario planned investment for the 10 years in the NHS allocated by work type in maintenance and preservation (combined), rehabilitation, reconstruction and new construction to total \$305.4 million, \$3.32 billion, \$190.8 million and \$500 million, respectively, resulting in a total of \$4.316 billion.

For the State of Acceptable Condition, IDOT has goals for the non-Interstate NHS, non-NHS marked and unmarked pavement routes of 90 percent, 75 percent and 50 percent, respectively. Based on the projected funding, IDOT will only achieve a State of Acceptable Condition of 71 percent, 32 percent and 29 percent for non-Interstate NHS, non-NHS marked and unmarked pavement routes, respectively. (Unmarked routes are roads over which IDOT has jurisdiction, but are not numbered as Interstates, US routes, or State routes). The TAMP also showed planned investments in non-NHS pavements to be \$107.3 million, \$1.177 billion and \$56.7 million in maintenance and preservation, rehabilitation, and reconstruction respectively totaling \$1.341 billion over the 10-year TAMP period. Similar investment information by year and work type was shown for NHS bridges and for non-NHS bridges.

The targets set for 2028 were 93 percent for Interstate and other NHS bridges by deck area and 90 percent for the non-NHS bridges by deck area in a State of Acceptable Condition. The TAMP indicated that by 2028 Interstate NHS bridges will reach a level of 91 percent in acceptable condition that is close to the target of 93 percent. However, by 2028 the other NHS bridges will achieve 89 percent in a State of Acceptable Condition which is 4 percent below what IDOT has targeted. The bridges on the marked routes will achieve 61 percent in a State of Acceptable Condition, while bridges on unmarked routes will be 58 percent acceptable by 2028.

The TAMP acknowledged that based on the analysis conducted, there were performance gaps between actual conditions and the State’s condition targets. Based on the TAMP projections funding is not sufficient to achieve the acceptable conditions on all systems. The analysis showed that an additional \$9.112 billion will be needed to close the performance gap in the 10-year period for bridges and pavements on the entire system.

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The IDOT TAMP showed the use of simple tools to develop detailed analysis of the investments needed, the planned funding, and funding gap to achieve the target condition for the entire pavement and bridge network.

### Summary

Practices from the TAMPs included in this case study show DOTs using simple spreadsheet tools to more complex management systems to develop 10-year financial plans to support their asset management needs. The practices showed how the DOTs developed pavement and bridge funding allocations based on anticipated revenue forecasts and estimates of funding needs for each asset class based on the LCP processes. The practices included also showed the results of the DOTs' forecasts of funding needed annually by work types over the 10-year TAMP period to achieve and sustain their assets in a state of good repair.

The examples included also showed DOTs acknowledging uncertainties and potential shortfalls in projected revenues and how they planned to address asset needs during such shortfalls. For example, to address funding shortages KYTC prioritized and used available funds for safety, maintenance and preservation activities and delayed large reconstruction and rehabilitation projects. WSDOT programmed projects that might exceed appropriation levels, preparing the agency to take advantage of any unused funds from other States/or Federal programs.

The TAMPs showed the funding gaps and resulting declining asset conditions. Examples from Vermont, Utah, and New York showed how forward-looking measures such as asset sustainability index, and asset consumption ratio were used to help decision makers understand investment challenges and to convey to stakeholders the implications of funding gaps on future pavement and bridge conditions. These examples can help other peers develop detailed 10-year financial plans for their future TAMP updates and also serve as another opportunity to communicate to stakeholders the importance of funding asset management.

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## Case Study on Financial Planning and Investment Strategies

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- <sup>1</sup> Kentucky Transportation Cabinet, June 2019 TAMP, p75
  - <sup>2</sup> Kentucky Transportation Cabinet, June 2019 TAMP, Chapter 5: Risk identification and Management, p56
  - <sup>3</sup> Kentucky Transportation Cabinet, June 2019 TAMP, p77
  - <sup>4</sup> Kentucky Transportation Cabinet, June 2019 TAMP, p27
  - <sup>5</sup> Kentucky Transportation Cabinet, June 2019 TAMP, p107
  - <sup>6</sup> Kentucky Transportation Cabinet, June 2019 TAMP, p110
  - <sup>7</sup> Michigan Department of Transportation, August 2019 TAMP, p37
  - <sup>8</sup> Michigan Department of Transportation, August 2019 TAMP, p37
  - <sup>9</sup> Michigan Department of Transportation, August 2019 TAMP, p40
  - <sup>10</sup> Michigan Department of Transportation, August 2019 TAMP, p46
  - <sup>11</sup> WSDOT Transportation Asset Management Plan, June 2019, p76
  - <sup>12</sup> WSDOT Transportation Asset Management Plan, June 2019, p57
  - <sup>13</sup> WSDOT Transportation Asset Management Plan, June 2019, p61
  - <sup>14</sup> New York State Department of Transportation, June 2019, pC-1
  - <sup>15</sup> New York State Department of Transportation, June 2019, p1-1
  - <sup>16</sup> Vermont Agency of Transportation, Transportation Asset Management Plan, June 2019, p3.
  - <sup>17</sup> Vermont Agency of Transportation June 2019 TAMP, Appendix B p21
  - <sup>18</sup> Illinois Department of Transportation, June 2019 TAMP, Executive Summary, pES-3
  - <sup>19</sup> Illinois Depart of Transportation, June 2019 TAMP, Executive Summary, pES-3
  - <sup>20</sup> Illinois Department of Transportation, June 2019 TAMP, Executive Summary, pES-2
  - <sup>21</sup> Illinois Department of Transportation, June 2019 TAMP, p79
  - <sup>22</sup> Illinois Department of Transportation, June 2019 TAMP, p23
  - <sup>23</sup> Illinois Department of Transportation, June 2019 TAMP, p79
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