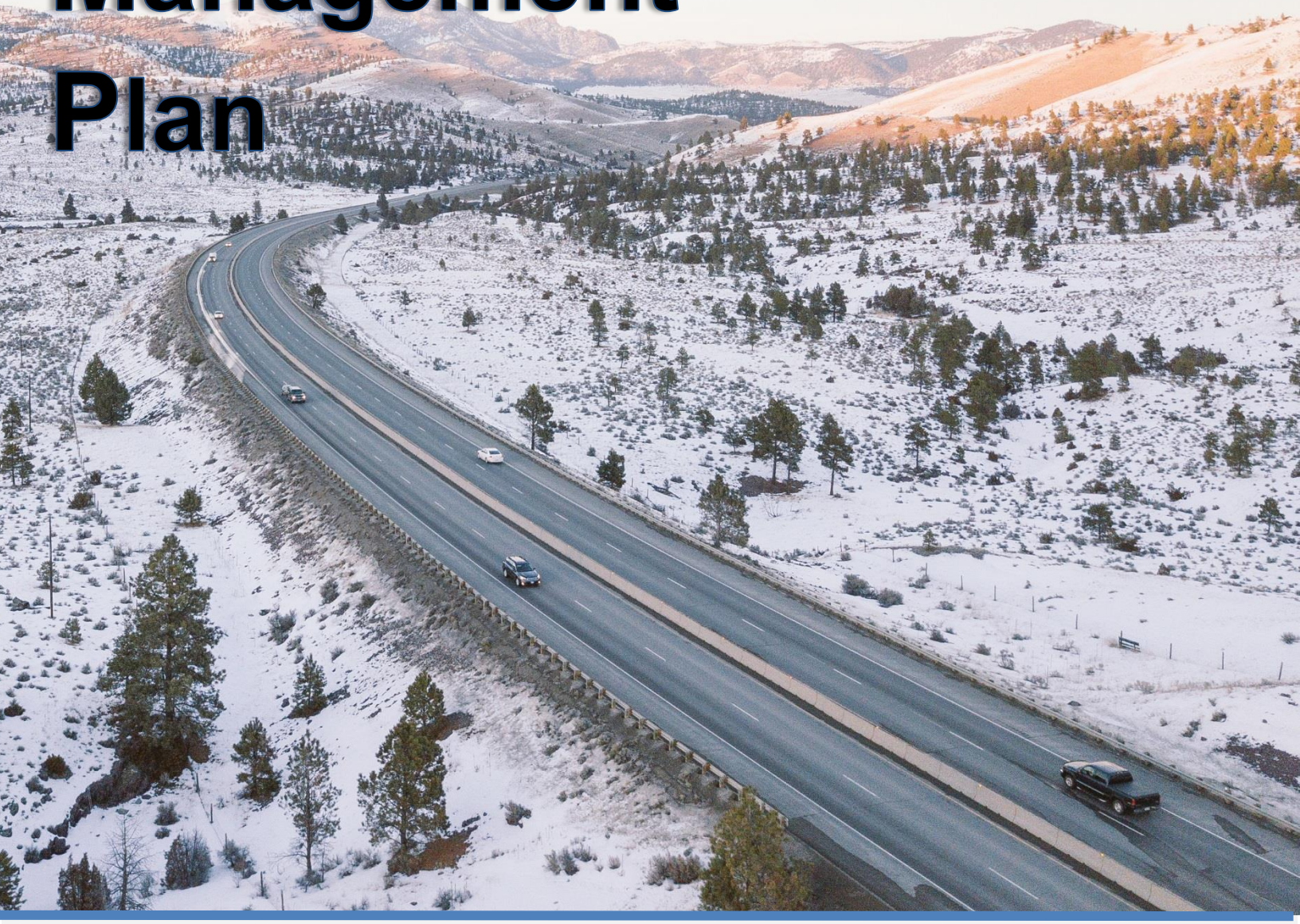
MONTANA
Department of Transportation

Transportation Asset Management Plan



2022

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MONTANA
Department of Transportation

Malcolm "Mack" Long, Director

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April 19, 2022

Lucia Olivera
Division Administrator
Federal Highway Administration
585 Shephard Way
Helena, MT 59601

Lucia,

I am submitting the updated Montana Department of Transportation Risk Based Transportation Asset Management Plan (TAMP) for FHWA review and certification as required by 23 USC Section 119(g).

As you know, MDT is responsible for providing safe and effective transportation systems for the traveling public, while supporting Montana's economic vitality, and our citizen's quality of life. Making good investment decisions to preserve, protect and maintain Montana's roads and bridges is critical for achieving and sustaining a state of good repair with the limited resources available.

Following enactment of MAP-21, MDT developed our first risk-based asset management plan, and we are performing this update to address the subsequent federal requirements while continuing to focus on best practices for managing Montana's transportation infrastructure needs.

MDT's updated TAMP considers physical conditions, life-cycle planning analysis, investment scenarios and risks associated with Montana's National Highway System pavements and bridges, and provides a roadmap for future investment strategies and expected levels of performance for these facilities.

MDT's asset management plan emphasizes performing the right treatment at the right time – with a focus on preservation and maintenance – consistent with TranPlanMT – our long-range transportation policy plan.

Sincerely,

Malcolm D. Long
Director

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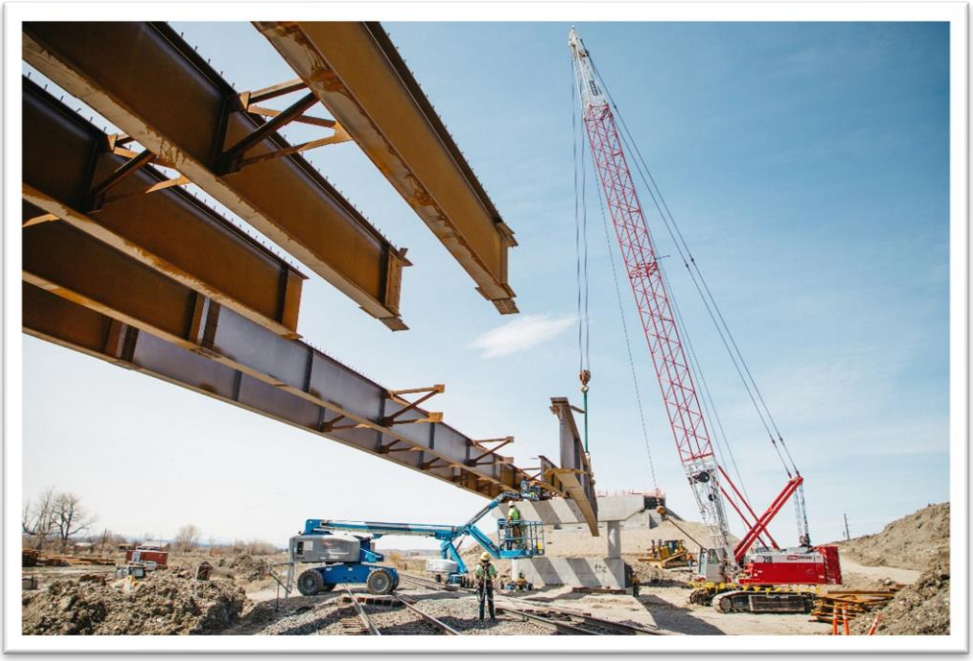


1 EXECUTIVE SUMMARY

Introduction

In this era of increasingly constrained resources, effectively managing transportation assets is a vital function of state transportation agencies. The Montana Department of Transportation (MDT) is committed to managing the condition and performance of Montana's state transportation system and strives to achieve state of good repair (SOGR) objectives through effectively investing those limited resources.

MDT's asset management history began in earnest in the late 1990's with the implementation of the Performance Programming Process (Px3). Px3 is based in Department policy and procedures to develop an optimal investment plan that achieves progress toward performance goals established in the state's long-range transportation policy plan, TranPlanMT.

Following the passage of the Moving Ahead for Progress in the 21st Century Act (MAP-21), MDT developed a risk-based transportation asset management plan (TAMP). The initial TAMP, adopted in 2015, bolstered MDT's existing asset management processes.

After FHWA adopted final rules for state risk-based asset management plans in late 2016, MDT initiated an update to the 2015 TAMP for federal compliance. The 2018 update expanded MDT's TAMP process description, analysis, and consideration of life cycle planning, performance gaps, non-condition related performance, and risk in developing recommended investment strategies. The 2022 TAMP continues to support agency efforts in achieving short-term performance targets and making progress toward MDT's vision for Interstate and Non-Interstate National Highway System (NHS) pavements and bridges.

The 2022 TAMP remains based on MDT's statewide policy and planning goals with decision making and analysis support provided by Department data management systems, procedures, and staff expertise.

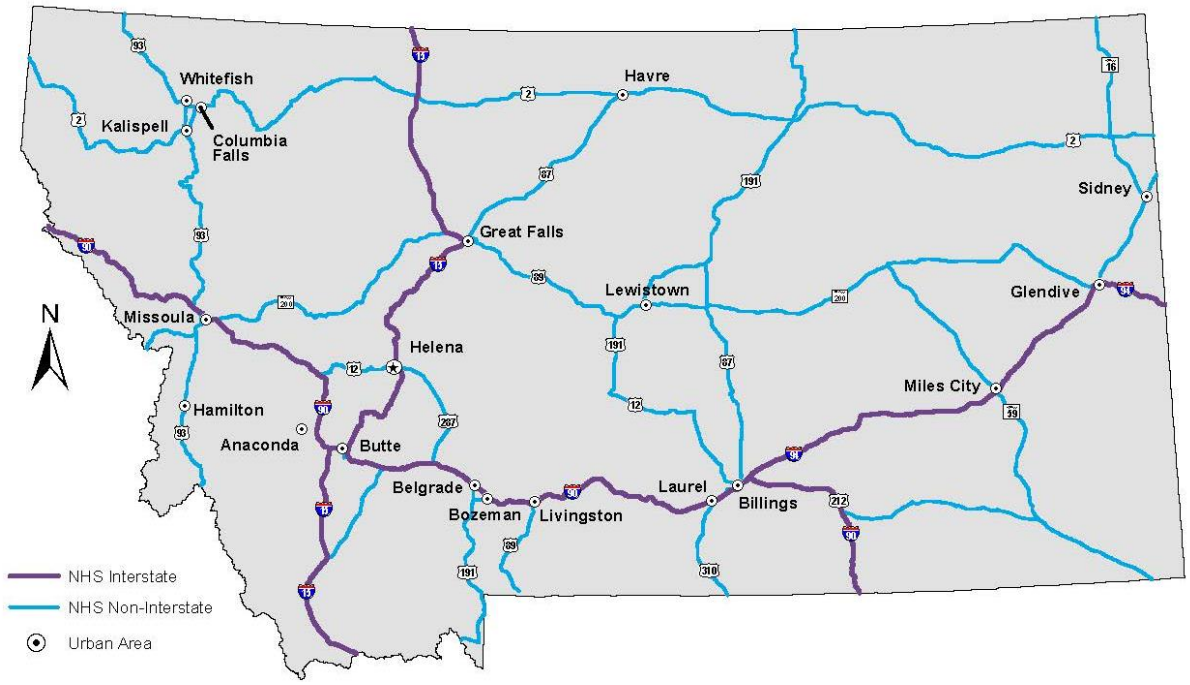
The TAMP documents MDT business practices. It also aligns the Department's Px3, data collection, and reporting used for asset management with related federal requirements. The foundation of Px3 continues to center on the MDT policy direction of providing the right treatment at the right time with a strong emphasis on preserving the condition and performance of existing transportation infrastructure.

To ensure compliance with federal requirements for Interstate and Non-Interstate NHS pavements and bridges, the TAMP addresses the following:

- Process to complete a performance gap analysis and identify strategies to close gaps;
- Process to complete life cycle planning;
- Process to complete risk analysis and develop a mitigation plan;
- Process to develop a financial plan covering at least a 10-year period;
- Process to develop investment strategies;
- Process of obtaining necessary data from other NHS owners; and
- Process for ensuring the TAMP is developed with the best available data and that the state has used bridge and pavement management systems.

NHS System Extent and Condition

There is one bridge and four short segments of NHS pavement, totaling less than 2 miles, that are maintained by local entities and reported as local ownership. MDT, however, is responsible for inspection, data collection and reporting, and project identification and development on all NHS facilities. Therefore, there was no need for MDT to coordinate with other NHS owners for data in the development of this TAMP. The following shows the extent of Montana's NHS systems.



Pavement and Bridge Data

MDT has dedicated offices for the collection and management of pavement and bridge data. MDT's Pavement Management Section collects pavement condition annually for the state highway systems. Pavement data is managed in a dedicated pavement management system (PvMS). MDT's Bridge Management Section inspects and collects bridge inventory data for Montana's bridges at scheduled intervals. The inventory includes all bridges and culverts that meet the definition of a bridge under National Bridge Inspection Standards (NBIS). Bridge data is managed in a dedicated structure management system (SMS) that utilizes the AASHTOWare BrM platform.

Pavement and bridge data is used throughout the Department for project development, design, and investment processes. These management systems are data sources for required annual federal reporting for the Highway Performance Monitoring System (HPMS) and National Bridge Inventory (NBI).

Current infrastructure condition is the baseline when considering an asset management approach. Montana's current NHS asset condition is shown in the following table.

System	Inventory	% Condition**		
		Good	Fair	Poor
Interstate Pavements	4,703 lane miles	57.4%	41.5%	0.1%
Non-Interstate NHS Pavements	6,529 lane miles	43.5%	55.2%	0.9%
NHS Bridge Deck Area	11,578,533 square feet	19.4%	74.4%	6.2%

** Value less than 100% due to missing/under construction segments.

Performance Targets and State of Good Repair

To effectively track system condition performance over time, MDT established short-term performance targets and a long-term SOGR vision for the condition of Interstate and Non-Interstate NHS pavements and the condition of NHS bridges. MDT's performance targets reflect state priorities established through public and stakeholder input provided during the development and implementation of TranPlanMT. MDT will use these performance targets to track and report progress for national performance management goals and considers these targets and SOGR when making investment decisions. MDT short-term performance targets and SOGR are shown in the following tables.

Performance Targets		
Asset	Good	Poor
Interstate Pavement	54%	3%
Non-Interstate NHS Pavement	40%	6%
NHS Bridge Deck Area	12%	9%

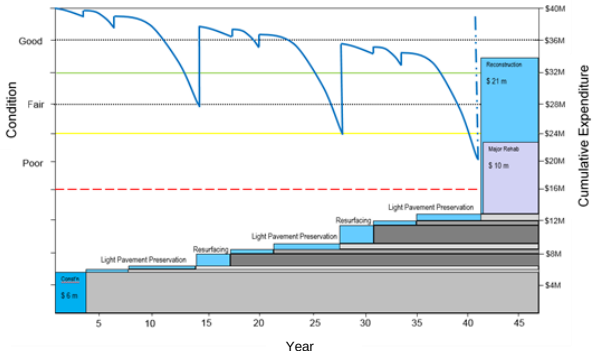
SOGR		
Pavement		
Interstate Pavement	80+	Ride Index
Non-Interstate NHS Pavement	76	Ride Index
Bridges		
NHS Bridge Deck Area	25%	Good
NHS Bridge Deck Area	3%	Poor

Life Cycle Planning

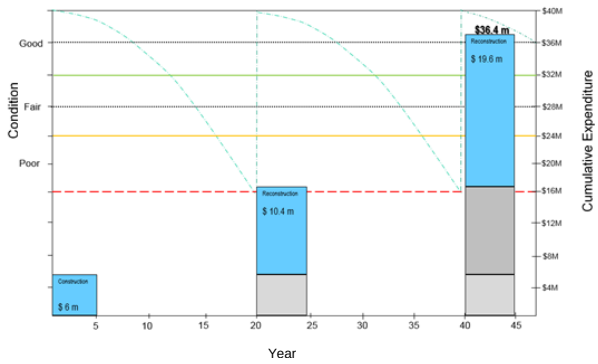
Knowing how to make the most effective investments is critical. Life Cycle Planning analysis considers the cost to manage an asset class from construction to replacement to help make effective investment decisions. Life cycle planning is the foundation of MDT's long-standing practice to employ the right treatment at the right time, since preserving existing assets costs much less than having to replace failing assets.

MDT's recommended pavement and bridge treatments in the TAMP are determined by using asset grouping and deterioration modeling to determine the lowest life cycle costs for the assets. The charts below demonstrate the cost/life span benefits of preserving assets rather than replacing them.

Preventative



Reactive



Performance Gaps and Strategies

With the right treatment model established, MDT identified gaps in performance by comparing current conditions and 10-year projected conditions versus the SOGR previously established, with the intent of determining strategies that could be implemented to close those gaps.

The current condition gap is a comparison of the SOGR versus the most recent data collected. The future gap considers current condition, resources available for future investment, projected system deterioration, planned investment by treatment type, competing needs, and potential risks, all resulting in likely future condition. The difference between the condition and the SOGR level results in system condition performance gaps. The NHS pavement and bridge SOGR gaps for 2021 and 2031 are as follows:

NHS Pavement Ride Index					
	SOGR Ride Index	Current Condition	Current Gap	Projected Condition (10-YR)	Projected Gap
Interstate Pavement	80+	82.4	0.0	80+	0.0
Non-Interstate NHS Pavement	76	73.2	2.8	76	0.0
NHS Bridge Deck Area					
	SOGR % Square Feet	Current Condition	Current Gap	Projected Condition (10-YR)	Projected Gap
Poor Condition	3%	6.2%	3.2%	3%	0%
Good Condition	25%	19.4%	5.6%	25%	0%

Though MDT has current performance gaps, the TAMP analysis projects that at the end of the 10-year period, pavement condition gaps will be eliminated. Bridge condition gaps will be eliminated as well. This expected result is largely attributed to MDT already implementing strategies to maintain current condition or achieve progress toward addressing these performance gaps.

MDT will continue to follow existing policy guidance to prioritize investments for NHS pavements and bridges. The Department anticipates achieving a desired SOGR on the NHS, assuming there are no broad changes in available resources.

In addition to condition related performance gaps, MDT also considered non-condition related issues that may negatively impact the performance of the Interstate and Non-Interstate NHS highways. This includes reoccurring congestion and non-reoccurring events.

Montana's relatively small population means reoccurring congestion is not a serious issue, while non-reoccurring events have a greater impact on mobility. To address non-reoccurring events, MDT has established practices for winter maintenance, construction work zone planning, traveler information systems, and preventing and addressing natural events and vehicle crashes.

Risk Management

MDT staff continues to assess the likelihood and consequence of risks or uncertainty that could affect Interstate and Non-Interstate NHS pavement and bridge conditions. The TAMP identifies the top three asset risks considering:

- Uncertainty related to safety, mobility, asset damage, financial impact, and agency reputation;
- Specific assets impacted;
- Likelihood of occurring; and
- Consequences.

MDT's top identified risks include: a change in political climate; transportation funding being reduced by 20 percent in real dollars; and purchasing power decreasing by more than 3% due to inflation, price volatility or mandates. Mitigation strategies have been identified and are in place to address these risks.

In addition to the risk assessment, MDT also performed a thorough review of past emergency events and determined there are no reoccurring repairs on the NHS. Issues at locations off the NHS have been identified, and mitigation measures are being planned or are underway.

Finances

The final asset management analysis before making investment decisions is to determine the sources and level of resources available. MDT's budget is a combination of state and federal funding. Montana is heavily dependent on the federal program with state funds limited to non-federal match. Funding for NHS pavements and bridges generally comes from the National Highway Performance Program (NHPP), National Highway Freight Program (NHFP), Bridge Formula Program (BFP), and the State Highway Special Revenue (SHSR) account.

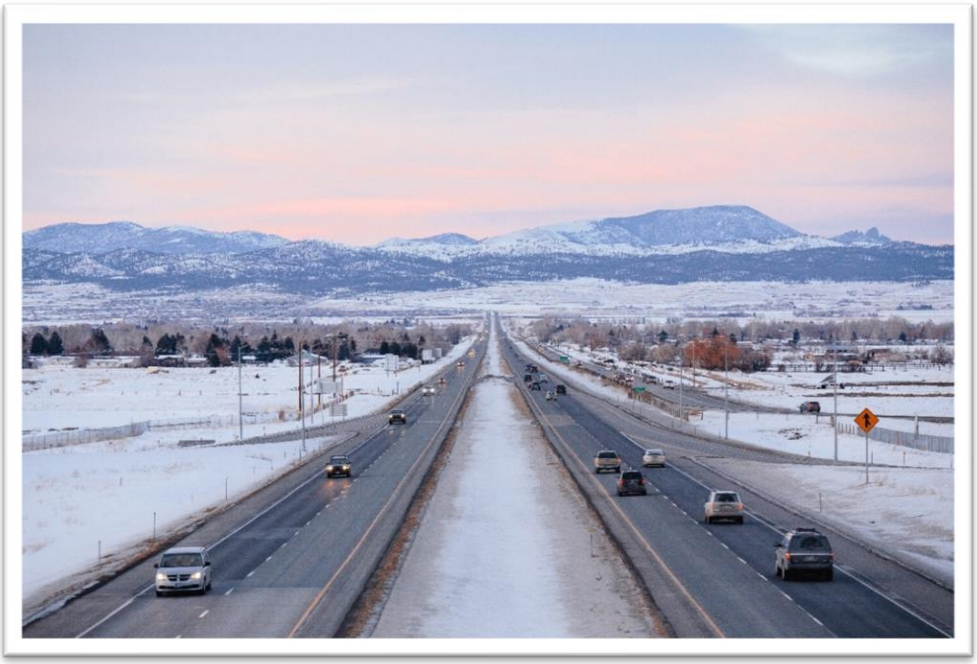
In 2021, MDT managed approximately $957 million in total funding. Of this, $563 million was directed to the Highway Construction Program. Federal funds for TAMP construction activities are expected to increase incrementally between 2022 – 2031 from $57 million to $74 million for Interstate pavement; $122 million to $160 million for Non-Interstate NHS pavement; and $43 million to $63 million for NHS bridges. MDT anticipates the value of Montana's NHS infrastructure will be maintained and system condition performance gaps will decrease, provided there are no changes in projected funding and MDT's focus remains on preservation.

Investment Strategies

MDT asset investment strategies were developed based on the preceding analysis considering short-term condition targets and long-range policy consistent with achieving or making progress toward the desired SOGR. The strategies supported by processes and data analysis consider life cycle planning, existing conditions, rates of deterioration, risks, and projected revenues to achieve the optimal investment with the available resources. MDT TAMP investment strategies are:

- Right Treatment at the Right Time — focusing on preventative and rehabilitative efforts to cost effectively manage existing infrastructure and avoid expensive deferred maintenance.
- Preservation — focusing on preserving and maintaining the existing infrastructure.
- Targeted Assets — targeting certain asset categories for increased investment to address current condition deficiencies and to mitigate risks.

Through implementation of the TAMP, MDT is projected to meet performance targets and SOGR in support of the national performance goals established by MAP-21. MDT will continue long established business practices related to asset management, while aligning with new federal requirements. MDT will reevaluate the TAMP as required along with reviewing performance targets in support of national goals. This will be accomplished while ensuring the Department fulfills its mission of providing a transportation system and services that emphasize quality, safety, cost effectiveness, economic vitality and sensitivity to the environment.



2 OVERVIEW

Actively managing transportation assets has been a fundamental business practice of the MDT for nearly 20 years. Since 1999, MDT has used the Px3 Process (http://www.mdt.mt.gov/pubinvolve/p3.shtml) to develop an optimal, fiscally constrained highway funding plan and measure progress toward goals established in the Department's long-range transportation policy plan.

The plan, TranPlanMT (http://www.mdt.mt.gov/tranplan/) - plus data about assets - guides MDT's Px3 in determining the best, system-wide mix of funding for resurfacing, rehabilitation, and reconstruction of the Montana highway system. This process annually evaluates investment alternatives through trade-off analysis to determine a cost-effective distribution of funds that achieves highway performance goals for pavement, bridge, congestion, and safety.

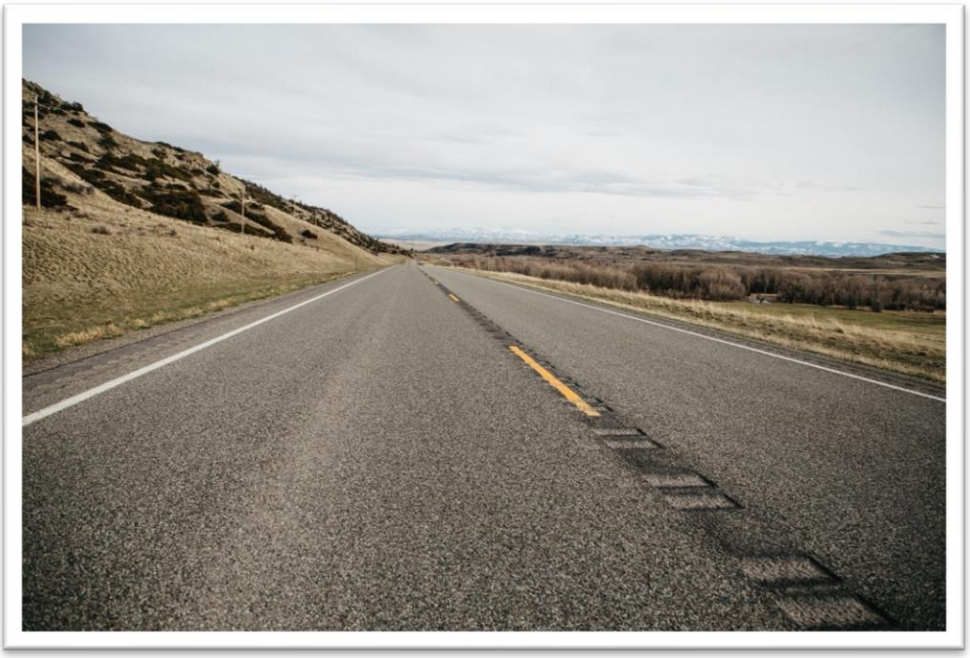
Through Px3, MDT sets condition targets, tracks progress, and evaluates network level conditions for pavements and bridges to maintain consistent conditions across Montana. As part of Px3, MDT allocates funds based on scenario analyses considering budget and work-type tradeoffs. These analyses are the foundation of the MDT asset management program.

Funding is distributed by district, highway system, and type of work. Then, specific projects are selected for the Statewide Transportation Improvement Program (STIP) (http://www.mdt.mt.gov/pubinvolve/stip.shtml).

MDT tracks the actual performance of the highway system after the investments are made to hone the predictive capacity of the management systems and MDT's overall accountability. Ride quality, traffic volume, bridge deck condition, and crashes are just a few of the many characteristics tracked.

The TAMP covers the period of 2022 – 2031 and builds on MDT's 2018 TAMP. It describes how MDT manages pavements and bridges to fulfill the requirements of MAP-21, the FAST Act, and the Infrastructure Investment and Jobs Act. This risk-based asset management plan will help MDT achieve and sustain a SOGR over the life cycle of the assets and improve and preserve the condition of the NHS. The MDT TAMP achieves federal compliance through describing MDT's processes and approach for:

- Collecting pavement and bridge data, ensuring data quality, and using management systems to analyze NHS bridge and pavement condition;
- Determining performance targets and SOGR;
- Life cycle planning;
- Identifying performance gaps and activities and resources needed to close those gaps;
- Assessing risks affecting NHS assets in Montana and managing these risks;
- Developing a financial plan;
- Identifying investment strategies that will help MDT achieve performance goals in a fiscally constrained environment; and
- Identifying future enhancements in the MDT asset management framework.



3 SCOPE AND CONDITION

3.1 Overview

MDT manages, maintains, and collects all pavement and bridge data for the NHS in Montana. This includes all pavement and bridge condition data on the Interstate and Non-Interstate NHS. Asset condition data is the foundation for this TAMP and for MDT's long-standing asset management approach, Px3. Inventory and condition data serve as the basis for MDT assessing current and future needs, establishing improvement work types and timing, determining where and when to invest funds, and monitoring the performance and value of assets and improvement projects over time.

3.2 Federal Requirements

Via MAP-21, the FAST Act, and the Infrastructure Investment and Jobs Act, Congress directed states and the Federal Highway Administration (FHWA) to implement and transition to using asset management to drive state and federal investment in the NHS. FHWA describes asset management as a strategic process for managing physical assets in an SOGR over their life cycle at minimum practicable cost.

In general terms, federal requirements related to asset management are:

- Ensuring the accuracy of the data by developing, documenting, and implementing procedures for collecting, storing, processing, and updating condition data;
- Using data management systems to support asset inventory and management activities;
- Developing risk-based asset management plans, including measures and targets for NHS pavement and bridge conditions;
- Establishing an SOGR vision for the condition of NHS pavements and bridges;
- Establishing 2-year and 4-year condition targets for NHS pavement and bridge conditions that promote achieving the state's SOGR in support of national goals;
- Achieving no more than 5 percent of Interstate pavement lane miles in poor condition; and
- Achieving no more than 10 percent of NHS bridge deck area in poor condition.

3.3 State Process

In addition to federal requirements, Px3 is used to allocate program funds for NHS pavements and bridges based on condition, deterioration models/life cycle treatments, and available resources. This is with consideration of investment needed in the individual asset categories (including but not limited to NHS pavements and bridges) to achieve MDT's overall system condition performance goals. Moving forward, MDT will conduct the Px3 analysis with consideration of the TAMP and national performance requirements to ensure MDT continues to meet Montana's infrastructure needs while making investment decisions consistent with the TAMP and the national performance goals for Interstate pavements, Non-Interstate NHS pavements, and NHS bridge deck area.

3.4 TAMP Scope and System Summary

This TAMP includes NHS pavements and bridges, MDT's most extensive assets in terms of cost and extent. All of the pavement and bridge data in the TAMP is based on the 2020 HPMS and NBI data submittals. The Montana state highway system is comprised of many other assets, however existing processes will continue to be relied on for their management, rather than including them in this TAMP. Figure 3-1 shows the Montana NHS, and Table 3-1 provides an inventory and condition summary of the NHS.

Figure 3-1 Montana NHS

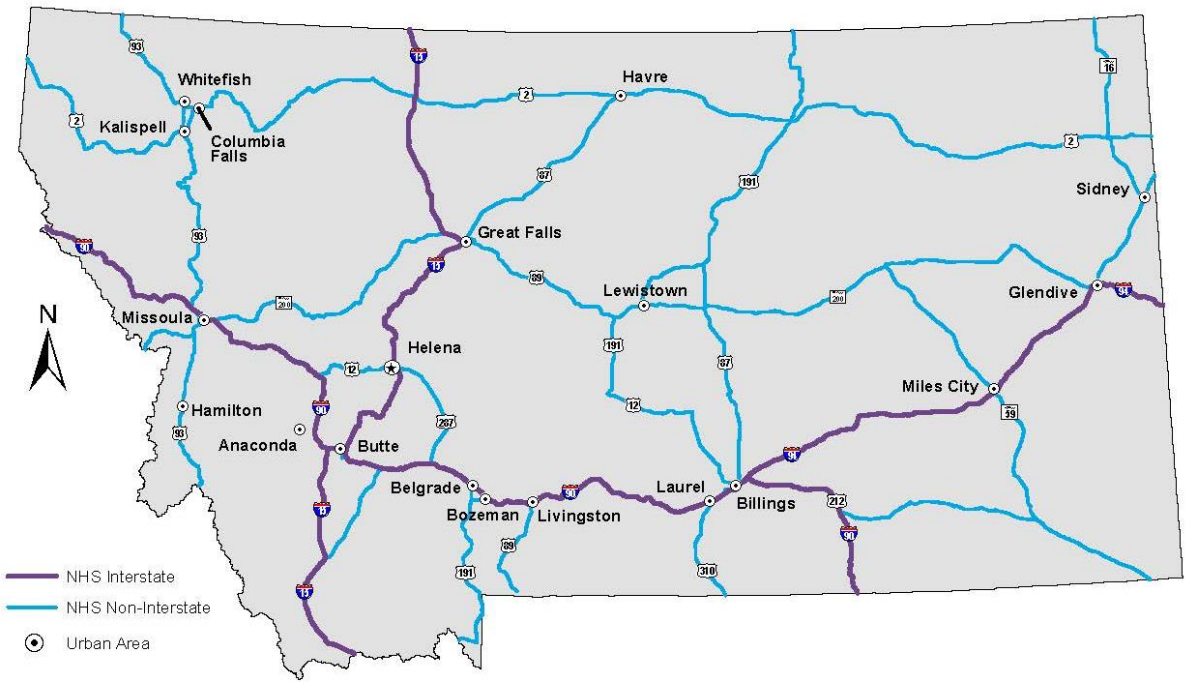


Table 3-1 Montana NHS Inventory and Condition

System	Inventory	% Condition**		
		Good	Fair	Poor
Interstate Pavements	4,703 lane miles	57.4%	41.5%	0.1%
Non-Interstate NHS Pavements	6,529 lane miles	43.5%	55.2%	0.9%
NHS Bridge Deck Area	11,578,533 square feet	19.4%	74.4%	6.2%

** Value less than 100% due to missing/under construction segments.

3.5 Managing Pavement

Pavements are designed to support anticipated traffic loads and provide a safe and relatively smooth driving surface. Keeping pavements in good condition lengthens their life, enhances safety, and helps reduce road user operating costs. MDT strives to achieve the right treatment at the right time to make the most of limited funding. Resurfacing and rehabilitation projects can extend the life of the asset and delay the need for reconstruction. For every dollar spent on timely preventative maintenance, $4 to $8 will be saved from complete reconstruction in the near term.

The MDT Pavement Program directly supports the statewide goals established by TranPlanMT. MDT continues to implement the following activities and actions in support of strategic statewide goals:

- **Preservation of the existing system** — providing the "right treatment at the right time" to actively manage pavements using cost-effective treatments. Activities include crack seal, seal and cover, rut fill, mill/fill, overlay, micro-surfacing, cold-in-place recycle, and hot-in-place recycle treatments.
- **Capacity expansion and mobility improvements** — improving the roadway network when the current roadway can no longer support continued growth using current geometrics. Activities include major rehabilitation and reconstruction treatments to address level-of-service deficiencies by adding lanes and/or shoulder width.
- **Safety and other improvements** — maintaining pavement condition to ensure safety for the traveling public. Activities related to safety include rut-fill, chip seal, and concrete diamond grind.

3.5.1 Pavement Inventory

There are approximately 74,000 center lane miles open to public travel in Montana with over 12 billion vehicle miles travelled annually. More than half the miles travelled occur on just six percent of the roadway system – the Interstate and Non-Interstate-NHS road networks.

3.5.2 Measuring Pavement Conditions

Monitoring and measuring pavement condition helps MDT assess the performance of the transportation system, predict future needs, allocate funding, and schedule projects.

MDT collects pavement condition data annually with automated data collection vehicles (ADCVs). The ADCVs use high-definition images and lasers to measure pavement condition every 0.1 mile of the Montana highway system.

Pavement condition data is managed in the MDT Pavement Management System (PvMS). Pavement conditions are monitored using metrics from analyzed data calculated on a scale of 0 to 100. Annually, pavement data is reported to the HPMS, FHWA's national database for highways. MDT uses the following metrics for evaluating pavement condition:

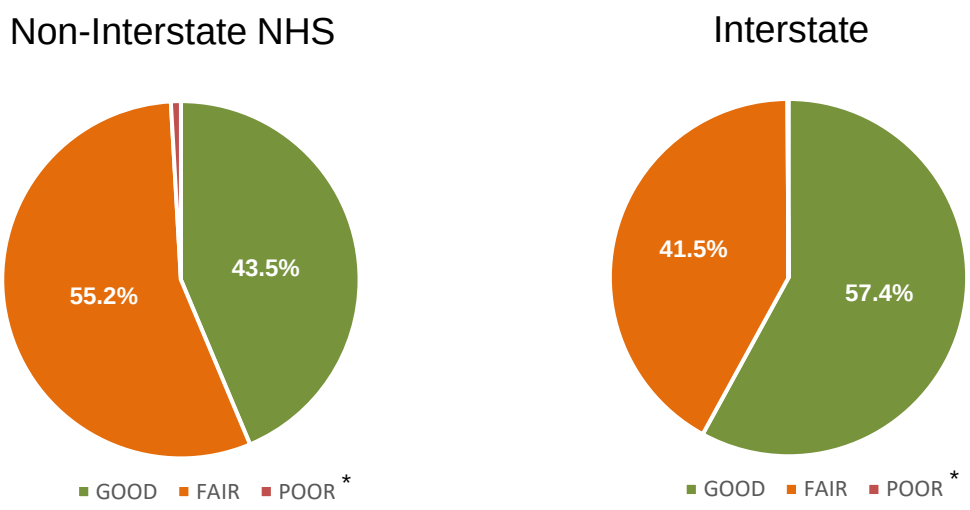
- **Ride Index (RI)** — A measure of traveler perception of ride smoothness. RI is based on the International Roughness Index (IRI), the international standard for smoothness. MDT assigns Good, Fair, Poor categories on a scale of 0 to 100 (with lower numbers being associated with Poor condition and higher numbers being associated with Good condition).
- **Rut Index** — A measure of rut depth along the wheel path.
- **Cracking**
  - Alligator Crack Index (ACI) — a measure of the amount of cracking caused by traffic loading (fatigue cracking)
  - Miscellaneous Crack Index (MCI) — a measure of the amount of non-load cracking (longitudinal/transverse cracking for asphalt, slab cracking for concrete)
  - Faulting — adjacent concrete pavement slab misalignment

MDT uses RI as the performance measure for pavements in Px3 as an indicator of pavement condition.

3.5.3 Pavement Condition Trends

MDT implements Px3 optimized investment plans, then measures progress towards statewide goals. Through Px3, MDT establishes Ride targets, tracks progress, and evaluates network level pavement Ride performance to maintain consistent performance throughout the state. Figure 3-2 shows the NHS pavement condition.

Figure 3-2 NHS Pavement Condition by Lane Miles



* Poor is 1% or less

3.6 Managing Bridges

The MDT Bridge Program supports the goals established in TranPlanMT by emphasizing work that prioritizes:

- **Preservation of the existing system** — providing the "right treatment at the right time" to manage bridges using cost-effective treatments. Activities include bridge deck preservation and rehabilitation, corrosion mitigation, joint repair or replacement, and bridge rail upgrades.
- **Safety** — maintaining bridge conditions to ensure safety for the traveling public. Activities related to traffic safety range from simple skid treatments to full replacements on new alignments. Other activities cover seismic retrofitting of vulnerable bridges and installation of scour countermeasures on susceptible bridges.
- **Efficient business decisions** — analyzing investment strategies to maximize system performance (given limited state and federal resources). Activities include management system upgrades and business process improvements that promote effectiveness and efficiency.
- **Mobility and economic vitality** — improving the roadway network when the current roadway can no longer support continued growth using current geometrics. Activities include full replacements on new alignments with increased traffic capacity.

3.6.1 Bridge Inventory

MDT inspects the status and condition of Montana bridges at regularly scheduled intervals and reports to FHWA annually. This reporting includes inventory and inspection data for bridges and culverts located on the NHS that meet the definition of a bridge under NBIS. In March of 2021, MDT reported 4,943 bridges and 328 culverts throughout the state that met these criteria. Table 3-2 shows a breakdown of the NHS bridge inventory that includes 1,239 bridges (25 percent of statewide total) and 119 culverts (36 percent of the statewide total). Unless specified otherwise, bridges as referenced in this TAMP include culverts that meet the definition of a bridge under NBIS.

Table 3-2 NHS Bridges and Culverts in Montana

System	Bridges (#)	Bridge Deck Area (ft^2)	Culverts (#)	Culvert Deck Area (ft^2)
Interstate	796	7,243,162	33	128,080
Non-Interstate NHS	443	4,103,098	86	104,193
All NHS	1,239	11,346,260	119	232,273

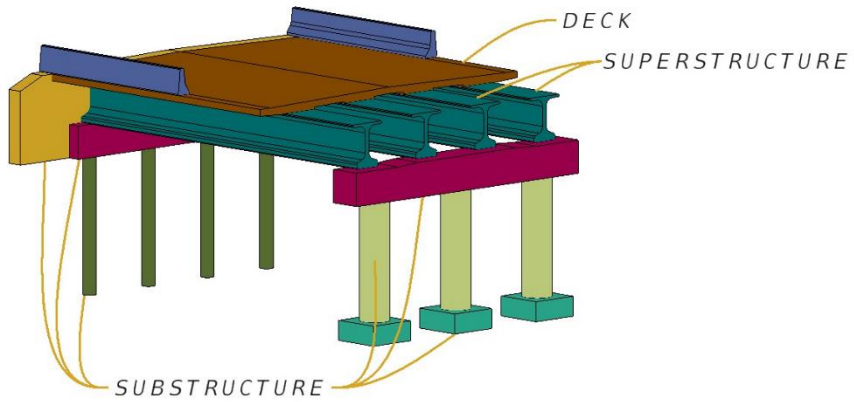
3.6.2 Measuring Bridge Condition

MDT performs full NBI and National Bridge Element (NBE) inspections on most bridges every two years with some bridges on differing cycles depending on condition and bridge type. MDT bridge staff has developed maintenance inspection procedures that maintenance personnel use to conduct routine maintenance inspections every six months to identify emerging issues.

MDT's Bridge Management Section is responsible for the overall bridge inspection program including primary responsibility for database management, the inspection data Quality Assurance/Quality Control (QA/QC) program, and program quality assurance. The Bridge Management Section also assists in updating the performance measures of structure and deck condition to determine whether proposed projects will meet program objectives. MDT's Bridge Inspection and Rating Manual describes program organization and function (Article 1.3.1) and QA/QC (Article 2.2.17).

Figure 3-3 shows the major bridge components that are individually inspected and rated. These components include: the deck, including the surface vehicles drive on; the superstructure supporting the deck; and the substructure that transfers the load of the bridge to the ground.

Figure 3-3 Major Components of Bridge Inspection



Bridge condition ratings are used to classify a bridge as being in Good, Fair, or Poor condition. The lowest of the three ratings for deck, superstructure, and substructure determines the overall rating for the bridge. If this value is 7 or greater, the bridge is classified as being in Good condition. If it is 5 or 6, the bridge is classified as being in Fair condition. If it is 4 or less, the bridge is classified as being in Poor condition. If any major component is classified as being in Poor condition, the bridge is considered SD. This designation does not indicate that a bridge is unsafe. Rather, it indicates deficiencies exist that require maintenance work, rehabilitation activities, or replacement of the structure.

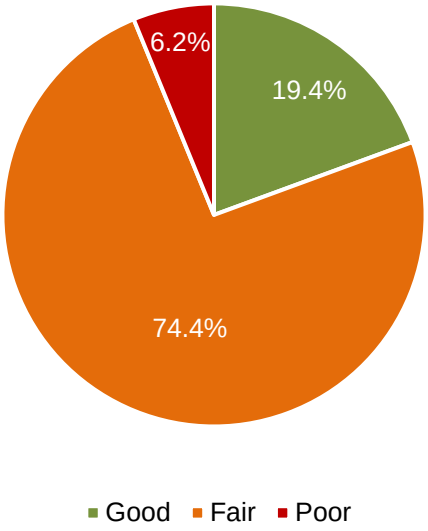
For culverts, a single rating of 0 to 9 is assigned for the entire structure. The numerical values for Good, Fair, and Poor culverts correspond to those for bridges as shown in Figure 3-4.

Figure 3-4 Bridge Condition Rating

NBI Ratings									
9	8	7	6	5	4	3	2	1	0
Good			Fair		Poor				

Figure 3-5 shows the percentage of Good, Fair, and Poor NHS bridges by deck area.

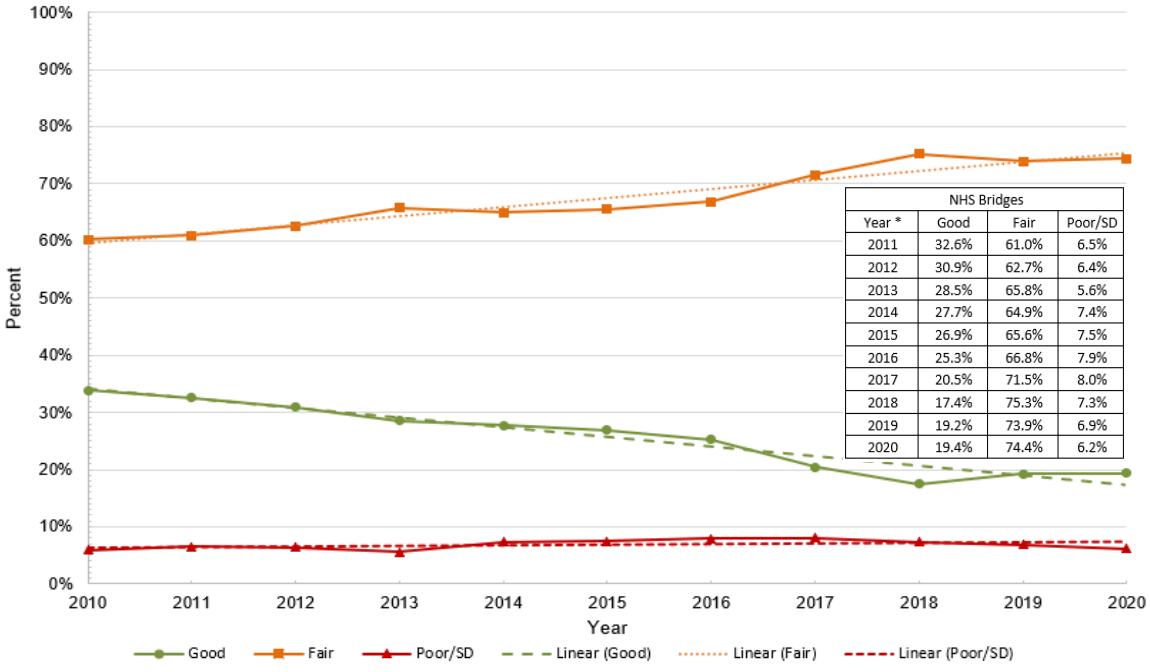
Figure 3-5 NHS Bridges by Condition Weighted by Deck Area



3.6.3 Bridge Condition Trends

In recent years, bridge and culvert conditions have deteriorated across the state. On the NHS, the percentage of Poor bridges and culverts (by deck area) is stabilizing while the percentage of Good bridges and culverts (by deck area) is beginning to show signs of trending positively. The percentage of Fair bridges and culverts (by deck area) appears to have peaked in 2018 and is trending slightly downward. Figure 3-6 illustrates these trends.

Figure 3-6 NHS Bridge Deck Area Condition Trends



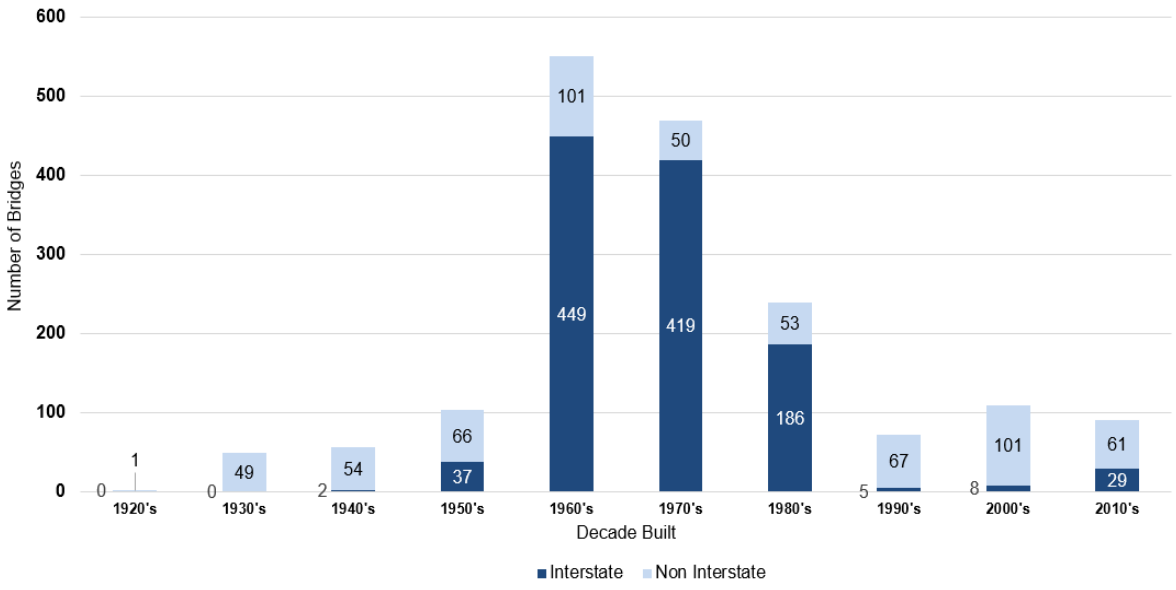
NHS Bridges			
Year *	Good	Fair	Poor/SD
2011	32.6%	61.0%	6.5%
2012	30.9%	62.7%	6.4%
2013	28.5%	65.8%	5.6%
2014	27.7%	64.9%	7.4%
2015	26.9%	65.6%	7.5%
2016	25.3%	66.8%	7.9%
2017	20.5%	71.5%	8.0%
2018	17.4%	75.3%	7.3%
2019	19.2%	73.9%	6.9%
2020	19.4%	74.4%	6.2%

* Note: 2020 year-end condition data = 2021 NBI submission date

While many factors contributed to an overall decline in NHS bridge condition, the primary contributor was the age of Montana NHS bridges. The majority of these bridges were built with the Interstate system as shown in Figure 3-7. Additionally, Montana's harsh environment makes construction and maintenance of bridge decks challenging.

With that said, MDT is making progress toward reversing these trends. Major program changes were initiated in response to the requirements of MAP-21, the FAST Act, and the Infrastructure Investment and Jobs Act (IIJA). MDT has substantially increased Bridge program allocations in recent years. Additionally, MDT has implemented cost-effective preservation and rehabilitation strategies to address degradation of bridge elements (primarily decks). As noted previously, these changes have helped stabilize the percentage of Poor bridges and reverse the downward trend for Good bridges.

Figure 3-7 Number of NHS Bridges by Year Built



4 PERFORMANCE TARGETS AND STATE OF GOOD REPAIR

Performance targets specifically identify pavement and bridge conditions that MDT seeks to achieve and sustain for the foreseeable future to support the Department's goals and objectives and to meet federal requirements for NHS pavements and bridges.

Montana targets reflect the state priorities established through public and stakeholder input provided during the development and implementation of TranPlanMT, Montana's Freight Plan (http://www.mdt.mt.gov/freightplan/default.shtml), and the Montana Comprehensive Highway Safety Plan (CHSP) (http://www.mdt.mt.gov/visionzero/plans/chsp.shtml).

Target setting is guided by system condition data, deterioration and optimization models, resource projections, and consideration of competing needs. The 2-year and 4-year targets are aligned with MDT strategic planning goals and will be used to direct decisions to support achieving the longer term SOGR.

MDT targets and SOGR were established by the MDT TAMP Steering Committee based on recommendations provided by working groups that were formed for each of the national performance areas. These working groups evaluated existing conditions, past performance, management system outputs, available resources, and policy and public input to develop target options. The processes and options were discussed with Montana Metropolitan Planning Organizations (MPO's) for their input prior to being presented to the TAMP Steering Committee.

The Steering Committee established the performance targets and SOGR shown in tables 4-1 and 4-2 for Montana NHS pavements and bridges.

Table 4-1 NHS Pavement and Bridge Performance Targets

Asset	Good	Poor
Interstate Pavement	54%	3%
Non-Interstate NHS Pavement	40%	6%
NHS Bridge Deck Area	12%	9%

Table 4-2 State of Good Repair

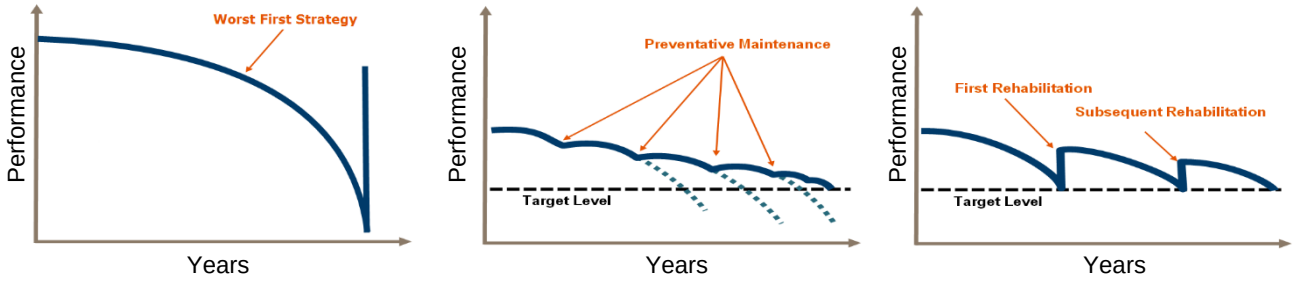
Pavement		
Interstate Pavement	80+	Ride Index
Non-Interstate NHS Pavement	76	Ride Index
Bridges		
NHS Bridge Deck Area	25%	Good
NHS Bridge Deck Area	3%	Poor

5 LIFE CYCLE PLANNING

FHWA defines life cycle cost as the cost of managing an asset class or asset sub-group for its whole life, from initial construction to replacement. A life cycle plan (LCP) is a strategy for managing an asset over its life to achieve a target level of performance while minimizing life cycle costs. LCP focuses on network-level asset management strategies that represent the most cost-effective sequence of maintenance, preservation, and rehabilitation treatments for a given asset.

Life cycle cost analysis (LCCA) is a technique for comparing cost alternatives over the life cycle of a project. LCCA is used for project level decisions to select the design option that minimizes the initial and discounted future costs over an analysis time period. The basic principle underlying both LCP and LCCA is fundamental to asset management: timely investments in an asset can result in improved condition and lower long-term cost. This principle is illustrated in Figure 5-1 depicting condition and costs over time.

Figure 5-1 Life Cycle Cost Considerations



MDT's life cycle planning processes are intended to maximize asset condition while minimizing cost through a systematic process of making investment and treatment decisions. These processes are based on the Department's strategic goals, with consideration of constraints and tradeoffs needed to achieve and sustain MDT's 2-year and 4-year performance targets and SOGR.

5.1 Pavement Life Cycle Planning

The overall life cycle for pavement begins in policies established by the Department. After construction, pavement condition is assessed annually through the cycle of treatments to the end of the pavement useful life when reconstruction may occur. The following figures show two example scenarios of pavement life cycle planning. Figure 5-2 is an asset management approach of proactive maintenance. Figure 5-3 is a costlier reactive approach.

Figure 5-2 Proactive Pavement Management Strategies

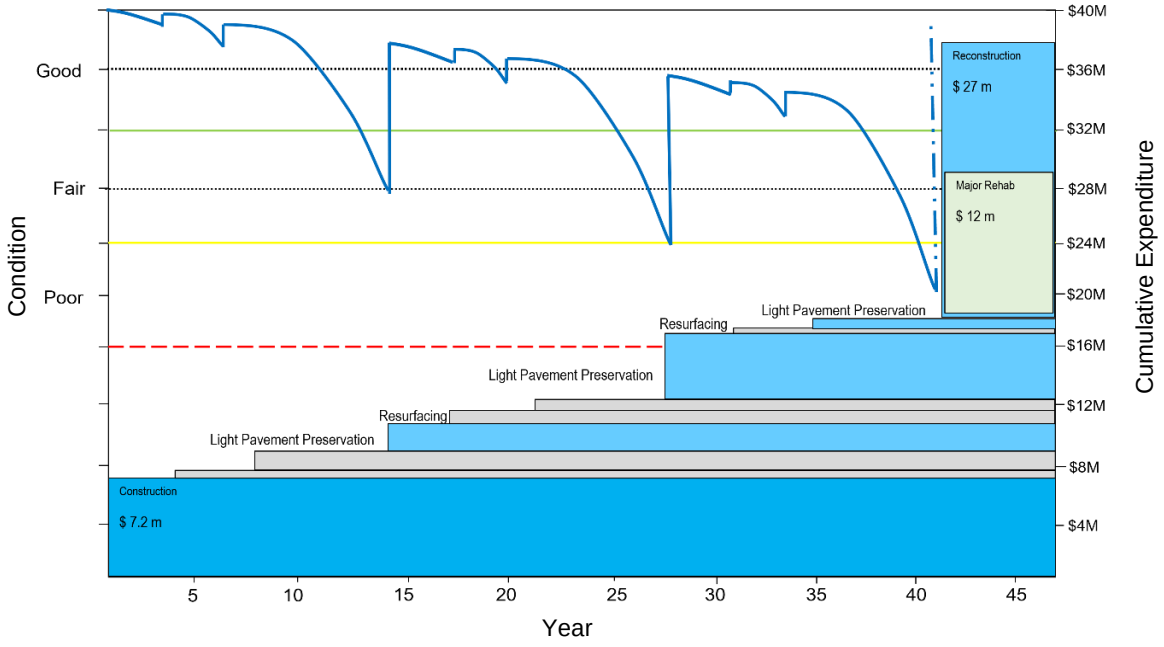
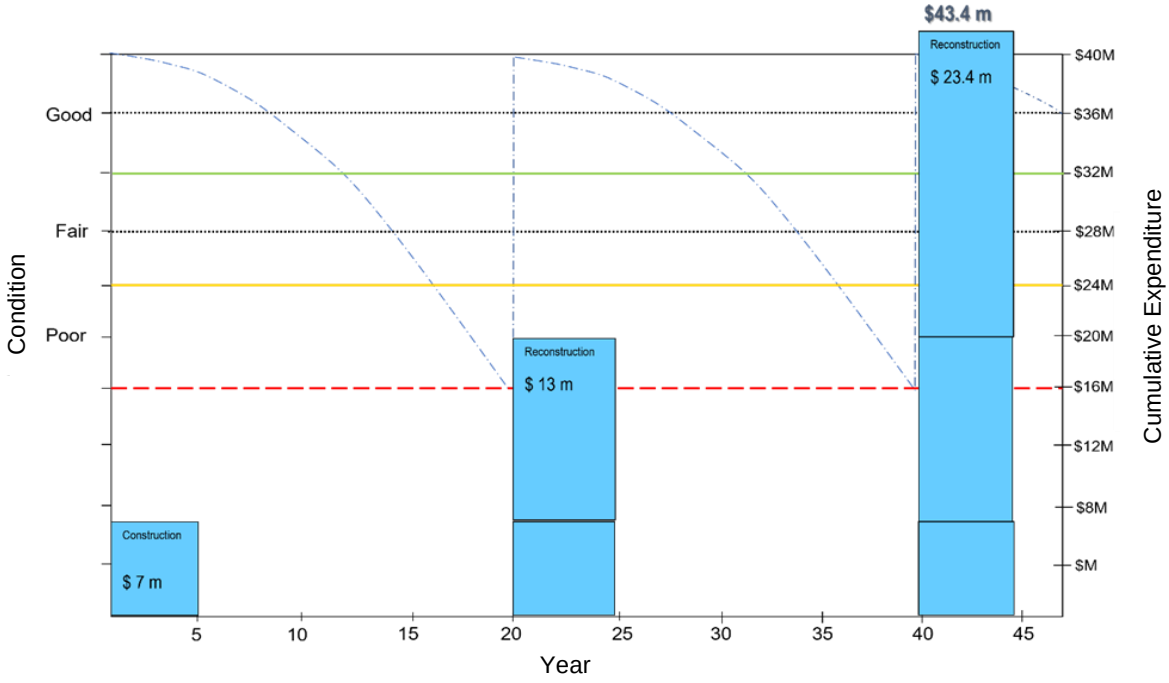
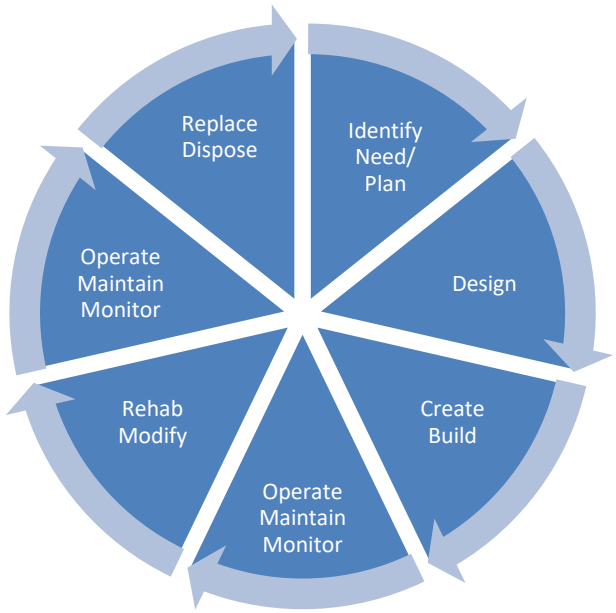


Figure 5-3 Reactive Pavement Management Strategies



MDT monitors and analyzes the life cycle of pavement assets in four categories including Interstate, Non-Interstate NHS, Primary, and Secondary roadways. The life cycle of pavements is shown in Figure 5-4.

Figure 5-4 Pavement Life Cycle



- The cycle begins or renews with identifying the need and planning for new construction or reconstruction.
- The design phase encompasses developing the right-of-way, safety, and geometrics for the given roadway.
- As the pavement ages after construction/reconstruction, MDT addresses pavement distresses with pavement preservation strategies, rehabilitation treatments, and maintenance for managing an overall cost-effective life cycle.

5.1.1 Pavement Data Collection

The MDT Pavement Management Unit collects pavement data with automated data collection vehicles (ADCVs) including: IRI, rutting, alligator cracking, and miscellaneous cracking on asphalt pavements. On concrete pavements, MDT collects IRI, rutting, slab cracking, and faulting. The Pavement Management System (PvMS) converts the raw measurements into distress (IRI, rut, and cracking) indices correlating to decision trees that determine treatments for each distress.

5.1.2 Pavement Modeling Approach

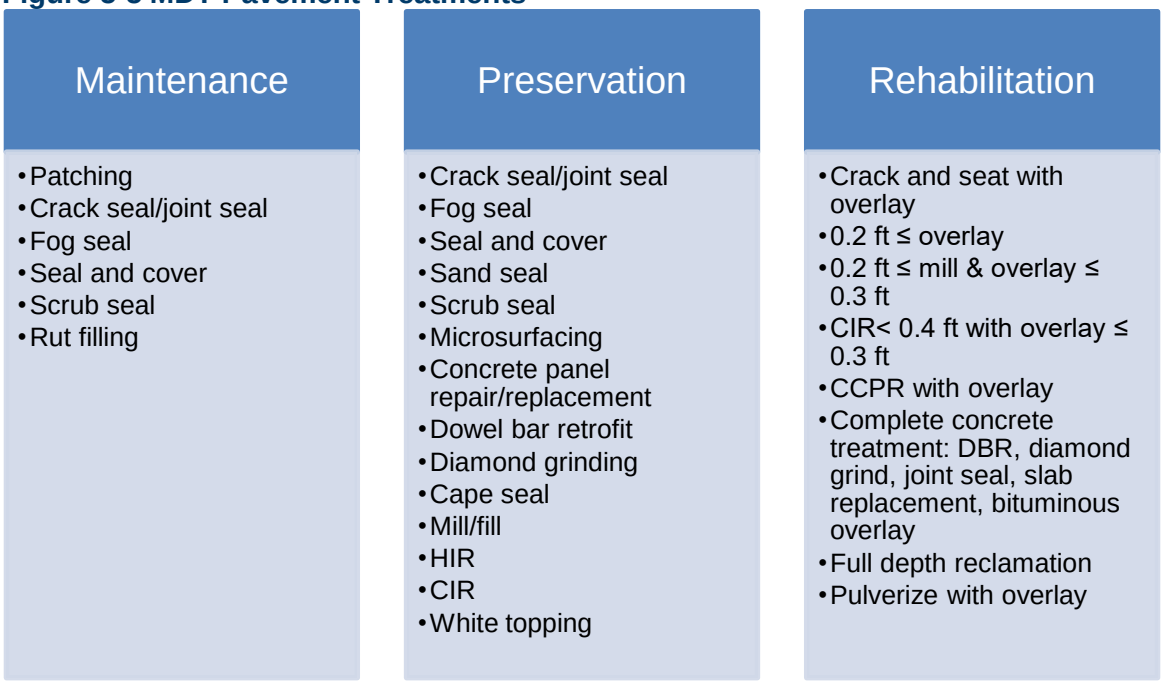
Data collected with the ADCVs are used in PvMS to model pavement deterioration and prioritize pavement treatments. Deterioration curves are based on statistical analysis of historical condition data by system and most recent treatment type. Within PvMS, MDT analyzes and predicts needs for each pavement segment based on its unique conditions and evaluates funding scenarios to determine the lowest life cycle cost. PvMS supports decision making based on a project optimization tool using pavement condition, pavement type, previous project history, and traffic level to propose the right treatment at the right time. PvMS allows MDT to model deterioration scenarios for each pavement segment depending on these variables and identifies the needs of each highway segment.

MDT pavement condition modeling includes assumptions about treatments, their impacts on condition, and their costs. Unit costs for treatments are based on an average of costs from construction and maintenance projects including material, traffic control, mobilization, and more.

5.1.3 Pavement Strategies

Decision trees are configured by system and distress index. The treatments, as shown in Figure 5-5, increase in complexity as the pavement deteriorates. The recommended treatments are options considered by MDT District staff during project nomination. MDT Headquarters and District staff work together through the design phase to further define the cost-effective scope of work to address the observed distress and roadway features.

Figure 5-5 MDT Pavement Treatments



5.1.4 Pavement Treatments

MDT's approach to treatment selection incorporates the cost effectiveness of each treatment in the pavement life cycle shown in Table 5-1. MDT addresses routine maintenance through light pavement preservation treatments. These include crack sealing and chip sealing, which may be applied multiple times after construction and between resurfacing projects.

Table 5-1 Pavement Treatment Cost Effectiveness (2021)

Scope	Treatment	Cost per lane mile	Years Gained per lane mile	Annual Cost per lane mile
Light Preservation	Crack Seal	$6,800	3	$2,300
	Chip Seal	$32,900	7	$4,700
Resurfacing	Microsurfacing	$81,700	7	$11,700
	Overlay	$135,500	12	$11,300
	Minor Rehab	$176,400	12	$14,700
Structural/ Capacity/ Geometric	Major Rehab	$271,700	15	$18,100
	Reconstruction	$598,700	20	$29,900

PvMS recommends treatments based on a series of decision tree considerations by MDT engineering staff to use in minimizing pavement life cycle costs. MDT also conducts detailed life cycle cost analysis for major rehabilitation and reconstruction projects. As part of this analysis, design staff evaluate multiple design alternatives and estimate the cost of future activities over a life cycle of 40 years or more. The goal of this process is to select a design alternative that leads to the lowest life cycle cost, even though this may not be the lowest initial construction cost.

MDT's guidelines for nomination and development of roadway projects identifies the business and development rules for pavement projects. Most surfacing treatments include a chip seal with the project. Pavement preservation treatments of crack seal and chip seal generally follow a surfacing project.

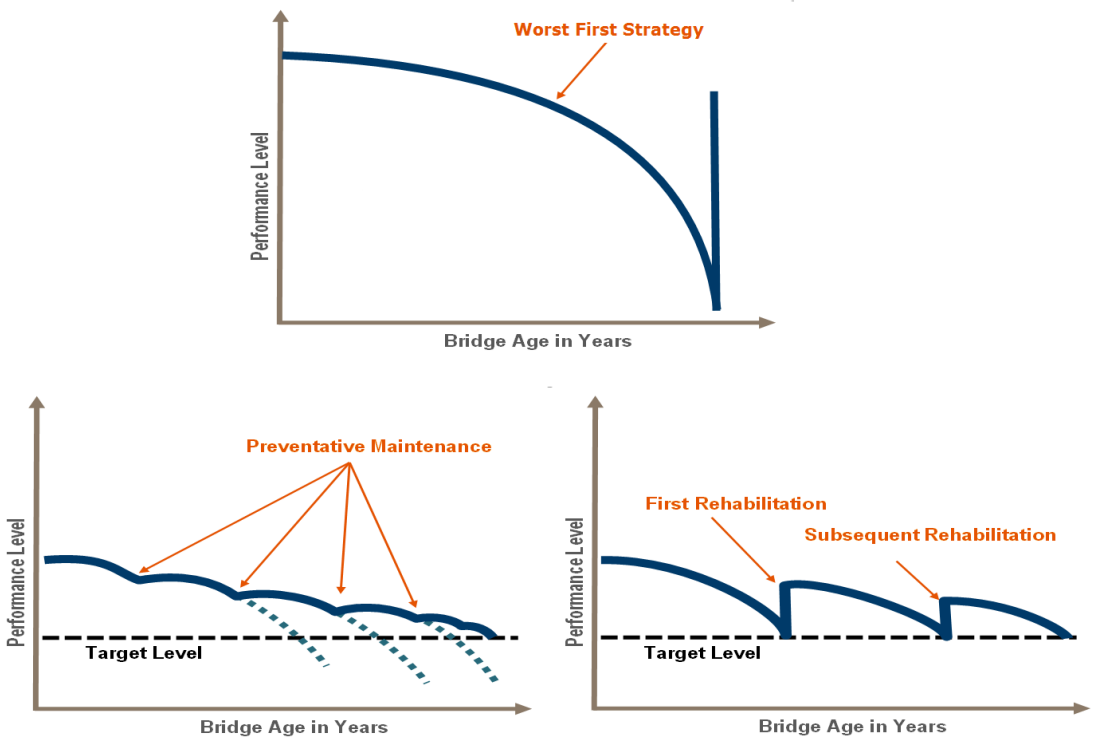
A crack seal treatment is typically applied in year three, followed by a chip seal between years seven and ten. Resurfacing treatments are used as the pavement condition deteriorates. The complexity of the resurfacing project depends on the pavement condition and geometrics, but usually the initial resurfacing treatment in the cycle is an overlay.

Each treatment type is assigned a priority within PvMS. Crack seal and chip seal have the lowest priority. The priorities progressively increase with the level of scope of work with reconstruction assigned the highest priority. As PvMS works through the indices, associated curves, and decision trees, the treatment with the highest priority for the given pavement segment is recommended.

5.2 Bridge Life Cycle Planning

Life cycle planning strategies that emphasize preservation activities are generally more cost-effective and maintain asset conditions at a higher performance level over time than rehabilitation or worst first strategies. Figure 5-6 illustrates the life cycle profiles for three different bridge investment strategies. The top graph shows the worst first strategy. The bottom left graph shows a life cycle planning strategy that emphasizes preservation. The bottom right graph represents a strategy that promotes rehabilitation treatments with minimal preservation activities.

Figure 5-6 Bridge Life Cycle Investment Strategies



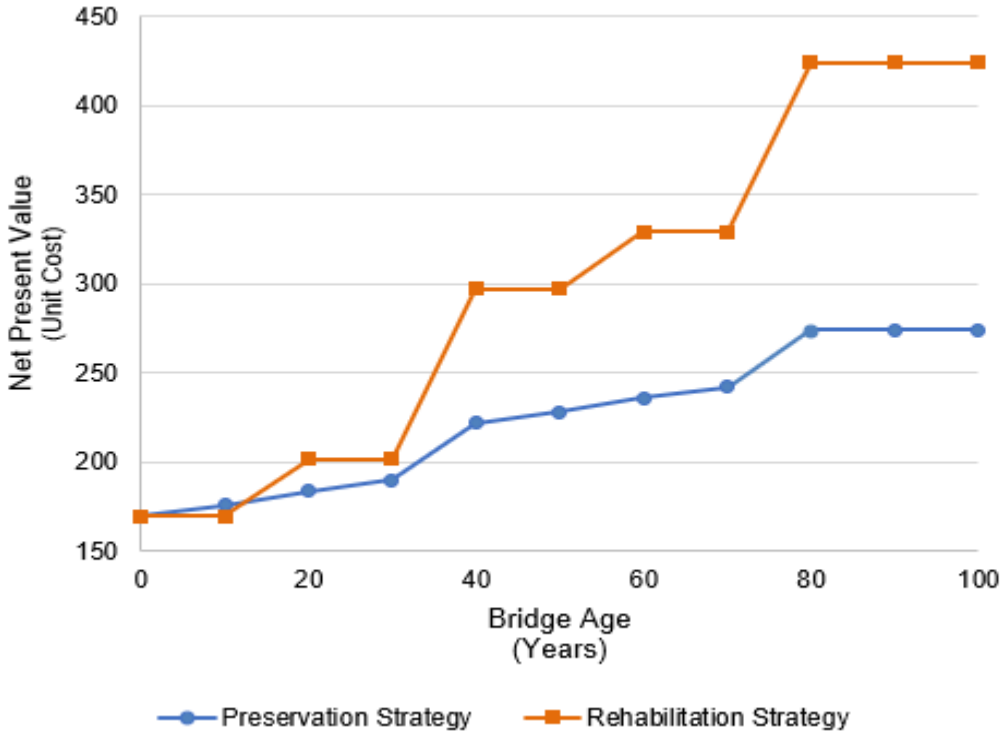
The treatments increase in complexity as bridge condition deteriorates. The recommended treatments shown in Figure 5-7 are some options considered for preventative maintenance, preservation, and rehabilitation of bridges.

Figure 5-7 Bridge Treatments

Maintenance	Preservation	Rehabilitation
• Debris Removal • Drain system cleanout • Patch and reseal joints • Repair minor damage to members	• Concrete surface coatings and sealants • Shallow concrete patches • Spot painting steel • Thin deck overlays • Joint seal replacement	• Deck milling and thick concrete overlay • Deck replacement • Joint replacement • Girder repair • Timber pile and cap repair • Reset or replace bearings

MDT's approach to treatment selection incorporates the cost effectiveness of each treatment in the bridge life cycle. Figure 5-8 shows rehabilitation versus preservation condition-based on life cycle planning strategies.

Figure 5-8 Bridge Condition-Based Life Cycle Planning Strategies



5.2.1 Bridge Data Collection

To evaluate the effectiveness of life cycle planning alternatives, MDT must obtain and maintain the best possible information on its bridges.

As mentioned previously, MDT performs full NBI and NBE inspections on most bridges every two years, with some bridges on differing cycles depending on condition and bridge type. The inspection cycles are completed by qualified bridge inspection team leaders and are consistent with the requirements of the NBI program. MDT maintenance personnel also conduct routine maintenance inspections between the standard federal inspection cycle to identify emerging issues.

During a routine inspection, a certified bridge inspector is responsible for performing element level inspections on all structural members of the deck, superstructure, and substructure. The conditions of the structural members are documented following the guidelines provided in MDT's bridge manual.

All data collected during the inspection process is documented and maintained in the MDT Structure Management System (SMS). The data is compiled and submitted annually to FHWA according to the Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges, Report No. FHWA-PD-96-001.

Bridge inspection staff receive ongoing training to provide consistent information on the best practices to address condition defects found during the inspection process. The results of each bridge inspection are documented in a formal Bridge Inspection Report that is electronically signed and stored in the Structure Management System (SMS).

5.2.2 Bridge Modeling Approach

Information contained in the SMS is the primary driver for models utilized to predict future performance for Montana bridges. By monitoring bridge conditions over time, it is possible to establish deterioration curves and expected benefits for various bridge treatment options. Treatment options are then evaluated versus costs to establish benefit-cost ratios. The grouping of treatment options that optimizes performance over time compared to other alternatives represents the preferred life cycle plan.

For NHS bridges, MDT has conducted statistical analysis on historical data to establish degradation curves and expected benefits for the majority of NHS bridge treatment options. In most cases, MDT has sufficient historical data to develop reasonable deterioration and performance models. Because the modeling process is dynamic, MDT is constantly refining models based on the latest inventory data, input from engineers, information from research efforts, and guidance from industry experts.

MDT's Bridge Management program is in the process of implementing AASHTOWare BrM as the operating platform for its SMS, including the Asset Management module. The BrM Asset Management module is a powerful modeling tool that predicts bridge preservation, improvement, and replacement needs and forecasts bridge performance measures for various budget levels and operating assumptions. MDT bridge staff have begun product testing using bridge condition data imported from SMS. BrM will be MDT's primary predictive modeling tool while further research and refinement of Montana specific deterioration models and tools are developed.

5.2.3 Bridge Strategies

MDT deterioration curves, performance models, and treatment costs help determine the cost-effectiveness of various bridge treatment strategies. Table 5-2 shows two life cycle planning strategies for a bridge through its anticipated life. The first strategy promotes rehabilitation treatments with minimal preservation activities. The second strategy emphasizes preservation treatments. Although both strategies are effective, MDT will benefit from pursuing a life cycle plan that emphasizes preservation activities.

Table 5-2 Rehabilitation Versus Preservation Life Cycle Planning Costs

Rehabilitation		
Activity	Year	Cost (ft^2)
New Construction	0	$170
Deck Rehabilitation	20	$30
Joint Replacement		$2
Deck Replacement	40	$95
Deck Rehabilitation (Mill & Thick Overlay)	60	$30
Joint Replacement		$2
Deck Replacement	80	$95
Replace Bridge	100	
Net Present Value		$424

Preservation		
Activity	Year	Cost (ft^2)
New Construction	0	$170
Preservation Treatment	10	$6
Preservation Treatment	20	$6
Joint Replacement		$2
Preservation Treatment	30	$6
Deck Rehabilitation (Mill & Thick Overlay)	40	$30
Joint Replacement		$2
Preservation Treatment	50	$6
Preservation Treatment	60	$6
Joint Replacement		$2
Preservation Treatment	70	$6
Deck Rehabilitation	80	$30
Joint Replacement		$2
Replace Bridge	100	
Net Present Value		$274

Examples of management strategies MDT will consider implementing for a preservation focused lifecycle management plan may include:

- After new construction, deck replacement, or rehabilitation, perform a preservation treatment within the first 10-years of service.
- After the initial preservation treatment, continue to apply preservation treatments at about 10-year intervals, based on individual bridge type life cycle and actual condition needs, until a deck rehabilitation or replacement treatment is necessary.
- Continue to monitor substructure and superstructure conditions to assess whether bridge replacement is the preferred treatment alternative.

In addition, MDT may consider additional preservation treatments during the life cycle; when opportunities exist and the bridge condition warrants additional work. These opportunities may include:

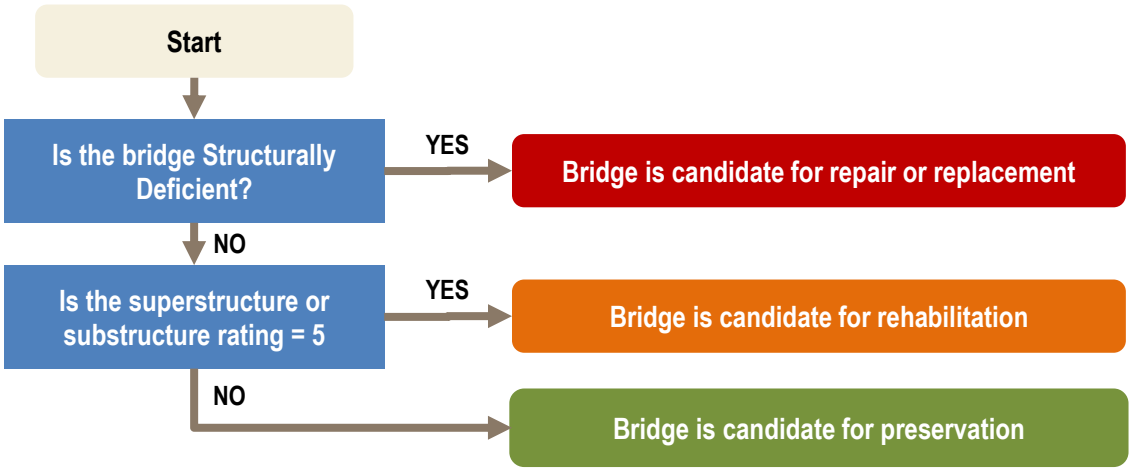
- Consider performing bridge treatments such as thin overlays with MDT pavement preservation projects to capitalize on mobilization and traffic control already in place.
- Install thin overlays early in the bridge lifecycle.
- Consider alternative contracting methods such as Job Order Contracts to strategically address specific bridge maintenance and preservation needs.
- Consider partnering with MDT Districts to advance Interstate and NHS projects that improve bridge conditions.
- Consider partnerships with the Highway Safety Improvement Program (HSIP) to advance safety projects that also improve bridge conditions.
- Consider utilizing NHFP funding for bridge projects as bridge reliability was identified as a high priority in the Montana Freight Plan.

The lifecycle treatments described here represent preservation strategies for new or newly rehabilitated structures. Existing bridges are at various stages of condition which may require alternative rehabilitation strategies and preventative maintenance to optimize performance over the anticipated remaining life.

5.2.4 Bridge Treatments

MDT applies a series of decision trees when selecting bridge preservation, repair, and rehabilitation treatments. MDT determines the candidate treatments for superstructure and substructure condition using the bridge improvement decision process illustrated in Figure 5-9.

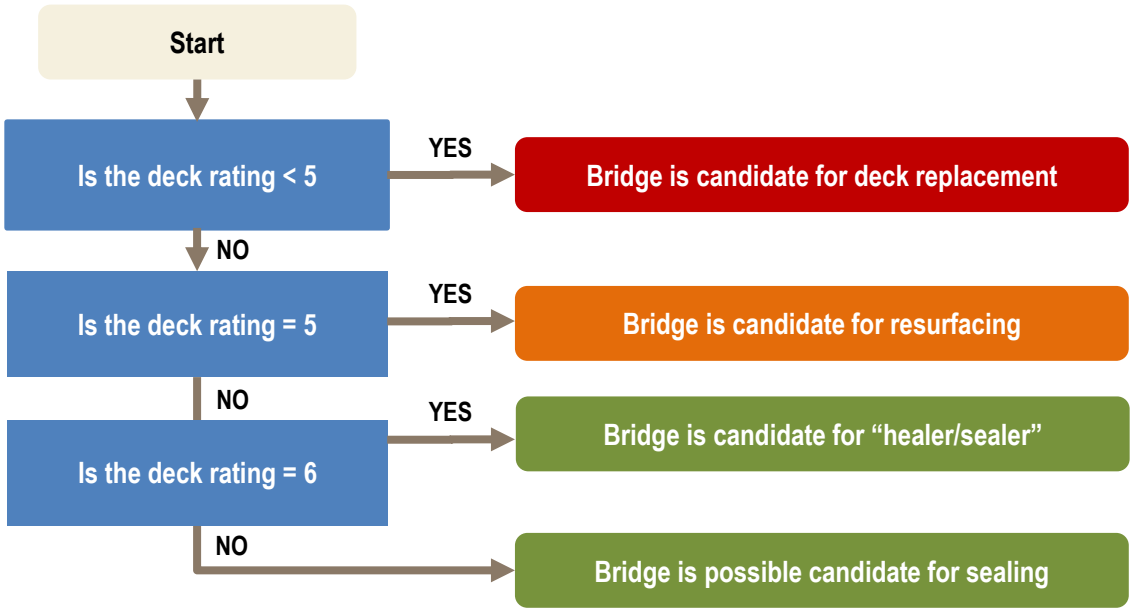
Figure 5-9 Bridge Improvement Type Decision Tree



MDT considers preservation activities for bridges in Good or Fair condition based on the potential for these activities to reduce life cycle costs and delay the need for more substantial and expensive bridge improvements.

Bridge decks generally deteriorate at a faster rate than other key bridge elements. Thus, MDT uses a bridge deck preservation decision process illustrated in Figure 5-10 to select appropriate deck work. Once MDT selects a bridge for deck work, the condition of other bridge elements is reviewed, and other structural work may be included if appropriate.

Figure 5-10 Bridge Deck Preservation Decision Tree



Life cycle cost implications of specific preservation treatments are also evaluated to assess their cost effectiveness relative to more substantial treatments. For example, the service life of a bridge deck is significantly less than other major bridge components. Consequently, assessing deck condition separately from overall bridge condition may enable MDT to defer the need for more costly bridge treatments such as rehabilitation or replacement when a bridge is otherwise in good condition.

6 GAP ANALYSIS

FHWA requires states to establish a process for conducting a performance gap analysis that identifies two things. The first is to identify alternative strategies to close the gaps between the current asset condition and targets for asset condition for the NHS. The second is to identify non-condition related gaps in the performance of the NHS that affect NHS pavements and bridges.

6.1 Gap Analysis Process

The MDT gap analysis process begins with establishing a vision for the SOGR for NHS pavements and bridges. MDT looks to several sources for guidance in establishing this vision, including the principles in MDT's mission, TranPlanMT, and the Montana Freight Plan. These were developed with public and stakeholder involvement and provide policy direction for the management of the Montana surface transportation program. Some guiding principles include:

- **MDT mission** — To serve the public by providing a transportation system and services that emphasize quality, safety, cost effectiveness, economic vitality, and sensitivity to the environment.
- **TranPlanMT policy goals**
  - **Safety** - Improve safety for all transportation users to achieve Vision Zero: zero fatalities and zero serious injuries on Montana roadways.
  - **System Preservation and Maintenance** — Preserve and maintain existing transportation infrastructure.
  - **Mobility and Economic Vitality** — Improve the safety, security, efficiency, and resiliency of freight transportation.
- **Montana Freight Plan goal** — Alleviate freight mobility issues on state owned infrastructure.

MDT's 2-year and 4-year pavement and bridge performance targets were also developed to align with these strategic planning goals and considered the same constraints and conditions. Therefore, efforts to achieve the SOGR will naturally result in MDT making progress toward and meeting the performance targets. Though this section is focused on SOGR, the gaps and strategies directly relate to performance targets.

6.2 NHS Pavements and Bridges State of Good Repair Levels

Based on these principles, MDT established the SOGR levels for NHS pavement and bridge condition demonstrated in Table 6-1.

Table 6-1 SOGR Levels for NHS Pavements and Bridge Condition

Pavement		
Interstate Pavement	80+	Ride Index
Non-Interstate NHS Pavement	76	Ride Index
Bridges		
NHS Bridge Deck Area	25%	Good
NHS Bridge Deck Area	3%	Poor

The TAMP considers performance gaps in terms of current condition and 10-year projected conditions based on the planned investment scenarios. Current condition gap is a comparison of the SOGR versus the most recent data collected. For the future gap, MDT begins by considering current condition, resources available for future investment, projected system condition based on deterioration and planned investment by treatment type, competing needs, and potential risks. This results in likely future condition. The difference between the condition and the SOGR level results in a system performance gap that can be related in terms of condition deficiency.

The result of MDT's condition gap analysis for NHS pavements and bridges is shown in Table 6-2. The analysis shows projected level of performance based on investment scenarios between 2021 and 2031 and the SOGR threshold.

Table 6-2 NHS Pavement and Bridge SOGR Gaps 2021 and 2031

NHS Pavement Ride Index					
	SOGR Ride Index	**Current Condition**	**Current Gap**	**Projected Condition (10-year)**	**Projected Gap**
Interstate Pavement	80+	82.4	0.0	80+	0.0
Non-Interstate NHS Pavement	76	73.2	2.8	76	0.0
NHS Bridge Deck Area					
	SOGR % Square Feet	**Current Condition**	**Current Gap**	**Projected Condition (10-year)**	**Projected Gap**
Poor Condition	3%	6.2%	3.2%	3%	0%
Good Condition	25%	19.4%	5.6%	25%	0%

TranPlanMT provides strong direction for decision making to prioritize the use of available resources specific to system preservation and maintenance including:

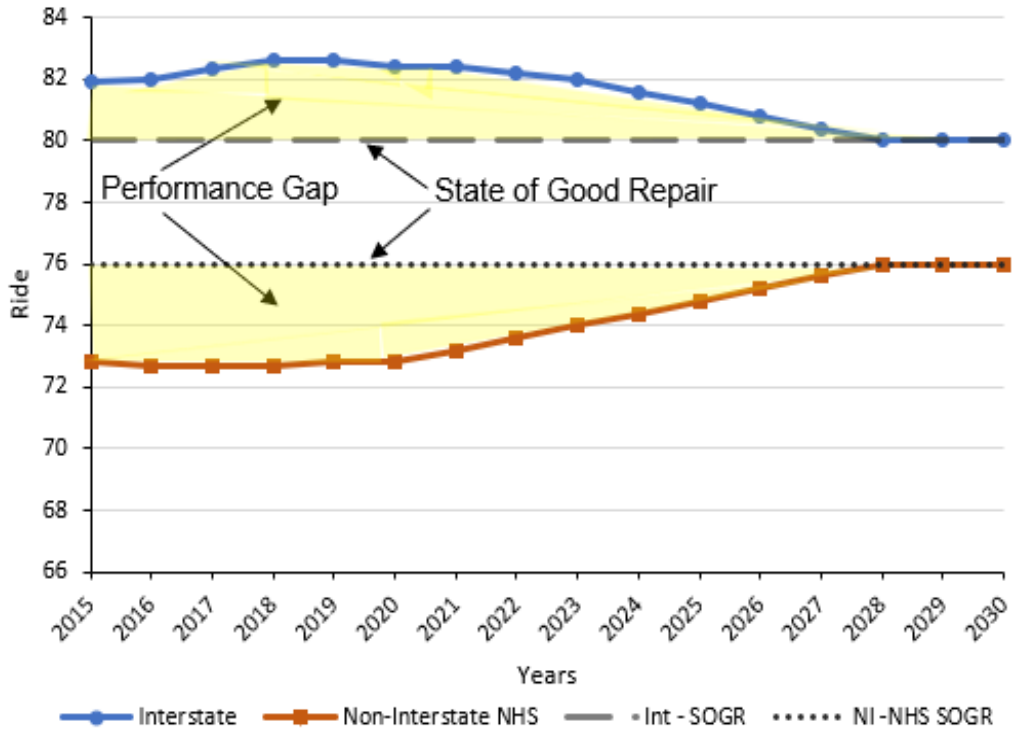
- Employ an asset management approach to monitor system performance and develop an optimal investment plan ensuring like conditions throughout the state.
- Provide the right improvements at the right time to manage infrastructure assets using cost-effective strategies.

MDT will continue to follow existing policy guidance to prioritize investments for NHS pavements and bridges. The Department anticipates achieving a desired SOGR on the NHS assuming there are no broad changes in available resources.

6.3 Predicting Future Pavement Conditions and Performance Gaps

Considering the current condition, expected deterioration, and planned level of investment, MDT plans to achieve the SOGR for Interstate and Non–Interstate NHS pavement condition within the 10-year plan horizon. Figure 6-1 shows this gap for pavement.

Figure 6-1 Future NHS Pavement Performance Gaps



Achieving SOGR is based on a continuation of investment practice adopted with the implementation of Px3 in 1999, which prioritized pavement preservation activities. The objective of the program is to slow the rate of pavement deterioration, while providing a smooth, safe, and durable roadway at the lowest life cycle cost. This strategy includes establishing funding program set-aside allocations for preservation treatments. Pavement deterioration results from environmental factors and traffic volumes. As pavements deteriorate, structural and/or functional capacity is lost. Pavement preservation and rehabilitation improves pavement condition, extends pavement service life, postpones major reconstruction needs, and provides a safe driving surface.

MDT will continue to manage Interstate and Non-Interstate NHS pavement assets consistent with MDT policy direction and associated processes through:

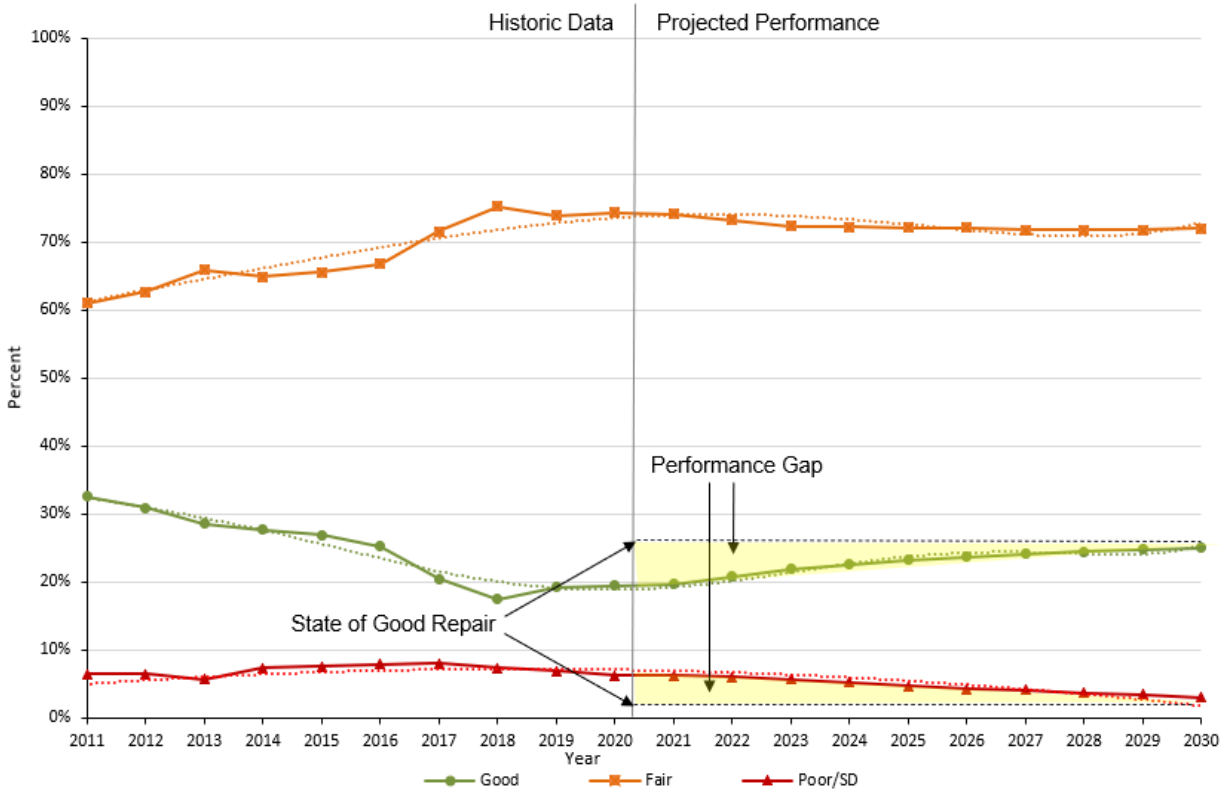
- Aggressively applying preventive preservation solutions such as chip seals with each new surfacing project;
- Deploying trained maintenance personnel and advanced technology to apply needed maintenance actions at the right time; and
- Designing new facilities for durability and longer life using state-of-the-art materials and methods.

6.4 Projecting Future Bridge Conditions and Performance Gaps

MDT identifies potential bridge projects that balance competing needs and minimize life cycle costs. There is a direct relationship between funding levels, bridge conditions, and overall performance levels for NHS bridges. The impact of these potential projects on the condition of Montana bridges depends on the resources available to deliver these projects.

Presently, on the NHS, there are gaps between current bridge conditions and MDT's desired SOGR as shown in Figure 6-2.

Figure 6-2 NHS Bridge Performance Gaps



To address these performance gaps, MDT doubled the annual allocation for NHS bridges - from around $25 million per year (in 2017) to over $50 million per year (in 2022).

Prior to this increase in funding, MDT performance models predicted that the percentage of Poor NHS bridges (by deck area) would rise above the 10 percent federal threshold. Additionally, the performance models predicted that the percentage of Good NHS bridges (by deck area) would continue to decline over time.

With additional funding, and an increased emphasis on bridge preservation and rehabilitation projects, these trends were reversed. The percentage of Poor NHS bridges (by deck area) has stabilized and is now trending downward – while the percentage of Good bridges (by deck area) is beginning to trend positively.

Moving forward, MDT anticipates that these positive trends will continue over the next ten years - as long as sufficient resources (dollars, staff, etc.) are dedicated to the NHS bridge program.

As noted previously, MDT anticipates that NHS bridge performance will improve over time. However, there are additional factors that may impact future bridge performance on the NHS:

- **Project delivery** — While MDT has identified and funded numerous NHS bridge projects, these projects take time to deliver. MDT is evaluating options such as innovative contracting to advance these projects as efficiently as possible.
- **Bridge deck construction** — At times, MDT has experienced rapid deterioration in newly constructed bridge decks, which significantly impacts NHS bridge deck performance. MDT recently completed a research project on this topic and is in the process of implementing new material and construction specifications to address the issue.
- **Timber bridges** — These bridges rapidly deteriorate from Fair to Poor condition. MDT has initiated a process to address many of these bridges and continues to closely monitor all timber bridges on the NHS.
- **Overheight vehicles** — At times, NHS bridges have been struck by overheight vehicles resulting in structure damage and roadway closures. MDT is currently evaluating strategies to prevent these types of impacts and minimize the damage to bridges when they do occur.
- **Seismic issues** — MDT proactively initiated seismic retrofits for many critical structures on the NHS to reduce vulnerability to bridges.
- **Extreme weather events** — There have not been repeated failures on NHS routes caused by extreme weather or natural disasters. Isolated slides and flooding have occurred, but not as recurring or cyclical events.
- **Reliability** — Overall, reliability is not an issue in Montana. Passenger vehicles and freight typically move freely and consistently on the NHS, though winter conditions occasionally interrupt travel on some NHS routes.

6.5 NHS Effectiveness Gap

System mobility can be associated with both reoccurring and non-reoccurring congestion. The state's relatively small population means reoccurring congestion is not a serious issue. Congestion that does occur is generally at peak hours for brief amounts of time.

Non-reoccurring events have a greater impact on mobility in Montana. Inclement weather and wildfires can have a considerable impact on the safe and effective movement of people and goods in and through the state.

An effectiveness gap analysis considers these non-condition related performance aspects of the Interstate and Non-Interstate NHS. MDT's mission and planning processes consider and account for non-condition related performance goals and needs - specifically for supporting safety, the economy, and mobility. Specific goals include:

- **TranPlanMT** — Mobility and Economic Vitality: Facilitate the movement of people and goods recognizing the importance of economic vitality.
- **Montana Freight Plan**
  - Reduce congestion to improve performance of the transportation system.
  - Improve safety, security, and resiliency of the transportation system.

MDT has processes (described below) to address non-condition congestion and will continue to employ system performance strategies to address non-condition related system performance gaps.

6.5.1 Winter Maintenance

MDT's winter maintenance guidelines establish priorities, provide uniform service between maintenance areas and optimize resource allocation. Four levels of service guide route priority and consider the following factors:

- **Safety**
- **Annual Average Daily Traffic**
- **School bus routes**
- **Availability of alternate routes**
- **Public interest and concern**
- **Potential economic impact**
- **Consequence of not providing higher level of service**
- **Available resources**

MDT has approximately 900 maintenance personnel available to clear 25,000 lane miles of ice, slush, and snow during winter. Maintenance personnel prepare for winter by stockpiling necessary supplies prior to the season. In the fall, the same trucks that are used during the summer for stockpiling, patching, and other maintenance operations are equipped with snowplows.

MDT monitors road conditions using infrared sensors, thermal mapping, and Road Weather Information Systems (RWIS). Snowplow operators follow "just-in-time anti-icing" guidelines. Once the anti-icing work is completed, MDT responds to winter storms as they occur and attempts to clear all roads as snow continues to fall. In situations where a storm covers a large area, a system of priorities is followed to provide the most effective service.

Operational treatments are continuously evaluated by MDT before, during, and after winter storms. Road treatments and applications are modified through all phases of a storm based on analysis of intensity, duration, and type of precipitation.

6.5.2 Intersection and Signal Improvements

MDT has several on-going and completed initiatives to improve performance. These include signalized intersections, signal timing, and synchronization projects, advanced signal control, and data collection.

Proper traffic signal timing promotes safe and efficient traffic flow. A well-timed traffic signal system can reduce fuel consumption and emissions, eliminate unnecessary stops and delays, and increase safety. MDT's Congestion Mitigation and Air Quality (CMAQ) Improvement Program funds are used for projects that improve corridor operations through upgrading traffic signal hardware and reviewing traffic signal timing.

MDT recently completed an Accelerated Innovation Deployment (AID) project that includes a concept of operations for traffic signals across the state, guidelines for adaptive signal control, and evaluation of 14 corridors in seven urban areas. Through this process, MDT is exploring long-term options that have the potential to improve traffic flow through signalized corridors. Options currently being considered include improved monitoring of traffic signal performance, additional detection at signals, freight priority at traffic signals, and adaptive traffic signal control.

MDT tracks travel times on corridors for signal retiming using Bluetooth or Wi-Fi to capture data from vehicles. Using multiple sensors along a corridor allows for the anonymous tracking of a vehicle from point-to-point to establish travel times. Data is available in real time provided the portable sensors are placed on the corridor. MDT is currently looking to expand the use of Bluetooth monitoring.

6.5.3 Construction and Work Zone Planning

MDT Work Zone Safety and Mobility Policy uses the best management practice of minimizing or reducing impacts before they occur. During the project pre-construction phase, a project-specific Transportation Management Plan (TMP) is developed to address demand management, corridor/network management, construction zone safety management, and traffic/incident management.

6.5.4 Traveler Services Information

MDT's Traveler Information System provides travelers with timely, accurate roadway information. The traveler information program is continually evolving, but currently includes the following:

- **511 toll-free phone system**
- **Traveler information website**
- **Mobile application**
- **73+ RWIS/cameras**
- **Highway Advisory Radios (HAR)**
- **Permanent and portable variable message signs**
- **Snowplow cameras**

The MDT website, www.mdt511.com, and the MDT travel information mobile application are widely used as sources for weather, construction and maintenance project information, reported incidents, road conditions, load and speed limit restrictions, and rest area locations and amenities. The 511 phone service provides route specific forecasting, regional reports, facility information, and access to surrounding states' road information.

The most recently deployed technology is snowplow cameras. While the plow is operating, dash-mounted cameras capture images about every half mile that are made available to the public via the MDT website and mobile app. This technology helps travelers determine conditions based on firsthand observations.

6.5.5 Corridor Planning

MDT conducts corridor planning studies to determine cost-effective solutions addressing transportation needs along a corridor. MDT invites local government and stakeholder representatives to assist in identifying corridor issues and concerns, potentially affected resources, and a range of options to improve transportation safety and operations. MDT uses the *Montana Business Process to link Planning Studies,* National Environmental Policy Act (NEPA), and Montana Environmental Policy Act (MEPA) to guide the process.

6.5.6 Highway Rail Crossings

MDT inventories all public at-grade crossings on a three-year cycle. The information collected is added to the MDT Highway-Rail Crossing Database and is reported to the Federal Railroad Administration (FRA) National Highway-Rail Crossing Database. This data is used to assess the safety of crossings and identify potential locations for safety improvements.

MDT monitors safety at highway-rail crossings and invests in safety improvements within available funding where improvements are feasible and cost effective. These efforts have continued to reduce the total number of highway-rail incidents in Montana.

Railroad companies continue to invest in capacity expansion as rail traffic increases. Train lengths are increasing, which affect vehicular delays at crossings. Longer trains may also impact crossings that are on sidings that weren't affected previously by shorter train lengths.

6.5.7 Natural Events

Various events, such as rock slides and flooding, may cause infrastructure failures or negatively impact system performance. When bottlenecks and delays result, MDT promptly initiates an incident management team to establish an appropriate detour. A second project team initiates the process to quickly implement repairs.

MDT strives to prevent failures before they occur. To prevent rockfalls, MDT utilizes a rockfall hazard rating process and system. The process and system screen for potential rockfall sites and rate sites according to estimated potential for rockfall on the roadway to prioritize areas of concern and respond effectively.

6.5.8 Wildfires

Wildland and rangeland fires are hazards that impact Montana every year. In mild fire seasons, there may be relatively small timber and crop resource losses. In extreme years, there can be resource devastation, habitat destruction, structure losses, and deaths. Transportation-related strategies for mitigating congestion and delay due to fires include removal of debris, such as burning trees near the roadway and provision for traffic control, if needed, to remove the debris. For evacuations, MDT personnel ensure that evacuation routes are safe and that information on safe, restricted, and closed routes is communicated to the proper authorities and the public.

6.5.9 Crash Delays

Depending on the severity, location, and alternate routes available, vehicle crashes can contribute to significant delay for highway users. If warranted and requested by the Montana Highway Patrol, MDT personnel will assist with traffic control until any investigation is complete and the roadway is cleared. Crashes are random in nature, but certain locations may exhibit a higher crash frequency than others. MDT has adopted an emergency operations and disaster plan that provides a basis for response to these types of events.

7 MANAGING RISK

The U.S. Department of Transportation defines risk as the positive or negative effects of uncertainty or variability upon agency objectives. Risk management is a process and framework for managing potential risks, including identifying, analyzing, evaluating, and addressing the risks to assets and system performance.

Major risk management elements within the context of the MDT asset management program and consistent with federal rules include:

- **Risk identification** — identify events that could impact MDT's ability to effectively manage pavements and bridges;
- **Risk assessment** — assess the likelihood of an event happening and the consequences if that event does occur;
- **Risk prioritization** — determine where to focus resources based on risk assessment;
- **Risk treatment** — identify and implement a treatment or mitigation activity for each priority risk;
- **Risk monitoring** — monitor and respond to possible events, evaluate the effectiveness of treatments, and periodically update risk priorities; and
- **Emergency event evaluation** — summary evaluation of NHS pavements and bridges repeatedly damaged by emergency events.

7.1 Identifying, Assessing, and Prioritizing Risks

During the TAMP development and update process, MDT Executive, Engineering, Information Services (ISD), Planning, District, and Administration staff members assessed the likelihood and impacts of risks related to asset management. An online survey was distributed to agency staff across these functional areas to help identify, assess, and prioritize potential risks and provide insights in the following areas:

- Identifying top three asset management risks;
- Describing potential consequences of risks with respect to safety, mobility, asset damage, financial impact, and agency reputation;
- Specifying the assets impacted by these risks;
- Assessing the likelihoods of these risks occurring; and
- Evaluating the consequences of these risks should they occur.

The survey resulted in a set of risks evaluated by the TAMP Steering Committee. Using the risks identified in the survey as a starting point, the Steering Committee finalized a list of 12 risks to include in the 2022 TAMP and assessed each through a formal evaluation process. As part of this process, the participants evaluated and scored each risk in the following categories:

- **Risk likelihood** — risks are assigned a likelihood level based on probability of occurrence. Steering Committee members assessed risk likelihood on a 1 (low) to 5 (high) scale and responses were averaged to determine the overall score.
- **Risk consequence** — risks are assigned a consequence level based on assumed impacts should they occur. Steering Committee members assessed these consequences related to the following factors:
  - **Safety** — the impact of the risk on fatal or serious injury crashes
  - **Mobility** — the impact of the risk on people and freight movement between locations
  - **Asset damage** — the impact of the risk on the physical and/or functional condition of an asset
  - **Financial** — the impact of the risk on agency or other costs pertaining to asset management

Values assigned by the Steering Committee were averaged for each category of impacts to determine overall safety, mobility, asset damage, and financial scores. The overall consequence level for each risk was then calculated as the weighted average of these scores. MDT considered all impact areas to be of equal importance and assigned each a weight of 25 percent.

- **Risk level** —The Steering Committee calculated an overall risk level for each identified risk as the product of the risk likelihood score and risk consequence score. MDT used these scores to assign a priority level to each risk that is included in an overall risk register as shown in Table 7-1.

Table 7-1 Evaluating Risk Likelihood and Consequence

Consequence Level / Likelihood Level	*1 Negligible*	*2 Minor*	*3 Major*	*4 Critical*	*5 Catastrophic*
1 Low	1	2	3	4	5
2 Medium Low	2	4	6	8	10
3 Medium	3	6	9	12	15
4 Medium High	4	8	12	16	20
5 High	5	10	15	20	25

7.2 Risk Management

The MDT risk management register in Table 7-2 identifies a prioritized set of risks and defines mitigation strategies for each. MDT will continue to monitor the risk landscape, the effectiveness of mitigation strategies, and will periodically update this risk register. MDT is currently conducting most of these mitigation strategies.

Table 7-2 Risk Management Register

Priority	Risk	Mitigation Strategy	Responsible
1	A. Change in political climate	• Educate lawmakers on importance of asset management • Formalize and document asset management processes so they are not easily disrupted • Improve IT resources to enable scenario analysis and response to legislative inquiries	• Director's Office • Planning Division • Engineering Division
	B. Transportation funding is reduced by 20% in real dollars	• Revert to TranPlanMT policy of preservation first and reassess funding levels	• Administrative Staff
	C. Purchasing power decreases by more than 3% due to inflation, price volatility, mandates, etc.	• Educate lawmakers on importance of asset management • Coordinate with FHWA and AASHTO to address funding uncertainty at the national level • Revert to TranPlanMT policy of preservation first and reassess programmatic funding levels	• Director's Office • Director's Office • Administrative Staff
2	D. A freight-intensive market sector or unexpected development changes traffic volumes/patterns or negatively impacts infrastructure	• Conduct impact reviews as part of permitting process • Track changing traffic patterns so that management systems reflect impacts and ensure project development processes remain adaptable for addressing emerging conditions	• Planning Division • Engineering Division, Motor Carrier Services & District Offices
	E. Bubble in asset replacement needs due to uneven asset age distribution	• Quantify and communicate the problem • Implement a Bridge Management System and assess opportunities to delay replacement by investing in bridge preservation, repair, and rehabilitation • Finalize and implement asset management plan • Rely on asset management to monitor and address long-term needs	• Engineering Division • Engineering Division • Planning Division • Administrative Staff
	F. Extreme weather event	• Document emergency response protocol • Set aside funds for routine emergency response • Work with federal partners to streamline emergency response process in terms of public involvement, environmental review, and right-of-way acquisition	• Planning Division • Administrative Staff • Planning Division
	G. Emerging transportation technology (driverless vehicles, etc.)	• Keep abreast of emerging technology and associated issues and opportunities, implement when beneficial (consider internal processes and external needs) • Participate in national committees/discussions related to these technologies	• Engineering, Planning, Motor Carrier Services & Maintenance Divisions • Engineering, Planning, Motor Carrier Services & Maintenance Divisions
3	H. Catastrophic infrastructure failure for reasons other than deterioration or scour (vehicle impact, natural disaster, etc.)	• Implement seismic retrofit program • Implement, update as needed, and ensure compliance with the Business Continuity Plan and Emergency Response Plan	• Engineering Division • Maintenance Division
	I. Lack of internal or external staffing resources	• Conduct succession planning throughout agency • Update recruitment strategy to reflect changing workforce needs • Implement tools that allow use of additional resources (consultant services for contract administration)	• Human Resources • Human Resources • Administrative Staff
	J. Reduced flexibility with federal funding	• Revert to TranPlanMT policy of preservation first and reassess programmatic funding levels	• Administrative Staff
	K. Increased ongoing, seasonal weather events	• Update hydraulic standards • Continue practice of cleaning major culverts to ensure uninhibited flow	• Engineering Division • Maintenance Division
4	L. Data, management systems, and other IT infrastructure are unable to support decision, analysis or business needs	• Implement a Bridge Management System and enhance Pavement Management System • Enhance Financial Management Suite and Program & Project Management System • Develop and implement a data governance plan	• Engineering Division • Information Services • Administration, Planning & Engineering Divisions • Administrative Staff
MDT is currently conducting strategies highlighted in blue.			

7.2.1 Reoccurring Repairs Caused by Emergency Events

Per 23 CFR 667, each state is required to conduct a statewide evaluation to determine if there are reasonable alternatives to roads, highways, and bridges that have required repair and reconstruction on two or more occasions due to emergency events. An emergency event is a natural disaster or catastrophic failure resulting in an emergency or disaster declaration by the Governor or the President of the United States.

This evaluation includes:

- Identification and consideration of alternatives that will mitigate or resolve the root cause of the recurring damage;
- Evaluation of risk of recurring damage and the cost of future repair under current and future environmental conditions; and
- Analysis to achieve a solution, if possible, and document the costs and likely duration of the solution.

The evaluation period begins January 1, 1997, or earlier if useful data is reasonably available. MDT will update the evaluation documentation every four years, or when an emergency event occurs that requires the addition of a highway segment to the evaluation document.

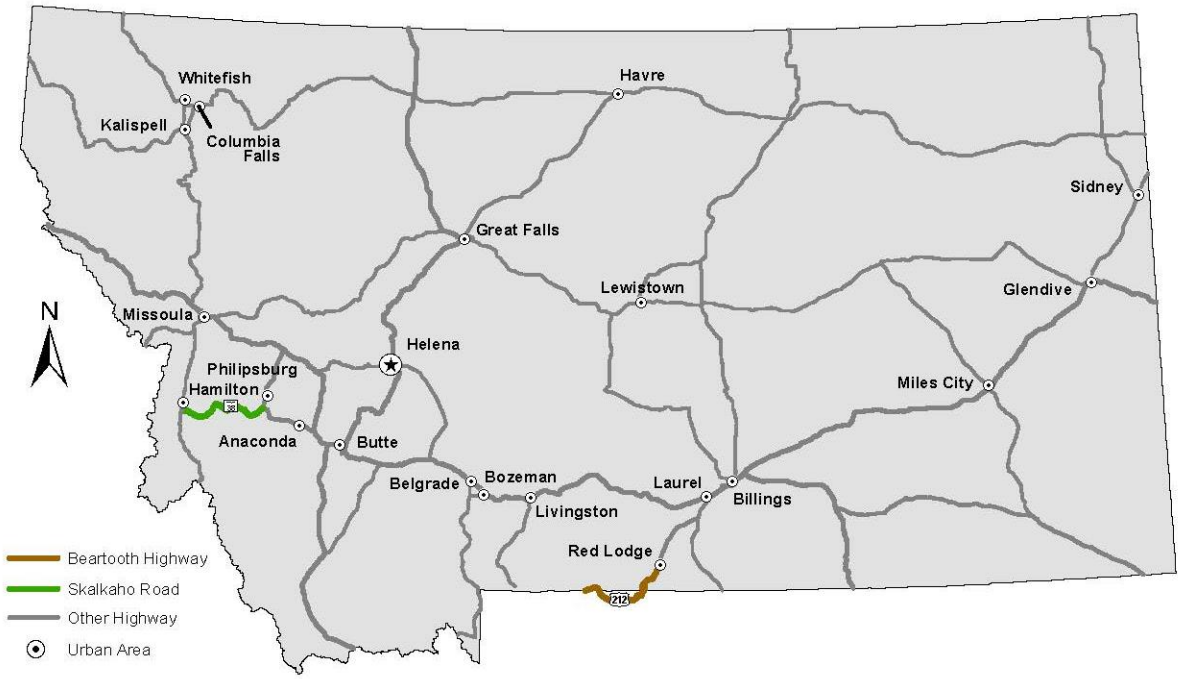
7.2.1.1 Evaluation Methodology

An initial review was conducted utilizing the MDT Program & Project Management System (PPMS) to identify emergency project locations on federal-aid routes. This information was cross-referenced with the FHWA Financial Management Information System (FMIS) to confirm project locations. Lastly, MDT reviewed Emergency Relief (ER) Program documentation and State of Montana records to assess whether emergency projects were associated with disaster declarations.

7.2.1.2 Evaluation Results

MDT has identified two route segments that meet the criteria for having recurring emergency events as shown in Figure 7-1.

Figure 7-1 Non-NHS Recurring Emergency Event Locations



- **Beartooth Highway** (US-212) is a seasonal route from Red Lodge to Yellowstone National Park via Cooke City. The highway experienced slope failures in 2005 and 2011 after excessive runoff/heavy rain that contributed to slope failures and debris flows. In 2005, approximately 10 miles was reconstructed at a cost exceeding $20 million. In 2011, a minor repair project of less than $100,000 was needed to clear debris and restore drainage to a culvert after a significant rain event. The Beartooth Highway is considered a National Scenic Byways All-American Road and is the Northeast Entrance to Yellowstone National Park. Consequently, no reasonable alternatives appear to exist for this roadway.
- **Skalkaho Road** (MT-38) is a state highway that connects US-93 near Hamilton to MT-1 near Philipsburg. Portions of this roadway experienced minor damage from excessive runoff due to heavy rain. In 1997, the total cost for roadway repair work was about $150,000. In 2011, restoration costs totaled slightly over $300,000. No reasonable alternatives appear to exist for this seasonal highway as the nearest similar corridors are more than 40 miles in either direction.

Although no reasonable alternatives exist for these roadways, MDT conducted an analysis to mitigate the root cause of the recurring damage.

No locations were identified on the Interstate System. Emergency events that impact Interstate routes are rare in Montana with occasional minor flooding and some slide activity, but no significant patterns have emerged to date.

No locations were identified on Non-Interstate NHS routes. A section of roadway on US-191 northeast of Lewistown near the Missouri River is potentially problematic. This section is prone to erosion events and slides. MDT initiated a geotechnical study to evaluate mitigation options at this location and has begun preliminary engineering work on a construction project to address identified issues.

Aside from the Beartooth Highway, no other locations were identified on Primary System routes. However, there are two areas of concern that are being monitored. The first location is on MT-80 north of Stanford near Arrow Creek. This area has highly erodible soils and is prone to slides. MDT has initiated a geotechnical study to evaluate mitigation options at this location and has begun preliminary engineering work on a construction project to address identified issues.

The second area of concern is US-12 along the Musselshell River. In recent years, numerous high-water events have accelerated erosion along embankment areas near the roadway. MDT has advanced a series of bank stabilization projects to help address the issue and prevent damage from future high-water events.

No locations were identified on the Secondary Highway System. However, MDT is monitoring one site on Secondary 228 near Highwood that has historically been prone to slides.

Aside from Skalkaho Road, no other locations were identified on state highways or other federal-aid routes.

7.3 Risk Management/Monitoring

MDT will evaluate the status of the top priority risks during the development of the annual national performance reports and consider if mitigation measures remain effective and/or if different mitigations need to be implemented on a 2-year and 4-year cycle, consistent with the TAMP update and target setting evaluation processes.

The Project Analysis Section of the Rail, Transit and Planning Division will perform the monitoring, and lead the TAMP update, the performance reporting, and the target setting efforts.

8 FINANCIAL PLAN

8.1 Valuing Montana Assets

Infrastructure is defined as long-lived assets that are stationary in nature and can be preserved for a significantly greater number of years than most capital assets. Examples of infrastructure assets include roads, bridges, tunnels, drainage systems, water and sewer systems, dams, and lighting systems.

FHWA requires state TAMPs to include an estimate of asset value for NHS pavements and bridges, including the investment needed on an annual basis to maintain the asset value.

8.2 NHS Pavement and Bridge Asset Value

MDT considered two methods of asset valuation, including replacement value based on unit costs and the Government Accounting Standards Board Statement No. 34 (GASB-34) depreciation method.

Replacement cost is a simple calculation based on unit costs per mile of pavement and per square foot costs for bridges. Estimates are based on assumed pavement widths and typical sections. Using this method, the NHS pavement replacement value is approximately $8.6 billion, and the NHS bridge replacement value is $3.1 billion.

As standard business process, MDT conducts an annual infrastructure valuation to ensure compliance with *Montana Operations Manual*, Chapter 335: Capital Asset Accounting. Under Section III.B.3 of this manual, infrastructure is required to be capitalized at its historical cost and depreciated over its useful life. Annually, MDT uses the GASB-34 depreciation approach to determine the value of state infrastructure assets.

The GASB-34 depreciation method considers NHS asset value depreciated for service life and annual investment in capital activities to offset the loss in value. Using this method, the 2021 depreciated book value of NHS pavements and bridges was $3.1 billion. During 2021, NHS pavements and bridges depreciated an estimated $87 million, while MDT invested $281 million in capital improvements and maintenance activities.

Using the GASB-34 method comparing the planned level of investment versus the annual depreciation, MDT will effectively maintain the value of NHS pavements and bridges.

8.3 Funding Sources

MDT's budget is a combination of state and federal funds. Federal funds are provided through the Infrastructure Investment and Jobs Act (IIJA) and state matching funds are provided through the biennial state budgeting process.

Funding for NHS pavements and bridges generally comes from the following sources:

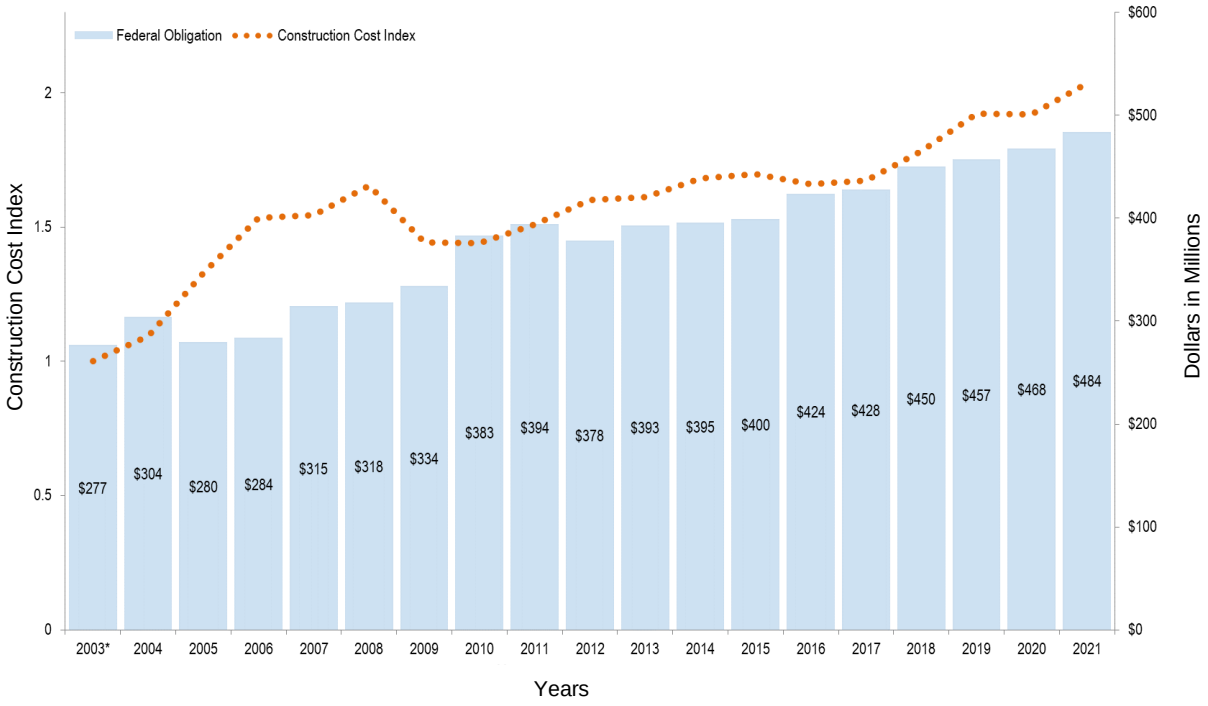
- **National Highway Performance Program (NHPP)** — provides funding to improve the condition and performance of pavements and bridges on the NHS.
- **Bridge Formula Program (BFP)** — provides funding to replace, rehabilitate, preserve, protect, and construct highway bridges.
- **National Highway Freight Program (NHFP)** — provides funding to improve efficient movement of freight on the National Highway Freight Network.
- **State Highway Special Revenue (SHSR)** — matching funds are generated by state fuel taxes and vehicle weight permits and fees. The majority, 87 percent, of HSSR funds are constitutionally restricted for the construction, reconstruction, repair, operation, and maintenance of Montana federal, state, and local highway roadway systems.

8.4 Balancing Needs and Funding

TranPlanMT sets MDT policy direction and vision and establishes strategies for how the statewide transportation system is managed and developed. To meet statewide priorities, MDT performs Px3 tradeoff analyses and develops a performance-based Funding Distribution Plan. The aim of Px3 is to balance available funding against needs and develop an optimal budget that delivers the best possible highway system performance outcomes. However, achieving targeted performance outcomes with increasingly limited funding is challenging.

The National Highway Construction Cost Index (NHCCI) tracks highway and street construction costs over time. The NHCCI reflects the increasing cost of key construction inputs, including labor, fuel, materials, and equipment. When construction costs and inflation increase at a faster pace than funding levels, the purchasing power of state and federal funds decreases. As shown in Figure 8-1, federal obligations to Montana continue to grow, but the value of those funds in real terms is not keeping pace with rising construction costs or overall statewide investment needs.

Figure 8-1 Federal Funding Flows and Inflation Indices



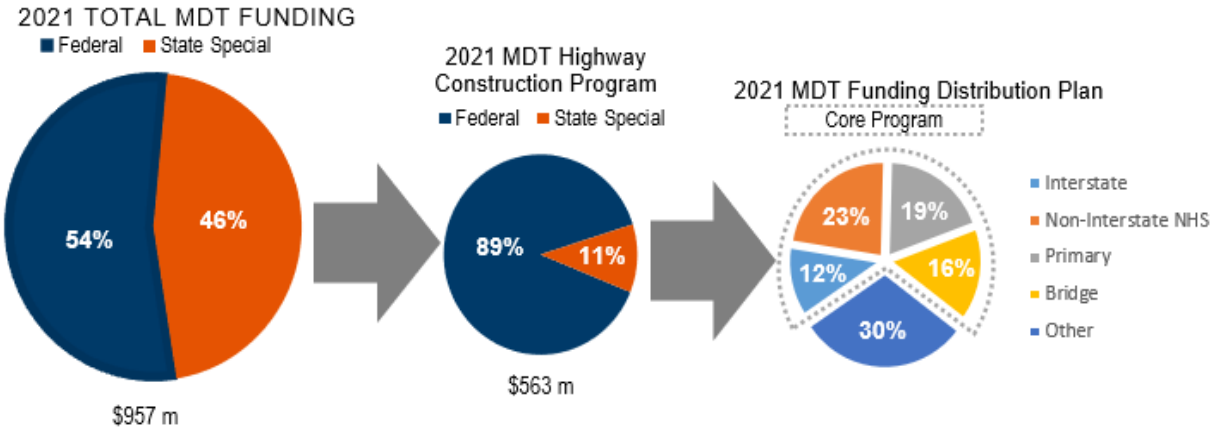
8.5 Allocating Funds for Asset Management

MDT managed approximately $957 million in total funding in 2021 including federal sources and SHSR amounts. MDT allocated $394 million, about 41 percent, of available state and federal funds for general operations, planning, maintenance, multimodal activities, and for distribution to other state agencies and tribal and local governments.

The remaining $563 million was directed to the Highway Construction Program. Typically, Px3 uses approximately 70 percent of the Highway Construction Program for Core Program allocations. The Px3-driven Core Program consists of Interstate, Non-Interstate NHS, Primary, and Bridge categories. The remaining distributions provided through state statute or federal programs are included in the “Other” category for purposes of the TAMP.

Figure 8-2 illustrates how MDT funds are allocated from total funding allocations to the Core Program. This allocation by system is based on need as determined in Px3.

Figure 8-2 MDT Funding Allocation



8.6 Anticipated Funding Levels

Annual allocations to the Core Programs through Px3 include recommended funding for pavements and bridges by District, system (Interstate, Non-Interstate NHS, and Primary), and type of work (preservation, rehab, or reconstruction). MDT directs funding to bridge and pavement programs to maintain target condition levels and allocations are based on an analysis of the relationships between funding and expected performance. Table 8-1 displays anticipated federal apportionment levels for TAMP assets (by MDT funding program) to achieve the projected level of performance over the next 10 years.

Table 8-1 Total Apportioned Federal Funds* for TAMP Assets 2022-2031

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Interstate Pavement										
Preservation	$ 20.0	$ 20.5	$ 21.2	$ 21.8	$ 22.5	$ 23.1	$ 23.8	$ 24.5	$ 25.3	$ 26.0
Rehabilitation	$ 22.2	$ 22.9	$ 23.6	$ 24.3	$ 25.0	$ 25.8	$ 26.5	$ 27.3	$ 28.2	$ 29.0
Reconstruction	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other (non-pavement)	$ 14.8	$ 15.3	$ 15.7	$ 16.2	$ 16.7	$ 17.2	$ 17.7	$ 18.2	$ 18.8	$ 19.3
Total	$ 57.0	$ 58.7	$ 60.5	$ 62.3	$ 64.2	$ 66.1	$ 68.0	$ 70.0	$ 72.3	$ 74.3
NHS Pavement										
Preservation	$ 24.5	$ 25.2	$ 26.0	$ 26.7	$ 27.6	$ 28.4	$ 29.2	$ 30.1	$ 31.0	$ 31.9
Rehabilitation	$ 20.8	$ 21.4	$ 22.1	$ 22.7	$ 23.4	$ 24.1	$ 24.8	$ 25.6	$ 26.4	$ 27.1
Reconstruction	$ 46.5	$ 47.9	$ 49.3	$ 50.8	$ 52.3	$ 53.9	$ 55.5	$ 57.2	$ 58.9	$ 60.7
Other (non-pavement)	$ 26.8	$ 27.7	$ 32.5	$ 33.4	$ 34.4	$ 35.5	$ 36.5	$ 37.6	$ 38.8	$ 39.9
US-93 Bond Debt	$ 3.8	$ 3.8	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ 122.4	$ 126.0	$ 129.9	$ 133.6	$ 137.7	$ 141.9	$ 146.0	$ 150.5	$ 155.1	$ 159.6
NHS Bridges										
Preservation	$ 1.8	$ 2.2	$ 2.6	$ 3.0	$ 3.5	$ 4.0	$ 4.5	$ 5.1	$ 5.7	$ 6.3
Rehabilitation	$ 12.4	$ 12.8	$ 13.3	$ 13.7	$ 14.2	$ 14.7	$ 15.2	$ 15.8	$ 16.3	$ 16.9
Reconstruction	$ 17.0	$ 17.6	$ 18.2	$ 18.8	$ 19.5	$ 20.2	$ 20.9	$ 21.6	$ 22.4	$ 23.2
Other (non-structural)	$ 12.0	$ 12.4	$ 12.9	$ 13.3	$ 13.8	$ 14.3	$ 14.8	$ 15.3	$ 15.8	$ 16.4
Total	$ 43.2	$ 45.0	$ 47.0	$ 48.8	$ 51.0	$ 53.2	$ 55.4	$ 57.8	$ 60.2	$ 62.8

*$ in millions of anticipated federal apportionment

For the purposes of this TAMP, MDT makes the following adjustments to estimated apportioned funds to reflect funds available for construction activities:

- Reducing distribution values by 10 percent to account for federal obligation limitation;
- Further reducing distribution values by 18 percent to adjust for non-construction phases (design, right-of-way, etc.);
- Removing non-pavement related investment needs, including but not limited to interchange/intersection work, guardrail, fencing, culverts, slide repair and bond debt service payments:
- Increasing adjusted values to account for the state match of 8.76 percent for the Interstate program and 13.42 percent for all other programs.

This results in anticipated total funding for TAMP construction activities as shown in Table 8-2.

Table 8-2 Funds for TAMP Construction by MDT Funding Program/Work Type 2022-2031

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Interstate Pavement										
Preservation	$ 16.1	$ 16.6	$ 17.1	$ 17.6	$ 18.2	$ 18.7	$ 19.3	$ 19.8	$ 20.4	$ 21.1
Rehabilitation	$ 18.0	$ 18.5	$ 19.1	$ 19.6	$ 20.2	$ 20.8	$ 21.5	$ 22.1	$ 22.8	$ 23.5
Reconstruction	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other (non-pavement)	$ 12.0	$ 12.3	$ 12.7	$ 13.1	$ 13.5	$ 13.9	$ 14.3	$ 14.7	$ 15.2	$ 15.6
IM Pavement Total	$ 34.1	$ 35.1	$ 36.2	$ 37.2	$ 38.4	$ 39.5	$ 40.8	$ 41.9	$ 43.2	$ 44.6
NHS Pavement										
Preservation	$ 20.9	$ 21.5	$ 22.1	$ 22.8	$ 23.5	$ 24.2	$ 24.9	$ 25.7	$ 26.4	$ 27.2
Rehabilitation	$ 17.7	$ 18.3	$ 18.8	$ 19.4	$ 20.0	$ 20.6	$ 21.2	$ 21.8	$ 22.5	$ 23.1
Reconstruction	$ 39.6	$ 40.8	$ 42.1	$ 43.3	$ 44.6	$ 46.0	$ 47.3	$ 48.8	$ 50.2	$ 51.7
Other (non-pavement)	$ 22.8	$ 23.6	$ 27.7	$ 28.5	$ 29.4	$ 30.2	$ 31.1	$ 32.1	$ 33.0	$ 34.0
NHS Pavement Total	$ 78.2	$ 80.6	$ 83.0	$ 85.5	$ 88.1	$ 90.8	$ 93.4	$ 96.3	$ 99.1	$ 102.0
NHS Bridges										
Preservation	$ 1.5	$ 1.9	$ 2.2	$ 2.6	$ 3.0	$ 3.4	$ 3.8	$ 4.3	$ 4.9	$ 5.4
Rehabilitation	$ 10.6	$ 10.9	$ 11.3	$ 11.7	$ 12.1	$ 12.6	$ 13.0	$ 13.4	$ 13.9	$ 14.4
Reconstruction	$ 14.5	$ 15.0	$ 15.5	$ 16.1	$ 16.6	$ 17.2	$ 17.8	$ 18.4	$ 19.1	$ 19.7
Other (non-structural)	$ 10.2	$ 10.6	$ 11.0	$ 11.3	$ 11.7	$ 12.1	$ 12.6	$ 13.0	$ 13.5	$ 13.9
NHS Bridge Total	$ 26.6	$ 27.8	$ 29.0	$ 30.4	$ 31.7	$ 33.2	$ 34.6	$ 36.1	$ 37.9	$ 39.5

$ in millions for CN/CE. Reduction includes obligation limitation, non-construction phases, non-pavement related investment, and addition of estimated state match.

MDT presents the Px3 recommended funding levels to the Montana Transportation Commission for concurrence and uses Px3 funding levels to develop a Funding Distribution Plan annually. Actual annual allocations for pavement and bridge projects are based on the best funding and condition data available when the Funding Distribution Plan is being developed. Not all allocations in the distribution plan are available to improve assets covered in this TAMP.

The Px3 allocations for TAMP assets are then aligned with MDT's policy-driven investment strategies, supported by life cycle planning processes, and with consideration of risks and non-condition performance needs. This results in a program of projects that maintains/improves NHS pavement and bridge condition and makes progress toward achieving MDT performance targets, SOGR, and national performance goals.

9 INVESTMENT STRATEGIES

TranPlanMT provides the foundation for MDT's commitment to asset management and strong direction for investment strategies. The processes described in the TAMP, including Px3, life cycle planning, risk management, and financial planning, follow the policy direction of TranPlanMT. These processes were developed to guide investment decisions and ensure that MDT optimizes available resources. Consistency among TranPlan MT, the TAMP, state and federal performance targets, and MDT's SOGR will lead to a program of projects in the STIP that will support state and national performance goals.

9.1 System Investment Related to TranPlanMT Goals and Strategies

★ System Preservation and Maintenance

- GOAL: Preserve and maintain existing transportation infrastructure.
- STRATEGIES:
  - SPM1: Employ an asset management approach to monitor system performance and develop an optimal investment plan ensuring like conditions throughout the state.
  - SPM2: Provide the right improvements at the right time to manage infrastructure assets using cost-effective strategies.
  - SPM3: Design new facilities for durability and longer life cycles using state-of-the-art materials and methods.

★ Business Operations and Management

- GOAL: Provide efficient, cost-effective management and operation to accelerate transportation project delivery and ensure system reliability.
- STRATEGIES:
  - BOM1: Coordinate with state and federal agencies to support transportation security and enable appropriate response and recovery from emergency and disaster situations.
  - BOM2: Develop and implement a long-range multimodal transportation improvement program that addresses Montana's statewide transportation needs, is consistent with the statewide long-range transportation plan and management system output, and maximizes the use of

federal funds through the Performance Programming Process (Px3) to ensure a cost-effective, efficient, and safe transportation system.

- BOM5: Invest at the appropriate level to achieve performance targets given available funding.
- BOM6: Employ proactive management strategies to ensure compliance with rules and regulations, identify risk to MDT and the transportation network, and facilitate equitable participation in MDT programs and services.

MDT's asset investment strategies were developed in consideration of various funding scenarios, short-term condition goals and targets, and long-range policy direction consistent with achieving or making progress toward the desired SOGR. The strategies and resulting funding allocation decisions are supported by processes and data analysis that consider existing conditions, rates of deterioration, risks, and projected revenues to achieve the optimal investment with the limited resources available.

9.2 Federal Requirements

FHWA requires states to include investment strategies as part of the asset management plan. Investment strategies are defined as:

> *"A set of strategies that result from evaluating various levels of funding to achieve State DOT targets for asset condition and system performance effectiveness at a minimum practicable cost while managing risk."*

The asset management plan describes how the investment strategies will collectively make or support progress toward achieving or sustaining an SOGR over the life cycle of the assets, improve or preserve the condition of the NHS assets, achieve the state's 2-year and 4-year targets for the condition of the NHS assets, and the process for developing the investment strategies.

9.3 MDT Strategies

The following strategies provide high-level investment direction based on TranPlanMT policy guidance, supported by Department processes and procedures, and provide MDT's investment vision to preserve and protect the state and federal investment in Montana's highway system.

When developing each of these investment strategies, MDT considered the life cycle planning analysis, financial planning, risk analysis, SOGR, and performance targets. Considerations:

- **Life cycle planning and gap analysis** — The performance gap analysis, supported by life cycle planning, establishes the scope and scale of future investment needed to optimize asset conditions while minimizing costs.
- **Future funding** — Identifies the resources available to address those investment needs identified in the gap analysis/life cycle plan and determines if condition optimization is possible. Generally, needs outpace available resources, so funding is a constraining factor in achieving the desired SOGR.
- **Risk assessment** — Risk introduces an additional variable that may pull available funding away from identified needs, further reducing the ability to achieve performance targets and/or the desired SOGR. As described in the risk register, MDT has taken steps to mitigate the negative impact of risk to the program.
- **State of good repair** — MDT's SOGR is based on the gap/life cycle planning recommendations to optimize performance at the least cost with consideration of public and stakeholder input through the policies established in TranPlanMT.
- **Performance targets** — Targets are reasonable and achievable levels of performance considering the gap/life cycle planning recommendations, future funding available for asset investment, and an assessment of the risks that may negatively affect system condition and performance.

9.4 Investment Scenarios

- **Right Treatment at the Right Time** — TranPlanMT goals related to investments emphasize making the right treatment at the right time and focus on preventative and rehabilitative efforts to cost effectively manage existing infrastructure in order to avoid expensive deferred maintenance. This approach enables prudent use of taxpayers' funding by slowing deterioration rates and extending the life of infrastructure.
- **Preservation**
  - MDT has a long history of focusing on preserving and maintaining the existing infrastructure. To ensure that preservation activities do not compete with capital construction projects, MDT established funding program set asides to be used on pavement preservation projects. These set asides also benefit bridge condition. If there are bridges in the pavement preservation project limits, MDT will also perform bridge preservation activities.
  - MDT is taking advantage of more flexible bridge program eligibilities (provided in recent Reauthorization Acts) that allow for an increased focus on preservation activities.
- **Targeted Assets** — Coupled with preservation activities, MDT will also target certain asset categories for increased investment to address current condition deficiencies and to mitigate risks. For example, MDT is directing NHFP funds to address bridge condition for freight reliability.

These investment practices allow MDT to protect the existing investment in pavement and bridge condition, to provide for an extended service life of assets - which delays the need for expensive reconstruction projects, and to make additional targeted investments to improve asset conditions and mitigate risk.

Through these strategies, continuing the focus on pavement preservation and increasing efforts on bridge preservation, MDT expects to continue to make progress toward achieving the state's pavement and bridge condition performance targets and SOGR. This will collectively support MDT's continued progress toward, and achievement of, meeting the national performance goals (originally established by MAP-21) for minimum pavement condition on the Interstate and structurally deficient deck area of NHS bridges.

10 FUTURE TAMP ENHANCEMENTS

MDT recognizes that condition, performance, and process gaps exist related to risk-based asset management. A comprehensive gap assessment was performed during TAMP development. Potential enhancements to strengthen MDT asset management practices were identified.

10.1 Data and Process Gaps

MDT continues to collect and analyze infrastructure condition data for making optimal investment and improvement decisions in terms that make good sense for Montana. While developing the TAMP and establishing national performance targets, MDT staff uncovered several gaps related to data and analysis capabilities.

The recent federal rulemaking (for asset management and performance management) advanced methodologies that differ from those historically utilized by MDT. This presented a gap in that past practices and previous data couldn't necessarily be used to generate trend information for expected performance – particularly for the new national performance metrics. Specific to HPMS, these types of changes precluded the use of past submittals in the development of future performance projections.

Additionally, MDT's existing bridge and pavement management systems needed enhanced functionality to address new data-gathering requirements, additional scenario analysis capabilities (needed for new performance metrics), and enhanced system evaluation tools - necessary for performing investment optimization analysis calculations and predictive modeling operations.

MDT is addressing the data/process gaps as follows:

- **Enhancing the Pavement Management System** — PvMS recommends treatments based on an optimization approach using pavement ride quality. MDT is currently working to improve cracking analysis, modeling, and reporting capabilities. MDT is investigating how to combine the guidance reporting elements of pavement performance in PvMS and capture the combined measures in future condition scenarios.

- **Implementing Bridge Management System Upgrades** — MDT's Bridge Management staff is in the process of implementing AASHTOWare BrM as the operating platform for its Structure Management System (SMS). The operating platform supports bridge management decision-making capabilities which includes the following:
  - Forecasting bridge deterioration;
  - Evaluating life cycle costs;
  - Identifying short-term and long-term budget needs; and
  - Recommending optimal work strategies and implementation schedules.

10.2 Process Gaps

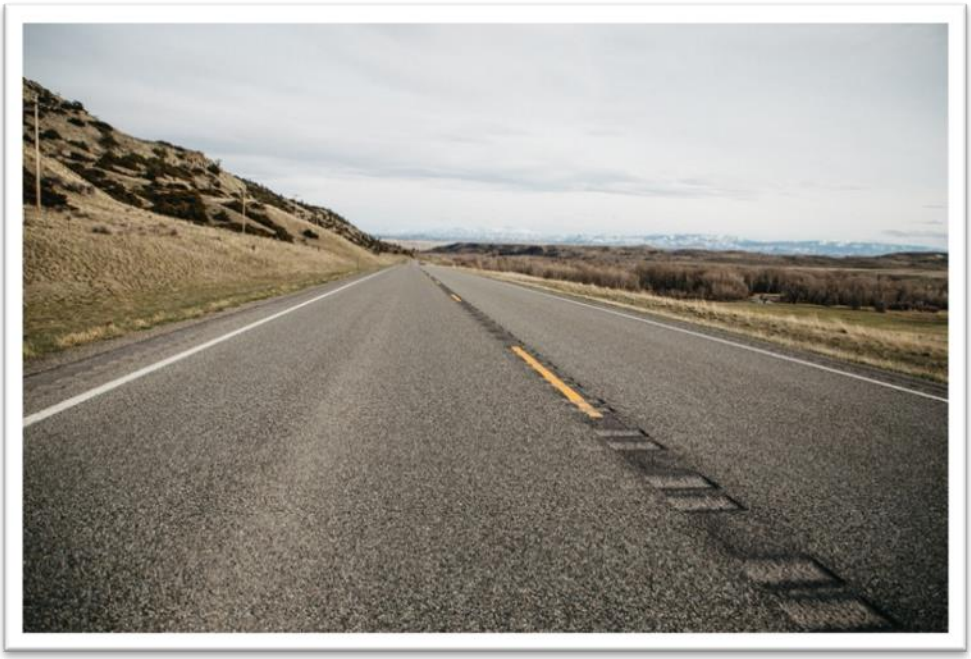
MDT staff completed the self-assessment survey from Volume I of the *AASHTO Asset Management Guide* to help assess MDT in terms of state-of-the-art asset management practices. MDT managers participated in interviews regarding existing practices and potential opportunities for improvement. MDT staff also participated in a self-assessment workshop that provided insights and established consensus on priorities for improvement.

Based on this input, priorities for enhancing the asset management program include:

- **Clarifying Alignment between Px3 and the 5-year Tentative Construction Program (TCP)** — This initiative addresses the perceived disconnect between the program-level funding decisions made during Px3 and the final allocation of funds in the TCP. MDT addressed this issue by:
  - Further documenting the TCP development process;
  - Clarifying the impact of transfers between programs and how District-specific factors may impede the agency's ability to meet the goals, objectives, and targets established through Px3; and
  - Further documenting the process that verifies the TCP is consistent with Px3 recommendations.
- **Improving Coordination Between Maintenance and Capital Activities** — This initiative was aimed at taking a comprehensive view of potential asset treatments and minimizing budget and organizational constraints for implementation. The initiative involves:
  - Identifying strategies for effectively managing pavements throughout the pavement life;
  - Determining the most efficient way to implement each strategy - such as using Maintenance forces versus a capital project or internal staff versus contractor staff; and
  - Pursing funding to ensure that the MDT Maintenance program has the training, equipment, staffing capacity and other resources necessary to implement such strategies.
- **Developing a Transportation Asset Management Information System (TAMIS)** — MDT is making advancements in data and information systems to support asset management decisions. A TAMIS is a set of software and business processes that help turn data from multiple systems into useable information. A TAMIS can help ensure that MDT implements future systems and system updates that maximize the ability to support asset management. Potential elements of a TAMIS include:
  - An enterprise data dictionary that defines core data items;
  - A data governance plan that identifies responsibility for collecting and managing core data items, defines a source of record for each item, and documents a data quality assurance/quality control process;
  - Linear Referencing System standards that enable data from multiple systems to be integrated efficiently via Geographic Information System;
  - Dashboards, mapping systems, and other applications that enable staff to quickly query and obtain data from multiple sources; and

- A system architecture that illustrates how core systems currently interact and provides a vision for future interaction.

- **Addressing Additional Assets in the Asset Management Program** — MDT's initial asset management focus is on bridges and pavements. Longer term, MDT will work to develop formal asset management programs for other assets. In determining priorities for additional assets, MDT will:
  - Assess the relative risk for asset groups;
  - Assess the degree to proactively mitigate the risk of failure;
  - Estimate the costs of implementing and sustaining each asset management element; and
  - Compare implementation costs to asset failure costs and determine elements, if any, to implement.



11 ASSET MANAGEMENT & THE IIJA

The Infrastructure Investment and Jobs Act (IIJA) was signed into law by President Joe Biden on November 15, 2021 – thus ushering in a new round of federal requirements related to transportation asset management plans (TAMPs). Although most TAMP provisions remain unchanged, there were two new emphasis areas added via the IIJA: extreme weather and resilience. States are now required to take extreme weather and resilience into consideration when performing lifecycle cost and risk management analyses. The potential impact of these requirements (on MDT programs) is discussed below.

11.1 Extreme Weather Events

In Chapter 7, extreme weather events were specifically evaluated (within MDT's risk assessment process) and the overall risk associated with these types of events was determined to be medium-low to medium. Generally speaking, Montana doesn't see the frequency or severity of weather events that other portions of the United States may experience. Montana isn't affected by hurricanes and rarely sees significant rainfall events. In fact, Montana routinely appears on the list of states that are least likely to be affected by extreme weather events.

With that said, Montana does experience weather events (floods, winter storms, fires, etc.) – but these events rarely lead to significant or repeated damage to National Highway System assets. As noted in Section 7.2.1 of this document, no National Highway System segment has ever experienced repeated damage from emergency events. Consequently, the life-cycle cost to NHS assets from extreme weather events is minimal and these types of events (by themselves) don't require MDT to modify our TAMP business processes.

11.2 NHS Assets & Resilience

Although MDT is rarely impacted by extreme weather events, the resiliency of NHS assets can be tested by more routine events – such as minor flooding, freeze-thaw cycles and traffic loads. When considering resilience, MDT evaluates the vulnerabilities associated with corridors, project segments and even material components.

At the corridor level, MDT utilizes management system information, planning information (documents, plans, studies, etc.), engineering studies, and other data sources to identify opportunities for improving the resiliency of NHS assets. On the Interstate System, no widespread vulnerabilities have been identified – although some pavement segments have shown a tendency to degrade more rapidly than others due to local environmental conditions.

For example, it has proven difficult to maintain the existing asphalt surfacing material on certain segments of the I-90 corridor near Lookout Pass – so MDT has chosen to utilize concrete surfacing materials at these locations – which increases the resiliency of these segments (and the entire I-90 corridor).

Similar to the Interstate System, no widespread vulnerabilities have been identified on Non-Interstate NHS routes. However, enhanced surfacing materials have been advanced in locations with harsher local environmental conditions and/or higher traffic loads.

It should be noted that every MDT project gives careful consideration to advancing the best possible surfacing alternative as projects are being developed. The “right treatment at the right time” is perhaps one of the most critical components of MDT’s approach to promoting resiliency for NHS assets.

For NHS bridges, MDT has initiated (and completed) engineering studies to evaluate the risks associated with scour, seismic activity and bridge component materials. In some instances, the analysis has led to specific NHS bridge projects to replace or rehabilitate structures. In all cases, the analysis has improved MDT’s project development processes by including design features that enhance the resiliency of individual structures (and the entire NHS network).

11.3 Funding for NHS Assets under IIJA

As noted earlier, MDT’s primary source of federal funding for NHS assets is the National Highway Performance Program (NHPP). Under the IIJA, this program is expected to grow by 17.3% in FFY 2022 and 2.0% annually from FFY 2023 to FFY 2026. Additional potential sources of IIJA funding (for NHS Assets) include the National Highway Freight Program (NHFP), the Bridge Formula Program (BFP), and the PROTECT Formula Program. State funding for NHS assets is limited to the State Highway Special Revenue (SHSR) account – which is utilized for non-federal match.

The increase in available federal funding (for NHS assets) is timely for the State of Montana – since MDT expects to see a significant increase in highway construction costs in the next few years. As of this writing, it appears that federal funding increases will offset expected inflation – but MDT will need to remain vigilant on this front. Funding levels in this TAMP document will be evaluated (annually) to determine whether proposed funding is adequate to ensure continued progress toward achieving TAMP performance goals.

As for state funds, it is expected that the total state contribution for non-federal match will continue to rise annually. Additionally, it is expected that state match amounts for discretionary grants will rise annually as well. Moving forward, it will be essential that MDT strike a balance between competing SHSR needs in order to continue to ensure non-federal match will be available through the IIJA and beyond.

Acronyms

AID	Accelerated Innovation Deployment
ACI	Alligator Crack Index
ADCV	Automated Data Collection Vehicles
BFP	Bridge Formula Program
CMAQ	Congestion Mitigation and Air Quality
ER	Emergency Relief
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FMIS	Financial Management Information System
FAST Act	Fixing America's Surface Transportation Act
GASB-34	Government Accounting Standards Board Statement No. 34
HAR	Highway Advisory Radio
HPMS	Highway Performance Monitoring System
HSIP	Highway Safety Improvement Program
IIJA	Infrastructure Investment and Jobs Act
ISD	Information Services
IRI	International Roughness Index
LCCA	Life Cycle Cost Analysis
LCP	Life Cycle Plan
MPO	Metropolitan Planning Organization
MCI	Miscellaneous Crack Index
CHSP	Montana Comprehensive Highway Safety Plan
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act
MAP-21	Moving Ahead for Progress in the 21st Century Act
NBE	National Bridge Element
NBI	National Bridge Inventory
NBIS	National Bridge Inspection Standards
NEPA	National Environmental Policy Act
NHFP	National Highway Freight Program
NHPP	National Highway Performance Program
NHS	National Highway System
PvMS	Pavement Management System
Px3	Performance Programming Process
RI	Ride Index
RWIS	Road Weather Information Systems
SHSR	State Highway Special Revenue
SOGR	State of Good Repair
STIP	Statewide Transportation Improvement Program
SD	Structurally Deficient
SMS	Structure Management System
TCP	Tentative Construction Program
TAMIS	Transportation Asset Management Information System
TAMP	Transportation Asset Management Plan
TMP	Transportation Management Plan

APPENDIX A — DATA QUALITY PLAN