Wisconsin Department of Transportation

2020-2029

TAMP

Transportation Asset Management Plan

Prepared in accordance with 23 USC Section 119
and 23 CFR Part 515

September 3, 2019

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September 3, 2019

Glen Fulkerson, Division Administrator
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Dear Mr. Fulkerson:

As required by 23 USC Section 119 and 23 CFR Part 515, the Wisconsin Department of Transportation (WisDOT) is submitting its Final Transportation Asset Management Plan (TAMP) to satisfy FHWA requirements related to the National Highway System.

WisDOT's goal is to keep all State Trunk Highway (STH) pavement and bridges in a state of good repair, delivering a high-quality STH system at minimum practicable cost. To achieve this goal, the department is committed to the pursuit of efficiency and to the use of the robust asset management principles detailed in the TAMP.

We have benefited from and appreciate FHWA's assistance throughout the TAMP development process.

Sincerely,

Craig Thompson
DOT Secretary-designee

Enclosure: Wisconsin's Final TAMP

Joseph Nestler, Administrator, Division of Transportation Investment Management
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Executive Summary

Wisconsin's State Trunk Highway (STH) system includes just 10 percent of the total highway and local road mileage in the state, but those miles are heavily used. Almost 60 percent of all vehicle miles traveled occur on the state highway system. These simple statistics underscore the critical importance of the system to Wisconsin's economy and to the mobility and quality of life of Wisconsin's citizens. A safe, efficient, reliable network of high-quality STH roads and bridges links Wisconsin's industrial, agricultural, tourism, and other businesses to the world. It provides access to jobs, educational opportunities, and the host of social and recreational activities that make Wisconsin a great place to live, work and play.

Managing the maintenance, improvement and operation of the STH system is the responsibility of the Wisconsin Department of Transportation (WisDOT). The agency's goal is for Wisconsin to keep all STH roads and bridges in a state of good repair, delivering a high-quality STH system at minimum practicable cost. To achieve this goal, WisDOT committed itself to the pursuit of efficiency and to the use of performance-based asset management principles. WisDOT's asset management systems reflect the agency's commitment to continuous improvement in its project planning and programming processes. WisDOT will always strive to sustain the highest quality system of STH roads and bridges possible within the funding made available through Wisconsin's Biennial Budget.

The NHS is a strategic system of roads and bridges important to the nation's economy, defense and mobility. The NHS includes the Interstate Highway System and other important state and local highways. The STH system includes 5,318 center line miles of NHS roadway and 3,253 NHS bridges. The WisDOT-owned NHS carries more than 80 percent of the vehicle miles traveled on the STH system. This makes the condition of WisDOT's NHS roadways and bridges important to both WisDOT and the Federal Highway Administration (FHWA). There are also 650 NHS center line miles and 310 NHS bridges under the jurisdiction of local governments in Wisconsin.

Federal law requires each state DOT to document its 10-year investment plan for the NHS in a TAMP. The NHS investment plan presented in the TAMP must be constrained by the level of funding expected to be reasonably available. Each state DOT must also develop targets for NHS pavement and bridge condition, demonstrate their NHS investment plan was developed using sound asset management processes, and document whether the plan will allow their NHS pavement and bridge targets to be met.

This TAMP presents WisDOT's investment plan for the state-owned NHS for the 10-years beginning with state fiscal year 2020 and extending through 2029. The investment plan assumes adoption of the transportation funding components of Governor Evers proposed 2019-2021 Biennial Budget, including the provision for indexing of the motor fuel tax. This assumption was necessary because of the legally required deadline for submitting this TAMP to

FHWA. That deadline was June 30, 2019, three days before the Governor signed AB 56 into law on July 3, 2019. The funding contained in AB 56 (the final 2019-2021 Biennial Budget) differs slightly from the levels assumed here and there is no provision for indexing of the motor fuel tax. However, the TAMP is a dynamic document and will be updated over time with new strategies and the most current budget assumptions available.

This TAMP was formally approved by FHWA on August 30, 2019. It reports the impact WisDOT's investment plan is expected to have on pavement and bridge conditions on the WisDOT-owned NHS and explains the rigorous, data-based, asset management principles and processes underlying WisDOT's NHS investment plan. The TAMP describes each of the Biennial Budget programs available for making investments in STH system infrastructure, along with the asset management principles and processes underlying the investment strategies in each program area. The processes WisDOT has in place to ensure the agency's NHS investment plan is implemented are also presented.

In setting the priorities and developing the investment strategies required to meet its goals for the STH system, WisDOT does not focus on the NHS per se. The agency's top priorities are safety, regardless of STH sub-system, the condition of all STH bridges, and the pavement and other roadway conditions on the Corridors 2030 Backbone system. The Backbone system includes all Interstate Highways (879 center line miles) plus an additional 718 center line miles of other high-volume STH roadways; all of them multi-lane, divided highways, and many built to freeway standards. Corridors 2030 Backbone highways are all part of the WisDOT-owned NHS, and form Wisconsin's premier highway system.

The investments in NHS infrastructure reported in the TAMP are drawn almost entirely from the State Highway Rehabilitation program, which funds a range of pavement and bridge rehabilitation and replacement projects, and from the Major Highway Development and Southeast Wisconsin Freeway Megaprojects programs, which fund costly infrastructure reconstruction and capacity expansion projects across Wisconsin. Over the 10-year TAMP analysis period, WisDOT anticipates investing $6.557 billion in state-owned NHS infrastructure.

The pavement and bridge condition data collected in 2018 and reported in the TAMP demonstrate Wisconsin highway users currently enjoy high-quality pavement and bridge conditions on the WisDOT-owned NHS. Assuming the Governor Evers proposed 2019-2021 Biennial Budget is adopted and increases in construction costs are in the range of 2.5% per year, implementation of the 10-year NHS investment strategy will continue to provide high-quality NHS pavement and bridge conditions in the coming years. Over the last decade, however, the funds available for investment in the maintenance and improvement of the STH system have not kept up with increases in construction costs. During this period, strong emphasis on improved efficiency and on sound asset management processes and priorities allowed WisDOT to sustain high-quality pavement and bridge conditions on the NHS and other

critical STH roadways. Adequate funding is critical to long-term pavement and bridge conditions on the NHS and across the non-NHS portion of the STH system. For Wisconsin to make long overdue improvements to the state's highways, funding must keep pace with the increasing system needs and construction costs over the coming decade.

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Chapter 1 Pavement and Bridge Performance on the WisDOT-Owned Portion of the National Highway System: Current Conditions and Condition Targets

Overview

Wisconsin's State Trunk Highway (STH) system continues to evolve to support the state's economy, the mobility needs of Wisconsin citizens and the broader public good. The STH system currently encompasses 11,742 center line miles and 5,277 bridges. While the STH system represents only 10 percent of all highway and local road mileage in the state, its critical importance is underscored by the fact that it has carried almost 60 percent of the annual vehicle miles of travel occurring on Wisconsin highways since the year 2000.

The Wisconsin Department of Transportation (WisDOT) is responsible for managing the maintenance, improvement and operation of the STH system, and its decisions rely on performance-based asset management principles. The investment strategies resulting from WisDOT's commitment to efficient and effective asset management are reviewed and updated as necessary to optimize STH system performance. Flexible and responsive planning, budgeting and project delivery processes ensure WisDOT makes the best possible use of the resources available.

A subset of the highways within the United States are designated as comprising the National Highway System (NHS). The NHS is made up of highways important to the nation's economy, defense and mobility. Nationally, the NHS is the highest priority portion of the highway system for the Federal Highway Administration (FHWA). The WisDOT-owned portion of the NHS makes up 45 percent of STH center line miles and carries 80 percent of STH vehicle miles. For this reason, the WisDOT-owned portion of the NHS is a priority WisDOT shares with FHWA.

This Transportation Asset Management Plan (TAMP) is prepared in response to federal law requiring each state DOT to document its plans for the NHS, in support of the broad national goals shown in Table 1-1. The TAMP describes WisDOT's investment strategies as they relate to the WisDOT-owned NHS. Consistent with both WisDOT and FHWA priorities, the TAMP describes the quality pavement and bridge performance currently experienced on the WisDOT-owned NHS. It also presents WisDOT's two and four-year targets for NHS pavement and bridge performance in Wisconsin. WisDOT believes meeting these targets will maintain Wisconsin's NHS pavements and bridges in a state of good repair.

The TAMP covers the 10-year period consisting of state fiscal years 2020 through 2029. By implementing the TAMP using a combination of state and federal funds, WisDOT believes those who rely on the WisDOT-owned NHS will continue to enjoy quality pavement and bridge conditions well into the future.

Table 1-1 National Goals for the Federal-Aid Highway Program [1/]

Goal Area	National Goal
Safety	To achieve a significant reduction in traffic fatalities and serious injuries on all public roads.
Infrastructure Condition	To maintain the highway infrastructure asset system in a state of good repair.
Congestion Reduction	To achieve a significant reduction in congestion on the NHS.
System Reliability	To improve the efficiency of the surface transportation system.
Freight Movement and Economic Vitality	To improve the National Highway Freight Network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.
Environmental Sustainability	To enhance the performance of the transportation system while protecting and enhancing the natural environment.
Reduced Project Delivery Delays	To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices.

[1/] 23 USC 150 (b).

The Inventory of WisDOT-Owned NHS Pavements and Bridges

Wisconsin's portion of the NHS totals approximately 5,967 center line miles of roadway and includes the following:

- NHS Interstate – Formally known as the Dwight D. Eisenhower National System of Interstate and Defense Highways, these highways retain a separate identity within the NHS;
- NHS Secondary Routes – These highways are secondary to the NHS Interstate, but remain important to the national economy, defense and mobility; and

- NHS Intermodal Connectors – These highways provide access between major intermodal facilities and other portions of the NHS.

Most of Wisconsin's NHS mileage, including the entire NHS Interstate, is WisDOT-owned, but some of the mileage is locally owned and outside WisDOT's jurisdiction. Chapter 8 discusses Wisconsin's locally owned NHS pavements and bridges in more detail. For a map of Wisconsin's NHS, see https://wisconsindot.gov/Pages/projects/data-plan/plan-res/nhs.aspx . Appendix H provides pavement and bridge inventory and condition information for Wisconsin's entire NHS, regardless of ownership.

Table 1-2 summarizes the current inventory of Wisconsin's WisDOT-owned NHS pavements and bridges. NHS center line miles can differ in terms of their number of lanes, making pavement lane miles the single best measure of the amount of pavement making up the WisDOT-owned NHS. By their nature, bridges vary by both length and width, making square feet of bridge deck the single best measure for the extent of the bridges needing to be managed on the WisDOT-owned NHS. For simplicity, Table 1-2 shows the inventory of pavements and bridges on NHS Secondary Routes and NHS Intermodal Connectors together, labeling them the Non-Interstate NHS.

Table 1-2 Current Inventory of WisDOT-Owned NHS Pavements and Bridges

NHS Sub-System	Pavements [1/]		Bridges [2/]	
	Center Line Miles	Lane Miles	Bridges	Sq. Ft. of Bridge Deck (Millions)
Interstate	878.53	3,931.75	1,297	17.8
Non-Interstate NHS	4,439.43	12,681.61	1,956	21.1
Total WisDOT-Owned NHS	5,317.96	16,613.36	3,253	38.9

[1/] For divided highways, one center line mile equals two roadway miles. Roadway and center line miles are equal for undivided highways. The pavement data is for 2018.

[2/] The bridge data is for 2018. Consistent with national definitions: a) only bridges more than 20 feet long (between abutments) are included in Table 1-2, and b) culverts more than 20 feet in width (length in the direction of travel) are counted as bridges.

The Value of WisDOT-Owned NHS Pavements and Bridges

The large inventory of WisDOT-owned NHS lane miles and bridges reflects the extensive financial commitment made when constructing WisDOT's NHS pavements and bridges. A

rudimentary estimate of the value of WisDOT's NHS pavement and bridge assets totals almost $45 billion and is shown in Table 1-3.

Table 1-3 Estimated Value of WisDOT-Owned NHS Pavement and Bridge Assets (State Fiscal Year 2019 $)

	Lane Miles	Estimated Replacement Cost (per lane mile) 1/	Estimated Replacement Cost
NHS Pavements	16613.36	$1,680,334	$27.9 Billion

	Sq. Ft. of Bridge Deck (millions)	Estimated Replacement Cost (per sq. ft.) 2/	Estimated Replacement Cost
NHS Bridges	38.9	$437	$17.0 Billion

1/ The estimated replacement cost per lane mile reflects a weighted average for differing types of pavement in rural and urban areas.

2/ The estimated replacement cost per square foot reflects the weighted average of the replacement costs for differing bridge configurations.

The Performance of WisDOT-Owned NHS Pavements and Bridges

Given the importance of the NHS as a national system, FHWA has defined performance measures for assessing NHS pavement and bridge conditions as part of their National Highway Performance Program (NHPP). FHWA's NHPP performance measures are intended to allow NHS pavement and bridge conditions to be meaningfully compared state to state, and states are required to develop targets for the NHS pavement and bridge conditions they are trying to achieve (23 CFR Part 490). The NHPP performance measures are described in Table 1-4.

Using NHPP definitions, the categorization of individual pavements and bridges (not including culverts counted as bridges) as being in either "good" or "poor" condition depends on three condition factors assessed as part of the regular pavement and bridge inspection processes. For each pavement lane mile, the three condition factors are the International Roughness Index (IRI), the degree of cracking and the degree of either pavement rutting or faulting (rutting for asphalt pavements and faulting for jointed concrete pavements). For each bridge, the three factors are the National Bridge Inventory (NBI) ratings for bridge deck, bridge superstructure and bridge substructure. The NBI rating for each factor is an integer value between 0 (failed condition) and 9 (excellent condition). Categorizing the performance of the culverts included in

Table 1-2 depends on the NBI rating factor for culvert condition, which is also an integer value ranging between 0 and 9.

Table 1-4 NHPP Pavement and Bridge Performance Measures [1/]

Pavement Performance Measures	Bridge Performance Measures
1. "Good" lane miles on the NHS Interstate (%) **2.** "Poor" lane miles on the NHS Interstate (%) **3.** "Good" lane miles on the non-Interstate NHS (%) **4.** "Poor" lane miles on the non-Interstate NHS (%)	**1.** "Good" NHS bridge deck area (%) **2.** "Poor" NHS bridge deck area (%)

[1/] Consistent with national definitions: a) only bridges more than 20 feet long (between abutments) are included, and b) culverts more than 20 feet in width (length in the direction of travel) are counted as bridges.

FHWA has defined the range of inspection values it believes determines whether the performance of an individual pavement is rated "good", "fair" or "poor". If all three conditions factors for a given pavement are "good", based on the latest inspection, FHWA rates the pavement as "good". If two or more of the condition factors are "poor", the pavement is rated as "poor". Pavements not falling into either of these categories are rated "fair".

Bridge performance (not including culverts counted as bridges) is classified as "good", "fair" or "poor" based on the lowest NBI rating for FHWA's three bridge condition factors. If the lowest rating among the three factors is a 7, 8 or 9, the bridge is rated as "good". If the lowest rating is a 5 or 6, the bridge is rated as "fair". If the lowest rating among the three condition factors is less than 5, the bridge is rated as "poor". Culverts counted as bridges are classified as "good", "fair" or "poor" based on the NBI rating factor for culvert condition using the same logic. A rating of 7, 8 or 9 means the culvert is classified as "good", and a rating less than 5 means the culvert is classified as "poor", with "fair" falling between these two extremes.

The current condition of WisDOT-owned NHS pavements and bridges is shown in Table 1-5. The data demonstrates that the pavements and bridges on the WisDOT-owned NHS are performing well. This positive outcome is a direct result of WisDOT's long-standing highway asset management approach. Since the late 1990's, WisDOT has used its asset management tools to help guide resource allocations and investment strategies relating to the STH system. WisDOT's investment strategy has consistently given high priority to investment needs relating to STH bridges and to pavements on Corridors 2030 Backbone routes. Corridors 2030 Backbone highways comprise the portion of the STH system of greatest importance to Wisconsin's

economic health and mobility. Backbone highways are Wisconsin's premier highway sub-system, making up 41 percent of the lane miles on the WisDOT-owned NHS. WisDOT recently updated its investment policies as part of its going commitment to asset management (see Chapter 5). This update will have a significant positive impact on the future pavement and bridge conditions experience on the WisDOT-owned NHS.

Table 1-5 Current Pavement and Bridge Conditions on the WisDOT-Owned NHS [1/]

NHS Infrastructure Component	Current Conditions (FHWA Performance Measures)		
	% Good	% Fair	% Poor
Interstate Lane Miles	59.1%	39.2%	1.7%
Non-Interstate NHS Lane Miles	36.2%	57.9%	5.9%
All NHS Pavement Lane Miles	41.5%	53.6%	5.0%
All NHS Bridge Deck Area	55.6%	42.7%	1.7%

[1/] The pavement and bridge conditions in this table reflect 2018 inspection data.

The data for NHS bridges in Table 1-5 reflects WisDOT's latest bridge inspections, using NBI data drawn from WisDOT's Highway Structures Information System (HSIS). The data for NHS pavements also reflects the latest conditions on the state-owned NHS based on WisDOT's Pavement Information File (PIF).

As noted above, WisDOT's investment strategy has consistently given high priority to the investment needs on STH bridges and pavements on Corridors 2030 Backbone routes. The positive impacts of this strategy are reflected in the current, high-quality, condition of WisDOT's NHS infrastructure. This is especially true for WisDOT's Interstate pavements and state-owned NHS bridges.

WisDOT's continued commitment to its long-standing asset management priorities is reflected in the pavement and bridge targets set for the Wisconsin portion of the NHS. In 2018, in compliance with 23 CFR Part 490 and 23 CFR Part 515, WisDOT set two and four-year targets for both the minimum percentage of "good" pavements and bridges and the maximum percentage of "poor" pavements and bridges on Wisconsin's Interstate and Non-Interstate NHS. These targets are shown in Table 1-6. A comparison with Table 1-5 demonstrates that the current condition of WisDOT's NHS pavements and bridges satisfies these target percentages.

WisDOT believes continuing to meet these targets will maintain WisDOT-owned NHS pavements and bridges in a state of good repair on an ongoing basis. The assessment of WisDOT's ability to continue meeting these targets will be based on HPMS and NBI data submitted to FHWA in 2020 and 2022, respectively. This data will reflect pavement and bridge condition surveys undertaken in calendar years 2019 and 2021.

Table 1-6 NHPP Pavement and Bridge Condition Targets for Wisconsin

	2020 Condition Targets (Two-year Targets)		**2022 Condition Targets** (Four-year Targets)	
	% Good	**% Poor**	**% Good**	**% Poor**
Interstate Pavements	≥ 45%	≤ 5%	≥ 45%	≤ 5%
Non-Interstate NHS Pavements	≥ 20%	≤ 12%	≥ 20%	≤ 12%
All NHS Bridges	≥ 50%	≤ 3%	≥ 50%	≤ 3%

The pavement targets in Table 1-6 are conservative. Conservative pavement targets were set because Wisconsin lacks experience using the NHPP pavement performance measures and has concerns about their ability to adequately portray the complexity of NHS pavement conditions and the types of improvements needed.

As an example of this concern, consider NHS concrete pavements. As discussed in Appendix A, WisDOT has a rich database containing reliable measurements on nearly a dozen pavement distress items for all STH pavements. The data is gathered and used according to rigorous national standards and measures (ASTM D6433) to express the condition of WisDOT's STH pavements using the Pavement Condition Index (PCI). WisDOT compared PCI-derived performance measures for NHS concrete pavements with the NHPP pavement performance measures for the same pavements and found that a significant percentage of the lane miles rated in "good"" condition using the NHPP metric were rated "fair" using the more comprehensive PCI measuring standard. Some were even rated "poor" using the PCI approach.

WisDOT understands the NHPP pavement performance metrics were created to allow national comparisons of pavement condition using inspection data it is reasonable for all states to collect. Moving forward, WisDOT will continue to make the detailed engineering decisions on STH pavement improvements using PCI and the individual distress items it incorporates.

However, as experience is gained with NHPP pavement performance information, WisDOT is committed to using it, as appropriate, to improve its asset management decision-making and priority setting processes and revise the targets set for Interstate and Non-Interstate NHS pavements. This commitment is consistent with WisDOT's ongoing process improvement initiatives and its efforts to make the best possible use of all available data and information when making investment decisions on the STH system.

The targets in Table 1-6 reflect the maximum percentages of "poor" NHS lane miles and NHS bridge deck area WisDOT believes are consistent with its commitment to high-quality infrastructure conditions. Rulemaking actions (23 CFR Part 490) by FHWA suggest national expectations for the maximum acceptable percentages for "poor" Interstate lane miles and NHS bridges. Restrictions on the use of future federal highway funding can be applied if the percentage of "poor" Interstate lane miles exceeds 5 percent. For NHS bridges, funding restrictions can begin to be applied if the percentage of "poor" NHS bridge deck area exceeds 10 percent. WisDOT is fully committed to avoiding these potential funding restrictions and has set its targets for "poor" Interstate pavements and NHS bridges accordingly.

Given the priority WisDOT places on STH bridges generally, Wisconsin has set the two and four-year targets for the percentage of "poor" NHS bridge deck area at a maximum of 3 percent, or less than half of FHWA's maximum acceptable level for NHS bridge deck area. The two and four-year targets for "poor" Interstate lane miles both call for a maximum of 5 percent, consistent with the FHWA limit, while the targets for the maximum percentage of "poor" Non-Interstate NHS lane miles are set at 12 percent. The lane mile weighted average of these two targets implies 10 percent is WisDOT's maximum acceptable "poor" percentage for NHS pavement lane miles, the same as FHWA's maximum acceptable percentage of "poor" NHS bridge deck area. If a maximum percent "poor" of 10 percent is acceptable for NHS bridges, WisDOT believes it is certainly acceptable as the maximum percent "poor" for NHS pavements. The two and four-year targets for the minimum percentage of "good" NHS pavement lane miles and bridge deck area reflects Wisconsin's emphasis on bridges and its commitment to high-quality NHS infrastructure, maintained in a state of good repair.

As part of its strong commitment to using PCI-derived information to inform the many decisions necessary to effectively manage Wisconsin's investment in the STH system, WisDOT has long-standing PCI-based targets for STH pavement condition in addition to the NHPP targets reported in Table 1-6. WisDOT's PCI-based targets are reported as part of WisDOT's MAPSS Performance Improvement Program Scorecard. See https://wisconsindot.gov/Pages/about-wisdot/performance/mapss/goalpreservation.aspx for more information.

WisDOT's PCI targets are shown in Table 1-7. These targets are consistent with the targets established for the NHPP pavement performance measures and are based on roadway miles (one mile of divided highway equals two roadway miles). Interstate highways within Wisconsin

comprise approximately 55 percent of Corridors 2030 Backbone roadway miles, and all Backbone highways are designated as part of the NHS. Non-Corridors 2030 Backbone highways make up the remainder of the STH system and consist of both NHS and non-NHS routes. Recent Backbone and non-Backbone pavement performance has exceeded these PCI targets and has been trending upward, reflecting WisDOT's strategic use of highway improvement funding and reliance on asset management principles to assure the long-term health of the STH system.

Table 1-7 WisDOT's PCI Performance Targets for the STH System
Source: MAPSS

	% With PCI Fair and Above
Corridor 2030 Backbone Pavements	≥ 90%
Non-Corridors 2030 Backbone Pavements	≥ 80%

In what follows, Chapters 2-7 describe the funding programs available to manage the maintenance, improvement and operation of the STH system, including the WisDOT-owned NHS. WisDOT's performance-based asset management investment strategies are described, along with a summary of the investments anticipated on the WisDOT-owned NHS over the 10-year period from state fiscal year 2020 through 2029 (see Chapter 6). Chapter 6 also compares the NHS pavement and bridge conditions expected to result from those investments to Wisconsin's two and four-year NHPP pavement and bridge targets. As noted earlier, Chapter 8 discusses Wisconsin's locally owned NHS pavements and bridges in more detail.

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Chapter 2 The Funding Programs Impacting the WisDOT-Owned Portion of the National Highway System and the Funding Assumptions Underlying the TAMP

Overview

The Wisconsin Department of Transportation's (WisDOT's) funding for maintenance, improvement, and operation of Wisconsin's State Trunk Highway (STH) system is contained in a set of budget appropriations approved during the State's Biennial Budget process occurring during odd-numbered calendar years. Each new state fiscal year begins on July 1. The types of highway and bridge work that can be paid for using funds contained in each budget appropriation is defined by Wisconsin law.

WisDOT is committed to working with the Governor and Legislature to allocate available funding across STH-related budget appropriations in a flexible manner, consistent with addressing the highest priority investment needs on the STH system. The following budget appropriations are available for the maintenance, improvement and operation of Wisconsin's STH system:

- State Highway Rehabilitation (SHR);
- Major Highway Development (Majors);
- Southeast Wisconsin Freeway Megaprojects (SEF);
- Major Interstate Bridge (MIB);
- High Cost State Bridge (HCB); and
- State Highway Maintenance and Traffic Operations (M&O).

State law provides SHR funding for the improvement of existing state trunk highways and bridges. MIB and HCB funding is provided for stand-alone bridge projects with costs exceeding limits set by state law. Majors funding is provided for high-cost projects typically involving reconstruction and expansion of the STH system, where "high-cost" is statutorily defined. Projects on the southeast Wisconsin freeway system, with a cost exceeding a statutory minimum, are defined as "megaprojects" and must be paid for using SEF funding.

WisDOT cannot unilaterally select projects for Majors, SEF, MIB and HCSB funding. The processes involved in developing these programs are described in Chapters 3 and 4.

The State Highway Rehabilitation Program

The SHR program funds a broad range of improvements on the STH system. It cannot, in general, be used for M&O-type activities. A partial list of typical SHR improvements includes the following: bridge preservation and rehabilitation activities such as deck overlays, deck replacements and bridge painting; pavement preservation and rehabilitation activities such as

pavement resurfacing and pavement replacement; improvements to safety through the redesign of dangerous intersections and the modification of roadway curvature or grade in high crash locations; and roadway and bridge reconstruction, when appropriate. SHR projects can include funding for some M&O-type activities, such as the installation or replacement of highway signs, traffic control signals, ITS infrastructure, highway lighting and lane marking, if those activities are incidental to the other SHR-eligible improvement activities being performed in conjunction with the project.

WisDOT has the flexibility to allocate SHR funding to the specific set of highway and bridge improvement projects it believes best fulfills the agency's asset management mission. The policies guiding identification of these projects are expressed through WisDOT's SHR investment strategy. Development of the SHR investment strategy is overseen by the Division of Transportation Investment Management (DTIM) Bureau of State Highway Programs (BSHP), with critical input from DTSD Region and Central Office staff. The process for developing the SHR investment strategy is described in Chapter 5. M&O funded activities are coordinated with SHR to preserve STH highway and bridge infrastructure in a cost-effective manner.

The improvements funded by the SHR program are primarily managed through two sub-programs. The Backbone Program covers SHR improvements on Corridors 2030 Backbone routes. The Region 3R Program covers SHR improvements on the remainder of the STH system. Management of the Backbone Program is centralized, with critical input from staff in each DTSD Region. Management of the Region 3R Program occurs at a Region level. 3R projects are identified and scheduled by staff in each DTSD Region under funding and policy guidance from DTIM and the DTSD Central Office.

The Major Highway Development and Southeast Wisconsin Freeway Megaproject Programs

Majors projects currently cost a minimum of $36.4 million and reconstruct or recondition an existing highway while adding lanes five or more miles in length to improve safety and traffic flow. Projects meeting this $36.4 million threshold that build new or relocate existing highways for 2.5 miles or more are also defined as Majors, as are projects that improve at least 10 miles of an existing multi-lane divided highway to freeway standards. In addition, any project currently costing a minimum of $91.1 million is also defined as a Majors project unless it is otherwise defined as a MIB, HCSB or SEF project. The cost thresholds listed above are adjusted annually to reflect increases in highway construction costs due to inflation. (See s. 84.013 for full details on the definition of a Majors project.)

SEF projects are defined as any project on a southeast Wisconsin freeway having a total cost exceeding $609.5 million. The latter cost threshold is adjusted annually to reflect increases in highway construction costs due to inflation. For this purpose, a southeast Wisconsin freeway is

defined as a freeway-type facility located on the STH system in Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington or Waukesha counties. Southeast Wisconsin freeways are all part of the WisDOT-owned NHS. (See S. 84.0145 for more details.)

The Major Interstate Bridge and High Cost State Bridge Programs

Bridge projects within the MIB program are defined as projects involving the construction or reconstruction of an STH bridge, including approaches, that crosses a river forming a boundary of Wisconsin where WisDOT's estimated cost share is at least $100 million. (See s. 84.016 (1) and (2) for more detail.) Bridge projects within the HCSB program are defined as projects involving the construction or rehabilitation of an STH bridge, including approaches, that does not cross a river forming a boundary of Wisconsin where the estimated cost exceeds $150 million. (See s. 84.017 (1) and (2) for more detail.) Currently, there are no provisions to adjust the dollar amounts in s. 84.016 (1) and s. 84.017 (1).

The State Highway Maintenance and Operations Program

Routine maintenance activities involve the daily or periodic repair and upkeep of the STH system. The M&O program is managed by staff in the Division of Transportation Systems Development (DTSD) Region offices working together with DTSD's Central Office staff. Most M&O activities are implemented using a work force and equipment made available through Wisconsin's counties. Counties are reimbursed for their work based on their labor and machinery costs and any materials supplied.

A partial list of routine maintenance activities includes the following: roadway surface, base and shoulder repair; minor bridge repair; drainage and culvert repair; repair of guard rails, traffic signs and other safety measures; and the maintenance of rest areas, information centers, waysides and similar roadside facilities. Besides funding routine maintenance activities, the M&O program also funds winter maintenance (plowing and deicing) and traffic operations. Traffic operations activities are designed to improve safety, manage congestion, mitigate delays, enable emergency response, warn and guide motorists, and optimize the operational performance of the STH system. The operation and maintenance of traffic control and intelligent transportation systems (ITS) are integral to traffic operations. The installation of traffic control and ITS hardware is sometimes funded as incidental to highway improvement projects within a non-M&O state highway program.

Given the difficulty of assigning M&O costs directly to the WisDOT-owned portion of the National Highway System (NHS), M&O activities are not included as part of this 10-year Transportation Asset Management Plan (TAMP). Such activities are, however, important to achieving WisDOT's NHS pavement and bridge condition targets over time. WisDOT's strong

commitment to and support for M&O activities as part of its asset management strategy is demonstrated by a 12 percent increase in M&O funding in the 2017-2019 Biennial Budget. That funding level continues in the proposed 2019-2021 Biennial Budget.

Information generated by WisDOT's pavement and bridge asset management systems is available to DTSD Region M&O staff to help focus cost-effective M&O activities where and when needed. In Wisconsin, STH maintenance activities are performed by county government employees under contract with WisDOT. DTSD Region M&O staff coordinate with the county maintenance forces on both routine and non-routine maintenance activities.

The Funding Assumptions Underlying the TAMP

Table 2-1 presents the funding levels assumed for this TAMP, representing the funds WisDOT expects to be reasonably available to support the management and operation of Wisconsin's STH system, including the state-owned NHS.

Table 2-1 Assumed Funding for State Highway Programs, by Fund Source
(Millions of YOE$)

State Fiscal Years 2019-2024

Program Area		2019	2020	2021	2022	2023	2024
SHR	**Total**	**$807.6**	**$928.9**	**$1,008.9**	**$1,029.5**	**$1,051.9**	**$1,075.6**
	State	$383.6	$503.2	$643.2	$656.5	$671.4	$687.5
	Federal	$424.0	$425.7	$365.7	$373.0	$380.5	$388.1
Majors and SEF	**Total**	**$590.6**	**$340.1**	**$490.1**	**$497.3**	**$504.8**	**$512.6**
	State	$34.5	$44.8	$74.8	$76.3	$78.1	$79.9
	Bond	$238.3	$228.7	$283.7	$289.4	$295.2	$301.1
	Federal	$317.8	$66.6	$131.6	$131.6	$131.6	$131.6
MIB and HCSB	**Total**	**$8.0**	**$27.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**
	State	$8.0	$0.0	$0.0	$0.0	$0.0	$0.0
	Bond	$0.0	$27.0 [1/]	$0.0	$0.0	$0.0	$0.0
M&O	**Total**	**$300.4**	**$300.3**	**$300.3**	**$306.5**	**$313.4**	**$321.0**
	State	$299.3	$299.2	$299.2	$305.4	$312.3	$319.8
	Federal	$1.1	$1.1	$1.1	$1.1	$1.1	$1.2
	Total	**$1,706.6**	**$1,596.3**	**$1,799.3**	**$1,833.3**	**$1,870.1**	**$1,909.2**

[1/] All $27 million is in MIB: including $17 million in new bond authority and $10 million transferred from HCSB.

State Fiscal Years 2025-2029

Program Area		2025	2026	2027	2028	2029
SHR	**Total**	**$1,099.5**	**$1,123.5**	**$1,147.7**	**$1,172.1**	**$1,197.0**
	State	$703.6	$719.8	$735.9	$752.0	$768.5
	Federal	$395.9	$403.8	$411.9	$420.1	$428.5
Majors and SEF	**Total**	**$520.5**	**$528.5**	**$536.6**	**$544.9**	**$553.3**
	State	81.8	83.7	85.5	87.4	89.3
	Bond	307.1	313.2	319.5	325.9	332.4
	Federal	131.6	131.6	131.6	131.6	131.6
MIB and HCSB	**Total**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**
	State	$0.0	$0.0	$0.0	$0.0	$0.0
	Bond	$0.0	$0.0	$0.0	$0.0	$0.0
M&O	**Total**	**$328.5**	**$336.0**	**$343.5**	**$351.1**	**$358.8**
	State	$327.3	$334.8	$342.3	$349.8	$357.5
	Federal	$1.2	$1.2	$1.2	$1.3	$1.3
	Total	**$2,035.1**	**$1,932.3**	**$2,142.8**	**$2,184.4**	**$2,228.9**

The entries in Table 2-1 are expressed in year of expenditure dollars (YOE$). Funding shown for state fiscal year 2019 is outside the TAMP analysis period and is provided for historical perspective. The funding shown in state fiscal years 2020 and 2021 is consistent with the 2019-2021 Biennial Budget proposed by Governor Tony Evers and submitted to the Wisconsin Legislature on February 28, 2019. (The final biennial budget is unlikely to be approved until after the due date for the TAMP.)

For state fiscal years 2022 and beyond, Table 2-1 incorporates the following assumptions regarding the level of funding reasonably available for state highway improvement programs:

1. State funds will increase consistent with expected increases in the motor fuel tax rate consistent with the fuel tax indexing provision contained in Governor Evers proposed biennial budget. Under the proposed indexing provision, the motor fuel tax rate will be adjusted every April 1st, beginning in 2020. The adjustment will reflect the increase in the U.S. Bureau of Labor Statistics Consumer Price Index for All Urban Consumers (CPI-U, U.S. city average) over the preceding two calendar years. Forecasts for CPI-U over the TAMP analysis period were obtained from IHS Global Insight.
2. Federal funds are expected to increase 2 percent annually beginning in SFY 2022.
3. Bonding will be held constant at SFY 2021 levels.

While WisDOT believes these assumptions are reasonable for use in developing the TAMP, future biennial budgets approved through the legislative process will determine the actual mix of state, federal and bond funding in each program area.

Chapter 3 Developing the Major Highway Development and Southeast Wisconsin Freeway Megaprojects Program Investment Strategies

Overview

The Wisconsin Department of Transportation (WisDOT) is committed to ongoing and effective stewardship of the financial resources Wisconsin's Biennial Budget provides for the maintenance, operation and improvement of the State Trunk Highway (STH) system. The Biennial Budget provides funding to WisDOT through a set of legislatively determined budget appropriations. The three largest improvement appropriations fund investments within the State Highway Rehabilitation (SHR), Major Highway Development (Majors) and Southeast Wisconsin Freeway Megaprojects (SEF) programs. The projects undertaken using Majors and SEF funding are WisDOT's largest and most costly. These projects not only rehabilitate and rebuild aging highway infrastructure, they enhance safety and increase the ability of the infrastructure to effectively handle growing traffic volumes, typically by providing an increase in the number of through travel lanes.

Because of their significant costs, there are relatively few Majors and SEF projects approved for funding at any given time. Unlike projects in the SHR program, Majors and SEF projects require the specific approval of the Governor and the Legislature through the Biennial Budget. Processes have been developed to ensure all Majors and SEF projects are thoroughly vetted, and well-justified before being approved. WisDOT works together with the Governor and Legislature to ensure only the highest priority projects are brought forward and that those projects have strong public support. The processes used to vet proposed projects are fully consistent with WIsDOT's commitment to responsible data-driven stewardship of the STH system.

The Transportation Projects Commission and Enumerated Majors Projects

The Transportation Projects Commission (TPC) was created in 1983 to review potential Majors projects and make recommendations to the Governor and Legislature regarding Majors that should be "enumerated" (i.e. authorized, by name, in state law). Without enumeration, WisDOT cannot proceed with the construction of a Majors project. Many factors define what is and is not a Majors project, but enumerated Majors typically reconstruct an existing highway while adding lanes for through traffic for more than five miles. (See Chapter 2 for further discussion of how Majors projects are defined.)

The TPC has 15 members, including five state Senate members, five state Assembly representatives and three citizen members. The Governor serves as TPC Chairman, and the WisDOT Secretary serves as a non-voting member. The commission is authorized to consider

potential Majors projects on a two-year cycle and meets only as necessary. WisDOT managers serve as staff to the TPC.

In fall of odd-numbered years, the TPC is authorized to review and approve potential Majors projects to advance to environmental study. WisDOT will only recommend potential high priority projects for TPC consideration and only after completing a thorough, data-driven, analysis of potential Majors across Wisconsin. In recommending a potential project for environmental study, WisDOT considers the relative urgency of its current and anticipated safety and traffic congestion needs, the condition of its pavement and bridge infrastructure and the benefits the potential project would provide to highway users as well as to state and regional economic development.

WisDOT cannot perform an environmental study on a potential Majors project until a study is approved by the TPC. The type of environmental study required is dictated by state and federal environmental law. In most cases, this involves a full Environmental Impact Statement (EIS), although in some cases a less extensive Environmental Assessment (EA) may be appropriate. The cost of performing an EIS (or EA) is significant and is funded within the budget for the Majors program. Potential studies compete for funding with the construction of already enumerated projects, so the TPC only approves study candidates they consider to be the highest priority. Completing the EIS process typically requires several years and involves extensive public input.

In the fall of even-numbered years, the TPC is authorized to review and recommend potential Majors projects for enumeration. The TPC cannot recommend enumeration until a final EIS (or EA) is approved by the Federal Highway Administration (FHWA). In addition, state law prevents the TPC from recommending projects for enumeration unless construction on the projects can begin within six years of enumeration.

WisDOT assists the TPC in their consideration of candidate enumerations by conducting an analysis and ranking of the candidates using a process defined in Administrative Rule (Trans 210). When potential enumerations are under review, the TPC has until December 15th to report its recommendations to the Governor (and Governor-Elect, if applicable), the Legislature and the Joint Committee on Finance. This allows time for the Governor (or Governor-Elect) to consider whether to include recommended enumerations in their proposed Biennial Budget, which is submitted to the Legislature the following January. WisDOT is not authorized to begin construction on an enumerated Majors project until the Biennial Budget containing the enumeration is signed into law.

WisDOT currently has seven Majors projects actively under construction (see Table 3-1). Majors projects have construction scheduled over many years, reflecting their cost and complexity.

Majors funding is allocated to specific projects on an annual basis consistent with an appropriate staging of construction and other activities. Costs are closely monitored at the project level to keep project costs within the overall project estimate. Costs are also managed at the program level to ensure the sum across all projects in each year remains within the total funding available. Once a Majors project is complete, the ongoing maintenance, operation and rehabilitation of the infrastructure is funded using Maintenance and Operations (M&O) and SHR funds.

Table 3-1 lists the seven enumerated Majors currently under construction. Each of these projects is located on the National Highway System (NHS) and, therefore, is part of WisDOT's NHS investment strategy (see Chapter 6).

Table 3-1 Currently Enumerated Major Projects

Project	Highway Number	Project Limits
1	USH 10	USH 10 – USH 10/441
2	STH 15	STH 76 – New London
3	USH 18/151	Verona Road
4	STH 23	STH 67- USH 41
5	IH 39/90	USH 12 to Illinois
6	STH 50	IH 94 – 43rd Avenue
7	USH 53	La Crosse Corridor

In addition to the projects in Table 3-1, the Governor's proposed 2019-2021 Biennial Budget provides for the enumeration of an additional project under the Majors program: IH 43 between Silver Spring Drive and STH 60 In Milwaukee and Ozaukee Counties. This project was recommended for enumeration by the TPC in 2014, but not enumerated at that time. Costs for the IH 43 project are not reflected in the NHS investment strategy presented in Chapter 6 for two reasons. First, approval for the enumeration of IH 43 will not occur prior to the due date for this TAMP. Second, assuming it is enumerated, an accurate schedule of the costs for IH 43 cannot be prepared until design engineering and other project development activities are well underway. Scheduled costs for IH 43 will be reflected in future TAMP updates as appropriate.

Enumerating Southeast Wisconsin Freeway Megaprojects

The Southeast Wisconsin Freeway Megaprojects program (SEF) is designed to fund improvement projects on the southeast Wisconsin freeway system currently costing more than $609.5 million. Authorization to proceed with the construction of a SEF megaproject can only occur after the enumeration of the project in the Biennial Budget.

The SEF program was created in 2011 (an earlier version was created in 2001). Although SEF projects are defined solely in terms of location and cost, they share similarities with Majors projects that reconstruct aging highway infrastructure, enhance safety and add lanes for through traffic.

The enumeration process for SEF projects does not involve the TPC. However, as with Majors, WisDOT reviews a broad array of factors to develop priorities for future southeast Wisconsin freeway megaprojects. Among the list of factors considered are infrastructure conditions, safety and capacity needs, state and regional economic development trends, public preferences and potential benefits to highway users. With priorities in place, WisDOT works with the Governor and Legislature in seeking enumeration of each SEF project and ongoing funding for its construction.

Currently, two SEF megaprojects are enumerated for construction, the Zoo Interchange and the IH 94 North-South Corridor. Each of these projects is located on the NHS and is part of WisDOT's NHS investment strategy presented in Chapter 6.

Inclusion of Majors and Southeast Wisconsin Freeway Megaprojects in the TAMP

As noted above, WisDOT has nine enumerated Majors and SEF projects currently under construction, and all are located on the NHS. WisDOT's investment strategy for completing the projects is summarized in Chapter 6. The investment strategy is consistent with the Wisconsin Department of Transportation Report to the Transportation Projects Commission on the Status of Major Highway Projects and Southeast Wisconsin Freeway Megaprojects, dated February 2019 (see https://wisconsindot.gov/Pages/SearchResults.aspx?q=transportation projects commission).

The construction schedules for enumerated Majors and SEF projects limit improvements called for as part of WisDOT's optimal State Highway Rehabilitation (SHR) investment strategy (see Chapter 5). If a pavement segment or bridge deck requires rehabilitation prior to its replacement by an enumerated Majors or SEF project, the required pavement and bridge work is performed for minimum possible cost. If the need is within five years of the scheduled infrastructure replacement, it is assumed the need will be addressed through the State Highway Maintenance and Operations (M&O) program, thereby deferring the capital improvement until

the Majors or SEF project occurs. This helps ensure the financial and system performance information in the TAMP is fully consistent with both the schedule for completing Majors and SEF projects and with WisDOT's SHR and M&O policies.

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Chapter 4 Developing the Major Interstate Bridge and High Cost State Bridge Program Investment Strategies

Overview

The Wisconsin Department of Transportation (WisDOT) typically funds individual bridge projects on the State Trunk Highway (STH) system through the State Highway Rehabilitation (SHR) program. Exceptions exist for bridges funded as part of larger projects within either the Major Highway Development (Majors) or Southeast Wisconsin Freeway Megaprojects (SEF) programs, and for high cost bridges that cannot be reasonably accommodated within SHR. Bridges in the latter category are funded through either the Major Interstate Bridge (MIB) or High Cost State Bridge (HCSB) programs. The eligibility criteria for these programs are defined by state law and were summarized in Chapter 2. Bridge projects funded through these programs occur infrequently. When they do arise, WisDOT works with the Governor and Legislature to obtain funding through the Biennial Budget.

Identifying Major Interstate Bridge and High Cost State Bridge Projects

Bridge projects funded through the MIB and HCSB programs are identified using the same data-driven asset management processes used to identify SHR-funded bridge projects on the STH system. Bridges are inspected on a regular cycle and the data is used by the Wisconsin Structures Asset Management System (WiSAMS) to help determine the need for and timing of bridge maintenance, rehabilitation and reconstruction projects. (See Appendix B for a more complete discussion of WiSAMS.)

To-date, the only bridge funded through the MIB program has been the Stillwater Bridge (also called the St. Croix Crossing) carrying STH 64 over the St. Croix River between Wisconsin and Minnesota in northwest Wisconsin. The only HCSB project funded-to-date has been the Hoan Bridge, carrying I-794 over the Milwaukee harbor. Both bridge projects were on the NHS and work on them is complete, although the proposed 2019-2021 Biennial Budget provides $27 million in bond authority related to the Stillwater Bridge. Although work on the bridge is complete, having this bonding authority in place is essential until all matters involving the bridge are resolved between the Minnesota Department of Transportation, WisDOT, and project contractors. Since it is unknown how much of this bonding will ultimately be required, none of this funding is listed as part of WisDOT's NHS investment strategy in Chapter 6.

WisDOT's Transportation Asset Management Plan (TAMP) covers state fiscal years 2019 through 2029. Two significant bridge replacement projects are currently under study and may need to be funded by the MIB and HCSB programs within this time-period. Program eligibility

will depend on the combined cost of the improvements required to the bridges and their approaches. Both projects are located on the NHS.

The Blatnik Bridge carries USH 53 and IH 535 over the St. Louis River between Wisconsin and Minnesota in Duluth/Superior. Options for replacement of the Blatnik are currently under study through a joint effort led by Minnesota DOT (MnDOT). The estimated cost for the Wisconsin portion of the bridge replacement will easily qualify the project for the MIB program.

A condition assessment is currently underway. The assessment will identify a more specific scope for the project, clarify the timeline of the main span replacement and evaluate the need for approach work. Construction may be ready to begin as early as state fiscal year 2028.

The Wisconsin River Bridge carries IH 39 across the Wisconsin River just west of Portage. The bridge will need replacement. Although the timing of the eventual replacement is uncertain, options are currently under study. As with the Blatnik, the cost of the bridge replacement project that emerges from the study phase will likely disqualify the project from SHR funding. Depending on cost, replacement of the Wisconsin River bridge could require funding through either the HCSB or Majors programs.

Given the current level of uncertainty surrounding the estimated costs and timing of both bridge replacement projects, the estimated costs for replacing the Blatnik and Wisconsin River bridges are not included as part of the NHS investment strategy presented in Chapter 6. As project development efforts continue, and these uncertainties are resolved, WisDOT will work with the Governor and Legislature to ensure these important projects are appropriately funded. Future TAMP updates will include costs and schedule information for these projects when appropriate.

Chapter 5 Developing the State Highway Rehabilitation Program Investment Strategy

Overview

The purpose of the Wisconsin Department of Transportation's (WisDOT's) Transportation Asset Management Plan (TAMP) is to describe WisDOT's highway investment strategy as it applies to the WisDOT-owned portions of the National Highway System (NHS) during the 10-year period covering state fiscal years 2020 to 2029. WisDOT's NHS investment strategy is one component of its overall investment strategy for the State Trunk Highway (STH) system. WisDOT's goal in defining its overall STH investment strategy is to provide for safe and efficient travel, over STH pavements and bridges kept in a state of good repair.

As noted in Chapter 2, the maintenance, improvement, and operation of the STH system is accomplished using funds contained in legislatively determined budget appropriations. The State Highway Rehabilitation (SHR) program is for the "improvement" of existing state trunk and connecting highways and bridges. SHR funding cannot be used for "maintenance and operations" (M&O) activities, southeast Wisconsin freeway megaprojects (SEF), high-cost major interstate bridge projects (MIB) spanning a river forming a state border, other high-cost state bridge projects (HCSB), or major highway projects (Majors). SHR funding can be used for a limited number of specific M&O-type activities, but only if those activities are incidental to the improvement of an existing state trunk or connecting highway or bridge.

Within these limits, WisDOT allocates SHR funding to the set of highway and bridge projects it believes best meets WisDOT's policy and performance goals. The policies guiding identification of these projects are expressed through WisDOT's SHR investment strategy. Development of the strategy is overseen by the Division of Transportation Investment Management (DTIM) Bureau of State Highway Programs (BSHP), with critical input from the Regions and Central Office Bureaus of the Division of Transportation System Development (DTSD). Development of WisDOT's SHR investment strategy relies heavily on the Meta-Manager Highway Asset Management System (MMS) and WisDOT's pavement and bridge asset management systems (see Appendices A, B and C). These systems help WisDOT identify highway and bridge improvement needs and understand the longer-term performance impacts of alternative SHR investment strategies over time.

Selection of the "optimal" SHR investment strategy defines the appropriate scope and priority for SHR investments addressing highway and bridge improvement needs on the STH system. It also helps define the appropriate split of SHR funding into WisDOT's SHR sub-programs. SHR sub-programs are defined for Corridors 2030 Backbone highways and bridges (the Corridors 2030 Backbone Program) and non-backbone highways and bridges (the Region 3R Program).

There is also a sub-program called SHR Large Bridge, for bridges that are too large to be easily accommodated within the Region 3R Program.

Table 5-1 provides a breakdown of the NHS and non-NHS roadways and bridges located on the Corridors 2030 Backbone and Region 3R systems. A map of the Corridors 2030 Backbone and Region 3R systems is shown in Figure 5-1. Note that the entire Corridors 2030 Backbone system is part of the NHS.

Management of the Corridors 2030 Backbone Program is centralized, with critical input from staff in each DTSD Region. Management of the Region 3R Program occurs at the Region level. 3R projects are identified and scheduled by staff in each DTSD region under funding and policy guidance from DTIM and the DTSD Central Office. Regardless of program management responsibility, the SHR projects selected for funding are heavily influenced by the highway and bridge projects identified as priorities by the MMS under the optimal SHR investment strategy. The optimal SHR investment strategy is, in turn, influenced by any gaps between WisDOT's pavement and bridge performance goals and the actual and anticipated performance of the STH system. Implementation of the Corridors 2030 Backbone and Region 3R Programs consistent with WisDOT's SHR investment strategy is critical to achieving acceptable STH system performance over time. By implementing these programs, WIsDOT will achieve its pavement and bridge performance goals. Chapter 7 includes a discussion of WisDOT's SHR program effectiveness measures (PEM) and their use in managing the Region 3R Program.

WisDOT's Approach to Defining Alternatives for SHR Highway and Bridge Projects

The MMS is discussed in detail in Appendix C. For highways, the MMS contains data for approximately 19,500 +/- one-mile roadway segments. For bridges, MMS data is defined at the individual bridge level. This section describes the scoping concepts reflected in the asset management tools developed for SHR highway and bridge projects. WisDOT's optimal SHR investment strategy limits the SHR treatments allowed on pavements and bridges affected by projects already scheduled within the Majors, SEF, MIB and HCSB programs. The optimal SHR strategy provides for the minimum SHR investment required to keep those pavements and bridges in acceptable condition until the more extensive improvements required are completed through those programs. Chapter 3 provided a discussion of the process used in developing the Majors and SEF projects included in the TAMP. Chapter 4 discussed the potential for future MIB and HCSB projects on the WisDOT-owned NHS.

Highway Project Scoping

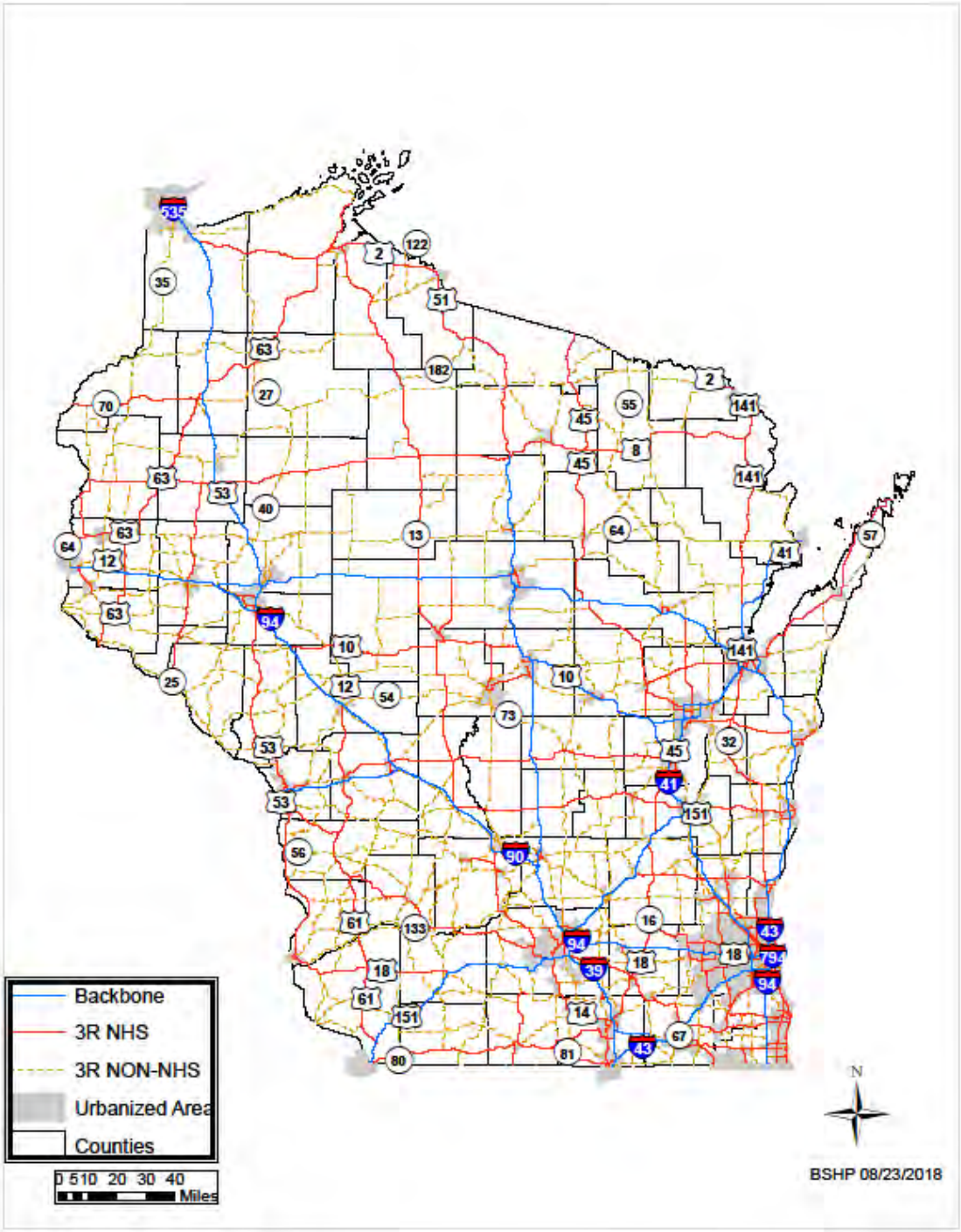
Once constructed, pavement conditions and ride deteriorate due to the cumulative impact of traffic, weather and other factors (including the pavement's design and its maintenance and

Table 5-1 STH Roadways and Bridges Located on the Corridors 2030 Backbone And Region 3R Systems

	NHS			
	Roadway		Bridge	
	Center Line Miles	Lane Miles	# of Bridges	Sq. Ft. of Bridge Deck (Millions)
Backbone System				
Interstate	878.53	3,931.75	1,297	17.8
Non-Interstate	718.33	2,864.85	750	9.0
Total Backbone	1,596.86	6,796.60	2,047	26.8
Region 3R System				
Principal Arterial	3,642.89	9,658.86	1,085	11.1
Minor Arterial	78.21	157.90	90	0.7
Collector	0.00	0.00	31	0.3
Total Region 3R	3,721.10	9,816.76	1,206	12.1

	Non-NHS			
	Roadway		Bridge	
	Center Line Miles	Lane Miles	# of Bridges	Sq. Ft. of Bridge Deck (Millions)
Backbone System				
Interstate	0.00	0.00	0	0.0
Non-Interstate	0.00	0.00	0	0.0
Total Backbone	0.00	0.00	0	0.0
Region 3R System				
Principal Arterial	275.62	718.78	21	0.2
Minor Arterial	4,732.30	9,560.25	1,151	7.2
Collector	1,409.00	2,824.02	522	3.3
Local	7.50	15.00	330	3.3
Total Region 3R	6,424.42	13,118.05	2,024	14.0

Figure 5.1 STH Roadways on the Corridors 2030 Backbone and Region 3R Systems



pavement section. (See Appendix A for more detail on the distress types surveyed). The detailed distress information is summarized into an overall measure of pavement condition called the Pavement Condition Index (PCI). PCI and detailed distress information forms the starting point for scoping highway projects.

WisDOT's Pavement Management Decision Support System (PMDSS) bases its assessment of alternative pavement treatments on the type and amount (density) of distress present on each PIF segment. Generally, two pavement treatments are identified by PMDSS. The "Best Value" treatment is the treatment having the lowest cost per year of service life extension (i.e. longest service life extension (SLE) per dollar invested). Typically, implementation of the "Best Value" alternative is consistent with the goal of minimizing pavement costs over time and maximizing the "health" of the WisDOT-owned highway system. Budget constraints, however, create situations where less expensive "Reduced Cost" treatments can assist in maximizing the system "health." PMDSS identifies "Reduced Cost" alternatives where appropriate. (See Appendix A for further discussion of the methods used to define "Reduced Cost" alternatives.)

The "Best Value" and "Reduced Cost" treatments identified by PMDSS are not always distinctly different pavement treatment options. (This topic is discussed in more detail in Appendix A). Sometimes a single treatment satisfies both criteria. The most straightforward situation creating this outcome is when PMDSS identifies a single treatment as appropriate for addressing all the distresses present on a pavement. Specific combinations of distress also increase the likelihood that the "Best Value" and "Reduced Cost" treatments will be the same even though more than one potential treatment is identified. For example, if an AC pavement has a minor amount of low severity alligator cracking and a moderate amount of low severity longitudinal and transverse cracking, PMDSS will suggest two potential treatments. The first would be patching, and the second would be an overlay. Given the cost difference between these treatments, and WisDOT's experience regarding the SLE's that can be expected, patching will be identified as both the "Best Value" and "Reduced Cost" option because it has the lower cost per year of SLE.

As described in Appendix A, WisDOT uses historical data to develop statistical relationships predicting changes in individual pavement distresses, PCI and IRI over time. To ensure they accurately represent actual field experience, these relationships are reevaluated as newly collected pavement condition ratings become available. After identifying "Best Value" and "Reduced Cost" pavement treatments based on existing conditions, PMDSS determines how the treatments will change over time if work is not undertaken when required. The result is a series of pavement conditions and treatment recommendations over an analysis period covering 10 years. This information is the starting point for the analysis of alternative SHR investment strategies within the TAMP.

The complete menu of potential pavement treatments identified by PMDSS vary in intensity. Certain treatments are classified as routine maintenance and, by law, can only be funded using the M&O appropriation. Details regarding needed M&O pavement treatments is made available to the DTSD Bureau of Highway Maintenance to help guide ongoing pavement maintenance activities. Prior to 2018, WisDOT collected STH pavement condition data on a two-year cycle. WisDOT is currently pursuing the collection of pavement condition updates on an annual basis. If these efforts are successful, the availability of annual data may allow PMDSS to assume a larger and more formal role in influencing pavement maintenance activities. WisDOT is currently considering ways to more formally integrate PMDSS into pavement maintenance decision making.

Following WisDOT policy, pavement treatments undertaken with SHR funds must have a service life extension (SLE) of at least four years. Treatments with an SLE of less than four years must be undertaken using M&O funds. The SLE of a pavement treatment is expressed as the expected number of years before the PCI of the improved pavement will again deteriorate and reach a desired minimum service level (DMSL). The DMSL sets a lower bound for the desired PCI and varies by highway functional class, with better pavement conditions being a priority on higher functional systems. WisDOT's historic DMSL's for assessing SLE are 70 for Corridors 2030 Backbone highways, 65 for other Principal Arterials and 60 for all Minor Arterial and Collector highways.

WisDOT recently adopted "downshift" DMSL's for use when defining "Reduced Cost" treatments on non-NHS Minor Arterial and Collector highways already functioning in a degraded state and where costly major rehabilitation or replacement would otherwise be required. The "downshift" concept defines an "acceptable", as opposed to "desirable", service level for these highways, which carry the lowest traffic volumes on the STH system. Under the "downshift" concept, the DMSL is reduced to a PCI of 55 whenever the PCI is already below 60 before a treatment can be implemented (otherwise, the DMSL would have been a PCI of 60). In other words, if a pavement segment is already functioning at a PCI level below 60 on these highways, the "downshift" concept tests the SLE of improvement alternatives by allowing the post-treatment PCI to deteriorate to a PCI of 55.

By adopting the "downshift" concept, WisDOT is temporarily balancing lower pavement performance on a limited number of low volume non-NHS highways with greater pavement performance across the entire STH system. Projects subject to "downshifting" will not be permanently subject to lower cost levels of improvement. In time, only a higher level of improvement will provide the required SLE, even with a DMSL of 55. By allowing slightly reduced pavement conditions for a relatively short period (but not significantly lower than recently experienced), the "downshift" concept creates a limited number of situations where lower cost, otherwise ineligible, treatments becomes eligible because their revised SLE's are

four years or more using the “downshift” DMSL. This allows lower cost treatments to be implemented instead of the significantly more expensive major rehabilitation or pavement replacement treatment otherwise required. The funding freed up through this process is then used to improve needy pavements that would otherwise have deteriorated due to a lack of funds. Eventually, all lower cost pavement treatments will fail to provide an SLE of at least four years using even a “downshift” DMSL, and more extensive treatments will be applied.

At this point in the process PMDSS has defined two alternatives for each PIF segment in need of a pavement treatment: “Best Value” and “Reduced Cost”. As noted, the alternatives will be the same in some cases. The next step is to combine information at the PIF segment level (i.e. short sections to facilitate pavement inventory and condition assessment) into treatments at the project analysis level (i.e. longer project analysis segments). The starting and ending points (termini) of project analysis segments approximate historic STH improvement project termini. Identifying these termini is accomplished by aggregating adjacent PIF segments possessing the same type and age of pavement into a single project analysis segment.

Information on the “Best Value” and “Reduced Cost” alternatives at the PIF segment level is aggregated to develop “Best Value” and “Reduced Cost” alternatives at the project analysis level. If 50 percent or more of a project analysis segment requires treatment, the entire segment is defined as needing improvement. The treatment selected as “Best Value” at the project analysis level is the lowest level “Best Value” treatment (from among those called for on the PIF segments) that “undertreats” no more than 30 percent of the length of the project analysis segment. The same process is used to define the “Reduced Cost” alternative at the project analysis level.

When considering the scope for a highway project, WisDOT considers more than the appropriate pavement treatment. Safety, geometric and traffic deficiencies are also considered. The MMS evaluates the nature and extent of each of these deficiencies and identifies treatments to address them. This information, together with the pavement alternatives, results in an expanded set of mutually exclusive treatment options at the project analysis level. Each of the options will have a differing cost estimate. Costs increase, sometimes substantially, with the number of deficiencies addressed.

Given the high priority WisDOT places on the safety of the STH system, potential SHR projects are also identified where crash data indicates there are significant safety issues even though pavement conditions are acceptable. The scope of projects in these cases might include an intersection improvement or “spot” safety improvement. The estimated cost of these projects is typically low because of their limited length, making them capable of providing high benefit per dollar invested.

Bridge Project Scoping

Like pavements, bridges are subjected to repeated traffic loadings and environmental factors such as heat, cold, snow and road salt. These factors all lead to progressive deterioration of bridge elements. Bridge maintenance, repair and rehabilitation activities are required to counter the effects of loadings and the environment. Some activities (such as deck sweeping and crack sealing) are performed using M&O funds. Other activities (concrete overlays, new decks, painting, etc.) are more extensive, require significant design efforts, and are let to contract using SHR funds. The scope of the work required on each bridge is determined by its current condition and where it is in its lifecycle. Safe, well-maintained bridges are critical to the functionality of the STH system, and for this reason, bridge improvements are a high priority in WisDOT's optimal SHR investment strategy.

The Wisconsin Structures Asset Management System (WiSAMS) is described in Appendix B. The bridge treatments called for by WiSAMS reflect WisDOT's Bridge Preservation Policy Guide (BPPG). Two of the primary goals of the BPPG are as follows:

- Keep bridges in a state of good repair using effective, low-cost treatments; and
- Implement timely preservation treatments on structurally sound bridges to promote optimal lifecycle costs, extend service life and lengthen the time between major rehabilitation and replacement activities.

WiSAMS identifies optimal treatments for each STH bridge, along with their estimated cost. Certain treatments will be funded through M&O and others through SHR.

The current condition of each STH bridge is based on the most recent bridge inspection. Forecasting the need for future treatments relies on forecasts of future bridge conditions. WiSAMS condition forecasts are based on deterioration curves developed using historic information on Wisconsin's bridges. Starting with the current condition of each bridge, the deterioration curves predict the condition of each bridge in future years, and those conditions define the timing and scope of the needed bridge treatments following the policies in the BPPG. (See https://wisconsindot.gov/Pages/SearchResults.aspx?q=bridge preservation policy guide).

WisDOT's Process for Defining the Optimal Investment Strategy for SHR Funds

Discussion of the Fundamental Concepts Involved in WisDOT's Policy Analysis

Development of the "optimal" SHR investment strategy requires all SHR highway and bridge investment needs to be identified along with a determination regarding how to best address them. Alternative SHR investment strategies are evaluated by comparing their expected performance outcomes. The performance outcomes for STH pavements and bridges are compared to WisDOT's performance goals, and any performance gaps are quantified. The

estimated number of years of pavement service life added to the STH system by alternative strategies is also considered, along with the backlog of pavement and bridge needs remaining unaddressed at the end of the analysis period and the cost of addressing those backlog needs. Each alternative investment strategy produces a unique set of performance outcomes. Clear tradeoffs are involved when comparing one set of outcomes to another. The alternative strategy with the preferred mix of performance outcomes becomes WisDOT's "optimal" SHR investment strategy.

The "optimal" SHR investment strategy described below addresses WisDOT's bridge and safety priorities and provides the best overall pavement conditions (best long-term system health) for the STH system. The "optimal" SHR investment strategy also produces pavement and bridge performance consistent with WisDOT's STH and NHS pavement and bridge performance targets.

In developing the "optimal" SHR investment strategy, the outcomes of the alternative strategies were simulated over a 10-year period using WisDOT's pavement and bridge management systems. Each strategy contained a different set of policies guiding the highway and bridge treatments chosen for funding within the SHR resources available each year. Differing strategies answered the following policy questions in differing ways:

- Should the pavement treatment be based on "Best Value" or "Reduced Cost"?
- If a pavement treatment is necessary, should safety, geometric or traffic needs also be addressed?
- Do the safety needs call for treatment even though the pavement is in acceptable condition?
- What is the relative priority of each potential highway and bridge treatment?

Each alternative strategy contained a set of policies to be applied to the following STH sub-systems: Corridors 2030 Backbone routes, Corridors 2030 Connector routes and the individual functional systems making up non-Corridors 2030 routes.

For each alternative, the highway and bridge treatments called for during any given year were determined by their priority. The total cost of the treatments allowed in any given state fiscal year could not exceed the SHR resources available. The analysis assumed treatments were implemented when called for, improving pavement and bridge conditions in those locations. The improved conditions associated with varying highway and bridge treatments reflect WisDOT's experience with those treatments in the field. Once improved, those pavement and bridges began to deteriorate once again during the remaining years of the simulation. Conditions also deteriorated year to year for the pavements and bridges not selected for treatment. This process resulted in each alternative strategy having a unique set of STH system performance outcomes at the end of the 10-year analysis period.

Defining WisDOT's SHR Investment Strategy for the Corridors 2030 Backbone Program

The Corridors 2030 Backbone Program is WisDOT's highest priority for the use of SHR funds. Backbone highways are all part of the NHS. They are Wisconsin's most intensively used highways, carrying 50 percent of all STH vehicle miles of travel and 85 percent of all STH freight ton-miles on just 22 percent of STH roadway miles. A high functioning Backbone system is essential to passenger and freight mobility and to a strong Wisconsin economy. Backbone highways are also Wisconsin's safest highways.

WisDOT is committed to ensuring this high level of performance. As evidence of WisDOT's commitment, SHR funding is reserved for the Backbone Program after allowing for "first draws" from the annual SHR appropriation to fund design and construction engineering and a limited number of change orders affecting ongoing construction contracts. WisDOT's "optimal" SHR investment strategy for the Corridors 2030 Backbone Program has been consistently and successfully applied for many years. The proportion of SHR funding dedicated to the Backbone Program is reviewed regularly. WisDOT's asset management tools are used to help identify the level of funding necessary to address all priority SHR needs on the Corridors 2030 Backbone system.

In addition to ensuring appropriate funding, the priority placed on the condition and operation of the Backbone system is reflected in the policies guiding the roadway and bridge treatments called for on the Backbone system. WisDOT's roadway and bridge treatment policies for the Backbone system are summarized in Table 5-2. The policies emphasize the preservation of Backbone pavements and bridges at the lowest practicable cost over time, while effectively addressing all safety deficiencies. As noted in Table 5-2, only limited capacity improvements (project lengths less than five miles) are made using SHR funding, and only if they are essential to highway safety. More extensive capacity improvement can only be implemented through the Majors and SEF programs. Recall that all Corridors 2030 Backbone routes are part of the NHS.

The Corridors 2030 Backbone Program is managed centrally by the Backbone Committee. The committee is led by BSHP, with membership from DTSD Region and Central Office staff. Developing the projects implemented within WisDOT's 10-year SHR investment strategy for the Corridors 2030 Backbone begins by using WisDOT's MMS analysis tools to identify highway and bridge projects (treatments) consistent with Table 5-2. The treatments are thoroughly reviewed by the Backbone Committee and the respective DTSD Regions before being finalized and approved. This process ensures all deficiencies deemed a priority are addressed within the scope of each Backbone project.

When available funding will not cover all approved projects, a prioritization process is applied. This process represents a second important part of WisDOT's Backbone investment strategy.

The adjusted schedule is again reviewed by the Backbone Committee and DTSD Region staff prior to final approval. Backbone Program priorities are shown in Table 5-3 and reflect the emphasis WisDOT's Backbone investment strategy places on improving safety, maintaining excellent bridge conditions and following a balanced approach when implementing cost-effective pavement treatments. These priorities have guided the Corridors 2030 Backbone Program for many years. WisDOT is confident they make the best possible use of the SHR funds dedicated to the Backbone system.

Table 5-2 Policies Guiding SHR Project Scoping within the Corridors 2030 Backbone Program

Functional System	Projects Scoping Policies
Corridors 2030 Backbone	• Address all warranted bridge treatments (non-M&O funded) • Address pavement deficiencies using the "Best Value" treatment (non-M&O funded) • Address all safety deficiencies as part of any pavement or bridge treatment • Address safety deficiencies using stand-alone projects when more extensive work to address pavement or bridge conditions is not required • Address highway capacity deficiencies, to the extent possible, when a safety deficiency is the direct result of inadequate capacity. (Under current state statute, only very limited capacity expansion can be performed using SHR funds. Most capacity improvements on the Backbone system are funded through the Majors and SEF programs.)

Defining WisDOT's SHR Investment Strategy for the Region 3R Program

WisDOT's ability to accomplish its goals for the pavements and bridges managed through the Region 3R Program depends on two primary factors: the effectiveness of the 3R investment strategy and the level of funding available for the program. WisDOT recently reevaluated its 3R investment strategy to ensure optimal use of SHR resources. The proposed 2019-2021 Biennial Budget, on which the TAMP is based, significantly increases the long-term funding available for 3R investments (refer to Table 2-1). Using WisDOT's asset management systems, the positive impacts of WisDOT's updated 3R investment strategy can be isolated from the positive impacts of the increased funding assumed to apply over the TAMP analysis period. The

impact of the updated 3R investment strategy is discussed in this section and the impact of the increase in SHR funding is presented at the end of this chapter.

WisDOT's revised 3R investment strategy, known as Theme X' (Theme X prime), provides significant benefits when compared with WisDOT's traditional 3R strategy, first developed in

Table 5-3 Corridors 2030 Backbone Program Priorities

Priority Class	Type of Project
Class 1	Projects where a significant share of project costs are covered by federal Highway Safety Improvement Program (HSIP) funding
Class 2	Projects addressing intersections with significant safety issues
Class 3	Projects addressing critical bridge and pavement needs
Class 4	Pavement and bridge preservation treatments
Class 5	Pavement resurfacing and reconditioning projects with a projected IRI GE 2.45
Class 6	Remaining pavement resurfacing and reconditioning projects
Class 7	Remaining pavement replacement and reconstruction projects
Class 8	Interchange projects or projects to improve operations

the mid-1990's. At the end of the 10-year TAMP analysis period, all metrics of STH system health improve when compared to the traditional approach. Table 5-4 summarizes the positive pavement condition impacts of Theme X' relative to WisDOT's traditional 3R investment strategy assuming state funding in SHR remains constant at SFY 19 levels across the analysis period and federal funding in SHR increases 2 percent per year from its SFY 19 level (SHR Trend Budget). 3R bridge needs are fully funded under both WisDOT's traditional and Theme X' strategies, and that is why Table 5-4 relates only to the pavements on the Region 3R system.

As shown in Table 5-4, Theme X' reduces the number of "poor" pavement lane miles at the end of the 10-year period when compared to WisDOT's traditional investment strategy, while the lane miles in "good" condition increase. Consistent with this, Theme X' also increases remaining pavement service life system-wide and reduces the "backlog" of infrastructure investment needs remaining after 10-years. The reduction in "poor" lane miles brought about

by the adoption of Theme X' is clearly significant. One-quarter of the reduction in "poor" lane miles in Table 5-4 is due to the introduction of the "downshift" DMSL concept as part of Theme X'. This highlights the value produced by this aspect of WisDOT's revised 3R investment strategy.

Table 5-4 The Impact of Theme X' vs. WisDOT's Traditional SHR Investment Strategy On Region 3R System Pavement Conditions Using PCI
(SHR Trend Budget) [1/]

	"Good"			"Poor"		
	Traditional	**Theme X'**	**%Δ**	**Traditional**	**Theme X'**	**%Δ**
3R Lane Miles	8,350	10,580	+26.7%	11,790	8,630	-26.8%

[1/] Measured post-SFY 2029. The SHR Trend Budget maintains SHR state funds at their SFY 2019 level and increases federal funds at 2 percent per year.

Table 5-5 shows that Theme X' also benefits pavement conditions on the NHS portion of the 3R system, as measured by the NHPP pavement metrics.

Table 5-5 The Impact of Theme X' vs. WisDOT's Traditional SHR Investment Strategy On Region 3R NHS Pavement Conditions Using NHPP Condition Metrics
(SHR Trend Budget) [1/]

	"Good"			"Poor"		
	Traditional	**Theme X'**	**%Δ**	**Traditional**	**Theme X'**	**%Δ**
3R NHS Lane Miles	3,980	5,560	+39.7%	4,540	2,960	-34.8%

[1/] Measured post-SFY 2029. The SHR Trend Budget maintains SHR state funds at their SFY 2019 level and increases federal funds at 2 percent per year.

The policies used to determine the scope of the eligible projects under Theme X' are shown in Table 5-6. Within Theme X', the policies defining eligible project treatments become more restrictive for lower functional classes. This reflects the lower traffic volumes typical of lower function roadways. Lower volumes imply fewer highway users benefit from an eligible treatment.

Table 5-6 Policies Guiding SHR Project Scoping within the Region 3R Program

Functional System	Project Scoping Policies
Corridors 2030 Connectors	• Address all warranted bridge treatments (non-M&O funded) • Address pavement deficiencies based on "Best Value" treatment (non-M&O funded) • Address all combinations of pavement, safety, geometric and capacity deficiencies, although no geometric improvements unless there is a safety deficiency at the same or greater scope, and no capacity improvement for urban projects unless the level of service (LOS) score is 5.0 or greater [1/]
Other Principal Arterials	• Address all warranted bridge treatments (non-M&O funded) • Address pavement deficiencies based on "Best Value" treatment (non-M&O funded) • Address all combinations of pavement, safety, geometric and capacity deficiencies, although no geometric improvements unless there is a safety deficiency at the same or greater scope, and no capacity improvement unless the pavement or safety deficiencies call for highway reconstruction
Minor Arterials	• Address all warranted bridge treatments (non-M&O funded) • Address NHS pavement deficiencies based on "Best Value" treatment (non-M&O funded) and non-NHS pavement deficiencies based on "Reduced Cost" treatment (non-M&O funded), using a **"downshift**" threshold where applicable • Address all combinations of pavement, safety and geometric deficiencies, although no geometric improvements unless there is a safety deficiency at the same or greater scope
Collectors	• Address all warranted bridge treatments (non-M&O funded) • Address pavement deficiencies based on "Reduced Cost" treatment (non-M&O funded), using a **"downshift**" threshold where applicable and with the maximum treatment being an overlay unless there is a safety deficiency • Address all combinations of pavement, safety and geometric deficiencies, although no geometric improvements unless there is a safety deficiency at the same or greater scope

[1/] The LOS score relates directly to Highway Capacity Manual (HCM) level of service codes A - F, where A represents free flow, B is reasonably free flow, C is stable flow, D is approaching unstable flow, E is unstable flow and F is breakdown flow. HCM codes A - F are assigned LOS scores of 1.0 - 6.0. The LOS score of each project level analysis segment is based on its traffic volume relative to the volumes defining the cut-points between the HCM codes for that type of highway. For example, if the traffic volume is halfway between the cut-points for E and F the LOS score would be 5.5, halfway between 5.0 and 6.0.

The primary way in which the eligible 3R project treatments allowable under Theme X' differ from WisDOT's traditional approach is through the incorporation of a "downshift" threshold into the scoping process for non-NHS Minor Arterials and Collectors (as highlighted in Table 5-6). Allowing slightly reduced pavement conditions for a relatively short period, the use of a "downshift" threshold can result in less expensive "Reduced Cost" treatments for certain pavements in the short run. Using these cost savings. WisDOT can improve more miles of pavement using 3R funds, resulting in better long-term system conditions.

To complete the definition of WisDOT's optimal 3R investment strategy, a project prioritization process is required, just as it was for the optimal Backbone investment strategy. Prioritization is where Theme X' differs most significantly from WisDOT's traditional approach.

Traditionally, 3R bridge projects were given top priority and highway projects received priority based on a 3R priority index assigned to each project: the higher the index the higher the priority. The index depended on the deficiencies existing on the project level analysis segment and whether the project scope would effectively address them. Each project's 3R priority index was the weighted sum of its pavement, safety and capacity scores. The pavement score received a weight of 0.5 and was a direct function of the PCI of the highway segment, with additional points for extremely rough pavement. The safety score received a weight of 0.25 and was based on the number of crashes on the segment, the severity of those crashes and whether the segment suffered from severe pavement rutting. The capacity score also received a weight of 0.25 and was determined by the level of congestion on the segment and the number of vehicle miles of traffic affected. The capacity score was set to zero for projects not addressing capacity deficiencies.

WisDOT's revised Region 3R Program priorities are shown in Table 5-7. The revised priorities place added emphasis on safety and prioritize pavement preservation while allowing pavements to function at a lower tolerance level if costly pavement replacement is required.

Taken together, the policies implementing WisDOT's optimal 3R investment strategy make more cost-effective use of 3R funds and result in better STH system performance when compared to past practice. The policies in Tables 5-6 and 5-7 were used to define the specific projects included in WisDOT's optimal 3R investment strategy covering the 10-year TAMP analysis period.

Under Theme X', definition of the optimal Region 3R Program begins by reducing each year's 3R funds by the cost of the bridge treatments warranted in that year, consistent with bridges having the highest priority within the 3R priority process. Funding is also reserved for a limited number of "non-modeled" costs, with the remainder of the funding becoming available for the set of eligible highway projects identified using the data and analysis processes of the MMS. Eligible highway projects are funded in descending priority order until all available 3R funds are

exhausted. Projects in Class 2 are funded before projects in Class 3, and so on, with the projects within each priority class being sorted by their traditional 3R priority index. This process ensures the highest priority set of 3R projects is selected for funding each year.

Table 5-7 Region 3R Program Priorities

Priority Class	Type of Project
Class 1	All warranted bridge projects
Class 2	Highway projects addressing a stand-alone safety priority
Class 3	Pavement preservation-only projects
Class 4	Highway projects where the PCI GE 70
Class 5	Remaining highway projects with a safety B/C of 1.75 or higher
Class 6	Remaining highway projects with a safety B/C between 1.0 and 1.75
Class 7	Remaining pavement-only projects with a minimal safety B/C
Class 8	Remaining pavement-only projects where "downshift" thresholds are applicable
Class 9	Remaining highway projects calling for a critical pavement replacement on a Principal Arterial having a daily traffic volume GE 10,000 and a PCI LE 45 [1/]
Class 10	Remaining highway projects calling for an overlay where the 50 < PCI < 70
Class 11	Remaining highway projects calling for less than a pavement replacement, allowing for capacity expansion only if there is a safety deficiency
Class 12	Remaining highway projects calling for a critical pavement replacement on a Principal Arterial where the PCI LE 45
Class 13	Remaining highway projects calling for a critical pavement replacement where the PCI LE 45
Class 14	Remaining highway projects

[1/] A critical pavement replacement is defined as a situation where a) no pavement treatment other than replacement or reconstruction would result in a SLE of more than four years, and b) an interim overlay test (short-term overlay) fails to provide five years of life extension.

During each year of the TAMP analysis period, the pavement and bridge conditions relating to the highway and bridge projects selected for treatment are reset to reflect the improved conditions that will result from the project. The improved conditions associated with varying

highway and bridge treatments reflect WisDOT's experience with those treatments in the field. In subsequent years, those conditions begin to deteriorate once again. Meanwhile, conditions on the project analysis segments and bridges remaining unimproved are deteriorated to represent the conditions expected in the following year. Those conditions then help define the highway and bridge projects that become eligible for funding in that year, and the iterative process repeats. This process captures cost increases that can occur due to a delay in a warranted treatment.

While all warranted 3R pavement needs cannot be fully funded each year, these "backlog" needs cannot simply be ignored. Some will require treatment. Instead of leaving "backlog" needs totally unaddressed, WisDOT's optimal 3R investment strategy reserves funding for judicious "low cost" pavement fixes that maintain acceptable service until a major rehabilitation or replacement can occur. Backlog segments considered high-risk may also be good candidates to have designs "on the shelf" ready for project advancement in the event of unexpected funding availability or rapid deterioration in conditions (see Appendix G).

Implementing WisDOT's Optimal SHR Investment Strategy

The ongoing development and implementation of the projects identified using WisDOT's optimal SHR investment strategy will be managed differently depending on whether the project is part of the Corridors 2030 Backbone Program or the Region 3R Program.

As noted earlier, the projects and project schedules within the Corridors 2030 Backbone Program are managed centrally by the Backbone Committee. Within the Region 3R Program, each DTSD Region is given an annual allocation of 3R funds. The funding allocated to each DTSD Region is reviewed regularly to reflect shifts in the proportion of optimal 3R investment needs in each Region.

Within its 3R allocation, each DTSD Region manages their own projects and project schedules. This allows each Region to incorporate project-level information and considerations that cannot be captured in the MMS planning-level analysis process. There is, however, a clear expectation that the 3R project locations identified in the TAMP will receive strong consideration and that the policies inherent in WisDOT's optimal 3R investment strategy will be followed unless there are specific, credible, reasons for any deviation. DTSD Region accountability for their program of 3R projects is monitored using WisDOT's Program Effectiveness Measure (PEM), which is described in Chapter 7 and reported as a corporate performance measure as part of MAPSS, WisDOT's public-facing performance improvement program. To further assist Region staff,

DTSD recently dedicated additional staff resources to streamlining the use of data-driven asset management programming, practical design concepts and performance measures related to planning and design. More detail on this effort is also provided in Chapter 7.

The Impact of Increased SHR Funding on STH System Pavement Conditions

As noted earlier, long-term pavement conditions on the STH system are influenced by both WisDOT's SHR investment strategy and the level of funding available within the SHR appropriation. Using PCI, Table 5-8 reports current STH system pavement conditions and compares the long-term pavement performance expected under two SHR funding alternatives: the Proposed SHR Budget (the Governor's proposed SHR budget as reported in Table 2-1), and the SHR Trend Budget (state funding in SHR remains constant at its SFY 19 level while federal funding increases 2 percent per year from its SFY 19 level).

Using "poor" lane miles as a measure, Table 5-8 demonstrates the Proposed SHR Budget is expected to maintain current STH system pavement conditions. Total "poor" lane miles barely change before and after the 10-year analysis period, decreasing from 20 percent of STH pavements today to 19 percent post-SFY 2029. This result implies a similarly small change in the number of lane miles rated "fair and above" (80 percent currently vs. an expected 81 percent). However, Table 5-8 demonstrates a change in the expected composition of those "fair and above" lane miles, with a 13 percent increase in the number of lane miles in "good" condition. In other words, the distribution of STH pavement conditions shifts in the direction of more "good" pavements over time. Clearly a positive result.

Table 5-8 Impact of WisDOT's SHR Investment Strategy on Long-Term STH Pavement Conditions Assuming Alternative SHR Funding Levels Using PCI

	"Good"	"Fair"	"Poor"
Current STH Pavement Conditions (lane miles)	61%	19%	20%
Alternative SHR Budget Assumptions			
Proposed SHR Budget (post-SFY 2029 conditions)	69%	12%	19%
SHR Trend Budget (post-SFY 2029 conditions) [1/]	57%	14%	30%

[1/] The SHR Trend Budget maintains SHR state funds at their SFY 2019 level and increases federal funds at 2 percent per year.

Note that under the SHR Trend Budget, these positive results would not be achieved. The percentage of “poor” STH lane miles would increase by 50 percent (going from 20 percent to 30 percent) and the percentage of “good” lane miles would decline by 7 percent, dropping from 61 percent down to 57 percent of all STH lane miles. The Proposed SHR Budget is clearly critical to maintaining STH system pavement conditions over time.

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Chapter 6 The Transportation Asset Management Plan for the WisDOT-Owned Portion of the National Highway System

Overview

The Wisconsin Department of Transportation's (WisDOT's) Transportation Asset Management Plan (TAMP) summarizes the investments the agency intends to implement on the WisDOT-owned portion of the National Highway System (NHS) during the 10-year period beginning in state fiscal year 2020 and extending through 2029. WisDOT's State Trunk Highway (STH) system investments over this period are consistent with the program development processes discussed in Chapters 3 through 5, and with WisDOT's goals for safe and efficient travel, infrastructure in a state of good repair, and an optimal mix of pavement and bridge conditions on the STH system. The WisDOT-owned NHS is a high priority portion of the STH system, and WisDOT's management systems are used to estimate the pavement and bridge conditions that will exist on the WisDOT-owned NHS after the planned TAMP investments are implemented though state fiscal year 2029.

Expected Investments in the WisDOT-Owned NHS

WisDOT's expected NHS investments are presented using the following three program sub-components:

1. The Major Highway Development (Majors) and Southeast Wisconsin Freeway Megaprojects (SEF) Programs;
2. The Major Interstate Bridge (MIB) and High Cost State Bridge (HCSB) Programs; and
3. The State Highway Rehabilitation (SHR) Program.

The processes used to define WisDOT's expected NHS investments in each of these program sub-components were discussed in detail in Chapters 3 through 5, respectively. The expected NHS investments shown in Table 6-1 cover the 10-year period between state fiscal years 2020 and 2029. [See Appendix I for definition of the detailed WisDOT work types assigned to the Perpetuation, Rehabilitation and Modernization categories shown in Table 6-1.] As noted earlier, State Highway Maintenance and Traffic Operations (M&O) expenditures on the WisDOT-owned NHS are not included in Table 6-1. The total funding assumed to be available for M&O activities on the entire STH was presented in Table 2-1.

The investments in Table 6-1 reflect WisDOT's currently scheduled state highway improvement program for Majors and SEF projects, MIB and HCSB projects, and SHR Large Bridge projects. All projects in the currently scheduled Corridors 2030 Backbone program are reflected in Table 6-1, along with 3R projects scheduled in state fiscal year 2020. Overall, the expected level of

SHR investment in the NHS reflects the increased SHR funding provided by the Governor's proposed 2019-2021 Biennial Budget (see Table 2-1) and WisDOT's SHR Investment Strategy.

The planned projects underlying Table 6.1 include projects on roadway segments identified during WisDOT's evaluation of NHS infrastructure that has required repeated repair and reconstruction due to emergency events. Following procedures required by 23 CFR Part 667, a complete list of the NHS infrastructure that has required repeated repair and reconstruction due to emergency events is contained in Appendix J. Consistent with 23 CFR Part 667 and Part 515, WisDOT is committed to identifying and implementing cost-effective design elements as part of these projects to mitigate the negative infrastructure impacts of future emergency events.

The investments by program area in Table 6-1 are expressed in year of expenditure dollars (YOE$) and include estimated engineering and other project delivery costs. Estimated YOE$ are obtained by applying a multiplier for construction inflation to current market prices. A forecast of construction cost inflation was obtained from IHS Global Insight (the Chained Price Index for State and Local Gross Investment in Highways and Streets) and is shown in Table 6-2.

As shown in Table 6-1, WisDOT expects its NHS investment plan to result in spending (obligating) $6.557 billion (year of expenditure dollars) on the WisDOT-owned NHS during state fiscal years 2020 through 2029, or an average of $655.7 million per year.

The investments shown in Table 6-1 for Majors and SEF projects are drawn from the Wisconsin Department of Transportation Report to the Transportation Projects Commission on the Status of Major Highway Projects and Southeast Wisconsin Freeway Megaprojects, dated February 2019. As discussed in Chapter 4, there are no costs reported for the MIB and HCSB programs. Scheduled costs for MIB and HCSB projects will be reported in future TAMP updates as projects are developed and enumerated for construction.

The Pavement and Bridge Condition Benefits of the TAMP on the WisDOT-Owned NHS

Without the NHS investments shown in Table 6-1, the pavements and bridges on the WisDOT-owned NHS will deteriorate over time due to traffic, weather and other factors. WisDOT's pavement and bridge management systems predict that the percentage of "poor" NHS lane miles would triple, and the percentage of "poor" NHS bridge deck area would increase by almost seven times if all pavement and bridge investments were suspended through state fiscal year 2029. The investment strategies contained in this TAMP play an essential role in avoiding these unsatisfactory results, just as WisDOT's past policies and investment strategies have been essential to the quality NHS pavement and bridge conditions seen today.

Table 6-1 WisDOT's Investment Plan for the WisDOT-Owned NHS [1/]
(Millions of YOE$)

State Fiscal Years 2020-2024

Program Area	2020	2021	2022	2023	2024
SHR					
Perpetuation	$351.2	$282.6	$359.2	$307.3	$421.0
Rehabilitation	$188.5	$240.6	$223.1	$280.5	$109.8
Total	$539.7	$523.2	$582.3	$587.8	$530.8
Majors and SEF					
Modernization	$337.4	$373.3	$84.7	$39.6	$86.3
MIB and HCSB					
Modernization	$0.0	$0.0	$0.0	$0.0	$0.0
Grand Total	$877.1	$896.5	$667.0	$627.4	$617.1

[1/] Only SHR supports Perpetuation and Rehabilitation improvements (see Appendix I). YOE $ equals year of expenditure $. SHR investments reflect the increased funding provided by the Governor's proposed 2019-2021 Biennial Budget. The proposed Biennial Budget also provides for the enumeration of IH 43 between Silver Spring Drive and STH 60 in Milwaukee and Ozaukee counties as a Majors project. The estimated costs for the IH 43 project are not reflected in this table. Assuming the IH 43 project is enumerated in the final 2019-2021 Biennial Budget, the estimated costs for IH 43 will be included in future TAMP updates once an accurate schedule of costs is available.

State Fiscal Years 2025-2029

Program Area	2025	2026	2027	2028	2029
SHR					
Perpetuation	$400.3	$400.1	$290.0	$296.4	$275.9
Rehabilitation	$182.3	$168.1	$267.7	$264.1	$226.5
Total	$582.6	$568.2	$557.7	$560.5	$502.4
Majors and SEF					
Modernization	$28.0	$72.4	$0.0	$0.0	$0.0
MIB and HCSB					
Modernization	$0.0	$0.0	$0.0	$0.0	$0.0
Grand Total	$610.6	$640.6	$557.7	$560.5	$502.4

Table 6-2 Forecast of Highway Construction Cost Inflation from IHS Global Insight By State Fiscal Year

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
1.38%	2.28%	2.31%	2.46%	2.52%	2.42%	2.34%	2.27%	2.24%	2.19%

Tables 6-3 compares WisDOT's two and four-year NHS pavement and bridge condition targets with estimated conditions post-2020 and post-2022. Estimated future conditions were developed using WIsDOT's management systems and assume the NHS investments summarized in Table 6-1 are implemented. Expected NHS pavement and bridge conditions are consistent with WisDOT's targets in both time periods.

Table 6-3 The Impact of the TAMP on Post-2020 and Post-2022 Pavement and Bridge Conditions on the WisDOT-Owned NHS

	2020 and 2022 Condition Targets		2020 and 2022 HPMS and NBI Conditions Expected to Meet Targets? [1/]	
	% Good	% Poor	% Good	% Poor
Interstate Pavements	≥ 45%	≤ 5%	Yes	Yes
Non-Interstate NHS Pavements	≥ 20%	≤ 12%	Yes	Yes
All NHS Bridges	≥ 50%	≤ 3%	Yes	Yes

[1/] HPMS is the Highway Performance Monitoring System and NBI is the National Bridge Inventory. Both are national data bases maintained by the Federal Highway Administration (FHWA) using data provided by state transportation agencies.

Chapter 7 The Relationship Between the Transportation Asset Management Plan, Program Effectiveness Measures and the Statewide Transportation Improvement Program

Overview

The Wisconsin Department of Transportation's (WisDOT's) optimal investment strategy for the State Highway Rehabilitation (SHR) program was discussed in detail in Chapter 5. Simply put, the strategy is designed to allocate SHR funding to the "right" place, at the "right" time, and for the "right" type of improvement. To ensure whether WisDOT's decentralized management of its 3R investment strategy is being effectively implemented, WisDOT created a set of Program Effectiveness Measures (PEM). The PEM process captures whether the 3R Program funded by each Division of Transportation System Development (DTSD) Region, is reasonably consistent with WisDOT's SHR investment strategy, and by extension, with the Transportation Asset Management Plan (TAMP).

Through the concept of "reasonable consistency", the PEM process balances WisDOT's commitment to data-driven decision-making with the reality that all data and management systems are imperfect and often need to be supplemented with information made available only through project-level design engineering conducted by DTSD Region staff. The PEM process also provides a mechanism for identifying the need for enhancements in existing data and management systems. In this way, the process supports WisDOT's commitment to the effective stewardship of SHR resources.

The Statewide Transportation Improvement Program (STIP) is a federally required listing of all transportation projects scheduled to receive federal funding over a four-year period. The federal funding represented by the projects in the STIP must be constrained by the level of federal funds expected in each federal program area. The STIP is maintained in consultation with Metropolitan Planning Organizations (MPOs), tribal governments and other local officials, and is made available for public review. There is a direct relationship between the TAMP and the STIP, providing further assurance that the TAMP will be implemented over time.

The PEM Process and the TAMP

The PEM process is based on the roadway projects contained in the first six years of WisDOT's scheduled 3R Program. Bridge project are not currently included in the PEM process, but the goal is to add them in the future. The question the PEM answers is whether the roadway projects in the 3R Program are "reasonably consistent" with the projects called for under WisDOT's optimal 3R investment strategy, Theme X', where consistency encompasses three factors: location, timing and type of improvement.

The “hybrid” segmentation of the State Trunk Highway (STH) system in the Meta-Manager Highway Asset Management System (MMS) is derived by “overlapping” segments from the following corporate databases (see Appendix C for more detail):

1. STH pavement conditions (PIF);
2. Scheduled STH highway and bridge projects (FIIPS); and
3. STH traffic counts (TRC).

In developing the optimal 3R investment strategy presented in Chapter 5, the project treatments (scopes) and priorities under alternative 3R investment strategies were evaluated using project level analysis segments. The starting and ending points (termini) of the project level analysis segments approximated historic STH improvement project termini. Identifying these termini was accomplished by aggregating adjacent PIF segments possessing the same type and age of pavement into a single project level analysis segment. The optimal 3R investment strategy resulted in a set of priority work-types in specific locations during specific years of the TAMP analysis period (call them TAMP work-types). The optimal 3R investments (Theme X’) occurring on the National Highway System (NHS) were included as part of the SHR investments presented in Table 6-1 for state fiscal years 2020 through 2029.

The PEM process defines its analysis segments in a somewhat different manner (call them PEM segments). First, a subset of PEM segments is defined using the starting and ending points of the actual projects making up each Region 3R Program. Obviously, these segments will only cover the portion of the STH system being treated within the program. PEM segments covering the remainder of the STH system are defined using historic STH improvement project termini.

The PEM process then analyses 3R improvement needs using the network of PEM segments and the data contained in the MMS. The process applies the same policies and financial constraints used in defining WisDOT’s optimal 3R investment strategy, and results in a second set of priority 3R work-types consistent with WisDOT’s optimal 3R investment strategy (known as PEM projects). Each of the PEM projects is tied to a specific location on the STH system and to a specific year.

By comparing the projects in the actual Region 3R Program to the PEM projects, the PEM process identifies where the two sets of projects agree and where they disagree. If there is complete agreement, the program of 3R projects is totally consistent with WisDOT’s optimal 3R investment strategy.

As noted above, PEM projects are developed using data from the MMS. Although this is the best set of data available for consistent policy analyses, more information needs to be considered when programming and designing projects in the field. Recognizing this, the PEM process does not expect 100 percent consistency between actual 3R projects and simulated PEM projects. For work-type and timing, the process determines whether the two sets of

projects are “reasonably consistent.” For project location, the PEM process uses a more rigorous standard of consistency.

The first step in determining reasonable consistency between actual 3R and PEM projects assigns scores between 1 and 6 to specific work-types: the higher the score, the more extensive the work. Scores are assigned to actual and simulated work occurring on PEM segments. The second step calculates the difference between the two scores. A positive difference indicates the 3R work is more extensive than the PEM work-type. A negative difference implies the opposite. If the difference is between -1 and 1, the actual 3R work-type is considered “reasonably consistent” with the optimal 3R investment strategy (i.e. the PEM work-type).

Reasonable consistency in timing is determined by calculating the difference between the year when the 3R project is scheduled to occur and the year when a PEM project is called for. A negative difference (2020 - 2022 = -2) indicates the 3R project is “early” (2020 instead of 2022). For pavement preservation work, a difference between -3 and 3 years implies “reasonably consistent” timing. For other work-types, the standard for “reasonable consistency” is a difference of between -4 and 4 years.

The PEM process expects actual 3R projects to be scheduled in areas where a PEM project is prioritized for improvement following WisDOT’s optimal SHR investment policies and consistent with annual 3R funding.

Standards have been set to rate 3R Program effectiveness as either “poor”, “acceptable” or “good” in terms of location, work-type and timing. The standards are as follows:

1. Location Measure
    a. Poor – 0 to 64 percent of actual 3R $ in locations with improvement need
    b. Acceptable – 65 to 79 percent of actual 3R $ in locations with improvement need
    c. Good – 80 to 100 percent of actual 3R $ in locations with improvement need;
2. Work-Type (Scope) Measure
    a. Poor – 0 to 44 percent of actual 3R $ on a “reasonably consistent” scope
    b. Acceptable – 45 to 64 percent of actual 3R $ on a “reasonably consistent” scope
    c. Good – 65 to 100 percent of actual 3R $ on a “reasonably consistent” scope; and
3. Timing Measure
    a. Poor – 0 to 44 percent of actual 3R $ at a “reasonably consistent” time
    b. Acceptable – 45 to 64 percent of actual 3R $ at a “reasonably consistent” time
    c. Good – 65 to 100 percent of actual 3R $ at a “reasonably consistent” time.

The resulting percentages are used to evaluate the performance of the Region 3R Program, both statewide and by DTSD Region. The results are reported as part of WisDOT’s MAPSS

Performance Improvement Program Scorecard. Each DTSD Region is held accountable for their 3R Program decisions. Program performance categorized as "poor" or marginally "acceptable" on any measure triggers a review of the reasons for this result. Information from the review may identify 3R Program adjustments required to improve performance. It can also indicate where enhancements are needed to the data, management systems and analysis tools used within the MMS. For more on the PEM within MAPSS, see https://wisconsindot.gov/Pages/about-wisdot/performance/mapss/measures/preservation/program-effectiveness.aspx .

WisDOT's goal is for each DTSD Region to maintain all three of its PEM percentages in the "good" category. Specific goals are 80 percent for the location measure, 65 percent for work-type, and 65 percent for timing. These goals reflect WisDOT's commitment to implementing the optimal 3R investment strategy, a key component of the TAMP. The latest reported PEM results for 2018, both statewide and by DTSD Region, are shown in Table 7-1. The information demonstrates that WisDOT is generally meeting its statewide goals for the PEM, although individual Regions vary in their relative performance. As WisDOT becomes more proficient in implementing its optimal SHR investment strategies, the PEM scores in Table 7-1 are expected to improve.

Table 7-1 3R Program Performance by DTSD Region – 2018
Source: MAPSS

DTSD Region	Location Measure	Work-Type Measure	Timing Measure
North Central	Good (93%)	Good (91%)	Acceptable (61%)
Northeast	Good (95%)	Good (87%)	Good (65%)
Northwest	Good (87%)	Good (83%)	Acceptable (52%)
Southeast	Acceptable (72%)	Good (86%)	Good (75%)
Southwest	Good (92%)	Good (85%)	Acceptable (52%)
Statewide 3R	Good (88%)	Good (86%)	Acceptable (60%)
Statewide Goal	80%	65%	65%

WisDOT's ongoing commitment to asset management principles, process improvement and performance measures is further underscored by the creation of DTSD's Office of Asset Management and Performance Management (OAM). OAM was created to ensure WisDOT's asset management initiatives are fully implemented at the project level in order to maximize the benefits of WisDOT's ongoing investments in the STH system. OAM spearheaded significant changes to WisDOT's Facilities Development Manual (FDM), standardizing the use of asset management protocols in project programming. These changes include inserting performance based practical design concepts into FDM protocols for standard highway improvements, pavement preservation treatments and safety projects. OAM also revised WisDOT's Highway Maintenance Manual (HMM) to directly link the decision logic for pavement maintenance activities with Theme X'. This ensures strategic use of highway maintenance dollars as an integral part of WisDOT's effort to optimize pavement health through its SHR investment strategy.

In addition to standardizing best practices in the FDM and HMM, the OAM is focused on ongoing tool development, education and training to increase knowledge and instill asset management best practices into the fabric of WisDOT's project development culture. Through the development of asset-based resource models and the analysis of project delivery processes and costs, OAM has refocused DTSD staff resourcing efforts to assure internal and external resource use aligns with effective system asset management.

In short, the OAM provides stewardship and oversight for streamlining project level asset management implementation using asset management programming concepts, practical design, and performance measures related to project development and design.

The STIP Process and the TAMP

The STIP lists all projects in the state highway improvement program scheduled to receive federal funding over a rolling four-year period. There is a direct relationship between the TAMP and the STIP, providing assurance that the TAMP will be implemented over time. The list of state highway improvement programs was discussed in Chapter 2 and includes SHR, Major Highway Development (Majors), Southeast Wisconsin Freeway Megaprojects (SEF), and two special bridge programs. For Majors, SEF, the special bridge programs, Large SHR Bridge and the Backbone Program within SHR, both the TAMP investments described in Chapter 6 and WisDOT's STIP are based on currently scheduled projects. For the 3R Program, the PEM process ensures the WisDOT's optimal 3R investment strategies are reflected in the scheduled program of projects, and the scheduled program automatically becomes part of the STIP.

Total federal funding represented by the projects in the STIP is constrained by expected federal funding in each federal program area. Federal programs and funding levels are authorized by

law and can change over time. Typically, federal programs are defined in a five-year "reauthorization" bill, which also authorizes the level of federal funding over the period.

WisDOT's Biennial Budget authorizes spending specific annual amounts of state, federal, local and bond funds on projects financed through specific state highway appropriations (state programs). The Biennial Budget does not specify the federal program(s) to be used as the source of the federal funds authorized for each state appropriation. Over the four-year period covered by the STIP, WisDOT assumes future Biennial Budgets will provide funding at currently approved levels.

Federal highway programs often focus on either certain highway systems (e.g. the National Highway System) or certain types of work (e.g. Bridge Replacement and Rehabilitation). The Federal Funds Management Section (FFMS) within the Office of Management and Budget (OMB) assigns federal funding from specific federal programs to projects scheduled across the state highway appropriations authorized by WisDOT's Biennial Budget. Projects must meet the eligibility requirements for the federal program(s) providing funds, and total federal funding for the projects financed from a given federal program cannot exceed expected federal funding authority for that program. In addition, the total federal funding assigned to projects in a state program (e.g. SHR) cannot exceed the amount of federal funding authorized for that program in WisDOT's Biennial Budget. Biennial Budget limitations on other types of funding are also observed.

There are many stages, or lifecycles, involved in the development and implementation of every highway and bridge improvement project. Within WisDOT's Financially Integrated Improvement Programming System (FIIPS), projects early in the development process are assigned to FIIPS Life Cycle 00. Projects are assigned to FIIPS Life Cycle 10 when their initial project scope, schedule, and budget have been identified. Although it may be some time before projects at FIIPS Life Cycle 10 can be constructed, these projects are drawn into the STIP if the staging of the project calls for funds to be obligated within the four-years covered by the STIP.

Federal regulations require WisDOT to develop the STIP cooperatively with local officials and tribal governments, while providing effective opportunities for public comment. WisDOT's public involvement process is summarized in the STIP Public Involvement Plan (see https://wisconsindot.gov/Pages/doing-bus/local-gov/astnce-pgms/highway/stip.aspx).

The project development process is ongoing and dynamic. To stay in sync with the state highway improvement program, the STIP is updated regularly. Small changes are processed as administrative modifications, and larger changes are processed as amendments requiring public involvement and a showing that the STIP remains consistent with expected funding.

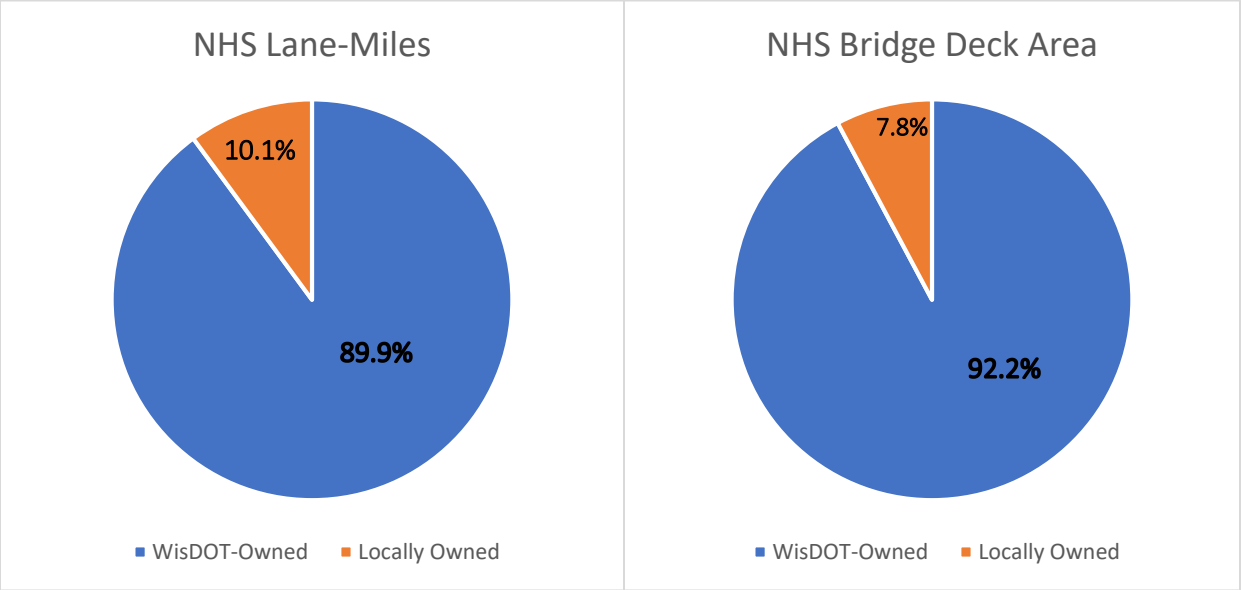
Chapter 8 Pavement and Bridge Conditions on Wisconsin's Locally Owned National Highway System and WisDOT Programs to Support Effective Asset Management at the Local Level

Overview

The Wisconsin Department of Transportation (WisDOT) owns and manages a substantial majority of the National Highway System (NHS) pavements and bridges in Wisconsin. As shown in Figure 8-1, 89.9 percent of NHS lane miles in Wisconsin are WisDOT-owned, with the rest being owned by local governments. 91.3 percent of the NHS bridges and 92.2 percent of the NHS bridge deck area in Wisconsin are also owned by WisDOT, with the remainder being locally owned. This chapter will discuss the current condition of locally owned NHS pavements and bridges in Wisconsin and WisDOT's efforts to help local governments effectively implement cost-effective NHS investment strategies.

WisDOT is committed to helping local governments manage their highway and bridge infrastructure using sound asset management principles and will continue efforts to make high-quality information from pavement and bridge management systems available to all local governments in Wisconsin. The most recent Biennial Budget increased the funding available to local governments for their highway programs, and WisDOT is currently studying ways to increase funding flexibility and reduce project delivery costs for local governments.

Figure 8-1 WisDOT-Owned vs. Locally Owned NHS Pavement Lane Miles and Bridge Deck Area Within Wisconsin



WisDOT Data Collection and Management Systems for Pavements and Bridges on the Locally Owned NHS

WisDOT inspects all bridges in Wisconsin on a minimum two-year cycle, regardless of ownership (as required by the National Bridge Inspection Standards (NBIS)). This provides bridge inspection information of uniform quality on all NHS bridges in Wisconsin. Using this information, WisDOT can assess bridge conditions on the entire NHS using the condition metrics required by the Federal Highway Administration (FHWA). Inspection data on local bridges is available to local governments through the Highway Structures Information System (HSIS). WisDOT provides bridge asset management assistance to local governments by sharing recommended bridge treatments from the Wisconsin Structures Asset Management System (WiSAMS). Appendix B discusses WiSAMS in more detail.

Pavement condition information using the Pavement Surface Evaluation and Rating (PASER) system is collected on a two-year cycle by local governments for all locally owned pavements and accessed within the Wisconsin Information System for Local Roads (WISLR). To assist local governments in developing cost-effective pavement maintenance and improvement strategies using this information, WisDOT developed the WISLR Pavement Analysis Tool and provides training to local governments in its use (see https://wisconsindot.gov/Pages/doing-bus/local-gov/wislr/default.aspx).

WISLR data does not allow WisDOT to assess locally owned NHS pavements using the condition metrics defined by FHWA. To fill this gap, WisDOT goes beyond WISLR and gathers the detailed information on pavement roughness, cracking, rutting and faulting required for the FHWA condition metric on locally owned NHS pavements. WisDOT will share this information with local governments to supplement the information contained within WISLR.

An Inventory of the Pavements and Bridges on the Locally Owned NHS

The local NHS in Wisconsin is composed of 650.16 center line miles of highway. 138 local governments contain some local NHS mileage, with 61 of those localities contain less than two miles of local NHS. Overall, 46.6 percent of local NHS roadway miles are in 13 localities having 10 miles or more. Ten of these 13 localities are in the greater Milwaukee area and the remainder are in the Madison, Fox Cities and Green Bay areas.

Wisconsin's local NHS also contains 310 bridges, which are distributed across the state differently than roadway miles. While the Southeastern Wisconsin Metropolitan Planning Organization (MPO) contains 63 percent of the locally owned NHS roadway miles, it contains 53 percent of the bridges. Meanwhile, 47 percent of local NHS bridges are in other MPO's or non-MPO areas, compared with only 37 percent of the local NHS roadway miles.

Table 8-1 provides an inventory of the locally owned NHS center line miles and bridges in Wisconsin.

Table 8-1 Inventory of Pavement Miles and Bridges on the Locally Owned NHS in Wisconsin

	Pavements [1/]		Bridges [2/]	
	Center Line Miles	Lane Miles	Bridges	Sq. Ft. of Bridge Deck (Millions)
Wisconsin's Locally Owned NHS	650.16	1864.00	310	3.3

[1/] For divided highways, one center line mile equals two roadway miles. Roadway and center line miles are equal for undivided highways. The pavement data is for 2018.

[2/] The bridge data is for 2018. Consistent with national definitions: a) only bridges more than 20 feet long (between abutments) are included in Table 1-1, and b) culverts more than 20 feet in width (length in the direction of travel) are counted as bridges.

The Condition of the Pavements and Bridges on the Locally Owned NHS

As discussed in Chapter 1, FHWA has defined NHS pavement performance measures for national use as part of the National Highway Performance Program (NHPP). The NHPP performance measures for pavements consider three condition factors: ride (through the International Roughness Index (IRI)), the percent of the pavement surface exhibiting cracking, and the degree of either pavement rutting or joint faulting (depending on whether the pavement is asphaltic concrete or Portland cement concrete, respectively). The condition factors each have criteria defining "good", "fair" and "poor" condition. A pavement lane mile is rated "good" if all three condition factors are "good", "poor" if two or more condition factors are "poor", and "fair" otherwise.

As with pavements, FHWA has defined NHPP performance measures for NHS bridges. The bridge performance measures consider three condition factors: bridge deck, superstructure and substructure. These condition factors are part of the National Bridge Inventory (NBI) rating system. The condition factors have criteria defining "good", "fair" and "poor" condition. An overall bridge rating (except for culverts counted as bridges) is assigned based on the lowest rating among the three condition factors: "good" if the lowest rating among the three factors is "good", "fair" if the lowest is "fair", and "poor" if the lowest is "poor". Culverts counted as bridges are classified as "good", "fair" or "poor" based on the NBI rating factor for culvert condition using the same logic. A rating of 7, 8 or 9 means the culvert is classified as "good", and a rating less than 5 means the culvert is classified as "poor", with "fair" falling between these two extremes.

Table 8-2 summarizes the condition of Wisconsin's locally owned NHS pavements and bridges using the most recently available data and the NHPP performance measures. The "good", "fair" and "poor" percentages for bridges are based on inspections of all locally owned NHS bridges, and clearly demonstrate that NHS bridges are a priority at both the state and local level in Wisconsin.

Table 8-2 Condition of Locally Owned NHS Pavements and Bridges in Wisconsin [1/]

	Based on Lane Miles		
	% Good	**% Fair**	**% Poor**
Wisconsin's Locally Owned NHS Pavements	9.1%	73.6%	17.3%
	Based on Deck Area		
	% Good	**% Fair**	**% Poor**
Wisconsin's Locally Owned NHS Bridges	34.1%	62.2%	3.7%

[1/] The pavement and bridge conditions in this table reflect 2018 inspection data.

As noted above, WisDOT is committed to supporting local pavement and bridge asset management and is working to improve the usefulness of the information and tools it provides to assist local governments. These efforts are directed at all local pavement and bridge infrastructure, not just the locally owned NHS.

WisDOT's Programs Providing Support for Local Highways and Bridges

WisDOT provides significant support for local pavement and bridge asset management through the provision of funding assistance for the maintenance and improvement of Wisconsin's local highway system. Funding is provided through the Biennial Budget, and for a summary of WisDOT's local highway and bridge programs see https://wisconsindot.gov/Pages/doing-bus/local-gov/astnce-pgms/highway/default.aspx .

In recognition of the important role the local highway system plays in supporting Wisconsin's economy and the mobility of its citizens, WisDOT's funding for local highways and bridges increased markedly during the 2017-2019 Biennial Budget and, if approved, Governor Evers proposed 2019-2021 Biennial Budget will provide even greater state funding in support of local highway and bridges. The three programs recently seeing significant increases in state funding include the following:

- Local Road Improvement Program (LRIP) – a program that assists local governments in improving seriously deteriorating county highways, town roads and city and village streets using state, but not federal, funds. This program increased 17.8 percent during the 2017-19 biennium.
- General Transportation Aids (GTA) – a program that partially offsets the costs local governments incur while maintaining and improving local roads and streets using state, but not federal, funds. This program increased by 6.8 percent during the 2017-19 biennium and the proposed budget for the 2019-2021 biennium increases it by an additional 10 percent starting with calendar year 2020 payments.
- Local Bridge Improvement Assistance Program (Local Bridge) – a program to rehabilitate and replace the most seriously deteriorating bridges on local roads and streets, using both state and federal funds. State funding for the Local Bridge program increased 24.9 percent during the 2017-2019 biennium and remains roughly constant in the proposed 2019-2021 Biennial Budget.

In dollar terms, GTA saw the largest funding increase among these programs, with a $146.3 million increase over both biennia, compared to a $20 million increase in Local Bridge and a $12 million increase in LRIP. Although not targeted specifically to local NHS routes, WisDOT's increased funding support will allow local governments to better care for the roadways and bridges making up this important part of Wisconsin's overall highway network.

WisDOT Initiatives to Improve Local Program Flexibility and Reduce Costs

The responsibility for prioritizing investments in Wisconsin's local highway system rests with local governments. WisDOT is undertaking two initiatives that encourage the best possible use of WisDOT's funding support. Both initiatives are in the Local Bridge area. The first initiative is placing increased emphasis on designing and construction cost-effective bridge projects. By encouraging reduced project costs where feasible and efficient, the goal of this initiative is to increase the number of bridge improvements completed using available Local Bridge funds.

The second initiative in Local Bridge is designed to increase program flexibility by making state funds available for lower cost bridge repair projects, rather than limiting their use to more costly bridge rehabilitation and replacement projects. The Local bridge strengthening program is intended for locally owned load posted bridges. The objective is to quickly and cost-effectively perform structural rehabilitation on targeted bridges to increase structural capacity and remove the load postings. This will enable safe and efficient freight movement in Wisconsin.

WisDOT Coordination with Metropolitan Planning Organizations Regarding NHS Pavement and Bridge Performance

WisDOT coordinates with the fourteen Wisconsin MPO's on a variety of highway and transit planning requirements in the development of long-range transportation plans (LRTP), Transportation Improvement Programs (TIP) and federal performance measures. Planning and programming staff from the Division of Transportation Investment Management DTIM) and the appropriate Division of Transportation System Development (DTSD) Region participate in the MPO's Technical Advisory Committee (TAC) meetings and coordinate state and local project selection and delivery schedules. WisDOT meets with the MPO staff at the quarterly Directors meeting with participation from the Regional Planning Commissions (RPC), MPOs, WisDOT, FHWA and the Federal Transit Administration (FTA). Federal performance measures, including pavement and bridge performance targets, have been topics of discussion at the Director meetings since the enactment of NHPP performance targets. WisDOT shares performance data on all performance measures at the Metropolitan Planning Area (MPA) level. MPOs approve MPA federal performance targets for all current performance measures in coordination with local officials and WisDOT. WisDOT will continue to utilize this important partnership with the MPOs in improving locally owned NHS pavement and bridge conditions.

Technical Appendix

A. WisDOT Pavement Management Decision Support System

B. WisDOT Wisconsin Structures Asset Management System

C. WisDOT Meta-Manager Highway Asset Management System

D. Future Traffic Volumes Expected on the State Trunk Highway System

E. Process Used in the Analysis of Performance Gaps

F. Process Used in Lifecycle Planning

G. Process for Developing the Risk Management Plan

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A. WisDOT Pavement Management Decision Support System

Introduction and Overview

The Wisconsin Department of Transportation (WisDOT) places a high priority on data-driven pavement management. WisDOT's first pavement management system was developed in the late 1980's. Since that time, the data, functionality and analytic capabilities of the system have continually improved. Today, the Pavement Management Decision Support System (PMDSS) is WisDOT's methodology for evaluating current and future pavement performance to identify cost-effective pavement treatment options. PMDSS relies on WisDOT's extensive history of high-quality data on pavement performance.

PMDSS is based on the Pavement Condition Index (PCI). PCI is part of a national standard (ASTM D6433) WisDOT uses to conduct visual surveys quantifying and classifying pavement distress. Beginning in 2018, all WisDOT-owned pavement segments will be surveyed each year. Data on pavement roughness, faulting and rutting will also be collected annually.

Whenever pavement condition indicates a pavement segment needs attention, PMDSS identifies a range of pavement treatment options addressing its deficiencies. Treatments can range from routine pavement maintenance to complete roadway reconstruction. PMDSS estimates the cost of each treatment alternative and its ability to extend the service life of the pavement.

The "Best Value" pavement treatment is defined as the treatment alternative providing the longest extension in service life per dollar invested. In most situations, implementation of the "Best Value" alternative is consistent with the goal of maximizing the "health" of the WisDOT-owned highway system and maintaining pavements in a state of good repair. Budget constraints, however, can create situations where "Reduced Cost" treatments are an effective way to assist in maximizing system "health". PMDSS identifies "Reduced Cost" alternatives where appropriate.

Moving beyond current conditions, PMDSS forecasts future pavement conditions year by year. The forecasts assume routine pavement maintenance continues to be performed consistent with past practice on each segment. Moving year by year through the forecast period, PMDSS reevaluates expected pavement conditions and revises pavement treatment recommendations as necessary. This process provides essential information to support the Transportation Asset Management Plan (TAMP), other short-to-long range planning efforts, and the development of WisDOT's highway maintenance and improvement programs.

WisDOT certifies that PMDSS exceeds the minimum standards for developing and operating pavement management systems in 23 CFR Part 515, section 515.7.

PMDSS Pavement Condition Data

Current Pavement Condition Data, Collection and Evaluation

WisDOT maintains a staff of pavement experts who collect and evaluate pavement distress information. This reflects the priority WisDOT places on pavement management and helps ensure timely, consistent, data collection and analysis. Beginning in 2018, data will be collected annually (previously data collection occurred on a two-year cycle). The WisDOT-owned highway system is divided into a series of pavement segments (nominally, one mile in length). In the case of divided highways, separate pavement segments are defined in both directions. Precise survey sections are selected within each pavement segment, and care is taken to ensure the survey sections are representative. Rutting and faulting measurements are continuous across the entire pavement segment (laser measured).

The pavement surveys are done using high resolution digital imagery. The stored images are carefully reviewed in a laboratory environment where the distresses are classified by type (see list below). Data on the severity (low, medium, high) and the extent (length or area) of each distress is also recorded. Table A-1 lists the types of distress evaluated by pavement type.

Table A-1 PMDSS Pavement Distress Items, by Pavement Type

Jointed Portland Cement Concrete Pavement	Asphaltic Concrete And Composite Pavement
1. Corner breaks 2. Linear cracked slabs 3. Divided slabs 4. Durability ("D") cracking 5. Patching (small) 6. Patching (large) 7. Spalled joints 8. Spalled corners 9. Pop outs 10. Punchouts 11. Faulting 12. Shrinkage cracks	1. Alligator cracking 2. Block cracking 3. Bleeding 4. Edge cracking 5. Joint reflective cracking 6. Longitudinal & transverse cracks 7. Patching 8. Potholes 9. Weathering and raveling 10. Rutting

The pavement distress data in Table A-1 is supplemented with laser measured pavement roughness information (using the International Roughness Index, or IRI) across the entire length of each pavement segment. The data is stored in the Pavement Information File (PIF). PMDSS

combines the PIF data with information on the history of each segment and the functional classification of the roadway to evaluate the condition and integrity of the existing pavement structure and assess the effectiveness of potential pavement treatments.

While pavement data is routinely collected in the spring and summer months, a supplemental collection occurs late each calendar year to capture changes IRI resulting from improvement projects completed earlier in the year. This ensures that PMDSS accurately captures and reflects field measured distress and IRI values for the entire State Trunk Highway (STH) system. PCI is derived from the measured severity and extent of each type of distress.

Forecasting Pavement Condition

PMDSS forecasts pavement conditions iteratively, year by year, beginning with the year following the most recent data collection. Using the rich set of pavement condition data stored in PIF, WisDOT has developed models expressing the rate of deterioration in PCI and IRI as functions of pavement type and age. Generally, deterioration accelerates later in the life of a pavement. Future forecasts of PCI and IRI for each pavement segment are developed by estimating annual deterioration rates and applying them to the latest field measurements. The pavement distresses expected on each segment are forecast in a manner ensuring consistency with the PCI projections. For each observed distress item, the projected increase in the extent of the distress is developed using an annual growth factor. Transition points between differing categories of distress severity are recognized as the projected extents reach thresholds appropriate for the differing distress types. Using historic data as a guide, new types of distress are introduced as relatively new pavements age over the forecast period.

In summary, the basic data elements used in PMDSS are the following:

- Pavement segment location;
- Functional classification;
- Pavement type;
- Number of overlays in place;
- Current and forecast values for roughness (IRI); and
- Current and forecast values for severity and extent (density) of each type of distress, including faulting for jointed Portland cement concrete (PCC) pavements and rutting for asphaltic concrete and composite (AC) pavements.

<u>The Range of Potential Pavement Treatments</u>

As noted above, the types of distress data gathered differ between PCC and AC pavements. It is not surprising, therefore, that potential pavement treatments also differ by pavement type.

PMDSS associates the severity and extent of a distress type with the treatment recommended to correct the problem. This is done for all the distresses exhibited on each pavement segment. For example, if a PCC pavement displays low severity durability cracking over 30 percent of its surface area, the recommended treatment would be spot repair. If the severity of the durability cracking were a degree higher (medium), and of the same extent, the recommended treatment would become a slab replacement. High severity durability cracking over 30 percent of the surface area would increase the recommended treatment still further, to a pavement replacement. Similar associations are made for all combination of distress, severity and extent.

The associations made by PMDSS between specific pavement problems and recommended pavement treatments were developed using intensive data analysis supplemented by expert judgment and experience. The associations were thoroughly reviewed and confirmed by WisDOT engineering staff with extensive field experience. The potential pavement treatments considered by PMDSS are listed in Table A-2. Visual examples of pavements where PMDSS would call for certain treatment alternatives are shown in Tables A-3 and A-4.

Table A-2 PMDSS Pavement Treatment Alternatives, by Pavement Type

Jointed Portland Cement Concrete Pavement	Asphaltic Concrete And Composite Pavement
1. Do nothing 2. Grind* 3. Spot repair* 4. Crack repair* 5. Patch* 6. Slab replacement* 7. Patch or slab replace plus an overlay 8. Pavement replacement (includes rubblization plus an overlay, and cracking and seating plus an overlay, as additional options) 9. Reconstruction	1. Do nothing 2. Crack seal* 3. Seal coat 4. Patch* 5. Mill (roughness issues)* 6. Overlay 7. Mill and overlay 8. Structural overlay 9. Patch and overlay (if over jointed concrete, then mill, patch and overlay) 10. Patch and structural overlay (if over jointed concrete, then mill, patch and structural overlay) 11. Pavement replacement 12. Reconstruction

* Lower level treatments are considered in combination with each other and with overlay and structural overlay treatments. There are 26 potential combination treatments for AC pavements and 36 for PCC treatments.

Table A-3 Visual Examples of Treatments Needed on Portland Cement Concrete Pavements

Treatment Needed: Patch	Treatment Needed: Slab replacement

Treatment Needed: Patch plus an overlay	Treatment Needed: Reconstruction

Table A-4 Visual Examples of Treatments Needed on Asphaltic Concrete and Composite Pavements

Treatment Needed: Crack seal	Treatment Needed: Overlay

Treatment Needed: Structural overlay	Treatment Needed: Reconstruction

Service Life Extensions Associated with Potential Pavement Treatments

The purpose of any pavement treatment is to extend the life of the pavement, where "life" is defined as the amount of time the pavement provides satisfactory service to the traveling public. PMDSS estimates the service life extension (SLE) made possible by each alternative pavement treatment. This information plays a critical role in developing pavement treatment recommendations. It also helps in defining whether the recommended treatment is appropriate for WisDOT's highway improvement program or routine maintenance.

The SLE of a potential pavement treatment relies on the concept of a "desired" minimum service level (DMSL) for pavements on the WisDOT-owned highway system. DMSL is expressed in terms of PCI and varies by the functional class of the roadway. The DMSL for Corridor 2030 Backbone highways and Non-Backbone Principal Arterials are set at PCIs of 70 and 65, respectively (100 reflects "like new" condition). The DMSL for highways functionally classified as Minor Arterial or below is set at a PCI of 60. In other words, the estimated SLE of a pavement treatment reflects WisDOT's goal for better pavement conditions on higher function, higher volume roadways.

To calculate the SLE of a potential pavement treatment, PMDSS begins by estimating the impact the treatment will have on the distresses of the pavement. Each combination of distress type, distress severity and distress extent impacts PCI through a unique "deduct" value (a positive number), with PCI being computed as 100 minus the sum of all "deduct" values for the distresses present. PMDSS estimates the reduction in "deduct" values caused by each potential treatment, and this reduction results in an increase in the post-treatment PCI for that alternative. Generally, the more substantial the treatment the greater the increase in PCI will be. Overlays and higher order treatments, for example, have PCI's of 100 immediately after implementation since they treat all types of distress, reducing the sum of the "deduct" values to 0.

Once a treatment is performed, the PCI of the pavement will begin to deteriorate. PMDSS estimates the rate of deterioration in PCI based on pavement type and pavement history. The SLE of each potential pavement treatment is the estimated number of years it will take for the expected post-treatment PCI to deteriorate to the DMSL for that pavement segment.

WisDOT Costs Associated with Potential Pavement Treatments

PMDSS cost models are based on the "relative" WisDOT costs associated with differing treatment types rather than their "absolute" cost differences. This methodology allows PMDSS to be used without having to constantly adjust costs to match the latest bid costs for differing treatment types. Although the "relative" costs between treatment types are stable over shorter term planning horizons, they can change. To capture any longer-term change, the costs

used by PMDSS are reviewed periodically and modified to maintain appropriate comparisons over time.

WisDOT costs for some pavement treatments vary by the length of the pavement segment involved, while costs for other treatments vary by the severity and extent of the distresses addressed. Pavement overlay and reconstruction treatments, for example, are of the "length" type while crack sealing and patching costs reflect "severity and extent". Accurate costs for some treatments, such as patch and overlay, need to reflect both "length" and "severity and extent" components.

Defining "Best Value" and "Reduced Cost" Pavement Treatments

PMDSS identifies both "Best Value" and "Reduced Cost" pavement treatments to support WisDOT's improvement program decision-making. If budget constraints did not exist, the long-term system "health" of the WisDOT highway system would be maximized by only selecting "Best Value" pavement treatments. However, with a constrained budget, adopting less extensive, and less costly, "Reduced Cost" pavement treatments in some circumstances, allows WisDOT's improvement budget to responsibly address more of the improvement needs that exist on the WisDOT-owned highway system.

PMDSS begins the process of identifying the "Best Value" and "Reduced Cost" treatments for each pavement segment by developing a list of potential treatment alternatives. The alternatives are developed by considering the severity and extent of individual distresses, one by one, and identifying the most appropriate treatment for each distress item. Pavement roughness is also considered. Following WisDOT policy, only treatments with an estimated SLE greater than four years are eligible for improvement program funding. By excluding treatments with an estimated SLE less than four years, PMDSS produces a list establishing a range of improvement alternatives (i.e. non-routine maintenance) for a given pavement segment.

As an example, assume an AC pavement segment has low severity alligator cracking over 3 percent of its surface area, low severity longitudinal and transverse cracking over 22 percent of its surface area and raveling affecting 50 percent of its surface. In this case, the list of treatment alternatives would include a seal coat for the raveling, an overlay for the longitudinal and transverse cracking, and a structural overlay for the alligator cracking.

In some cases, the list of alternatives for improvement program consideration is modified by the need for base patching, crack and joint repairs, and other routine maintenance type activities even though these lower level treatments have SLE's of less than four years on their own. Assume, for example, that an AC pavement has a small amount of low severity alligator cracking (calling for patching) and extensive block cracking (calling for mill and overlay). In this example, the only treatment on the initial list of alternatives would be a mill and overlay.

Patching would have been dropped since it has an SLE less than four years on its own. Still, addressing the need for patching prior to the mill and overlay would benefit future pavement performance, so PMDSS modifies the treatment on the final list to a patch, mill and overlay.

Once the range of the final treatment alternatives is set for each pavement segment, PMDSS estimates the cost and SLE of each treatment on the list. The "Best Value" pavement treatment is defined as the treatment alternative providing the longest SLE per dollar invested (i.e. the maximum (SLE/Cost)). The tentative "Reduced Cost" treatment is defined as the alternative having the lowest dollar cost.

One of the goals of WisDOT's programming policy is to be sure that smart, effective, pavement treatments are considered when a pavement requires extensive, and costly, treatment. To ensure this occurs, PMDSS re-evaluates the tentative "Reduced Cost" treatment when the "Best Value" treatment is equal to one of several specific alternatives. The combinations of "Best Value" and "Reduced Cost" treatments considered are shown in Table A-5. If the SLE conditions reflected in the column labeled the Final "Reduced Cost" Alternative are met, the treatment in that column becomes the recommended "Reduced Cost" treatment. If those SLE conditions do not hold, the final "Reduced Cost" treatment is set equal to the "Best Value" treatment to ensure limited improvement funds are used wisely.

There are other cases where the "Best Value" and "Reduced Cost" treatments identified by PMDSS are the same. Sometimes a single treatment type satisfies both criteria. The most straightforward situation creating this outcome is when the distresses present on a pavement can only be addressed using a single type of treatment. An overlay may, for instance, be the only response PMDSS identifies as appropriate for some patterns of distress. In other situations, the specific combination of distresses increases the likelihood that the "Best Value" and "Reduced Cost" treatments will be the same even though more than one potential treatment is identified.

One example where this is likely to occur is with an AC pavement experiencing a minor amount of low severity alligator cracking and a moderate amount of low severity longitudinal and transverse cracking. In this situation, PMDSS will suggest two potential treatments. The first would be patching, and the second would be an overlay. Given the cost difference between these treatments, and WisDOT's experience regarding the SLE's that can be expected from them, patching will be identified as both the "Best Value" and "Reduced Cost" option because it has the lowest cost overall and the lower cost per year of SLE.

Once all "Reduced Cost" alternatives are finalized, both the "Best Value" and "Reduced Cost" treatments are input to the Meta-Manager Highway Asset Management System (MMS) to support WisDOT improvement programming decisions and guide the development of WisDOT's optimal SHR investment strategy.

Newer pavement segments may require only routine maintenance (or perhaps, no action at all) since pavement conditions have yet to deteriorate to the point where an improvement project (or preventive maintenance) is called for. In these cases, PMDSS information can be used to help guide decisions regarding WisDOT's routine maintenance program.

Table A-5 Criteria for the Re-Evaluation of "Best Value" and "Reduced Cost" Alternatives

Pavement Type	"Best Value" Treatment	Final "Reduced Cost" Alternative
Jointed Portland Cement Concrete Pavement	1. Pavement Replacement 2. Reconstruction	Patch, Repair and Overlay, if it provides an SLE greater than four years
	Patch, Repair and Overlay	Least expensive of the following if any provide an SLE greater than four years: 1. Patch 2. Spot Repair 3. Crack Repair
Asphaltic Concrete or Composite Pavement	1. Pavement Replacement 2. Reconstruction	Overlay, if it provides an SLE greater than four years
	1. Structural Overlay 2. Patch and Overlay 3. Patch and Structural Overlay	Overlay, if it provides an SLE greater than four years

Special PMDSS "Flags"

PMDSS produces two "flags" to assist in setting highway program priorities. The first programming flag is a "critical pavement" flag. In situations where the "Best Value" treatment is a pavement replacement or reconstruction, and the less extensive "Reduced Cost" alternative in Table A-5 does not provide an SLE of at least four years, PMDSS assigns a "critical pavement" flag to the pavement segment. The presence of this flag means the pavement replacement or reconstruction on the segment has high priority.

The second flag is a "pavement preservation" flag. The most cost-effective method for maintaining acceptable pavement performance over time is through early intervention, when distresses are minor, and the actions needed to address them are less expensive. PMDSS identifies pavement segments in this category and flags them as candidates for early intervention. Pavement segments qualifying for the "pavement preservation" flag have a PCI of 80 or more and the SLE's for lower level pavement treatments, up to and including patch and overlay, are at least four years.

"Downshift" the Desired Minimum Service Level

As described earlier, the SLE of a pavement treatment must be at least four years for it to be considered for inclusion in the improvement program (and the TAMP). In response to WisDOT's constrained funding environment, a "downshift" concept was developed to lower the DMSL used in computing SLE's in certain circumstances. A lower DMSL increases the SLE of a pavement treatment beyond what it would be using a higher DMSL.

The "downshift" concept is only considered on lower function roads (Minor Arterials and below) located off the NHS. These roadways typically have the lowest traffic volumes on the STH system. The "downshift" concept defines an "acceptable" as opposed to "desirable" service level for these roadways if certain conditions exist. Specifically, the "downshift" concept reduces the DMSL from a PCI of 60 to a PCI of 55 if the roadway is already functioning with a PCI below 55.

With a budget constraint, pavement treatments providing an SLE of four years using the "downshift" concept are an effective programming response on lower function roads. When "downshift" conditions apply, the "Reduced Cost" calculations within PMDSS are run using the "downshift" DMSL. If a potential pavement treatment provides an SLE of four years or more using the lower DMSL, PMDSS recommends it for consideration. This results in "acceptable" pavement performance on the roadway in question, while freeing budget dollars for use on other roadways that would otherwise not be improved.

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B. WisDOT Wisconsin Structures Asset Management System

Introduction and Overview

Since the 1980's, the data and analytic processes underlying WisDOT's bridge management efforts have continually improved. The Wisconsin Structures Asset Management System (WiSAMS) reflects WisDOT's latest policies for assessing bridge condition and recommending cost-effective treatments needed to maintain acceptable bridge conditions over time.

WiSAMS relies on an extensive set of bridge inventory and inspection data contained in WisDOT's Highway Structures Information System (HSIS). HSIS bridge inventory data describes the unique characteristics of each bridge on the State Trunk Highway (STH) system. Example inventory items include the date the bridge was constructed, its rehabilitation history and current load rating, the number of spans, as well as span length and deck width. The HSIS bridge inspection data collected by WisDOT covers the broad array of bridge elements necessary to assess detailed bridge conditions.

WiSAMS uses HSIS data to track bridge conditions, perform analyses and create management reports for individual bridges and for the STH system. HSIS data is used to anticipate future bridge conditions and predict bridge maintenance, rehabilitation and replacement needs over time. The Transportation Asset Management Plan (TAMP) relies on this information to ensure NHS bridge needs are funded appropriately. The information also guides decisions on the specific bridge investments made through WisDOT's highway maintenance and improvement programs.

WisDOT certifies that WiSAMS exceeds the minimum standards for developing and operating bridge management systems in 23 CFR Part 515, section 515.7.

The HSIS Database

The HSIS database is maintained by the Division of Transportations System Development (DTSD) Bureau of Structures (BOS). BOS is responsible for the design, inspection and maintenance of all 5,200+ STH bridges. The collection and storage of STH bridge information in the HSIS has evolved over time. Example HSIS inventory items include the following:

- Owner
- Municipality
- Original construction date
- Superstructure/Substructure type
- Number of spans
- Span length
- Deck width
- Feature carried (roadway ID)
- Feature under (roadway, waterway)
- Vertical clearance
- Average daily traffic (ADT)
- Construction/rehabilitation history
- Design loading
- Load ratings (capacity measures)

HSIS inventory data is collected after the initial construction of a bridge and updated, as appropriate, after all rehabilitation or repair efforts. The inventory data collected goes beyond the requirements for the National Bridge Inventory (NBI), which is submitted to the Federal Highway Administration (FHWA) on an annual basis.

FHWA created National Bridge Inspection Standards (NBIS) during the 1970's in response to the collapse of the Silver Bridge on the Ohio-West Virginia border. The initial NBIS standards took effect in 1978 and were limited in scope. Inspectors were required to report bridge superstructure, substructure and deck condition using a 0-9 scale (0 = failed condition, 9 = excellent condition). Recent revisions to the NBIS require the collection of much more detailed data. WisDOT began collecting more detailed data on select bridge elements beginning in the early-1990s, putting it ahead of the curve. WisDOT implemented detailed NBIS element-based bridge inspections in 2014, providing the sort of granular condition information needed to support detailed asset management efforts. Typically, bridge condition inspections occur every two years.

Due to long bridge service life, and the continual evolution of bridge inventory and inspection standards, WisDOT does not have a complete data record going back to the original construction of many STH bridges. HSIS inspection records typically go back to the mid-1990s, at best.

Early on, BOS utilized a mainframe database to store bridge inventory and inspection data. The ability to enter and access bridge data was limited and time-consuming. The internet made a truly connected and accessible database possible. BOS developed the HSIS to take advantage of these developments in the early 2000's and has continued to enhance the system to meet business needs. Notable features of the HSIS include the following:

- A web-based interface so HSIS is widely accessible internally and externally;
- Live updates, meaning new inventory information and new inspection data are available for immediate access;
- The ability for bridge inspectors to upload inspections directly to the HSIS site;
- Compatibility with multiple internet browsers and mobile devices (tablets, smartphones);
- The ability for the user to select parameters from drop-down menus and query information from the database;
- The presence of customized reports to meet business needs;
- A portal to access bridge plans and other contract design documents; and
- Compatibility with other applications used by WisDOT for easy transfer of data.

Creation of the HSIS was a necessary and critical step along WisDOT's bridge asset management path. HSIS gives BOS the capability to collect, store, and manipulate all the data necessary for asset management activities.

Early Bridge Management at WisDOT

Even before the development of HSIS, BOS understood the need for a bridge asset management system that can provide guidance on bridge maintenance, rehabilitation and replacement needs to WisDOT planning and programming engineers. The goal of a bridge asset management system is to identify a structured sequence of maintenance, preservation, repair, rehabilitation and replacement actions that achieve and sustain a desired state of good repair, at minimum practicable cost, over the lifecycle of the stock of bridge assets. In the late 1990s, BOS partnered with the Bureau of State Highway Programs (BSHP) in the Division of Transportation Investment Management (DTIM) to provide six-year rehabilitation and replacement projections for every WisDOT-owned bridge in Wisconsin. There were obvious limitations: condition data was not as detailed as modern element-based inspection data, the equations used to extrapolate future deterioration were rudimentary, and the treatment recommendations were limited. The development of HSIS and the move to element-based bridge inspections presented an opportunity to develop a more robust bridge asset management process. To take advantage of the opportunity, BOS recognized that a rigorous set of bridge preservation and rehabilitation policies was required.

WisDOT BOS Bridge Preservation Policy Guide

To develop the required set of bridge preservation and rehabilitation policies, BOS created the Bridge Management Next Generation (BMNG) team in 2011. The BMNG team represented a collaborative effort among members of the BOS Development and Maintenance sections and the bridge inspection program managers in each DTSD Region. The BMNG also incorporated input from WisDOT's FHWA liaison and an expert engineering consultant. The goals of the BMNG team included the following:

- Establish specific bridge preservation objectives;
- Establish performance measures for the objectives; and
- Identify the bridge preservation treatments (both the Maintenance and Operations [M&O] and State Highway Rehabilitation [SHR] funded treatments) that allow the objectives to be met and establish data-based criteria defining when each treatment is to be performed.

Completed in the summer of 2015, the BOS Bridge Preservation Policy Guide (BPPG) serves as the basis for optimal treatment decisions regarding STH bridges. The BPPG offers a statewide

baseline for planning and scoping bridge preservation treatments over the lifecycle of each bridge. The goals of the WisDOT bridge preservation program include the following:

- Maintain bridges in a state of good repair using low-cost yet effective strategies;
- Implement timely preservation treatments on structurally sound bridges to promote optimal lifecycle costs, extend service life and lengthen the time between major rehabilitation and replacement activities;
- Limit adverse impacts to traffic operations and various affected stakeholders;
- Promote and support budgeting of preventive maintenance activities;
- Establish program performance goals and monitor progress toward meeting them; and
- Optimize the benefits and effectiveness of long-term maintenance investments in achieving a state of good repair for WisDOT's bridge inventory.

Effective bridge preservation requires the identification of actions (treatments) that accomplish the following:

- Prevent, delay or reduce the deterioration of bridges or bridge elements;
- Restore the functionality of existing bridges;
- Keep bridges in good condition; and
- Extend useful bridge life.

Bridge preservation actions encompass both maintenance and rehabilitation. They may also be either preventative in nature or condition driven. This breakdown is shown in Figure B-1.

Figure B-1 WisDOT Bridge Preservation Actions

The bridge preservation activities in the BPPG relate to bridge deck, superstructure and substructure elements. Table B-1, taken from the BPPG, lists the most common preservation activities. (See https://wisconsindot.gov/Pages/SearchResults.aspx?q=bridge preservation policy guide).

Table B-1 Common Bridge Preservation Activities

Bridge Component	Bridge Preservation Type	Activity Description	Preventive Maintenance Type	Action Frequency (Years)
All	Preventive Maintenance	Sweeping, power washing, cleaning	Cyclical	1-2
Deck	Preventive Maintenance	Deck washing	Cyclical	1
		Deck Sweeping		1
		Deck Sealing/Crack Sealing		4-5
		Thin polymer (Epoxy) overlays		10
		Drainage cleaning/repair		As needed
		Joint cleaning		
		Deck Patching	Condition Based	1- 2
		Chloride extraction		1 -2
		Asphalt overlay with membrane		12-15
		Polymer modified Asphalt overlay		6-12
		Joint seal replacement		10
		Drainage cleaning/repair		1
	Repair or Rehab Element	Rigid concrete overlays	Condition Based	As needed
		Structural Reinforced concrete overlay		
		Deck joint replacement		
		Eliminate joints		
Super	Preventive Maintenance	Bridge approach restoration	Cyclical	2
		Seat and beam ends washing		2
	Repair or Rehab Element	Bridge rail restoration	Condition Based	As needed
		Retrofit rail		
		Painting		
		Bearing restoration (replacement, cleaning, resetting)		
		Superstructure restoration		
		Pin and hanger replacement		
		Retrofit fracture critical members		
Sub	Preventive Maintenance	Substructure Restoration	Condition Based	As needed
		Scour Counter Measure		
		Channel Restoration		

Following the hierarchy shown in Figure B-1, Table B-1 lists preservation activities falling into either preventive maintenance or element rehabilitation for each major bridge component. Table B-1 also indicates whether the need for the activity is cyclical in nature or based on a condition survey. It also lists the frequencies with which cyclical and some condition-based activities are typically performed.

Saying the need for a bridge preservation activity is based on condition begs the question of what conditions are relevant. To address this, the BPPG contains specific criteria establishing

when various bridge elements are eligible for select condition-based (and some cyclical) preservation activities. These criteria are shown in Tables B-2 and B-3.

The WiSAMS Bridge Management System

With the HSIS and BPPG in place, the next step in developing WisDOT's improved bridge management system was the creation of new bridge management software (WiSAMS). Developed in-house, WiSAMS relies on the bridge inventory and condition inspection data stored in the HSIS. WiSAMS represents a strategic, systematic process for operating, maintaining and improving WisDOT's bridge assets, focusing on engineering and economic analyses based on quality information.

WiSAMS Background Logic

WiSAMS relies on a set of decision rules applied consistently to a set of HSIS data. Each decision rule takes the form of an "if-then" statement derived from the policies in the BPPG. If the evaluation criteria contained in an "if-then" statement are met, a specific work action (bridge treatment) is assigned to the bridge. This ensures the bridge treatments recommended by WiSAMS will be consistent with BPPG policy.

To illustrate, decision rules #1 and #10 are as follows:

WiSAMS Rule #1

- If the following criteria are met…
    - The current NBI rating for substructure is less than or equal to 3, and
    - The structure is scour critical,
- …then the recommended work action is "REPLACE STRUCTURE."

WiSAMS Rule #10

- If the following criteria are met…
    - The current NBI rating for superstructure is less than or equal to 3, and
    - The structure is > 50 years old, and
    - The superstructure is fracture critical,
- …then the recommended work action is "REPLACE STRUCTURE."

These decision rules are simple in nature and rely largely on NBI condition data. As the history of element-based inspection data continues to develop, WiSAMS will be able to apply ever more sophisticated decision rules. Some current rules are more complex and already use element-based condition data. An example of one of these rules is as follows:

Table B-2 Concrete Deck/Slab Eligibility Matrix

NBI Item 58	Deck Element Distress Area (%) ①	Preservation Activity	Benefit to Deck from action	Application Frequency (in years)
≥7		Deck Sweeping/Washing	Extend Service Life	1 to 2
		Crack Sealing	Extend Service Life	3 to 5
		Deck Sealing	Service life extended	3 to 5
		Polymer Modified Asphalt Overlay	Service life extended	12 to 15
		Polymer Overlay	Service life extended	8 to 12
=6		Deck Sweeping/Washing	Extend Service Life	1 to 2
	<20%	Crack Sealing	Extend Service Life	3 to 5
	<20%	Deck Sealing	Service life extended	3 to 5
	<5% ②	Deck Patching	Service life maintained	As needed
	<5%	Deck Patching, Cathodic Protection	Extend Service Life	As needed
	<10%	HMA w/ membrane	Improve NBI (58) ≥ 7	8 to 12
	<20%	Polymer Modified Asphalt Overlay	Improve NBI (58) ≥ 7	12 to 15
	<20%	Concrete Overlay	Improve NBI (58) ≥ 7	12 to 30
=5	<20% ②	Deck Patching	Service life maintained	As needed
	<20% ②	Deck Patching, Cathodic Protection	Extend Service Life	As needed
	20 to 25% ③	Concrete Overlay	Improve NBI (58) ≥ 7	12 to 30
	20 to 25% ③	Structural Concrete Overlay ④	Improve NBI (58) ≥ 7	12 to 30
≤ 4	<40%	Deck Replacement ⑤	Improve NBI (58) = 9	25 to 50

① Use NBI and deck distress area together to determine the repair action.

② Refers to deck defects of delaminations and spall and refer to defect 1080.

③ The maximum area of deck delamination is 25 percent. When WisDOT fully transitions to elements, this will refer to defect 1080.

④ Consult BOS - not for deck girder bridges.

⑤ Consider remaining bridge conditions to determine if activity is desirable and cost-effective.

Table B-3 Other Bridge Elements Eligibility Matrix

NBI Item	Element	NBI Criteria	Defect	Element Defect Condition State Criteria	Repair Action	Potential Benefits to NBI or CS	Anticipated Service Life Years
Deck	Joints	Item 58 ≥ 5	2350	CS2, CS3, or CS4	Joint Cleaning	CS1 or CS2	
			2310	CS2, CS3, or CS4	Joint Seal Replacement/Restoration ⑦	CS1	5 to 8
			2310 or 2360	CS3 + CS4 ≥ 10%	Joint Replacement ④	CS1	10 to 20
				All Condition State	Joint Elimination ④	Elimination	15 to 25
	Railing	Item 58 ≥ 5		CS3 or CS4	Railing Restoration	CS1 or CS2	3 to 10
				CS3 or CS4	Railing Replacement/Retrofit ⑧	CS1	10 to 20
Super	Steel Elements	Item 59 ≥ 5		N/A	Superstructure Washing/Cleaning	NA	1 to 2
			3440	CS2 + CS3 Area> 5% ⑥	Painting - Spot	CS1	1 to 5
				CS3 Area ≤ 25% ⑥	Painting - Zone	CS1①	5 to 7
				CS3 Area ≥ 25% ⑥	Painting - Complete	CS1②	15 to 20
		Item 59 ≥ 4		CS2, CS3, or CS4	Superstructure Restoration ③	NBI ≥ 7	5 to 20
	Bearings	Item 59 ≥ 5		CS3 or CS4	Bearing Reset/Repair	CS1 or CS2	1 to 5
				CS2 or CS3	Bearing Cleaning/Painting	CS1 or CS2	5 to 7
				CS3 or CS4	Bearing Replacement	CS1or CS2	10 to 15
Sub		Item 60 ≥ 5		N/A	Substructure Washing/Cleaning	NA	1 to 2
			3440	CS2+CS3+CS4 Area > 5% ⑥	Painting - Spot	CS1	1 to 5
			3440	CS3 Area > 25% ⑥	Painting - Complete	CS1 ②	10 to 20
				CS2 or CS3 or CS4	Substructure Restoration ⑤	NBI ≥ 7	5 to 20
			9290	CS1 or CS2	Pier Protection ⑨	NBI ≥ 7	5 to 20
				CS3 or CS4	Scour Counter Measure ⑩	NBI ≥ 7	5 to 20

① Increase NBI only if combine with structural steel repairs.

② Complete painting only if combined with structural steel repairs to improve the component NBI ≥ 7.

③ Superstructure restoration includes all work related to the superstructure including but not limited to strengthening, pin and hanger replacement, retrofit FC member, etc.

④ Combined with deck overlay or replacement project.

⑤ Substructure restoration includes all work related to the substructure including but not limited to fiber wrapping, strengthening, crack injection, encapsulation, etc.—regardless of material type.

⑥ Element condition state for steel protective coating.

⑦ Includes but is not limited to end block/paving block replacement.

⑧ Must bring railing to current standards or have an approved exception to standards.

⑨ Examples are pier protection dolphins and fender systems.

⑩ Provide scour countermeasures after repairing any other substructure defects.

WiSAMS Rule #32

- If the following criteria are met…
    - The number of previous overlays (concrete or asphalt) is less than 4, and
    - The current NBI rating for deck is greater than or equal to 6, and
    - The total quantity of deck area in CS-2, CS-3, and CS-4 for defect 1080 (de-laminations, spalls, and patches) is less than 5 percent of the total deck area, and
    - The total quantity of deck area in CS-2, CS-3, and CS-4 for defect 3210 (de-bonding, spalls, patched area, pothole – wearing surface) is greater than 20 percent of the total deck area, or
    - The total quantity of deck area in CS-2, CS-3, and CS-4 for defect 3220 (crack – wearing surface) is greater than 50 percent of the total deck area, or
    - The total quantity of deck area in CS-3 and CS-4 for defect 8911 (abrasion, wear, rutting, or loss of friction – wearing surface) is greater than 20 percent of the total deck area,
- …then the recommended work action is "CONCRETE OVERLAY."

Each of the WiSAMS decision rules is evaluated in sequential order using relevant inventory and condition data from HSIS. When the criteria for a rule are met, the work action associated with that rule is reported as the optimal bridge treatment. If a bridge is currently in good condition, there may be no treatment recommended.

Forecasting Future Work Actions

As described above, the process for identifying optimal bridge treatments depends on the condition data contained in HSIS. The current condition of each bridge is based on the most recent inspection, which, as noted above, typically takes place on a two-year cycle. Forecasting the need for future treatments relies on forecasts of future bridge condition. These condition forecasts are developed using condition deterioration curves. Based on the current condition of an individual bridge, the deterioration curves predict the condition of that bridge in future years. Then, applying the decision rules discussed above, WiSAMS recommends a series of future bridge treatments. Taken across the entire STH bridge inventory, the set of current and future treatment recommendations forms the basis of effective bridge asset management. The recommendations give DTSD Region engineers the insights necessary to preserve their bridge inventory in the most cost-effective manner possible using available Maintenance and Operations (M&O), and State Highway Rehabilitation (SHR) program funding.

Other WiSAMS Features

WiSAMS is intended to be a tool used to provide DTIM and DTSD Region staff with the best information available to program and scope an optimal set of bridge treatments. Consistent with this goal, WiSAMS provides information beyond just current and future recommended work actions. Some of this information includes:

- A comparison between WiSAMS recommended bridge treatments and bridge projects currently scheduled for construction in WisDOT's Financial Integrated Improvement Programming System (FIIPS) – FIIPS is independent of WiSAMS, and the comparison between the two systems on a bridge by bridge basis helps ensure optimal bridge treatments are being implemented.
- Cost estimates – WiSAMS uses actual cost data from recent projects to provide cost estimates for all recommended bridge treatments.
- Condition Assessment Index (CAI) – While the CAI is still being refined, the intent is to provide a single parameter to assess the overall condition of a bridge. The condition of individual bridge elements will contribute to the CAI, with each element being weighted based on criticality. The CAI will capture the effects of the bridge treatments that are performed.
- Priority Index (PI) – Like the CAI, the PI is still being refined. The intent of the PI is to provide a standard, objective measure to assist in setting priorities for recommended bridge treatments. Average Annual Daily Traffic (AADT) is one factor that will contribute to this measure. Bridges experiencing higher traffic volumes are more critical than those with low traffic counts. Similarly, bridges that are currently load posted may take priority over those that are not. Each factor contributing to the PI will be weighted and summed to provide the overall PI.

The information available through WiSAMS will continue to be modified and enhanced as necessary to improve the ability of the system to effectively aid WisDOT in identifying and implementing cost-effective STH bridge investment strategies.

WiSAMS and the WisDOT Bridge Asset Management Program

As noted earlier, BOS houses the bridge expertise for WisDOT, but DTIM and the DTSD Regions are the primary entities responsible for funding allocations, project selection, planning, scoping, and project delivery. Successful bridge asset management depends on effective communication, coordination and collaboration between all involved.

WiSAMS is a key component of WisDOT's bridge asset management program. The reports produced by WiSAMS allows BOS to supply accurate, refined information to DTIM and the DTSD

Regions. The format of WiSAMS reports and the information contained in them will continue to evolve to meet ever changing customer needs.

BOS produces and distributes reports twice annually to planning and scoping staff in the DTSD Regions. Here the collaborative process is key. BOS depends on feedback from the Regions to help assess the quality of the recommendations produced by WiSAMS. Constructive critiques of WiSAMS output help BOS identify refinements needed to produce treatment recommendations more in line with actual observed bridge condition and deterioration.

Implementing WiSAMS recommendations represents a major step forward from past practice, but WiSAMS is only part of a larger asset management effort within BOS. To that end, the Bridge Rating and Management unit is tasked with ongoing asset management support. This support takes many forms, including the following:

- Maintaining, updating, and improving the WiSAMS application to provide more accurate work recommendations and additional information to help inform planning and scoping decisions;
- Answering questions and supplying data to DTSD Region planning and project scoping staff as necessary;
- Attending DTSD Region planning and project scoping meetings to offer bridge expertise; and
- Coordinating with DTIM and attending related meetings, including the monthly Backbone Committee meeting.

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C. WisDOT Meta-Manager Highway Asset Management System

Overview

The Wisconsin Department of Transportation (WisDOT) has long embraced a "data-driven" asset management approach to the development of projects and programs that improve the State Trunk Highway (STH) system. In conjunction with reliance on data for decision-making, WisDOT is also committed to a process of continual improvement in data quality (e.g. standards for data collection and storage, leveraging of technology, and data integration strategies).

As a central part of its commitment to data-driven decisions, WisDOT developed the Meta-Manager Highway Asset Management System (MMS). The MMS provides WisDOT staff with a comprehensive suite of data and analysis tools to support development, monitoring and management of the highway improvement program for the STH system. The MMS combines information from WisDOT's pavement and bridge management systems (PMDSS and WiSAMS, discussed in Appendices A and B, respectively) with detailed information on the physical and safety characteristics of STH highways and the level and composition of traffic using the STH system.

The information in the MMS database can be divided into the following general categories:

- Current STH pavement and bridge conditions;
- Geometric characteristics and other physical attribute information for STH highways and bridges;
- Highway crashes, highway capacity, traffic volumes (auto and truck), traffic forecasts, and other information related to current and future performance of STH system;
- The currently scheduled program of STH highway and bridge improvement projects; and
- Predicted rates of deterioration in the physical condition of the individual STH pavements and bridges, along with the positive effects scheduled improvement projects will have on those conditions.

The MMS database is updated regularly and is readily available to all planning, programming and engineering staff in WisDOT's Division of Transportation Systems Development (DTSD) Regions and Central Office.

The suite of analysis tools developed for the MMS is tailored to address the following program management issues:

- Future highway and bridge investment needs and the alternative improvement projects to consider in responding to those needs;
- Estimated costs for alternative improvement projects;
- Improvement program priorities; and

- Impacts of varying budget constraints on the highway improvement program and resulting STH system performance.

Taken together, the MMS database and analysis tools provide significant insights relating to current and future conditions, improvement needs, and priorities on the STH system. The MMS helps ensure consistent policies underlie the development of the statewide highway improvement program, and WisDOT relies on it to help optimize highway program performance (see Chapter 5). Enhancements to the MMS are made on an ongoing basis, consistent with WisDOT's emphasis on continuous process improvement.

The MMS Database

One of the fundamental functions of the MMS is to bring data together from the many independent databases relating to the STH system. WisDOT has a long history and its corporate databases have evolved over time. Typically, the information contained in any specific database is intended to address only a limited number of issues. By themselves, each database provides only a partial, limited, view of the condition, use and performance of the STH system. By integrating information from differing databases, MMS brings together a comprehensive set of information essential to developing, monitoring and managing the STH highway improvement program.

The MMS integrates information from differing databases using WisDOT's Location Control Management (LCM) system. WisDOT's LCM system allows data in each database to be tied to precise locations along the STH system. Using LCM, the MMS divides the overall STH system into short segments. Data representing pavement and bridge conditions, traffic, crashes and other attributes for those segments is then assembled into a single, comprehensive, database.

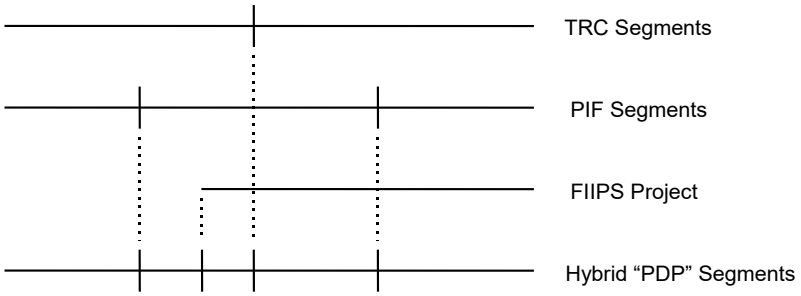
Location information defining the roadway segments contained in three corporate databases is used to derive the STH system segmentation used in the MMS. These databases are as follows:

1. STH pavement conditions (PIF);
2. Scheduled STH highway and bridge projects (FIIPS); and
3. STH traffic counts (TRC).

The beginning and ending points for the roadway segments in these databases are "overlapped" using special geographic information system (GIS) tools, producing a new set of "hybrid" segments for the MMS. Figure C-1 provides an example where the overlap of two TRC segments, three PIF segments and one FIIPS segment produces five hybrid segments.

The segments in the PIF database average one mile in length. These are the shortest among the three databases used to create the hybrid segments underlying the MMS. The overlap process produces approximately 19,500 hybrid segments representing the entire STH system.

Figure C-1 Visual Representation of the MMS "Overlap" Process



Each direction of a divided highway is represented separately within the MMS database. With over 19,000 segments, the MMS database provides a finely grained picture of the condition, use and performance of the STH system.

Once the hybrid segments are defined, a relationship is created between each segment and data in WisDOT's STH "inventory" tables, which contain geometric design information relating to the STH system. The inventory data values "fitting" within each hybrid segment are identified. When more than one data value "fits" within a segment, the "predominant" data value is chosen to represent the hybrid segment.

Data on pavement conditions, traffic volumes, and scheduled STH improvement projects can be directly tied to hybrid segments because of the overlap process. Information on STH bridges can be tied to the hybrid segments where they are located, and data on motor vehicle crashes can be tied to the specific points along the segments where the crashes occur.

At the corporate level, MMS data is stored as a Statistical Analysis System (SAS) database since SAS effectively supports analysis and reporting at the statewide level. For ease of use by staff in each DTSD Region, the MMS data for the highways and bridges located in each Region is provided as an MS Excel workbook. To facilitate geographic analysis, comprehensive data mapping is facilitated through the provision of GIS shape files.

The MMS Analysis Tools

The MMS analysis tools provide WisDOT managers with an understanding of current and future STH performance and investment needs. The budget available for the state highway improvement program is limited, making it impossible for all STH deficiencies to be addressed.

A process is needed to assess the impact of alternative investment priorities on STH performance. The basic questions that must be analyzed include the following:

1. Which current and future STH deficiencies should be addressed within the funds available?
2. How should they be addressed?
3. When should they be addressed?

WisDOT has developed a set of policy-driven MMS analysis tools for answering these questions. The "optimal" answers are derived by simulating the impacts of alternative policies on STH system performance. The data needed to perform these policy simulations is contained in the MMS database.

Working together, staff from WisDOT's Division of Transportation Investment Management (DTIM) Bureau of State Highway Programs (BSHP) and Division of Transportation Systems Development (DTSD) have developed analytic tools that identify alternative improvement projects for addressing deficiencies on STH roadways and bridges. Deficient roadway segments are usually composed of several hybrid MMS segments, providing for logical project beginning and end points. For each deficient segment, a range of alternatives is defined. One alternative improves all the roadway deficiencies that exist on a roadway segment: pavement, safety, geometric, congestion, etc. Other alternatives address individual and select groupings of deficiencies. Taken together, these alternatives create a range of potential improvement projects for each segment. The cost of implementing each alternative is estimated based on the best information available on actual WisDOT costs. Alternatives and costs for addressing bridge deficiencies are also identified, independent of any deficiencies that may exist on the roadway segments where they are located.

MMS analysis tools developed for performing budget constrained policy analyses are used to evaluate alternative state highway improvement policies over analysis periods ranging from 5 to 10 years. Estimated STH roadway and bridge conditions coming into the analysis period reflect implementation of the actual state highway improvement program through that point in time.

Each policy analysis unfolds iteratively, year by year. During the initial iteration, STH roadway and bridge conditions in the first year of the analysis are evaluated and deficiencies are identified. The range of alternatives for treating those deficiencies is defined as described above. From this range of improvements, a single alternative (project scope) is selected for each deficient bridge and roadway segment. This selection process is policy driven, reflecting a consistent process for defining which deficiencies will be addressed (and won't be addressed) during project scoping. Bringing together the total budget available and the estimated cost of the selected alternatives, policy priorities then determine which alternatives (i.e. projects)

should be undertaken in that year versus being delayed to a future period. The scope (and cost) of needed improvements may increase over time if work is not made when first called for.

Prior to moving to the next year of the analysis, conditions on roadways and bridges not selected for improvement are deteriorated to reflect an additional year of wear and tear, and conditions on the roadways and bridges selected for improvement are reset to reflect the positive effects of the improvements made. Future iterations of the analysis then proceed in the same manner as the first, reflecting the same policies for defining project scope and prioritizing projects for funding. When complete, the policy analysis will have defined the year by year program of projects consistent with the policies being evaluated, and the resulting STH system performance over the analysis period.

Chapter 5 describes the policies defining the WisDOT's "optimal" SHR investment strategy. The MMS analysis tools were essential in the development this strategy, and the results of the analysis are an essential component of WisDOT's Transportation Asset Management Plan (TAMP).

As this discussion makes clear, the MMS database and analysis tools provide essential, data-driven, support for defining and managing the state highway improvement program. WisDOT planning and programming staff regularly uses the MMS to:

- Estimate future STH roadway and bridge conditions and improvement needs;
- Identify, scope and prioritize potential STH improvement projects;
- Allocate available funding to sub-programs within the State Highway Rehabilitation (SHR) Program and to DTSD Regions;
- Establish highway improvement program goals and performance measures; and
- Evaluate highway improvement program performance (e.g. Before/After analyses).

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D. Future Traffic Volumes Expected on the State Trunk Highway System

Overview

The Wisconsin Department of Transportation (WisDOT) has produced traffic forecasts and analyses for many years. For more than 25 years, WisDOT has refined techniques, developed policies and standardized procedures that have guided transportation analyses. Today, several tools and sophisticated models exist to forecast traffic on Wisconsin's State Trunk Highway (STH) system. These tools and models are discussed in Chapter 9 of WisDOT's Transportation Planning Manual (see https://wisconsindot.gov/Documents/projects/data-plan/plan-res/tpm/9.pdf), which outlines WisDOT's forecasting process, from the input assumptions to the final forecasts.

This appendix summarizes the STH system traffic forecasts contained in the latest release (October 2019) of the WisDOT Meta-Manager Highway Asset Management System (MMS) database. These forecasts were produced by the current version of WisDOT's Traffic Analysis Forecasting and Information System (TAFIS) for 7,200+ traffic count segments. As noted in Appendix C, traffic count segments (TRC) are a direct input used to develop the MMS segmentation for the STH system. This helps to ensure the validity of assigning forecasts to specific segments within the MMS.

The MMS contains forecasts of the average annual daily traffic and the average daily truck percentage for all highway segments comprising the STH system. Forecasts are included for a base year (currently 2019) and four future years (currently 2023, 2028, 2033 and 2038). Well established and consistent protocols are used so that enterprise-based information systems across WisDOT are consistent with one another.

The TAFIS traffic forecasts underlying the Transportation Asset Management Plan (TAMP) accurately capture recent traffic volumes and growth trends on the STH system. The average annual growth rate is approximately 0.6 percent, with only a handful of traffic count segments demonstrating annual growth rates exceeding 2 percent. This level of expected traffic growth is much lower than that seen during the 1980's and 1990's, when average traffic growth on the STH system was almost 3 percent per year. Traffic growth has moderated significantly over the last 20 years, and WisDOT's TAFIS forecasts expect these moderate growth rates to continue.

TAFIS forecasts are used to develop level-of-service (LOS) projections and safety metrics within the MMS. LOS is a measure of the reliability of traffic flow and the future LOS of a given highway is calculated using forecast daily traffic volume and data on roadway geometry. LOS thresholds are defined for differing classes of highway and are considered during the highway design process. If the forecast LOS for a highway exceeds its class threshold, traffic flow on the highway has slowed and will become more unreliable over time unless highway improvements

are undertaken. MMS crash rate metrics are developed using historical TAFIS information. Crash rates are an important indicator of the need to improve a highway and the type of improvement considered during the design process. TAFIS forecasts also influence the safety analysis underlying the optimal State Highway Rehabilitation (SHR) Investment Strategy (see Chapter 5).

TAFIS Forecasts of the Total Vehicle Miles of Travel Expected on the STH System

TAFIS forecasts are produced for each of the 7,200+ traffic count segments covering the STH system. Traffic counts are made at varying time frequencies, depending on the importance of the highway. Some counts are continuous, while others are taken over much shorter periods every few years.

Plotting historic traffic counts over time for any given count segment typically shows a significant degree of variation around a trend. One count may exceed the trendline while the next may be below trend. TAFIS forecasts are designed to capture traffic count trends and are conservative in nature. The MMS links TAFIS data to specific highway segments, each with a defined mileage. This information can be used to estimate annual vehicle miles of travel (VMT). During the 20-year period from 1997 through 2017 total STH system VMT increased at a compound annual growth rate of 0.89 percent. The TAFIS forecasts underlying the TAMP show slightly lower average growth in the future, as shown in Table D-1.

Consistent with historic trends, forecast VMT growth is expected to be slightly stronger on the C2030 Backbone and C2030 Multilane Connectors than on the two-lane portion of the STH system. Taken together, C2030 Backbone and C2030 Multilane Connector routes account for nearly 60 percent of the annual VMT on the STH system. This reflects the important role these STH sub-systems play in linking Wisconsin's regional economies together and to the rest of the world. The rate of growth in TAFIS VMT forecasts (and in the average daily traffic forecasts underlying VMT) declines over time. This relates to the TAFIS methodology used to capture historic trends and is explained further in Chapter 9 of the Transportation Planning Manual.

Table D-2, provides forecast annual growth rates for the Interstate and the Non-Interstate National Highway System (NHS) routes on the STH system. Growth rates for each NHS sub-systems are very similar, with growth slightly below that expected on C2030 Backbone and C2030 Multilane Connector routes. The forecast growth rates for the Interstate and state-owned Non-Interstate NHS routes are close to one another and to the overall growth expected on the STH system. The similarity to the overall STH system is to be expected since approximately 80 percent of overall STH VMT takes place on state-owned NHS routes.

Table D-1 Forecast Annual Growth in VMT by STH Sub-System
(Compound Annual Growth Rates)

STH Sub-System	2019-2023	2023-2028	2028-2033	2033-2038	2019-2038
Corridors 2030 (C2030) Backbone	0.71%	0.67%	0.62%	0.58%	0.64%
C2030 Connector – Multilane	0.76%	0.70%	0.64%	0.60%	0.67%
C2030 Connector – Two-Lane	0.46%	0.44%	0.41%	0.40%	0.42%
Non-C2030	0.54%	0.51%	0.48%	0.46%	0.49%
Total STH System	0.64%	0.60%	0.56%	0.53%	0.58%

Table D-2 Forecast Annual Growth in VMT by State-Owned NHS Sub-System
(Compound Annual Growth Rates)

NHS Sub-System	2019-2023	2023-2028	2028-2033	2033-2038	2018-2038
Interstate	0.64%	0.60%	0.57%	0.54%	0.58%
Non-Interstate NHS	0.67%	0.62%	0.57%	0.54%	0.60%

Variations in Forecast Growth Rates for Travel on Individual Traffic Count Segments

Table D-3 shows the percentage of traffic count segments with forecasts of average annual growth within the following ranges: less than 1.0 percent growth; 1.0 percent-1.25 percent growth; 1.25 percent-1.5 percent growth; and greater than 1.5 percent growth. The table also reports the maximum growth rate across all traffic count segments within each STH sub-system.

Table D-3 demonstrates that just less than 92 percent of all traffic count segments have expected average annual growth rates less than 1.0 percent, including 85 percent of the count segments on the C2030 Backbone. About 6 percent of all count segments have average annual growth rates between 1.0 percent and 1.25 percent. The C2030 Backbone has expected annual growth rates above 1.25 percent on about 4 percent of its count segments, but Non-Corridors

2030 routes and two-lane C2030 Connector have 2 percent or less of their counts segments showing annual growth in this range. The largest annual growth rate for any traffic count segment is on the Non-Corridors 2030 sub-system, but it represents an extreme outlier. Only 4 of the 5083 count segments on Non-Corridors 2030 routes have expected annual growth rates above 2 percent.

Table D-3 Distribution of Traffic Count Segments by Average Annual TAFIS Traffic Growth Rate and STH Sub-System
(Compound Annual Growth Rates Through 2038)

Average Annual Traffic Growth Rates	C2030 Backbone	C2030 Connector Multilane	C2030 Connector Two-Lane	Non-C2030	Total STH System
Less than 1.0%	551	547	839	4704	6641
1.0-1.25%	74	38	39	290	441
1.25-1.5%	19	11	3	72	105
Greater than 1.5%	7	10	3	29	49
Total Segments	651	606	884	5095	7236
Maximum Growth on Any Segment	1.81%	2.05%	1.96%	2.79%	2.79%

Compared to the C2030 Backbone, a greater proportion of Interstate and state-owned Non-Interstate NHS count segments have growth rates less than 1.0 percent (93 percent for the NHS vs. 85 percent for C2030 Backbone routes). This is consistent with the slightly lower VMT growth rate on the WisDOT-owned NHS.

Implications of Latest TAFIS Forecasts for Expected STH Traffic Congestion

As noted earlier, traffic growth has moderated significantly from the 1980's and 1990's. Information from the MMS indicates that several hundred C2030 Backbone and Connector miles currently exceed WisDOT level-of-service (LOS) thresholds, suggesting additional travel lanes (capacity expansion) should be considered due to the traffic congestion being experienced. Most of these miles are on the NHS. Using the TAFIS forecasts summarized in Tables D-1 through D-3, congested miles on the C2030 Backbone and Connector systems will increase significantly over the next 20 years unless investments beyond the already approved

STH capacity expansion projects continue to be made. WisDOT will continue to analyze congestion, safety and other factors impacting these roadways and will bring priority capacity expansion needs forward for enumeration within the Major Highway Development and Southeast Wisconsin Freeway Megaprojects programs as appropriate.

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E. Process Used in the Analysis of Performance Gaps

Overview

The Wisconsin Department of Transportation's (WisDOT's) performance targets for the State Trunk Highway (STH) system reflect WisDOT's asset management priorities and the level of resources available for highway investment. Performance targets are set for future STH pavement and bridge conditions, including those on the WisDOT-owned National Highway System (NHS). The key to achieving these targets on a consistent basis is making sure that WisDOT resources are directed toward highway and bridge projects scheduled in the right places, with the right scope, and at the right time.

To design and deliver the "right" highway investments at the "right" time, WisDOT needs to both anticipate future system performance and have the "right" set of projects in the project delivery pipeline. Design, real estate acquisition and utility coordination activities all require long lead times.

Predicting STH pavement and bridge performance is subject to uncertainty. Given this reality, WisDOT continually monitors STH performance and refines the agency's highway investment strategies as required. By using this process to adjust the specific projects in the project delivery pipeline, WisDOT increases the likelihood that STH performance targets will be achieved. The process is accomplished using the database and analysis tools of WisDOT's Meta-Manager Highway Asset Management System (MMS).

Estimating Future System Performance and Identifying Potential Performance Gaps

As described in Appendix C, the MMS database integrates information from WisDOT's pavement and bridge management systems (PMDSS and WiSAMS, respectively, as described in Appendices A and B) with data from many other WisDOT sources. Information on traffic volumes, highway and bridge design characteristics and traffic crashes is included, along with detailed information on the STH highway and bridge projects currently in the project delivery pipeline (from FIIPS, the Financial Integrated Improvement Program System).

Using this rich database, WisDOT can summarize current STH pavement and bridge conditions and forecast them into the future. Future pavement and bridge conditions will be influenced by both physical deterioration and the scope and timing of future STH improvement projects. Since this information is available from PMDSS, WiSAMS and FIIPS, WisDOT can use the MMS database to forecast STH pavement and bridge conditions both with and without the projects scheduled for future construction.

Depending on the underlying budget appropriation, STH highway and bridge projects are scheduled for a minimum of six years into the future and can extend for 10 years or more. The program of projects is adjusted and extended an additional two years at the start of each biennium (July of odd-numbered years). The resulting program update reflects WisDOT's investment strategies, consistent with agency priorities and funding expectations.

WisDOT's targets for future STH and WisDOT-owned NHS pavement and bridge conditions are set using the same priorities, funding expectations and investment strategies. This means the updated program of projects (the projects in the project delivery pipeline) at the start of each biennium is expected to meet WisDOT's STH pavement and bridge targets.

Many risk factors influence whether WisDOT's condition targets are met two, four or more years in the future. The physical deterioration rates experienced by individual pavements and bridges will differ from historic average rates. The final bid costs for individual projects will differ from their early program estimates, impacting the number of projects that can be constructed using available program funds. Unexpected delays will mean some projects originally scheduled in the early years of the program are shifted back in time while others are shifted forward to make use of available construction dollars. The impact of these and other risk factors will become clear as pavement and bridge condition data continues to be gathered over time.

Throughout each fiscal year, WisDOT updates the MMS database and analyzes the impact updated condition data and the shifting program of projects has had on expected STH pavement and bridge performance. This analysis may uncover a performance gap, where actual performance lags what had been expected. By monitoring actual vs. expected performance on an ongoing basis, WisDOT can quickly respond to emerging performance gaps.

Closing Potential Performance Gaps by Adjusting the Project Schedule and Revising the State Highway Rehabilitation (SHR) Investment Strategy

WisDOT responds to information on emerging STH and WisDOT-owned NHS pavement and bridge performance gaps in three ways: two occurring on an ongoing basis and the third occurring as the program of projects is updated at the start of each new biennium.

As noted above, one of the risk factors contributing to unexpected performance gaps is a difference between the projects planned for construction and the projects that ultimately occur. The greater the difference between the projects planned for a fiscal year and the projects delivered, the greater the chance for unexpected performance gaps to emerge. One of ways used by WisDOT to minimize this risk on an ongoing basis is by monitoring internal performance measures that place high priority on meeting planned project delivery

schedules and minimizing differences between estimated and actual project costs. (See Appendix G for a discussion of these and other aspects of WisDOT's risk management processes.)

Ultimately, delays are unavoidable for some projects due to the complexities of designing and delivering projects for construction. In response to this reality, WisDOT's risk management process calls for a limited set of projects to be ready for construction well before construction is scheduled. These projects are referred to as being on the "shelf." As delays occur, WisDOT helps minimize future performance gaps by using information on emerging gaps while choosing projects to take off the "shelf" and move forward in the program. Projects are preferred if they help close emerging performance gaps, although there are other policy considerations as well.

At the start of each new biennium, the Biennial Budget presents WisDOT with a revised set of funding realities. The total funding the budget provides, and its distribution across program appropriations, may differ from WisDOT's expectations as the existing schedule of projects was updated at the start of the previous biennium and managed over the intervening two years. To adjust to these new realities, WisDOT uses the MMS database and analysis tools to reevaluate, and potentially adjust, the optimal investment strategy for the SHR Program. (The analysis process is described in detail in Chapter 5.)

The process of reevaluating the optimal investment strategy for SHR might, for example, indicate a larger share of available funding must be allocated to NHS bridges and to the Corridors 2030 Backbone system if WisDOT is going to continue meeting its performance targets for these STH sub-systems. If this were the case, the investment strategies used when responding to pavement needs on non-Corridors 2030 Backbone highways might also need to be revised if WisDOT is to continue meeting its pavement targets for these highways. WisDOT might also choose to adjust some of its performance targets due to the new funding realities. Whatever the exact outcome, this process provides WisDOT with the ability to use the latest information on STH pavement and bridge conditions, the latest pavement and bridge deterioration rates from PMDSS and WiSAMS, the current schedule of construction projects and other updated information to reconsider its investment policies and performance targets.

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F. Process Used in Lifecycle Planning

Overview

The Wisconsin Department of Transportation (WisDOT) is committed to asset management principles as part of its efforts to preserve the State Trunk Highway (STH) system at minimum practicable cost. WisDOT's Pavement Management Decision Support System (PMDSS) and Wisconsin Structures Asset Management System (WiSAMS) identify investment strategies for addressing pavement and bridge deficiencies. The investment strategies called for during the lifecycles of pavement and bridge assets are responsive to current asset conditions and consider both current and future costs. Strategies having lower costs today may have higher costs over time due to their impact on future asset condition. WisDOT's asset management policies focus on identifying and implementing investment strategies that minimize infrastructure costs over the lifecycles of the pavements and bridges making up Wisconsin's STH system.

Pavement Investment Strategies

WisDOT's pavement management system (PMDSS) is described in some detail in Appendix A. Based on pavement type, pavement history and current pavement condition, PMDSS identifies two options for treating pavements in need of rehabilitation: a "Best Value" option and a "Reduced Cost" option. To derive the "Best Value" option, PMDSS identifies alternative pavement rehabilitation treatments and divides the service life extension SLE) each provides by their cost. The "Best Value" option is the pavement treatment having the maximum SLE per dollar. The "Reduced Cost" option is derived after considering the same set of alternative rehabilitation treatments, and is the pavement treatment having the lowest cost, regardless of the SLE it provides (subject to a minimum SLE of four years, per WisDOT policy).

Implementing "Best Value" pavement treatments is consistent with minimizing the lifecycle costs of preserving STH system pavements over time. Table F-1 provides four examples demonstrating this point. Each example represents an existing pavement on the STH system, and in each case, pavement conditions call for a pavement treatment. Table F-1 compares the present value of a 25-year stream of costs resulting from implementation of each pavement's "Most Comprehensive" treatments over time with the present value of a 25-year cost stream associated with implementing each pavement's "Best Value" treatments. In each case, the "Most Comprehensive" option is defined as the series of pavement treatments addressing all expected pavement deficiencies at the time pavement rehabilitation is required. Comparing dollar weighted average present values, the average cost for the four "Best Value" strategies is 22.6 percent less than the average cost under the "Most Comprehensive" approach.

Comparing the present value of costs for a stream of "Best Value" pavement treatments with the present value of costs for a stream of "Reduced Cost" pavement treatments does not provide a reliable comparison of the two strategies because the pavement service they provide to the traveling public varies due to overall pavement quality and the level of travel disruption caused by differences in the frequency of treatments. "Reduced Cost" treatments achieve a minimum level of pavement service at low cost. This makes them appropriate to consider when funding is limited, but they are not intended to provide a high level of pavement service at lowest lifecycle cost.

Table F-1 Comparison of "Best Value" and "Most Comprehensive" Pavement Treatments[1/]

	"Best Value"			"Most Comprehensive"		
	Treatment Stream	**SLE**	**Cost**	**Treatment Stream**	**SLE**	**Cost**
Pavement 1	Crack Repair	5	$12k	PCC Patch	6	$61k
	Patch, Repair, Overlay	13	$180k	Patch, Repair, Overlay	13	$180k
	Patch, Repair, Overlay	13	$180k	Patch, Repair, Overlay	13	$180k
		PV Costs	$227.8k		PV Costs	$266.6k
	% Change From "MC"		-14.5%			
Pavement 2	Crack Repair	5	$5k	PCC Patch	6	$17k
	Patch, Repair, Overlay	13	$180k	Patch, Repair, Overlay	13	$180k
	Patch, Repair, Overlay	13	$180k	Patch, Repair, Overlay	13	$180k
		PV Costs	$220.8k		PV Costs	$222.6k
	% Change From "MC"		-0.8%			
Pavement 3	PCC Patch	6	$127k	Replace Pavement	15	$600k
	Patch, Repair, Overlay	13	$180k	Patch, Repair, Overlay	13	$180k
	Replace Pavement	15	$600k			
		PV Costs	$498.8k		PV Costs	$686.6k
	% Change From "MC"		-27.4%			
Pavement 4	Patch, Repair, Overlay	13	$213k	Replace Pavement	15	$600k
	Replace Pavement	15	$600k	Patch, Repair, Overlay	13	$180k
		PV Costs	$531.2k		PV Costs	$686.6k
	% Change From "MC"		-22.6%			

[1/] Present value (PV) calculated over 25 years at a discount rate of 5 percent. SLE is the expected service life extension from the pavement treatment. Costs are expressed in current base year $ and are on a per lane mile basis. 2019 is the base year for the calculation of present value, so an SLE of "5" implies the cost occurs in 2024, and so on. The treatment streams and years (SLE's) for the "Best Value" alternatives follow guidance on pavement lifecycles and service lives in WisDOT's Facilities Development Manual (FDM 14-15, Pavement Type Selection). This guidance is reviewed regularly and updated as needed to reflect current WisDOT experience. A review will be completed in 2019.

WisDOT's optimal State Highway Rehabilitation (SHR) investment strategy (Theme X') calls for implementing "Best Value" pavement treatments on the Corridors 2030 Backbone and Connector systems and all Principal Arterial highways (see Chapter 5). Since, these highways make up over 99.5 percent of the roadway miles on the WisDOT-owned National Highway

System (NHS), the lifecycle planning process underlying WisDOT's optimal SHR investment strategy manages WisDOT-owned NHS pavements at lowest lifecycle cost.

Bridge Investment Strategies

The Wisconsin Structures Asset Management System (WiSAMS) is described in Appendix B. WiSAMS is consistent with WisDOT's Bridge Preservation Policy Guide (BPPG), which promotes optimal lifecycle costs, as shown in Table F-2.

Table F-2 contains four examples demonstrating the cost-effectiveness of WiSAMS and the BPPG: two relating to pre-stressed concrete girder bridges and two relating to steel girder bridges. For each bridge type, the first example relates to a bridge already in-service and the second relates to a newly constructed bridge. Lifecycle costs for the sequence of bridge treatments recommended by WiSAMS are compared to the lifecycle costs of treatments consistent with typical bridge preservation practices from the 1980's and 1990's.

WisDOT's optimal SHR investment strategy (Theme X') implements WiSAMS recommended bridge treatments on all STH system bridges (see Chapter 5). This policy is consistent with the priority placed on STH bridges and means WisDOT's lifecycle planning process manages the performance of the National Highway System (NHS) bridges on the STH system at lowest lifecycle cost.

Table F-2 Comparison of WiSAMS and "Typical Past Practice" Bridge Treatments[1/]

	WiSAMS			"Typical Past Practice (TPP)"		
	Treatment Stream	Year	Cost	Treatment Stream	Year	Cost
Pre-stressed Concrete Girder – In-Service	Concrete Overlay	24	$64k	New Deck	35	$277k
	New Deck w/ Polymer Overlay	49	$300k	Replace Bridge	52	$515k
	Concrete Overlay	79	$64k	New Deck	85	$277k
		PV Costs	$123.0k		PV Costs	$240.9k
	% Change From "TPP"		-49.0%			
Pre-stressed Concrete Girder – New	New Construction w/ Polymer Overlay	0	$538k	New Construction	0	$515k
	Concrete Overlay	30	$64k	New Deck	33	$277k
	New Deck w/ Polymer Overlay	55	$300k	Replace Bridge	50	$515k
	Concrete Overlay	85	$64k	New Deck	83	$277k
		PV Costs	$1146.6k		PV Costs	$1240.2k
	% Change From "TPP"		-7.6%			
Steel Girder – In-Service	Concrete Overlay, Paint	28	$973k	New Deck	34	$1695k
	New Deck, Polymer Overlay, Paint	53	$2418k	Replace Bridge	60	$4212k
	Concrete Overlay	83	$393k	New Deck	94	$1695k
		PV Costs	$1104.8k		PV Costs	$1428.8k
	% Change From "TPP"		-22.7%			
Steel Girder – New	New Construction w/ Polymer Overlay	0	$4355k	New Construction	0	$4212k
	Concrete Overlay, Paint	30	$973k	New Deck	34	$1695k
	New Deck, Polymer Overlay, Paint	55	$2418k	Replace Bridge	60	$4212k
	Concrete Overlay	85	$393k	New Deck	94	$1695k
		PV Costs	$4751.6k		PV Costs	$4777.4k
	% Change From "TPP"		-0.5%			

[1/] Present value (PV) calculated at a discount rate of 5 percent. Costs are expressed in current base year $. 2019 is the base year for calculating PV. For the in-service bridges, 2024 is "24", and so on. For the newly constructed bridges, 2049 is "30", and so on.

G. Process for Developing the Risk Management Plan

Overview

The Wisconsin Department of Transportation (WisDOT) is fully committed to effective asset management. This commitment requires WisDOT to systematically consider the many uncertainties impacting the State Trunk Highway (STH) system, management of the state highway improvement program and the design of the projects it contains. A robust risk management process is needed to identify and mitigate these risks. Failure to do so would compromise WisDOT's ability to reach its performance objectives for the STH system.

Table G-1 summarizes the risks identified by WisDOT's risk management process using a Transportation Asset Management Plan (TAMP) Risk Register. For each risk identified, the TAMP Risk Register summarizes its likelihood and potential impact, along with the mitigation strategy in place and the organizational area(s) responsible for implementing and monitoring the effectiveness of the strategy. Several strategies relate directly to the priorities and project-level treatments inherent in the investment strategies developed as part of the TAMP. Others relate to ensuring the TAMP is effectively implemented within the financial and staff resources available for the state highway program. Strategies have also been put in place to ensure environmental, traffic and other factors are adequately considered in the project design process, minimizing the risk that projects will not perform as anticipated over time.

The development and implementation of WisDOT's risk management plan is the responsibility of the Administrators of the Division of Transportation Investment Management (DTIM) and the Division of Transportation System Development (DTSD). The risk management plan will continue to evolve. The Director of the Bureau of State Highway Programs (BSHP) and staff from BSHP's Program Development and Analysis section work closely with staff in the DTSD Regions, the DTSD Central Office and the Director and Federal Funds Management Section (FFMS) of the Office of Management and Budget (OMB) to develop and implement program-level risk mitigation strategies as part of WisDOT's overall investment strategy. Development and implementation of project-level risk mitigation strategies are led by DTSD, with input from the DTSD Regions and several Central Office Bureaus, including the Bureaus of Project Development, Structures, Traffic Operations and Technical Services.

Table G-1 TAMP Risk Register

Risk Event	Likelihood	Impact	Priority	Mitigation Strategy	Responsible for Strategy	Status
Projects are not ready for letting to contract in the year originally scheduled.	High	Delayed infrastructure improvements at higher cost due to inflation.	High	Monitor and adjust the projects in the letting schedule to meet the annual "let goal."	DTIM, DTSD	Ongoing
				Monitor the Project Management Plan (PMP) "Project Health Report" throughout the project development process to identify and address schedule risks.	DTSD	Ongoing
				Maintain close coordination between project design and project scheduling staff.	DTSD	Ongoing
				Maintain an adequate number and variety of "shelf" projects ready to take the place of projects that slip from the letting schedule.	DTSD	Ongoing
				When possible, design projects to be eligible for both state and federal funding and meet both NEPA and WEPA requirements.	DTSD	Ongoing
Actual state or federal funds are below the levels assumed in the Biennial Budget, or actual YTD let contract costs are above YTD PS&E estimates.	Medium	Potential delays to higher priority projects instead of lower priority projects.	High	Monitor state revenue collections, federal highway apportionments and "let savings".	OMB, DTIM, DTSD	Ongoing
				Schedule work associated with higher priority projects early in the state fiscal year. Monitor the MAPSS measure related to "timely scheduling of contracts".	DTIM, DTSD	Ongoing
				Adjust the projects in the schedule to avoid exceeding available funding, typically later in the state fiscal year	DTIM, DTSD	Ongoing
				When possible, design projects to be eligible for both state and federal funding and meet both NEPA and WEPA requirements.	DTSD	Ongoing

Table G-1 TAMP Risk Register (continued)

Risk Event	Likelihood	Impact	Priority	Mitigation Strategy	Responsible for Strategy	Status
Actual state or federal funds are above the levels assumed in the Biennial Budget, or actual YTD let contract costs are below YTD PS&E estimates.	High	Missed opportunity to complete projects on an accelerated schedule and improve longer term infrastructure conditions unless the funds can be spent and there are projects available to bring forward in the schedule.	High	Monitor state revenue collections, federal highway apportionments and "let savings".	OMB, DTIM	Ongoing
				If required, develop a Federal Plan (for federal $) or 13.10 request (for state $) for approval by the Joint Committee on Finance.	OMB, DTIM	As Needed
				Maintain an adequate number and variety of "shelf" projects ready to quickly advance into the letting schedule.	DTSD	Ongoing
				Adjust the projects in the schedule to make use of all available state and federal funding.	DTIM, DTSD	Ongoing
				When possible, design projects to be eligible for both state and federal funding and meet NEPA and WEPA requirements.	DTSD	Ongoing
Staffing resources are not available to fully deliver the state highway program.	High	Delayed infrastructure improvements at higher cost due to inflation.	High	Assess the level of staff resources needed to deliver the program, compare the needed resources with available WisDOT staffing, and identify the level of consultant resource necessary to ensure project/program delivery.	DTSD. DTIM	Annual
Future Biennial Budgets and infrastructure conditions differ from assumptions made when structuring the highway program.	High	Projects scheduled beyond the first two years of may need to be adjusted to attain infrastructure condition targets.	High	Adjust SHR programming guidelines, project schedules and the TAMP on a 2-year cycle consistent with the latest Biennial Budget and the latest information on infrastructure condition.	DTIM, DTSD	Biennially

Table G-1 TAMP Risk Register (continued)

Risk Event	Likelihood	Impact	Priority	Mitigation Strategy	Responsible for Strategy	Status
The projects contained in the long-range highway program are not fully consistent with WisDOT's highway investment strategy.	High	Increased average project costs, leading to the completion of fewer projects within available funds and unmet infrastructure condition targets.	High	Monitor the MAPSS measure related to "program effectiveness" to ensure reasonable progress in programming improvement projects in the right place, at the right time, and at the right level of improvement, as called for by WisDOT's highway investment strategy.	DTIM, DTSD	Annual
Funding negatively impacts safety and infrastructure condition on the Corridors 2030 Backbone and other NHS routes.	Medium	Corridors 2030 Backbone routes and other NHS highways are unable to efficiently serve the mobility needs of individuals and businesses.	High	Design preservation and improvement projects on the Corridors 2030 Backbone and other NHS routes to minimize lifecycle costs.	DTIM, DTSD	Ongoing
				Consider investment policy tradeoffs on lower volume and lower function highways when developing WisDOT's highway investment strategy	DTIM, DTSD	Biennially
Unexpected bridge deterioration requires the imposition of bridge closures or weight restrictions.	Medium	The STH system is unable to efficiently serve the mobility needs of individuals and businesses.	High	Give bridges high priority within WisDOT's highway investment strategy and allocate resources consistent with WiSAMS bridge preservation and improvement needs.	DTIM, DTSD	Ongoing
				Adjust SHR programming guidelines and the TAMP on a 2-year cycle consistent with the latest Biennial Budget and the latest information on infrastructure conditions.	DTIM, DTSD	Biennially

Table G-1 TAMP Risk Register (continued)

Risk Event	Likelihood	Impact	Priority	Mitigation Strategy	Responsible for Strategy	Status
Unique environmental, traffic or other project level risks are either overlooked or not adequately considered within the project design process.	Medium	The project does not perform as planned over time, increasing costs and potentially limiting the ability of the infrastructure to serve the mobility needs of individuals and businesses.	High	Regularly review and update project design standards to ensure they adequately provide for environmental, traffic and other project level risks.	DTSD	Ongoing
				Provide effective oversight of the "project scoping process" to ensure the unique risks impacting individual projects are not overlooked and are adequately considered in the project design process.	DTSD	Ongoing
Natural disasters or catastrophic infrastructure failures leading to the declaration of emergency or disaster declarations.	Low	Roadways and bridges impacted by emergency events provide unreliable service and past investment is significantly compromised, greatly increasing long-term infrastructure costs and sacrificing reliability.	High	Conduct regular evaluations of roadways and bridges subject to repeated emergency events consistent with 23 CFR Part 667. Identify and consider alternatives that will mitigate, or partially or fully resolve the root problem, including their cost impact of the risk of recurring damage.	DTIM, DTSD	Ongoing
				Ensure the findings of these evaluations are fully considered prior to the moving a project to FIIPS LC 11 and are reexamined before the completion of the Design Study Report.	DTSD	Ongoing

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H. Pavement and Bridge Inventory and Condition Information for the Wisconsin Portion of the National Highway System

Overview

Chapters 1 and 8 presented inventory and condition information for the WisDOT-owned and the locally owned pavement and bridge assets on Wisconsin's portion of the National Highway System (NHS). Tables H-1 and H-2 combine this information together to provide a unified inventory and condition assessment for all NHS pavement and bridge assets in Wisconsin.

Table H-1 Current Inventory of Wisconsin's NHS Pavements and Bridges

NHS Sub-System	Pavements [1/]		Bridges [2/]	
	Center Line Miles	Lane Miles	Bridges	Sq. Ft. of Bridge Deck (Millions)
Interstate	878.53	3,931.75	1,297	17.8
Non-Interstate NHS	5,088.06	14,540.07	2,266	24.4
Total Wisconsin NHS	5,966.59	18,471.82	3,563	42.2

[1/] For divided highways, one center line mile equals two roadway miles. Roadway and center line miles are equal for undivided highways. The pavement data is for 2018.

[2/] The bridge data is for 2018. Consistent with national definitions: a) only bridges more than 20 feet long (between abutments) are included in Table 1-1, and b) culverts more than 20 feet in width (length in the direction of travel) are counted as bridges.

Table H-2 Current Pavement and Bridge Conditions on Wisconsin's Portion of the NHS [1/]

NHS Infrastructure Component	Current Conditions (FHWA Performance Measures)		
	% Good	% Fair	% Poor
Interstate Lane Miles	59.1%	39.2%	1.7%
Non-Interstate NHS Lane Miles	32.7%	59.9%	7.4%
All NHS Pavement Lane Miles	38.1%	55.6%	6.2%
All NHS Bridge Deck Area	53.9%	44.2%	1.9%

[1/] The pavement and bridge conditions in this table reflect 2018 inspection data.

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I. The Assignment of WisDOT's Detailed Improvement Types to the Work Classifications Reported in the TAMP

Overview

Table I-1 and I-2 list detailed State Highway Rehabilitation (SHR) improvement types (from FIIPS, PMDSS and WiSAMS) and how those detailed improvement types map into two generalized work classifications defined in WisDOT's Facilities Development Manual (FDM): Perpetuation and Rehabilitation. These are the only FDM work classifications that apply to SHR.

Table I-1 Bridge Work Types [1/]

FDM Work Classification	FIIPS Concept Type	FHWA Work Type	WiSAMS (FIIPS) Improvement Type
Perpetuation		Preservation	PAINT - COMPLETE
Perpetuation		Preservation	OVERLAY DECK - THIN POLYMER
Perpetuation		Preservation	OVERLAY DECK - THIN POLYMER / REPAIR JOINTS
Perpetuation		Preservation	OVERLAY DECK - THIN POLYMER / NEW JOINTS
Perpetuation		Preservation	REPLACE SUPERSTRUCTURE
Perpetuation		Preservation	OVERLAY DECK - CONCRETE / NEW RAIL AND JOINTS
Perpetuation		Preservation	OVLY DECK - BIT. HOT MIX ASPHALT (HMA) W/ MEMBRANE
Perpetuation		Preservation	OVERLAY DECK - CONCRETE / NEW JOINTS
Perpetuation		Preservation	OVERLAY DECK - BIT. POLYMER MODIFIED ASPHALT
Perpetuation		Preservation	REPLACE DECK / WIDENING
Perpetuation		Preservation	REPLACE DECK / PAINT - COMPLETE
Perpetuation		Preservation	OVERLAY DECK - POLYESTER POLYMER
Perpetuation		Preservation	REPLACE DECK / THIN POLY OVLY / PAINT- COMPLETE
Perpetuation		Preservation	REPLACE DECK / THIN POLYMER OVERLAY
Perpetuation		Preservation	OVERLAY DECK - CONCRETE / PAINT
Perpetuation	BRRHB	Preservation	BRIDGE REHABILITATION – (FIIPS ONLY)
Perpetuation	BRSHRM	Preservation	BRIDGE REHABILITAION (SHRM) – (FIIPS ONLY)
Rehabilitation	MISC	Rehabilitation	MISCELLANEOUS
Rehabilitation	BRNEW	Rehabilitation	NEW STRUCTURE - BRIDGE OR BOX CULVERT
Rehabilitation	BRELIM	Rehabilitation	BRIDGE ELIMINATION – (FIIPS ONLY)
Rehabilitation	BRRPL	Rehabilitation	BRIDGE REPLACEMENT
Rehabilitation	BRRPLE	Rehabilitation	BRIDGE REPLACEMENT, EXPANSION

[1/] FIIPS = Financially Integrated Improvement Programming System
PMDSS = Pavement Management Decision Support System
WiSAMS = Wisconsin Structures Asset Management System
FHWA Work Type = per 23 USC Part 515

Table I-2 Roadway/Pavement Work Types

FDM Work Classification	FIIPS Concept Type	PMDSS Improvement Type	FHWA Work Type	Concept Type Description
Perpetuation	PSRS10	PSRS10	Preservation	SEAL COAT/CRACK FILL/JOINT, CRACK OR SPOT REPAIR
Perpetuation	PSRS20	PSRS20	Preservation	PATCH/RUT FILL/REPAIR AND GRINGD/SLAB REPLACE
Perpetuation	PSRS30	PSRS30	Preservation	SOME COMBO OF PATCH/RUT/REPAIR/SEAL/CRACK/GRIND
Perpetuation	PSRS40	PSRS40	Preservation	SHORT TERM OVERLAY (MILL AND OVERLAY)
Perpetuation	RDMTN		Preservation	ROADWAY MAINTENANCE
Perpetuation	RESURFACE		Preservation	RESURFACING
Perpetuation	RSRF10	RSRF10	Preservation	RESURFACING (OVERLAY < 2.5 INCHES)
Perpetuation	COLD10		Preservation	PARTIAL DEPTH CIR WITH <=2.5 INCH CAP
Perpetuation	RSRF20	RSRF20	Preservation	RESURFACING (OVERLAY >=2.5 INCHES AND < 4 INCHES
Perpetuation	RSRF30	RSRF30	Preservation	RESURFACING (OVERLAY >= 4 INCHES)
Perpetuation	COLD20		Preservation	PARTIAL DEPTH CIR WITH > 2.5 INCH CAP
Rehabilitation	MISC		Rehabilitation	MISCELLANEOUS
Rehabilitation	RCND10	RCND10	Rehabilitation	RECONDITION (INTERSECTION/WIDEN/SHOULDER)
Rehabilitation	RCND20	RCND20	Rehabilitation	RECONDITION (IMPROVE CURVE/GRADE/SIGHT/INTERSECT)
Rehabilitation	RECOND		Rehabilitation	RECONDITIONING
Rehabilitation	PVRPLA	PVRPLA	Rehabilitation	PAVEMENT REPLACEMENT
Rehabilitation	COLD30		Rehabilitation	FULL DEPTH CIR
Rehabilitation	PVRP_O	PVRP_O	Rehabilitation	PAVEMENT REPLACEMENT AND OPERATIONAL IMPROVEMENT
Rehabilitation	RECST	RECST	Rehabilitation	RECONSTRUCTION
Rehabilitation	RECSTE	RECSTE	Rehabilitation	RECONSTRUCTION, EXPANSION

23 CFR Part 515 defines work types that differ from those in use by WisDOT. WisDOT will use its FDM definitions to report expected SHR investments on the NHS (in Table 6.1).

The FDM defines a third work classification: Modernization. Modernization is equivalent to reconstruction in 23 CFR Part 515. The NHS investments made through the Major Highway Development (Majors), Southeast Wisconsin Freeway Megaprojects (SEF), Major Interstate Bridge (MIB) and High Cost State Bridge (HCSB) Programs, are all defined as Modernization. That is how the WisDOT investments in these programs will be reported in Table 6.1

J. NHS Infrastructure in Wisconsin Repeatedly Requiring Repair and Reconstruction Due to Emergency Events

Overview

23 USC Part 667 requires each state 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. Table J-1 contains the list of NHS infrastructure impacted by repeated emergency events in Wisconsin. This evaluation was completed in November 2018.

Table J-1 Wisconsin NHS Infrastructure Repeatedly Impacted by Emergency Events[1/]

Highway	County	Location	Type of Damage	Mitigation to Date
USH 2	Ashland	Denomie Creek/Kakagon Creek/Bad River/Odanah Areas	Shoulder washouts, pavement loss	Several areas riprapped to reduce future flood damage
USH 2	Ashland	City of Ashland at Bayfront	Shoulder washouts, pavement loss	Several areas riprapped to reduce future wave damage
USH 2	Bayfield	STH 137 to City of Ashland	Shoulder washouts, pavement loss	Several areas riprapped to reduce future wave damage
USH 63	Bayfield	Grand View to CTH E/Bibon Swamp Area	Flooding due to low road grade	Raised the roadway grade, but is subject to future settling
USH 13	Ashland	Glidden, near North Grant Street	Shoulder washouts, pavement loss	To be determined as part of any future project
USH 35	Vernon	Intersection with STH 56 near Genoa	Slope failures, shoulder washouts	To be determined as part of any future project
USH 35	Crawford	Prairie du Chien to STH 82	Slope failures, shoulder washouts	Plan to install inlets and storm sewer network in high risk areas in 2022

[1/] Defined following procedures required by 23 USC Part 667.