TAMP

Transportation Asset Management Plan

Alaska Department of Transportation & Public Facilities

DECEMBER 2022

ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

TRANSPORTATION ASSET MANAGEMENT PLAN

DECEMBER 2022

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Message from the Commissioner

The Alaska Department of Transportation and Public Facilities (DOT&PF) manages a diverse range of transportation assets and facilities in the largest State in the nation. A sound transportation system is critical to Alaska's economy and communities. DOT&PF, as the state transportation authority designated to plan, construct, maintain, and operate the system, utilizes asset management principles to improve performance, raise customer satisfaction, and minimize cost. These principles are applied to optimize life-cycle planning and overall performance of Alaska's transportation assets.

The Bipartisan Infrastructure Law enacted in 2021 provides funding resources to assist Alaska in maintaining its assets in a state of good repair. Transportation asset management links planning and programming through data informed analysis of funding, desired outcomes, risk, and resilience to provide a strategic investment plan for managing Alaska's transportation infrastructure. This systematic, data-driven, transparent approach supports our mission, our goals, and ultimately the Alaskans that rely on well-maintained transportation infrastructure.

This report is Alaska's second Transportation Asset Management Plan (TAMP). We are excited to continue learning and improving in asset management practices. We believe that a focus to enhance and expand our asset management program will assist us in our mission, to keep Alaska moving through service and infrastructure.

This TAMP tells our story.

I approve this Transportation Asset Management Plan for the State of Alaska, Department of Transportation & Public Facilities.

Ryan Anderson, P.E.
Commissioner

12/22/22
Date

Executive Summary

This risk-based, Transportation Asset Management Plan (TAMP) is one of a series of state plans required by federal rulemaking to achieve the Nation's transportation goals. Transportation Asset Management (TAM) keeps Alaska moving through service and infrastructure by making good infrastructure cost less. TAM provides a long term, systematic approach to cost-effectively sustain Alaska's infrastructure. The TAMP provides a 10-year financial plan that provides the connection between the Long-Range Transportation Plan (LRTP), which covers a span of more than 20 years, and the State Transportation Improvement Program (STIP), with its scope of 4 years.

TAM supports the overall Department vision by strengthening the efficiency and effectiveness of the Alaska Department of Transportation and Public Facilities (DOT&PF) at planning, designing, constructing, operating, and maintaining transportation systems. This vision strengthens transparency and accountability while encouraging innovation and quality of services.

The TAMP includes National Highway System (NHS) bridges and pavements only. As of July 2021, Alaska has 1,080 miles of Interstate and 1,148 miles of non-Interstate roads including 326 miles of unpaved non-Interstate NHS, which represents the nation's only gravel roadways on the NHS. All but twenty-two miles of the NHS are owned and operated by DOT&PF. The remainder are managed by local agencies. Alaska has 425 bridges on the NHS, with five of these bridges owned by other local agency entities and three by Anchorage International Airport. The Department is confident that these eight bridges and 22 miles of NHS pavement will not affect the overall state target or national goals.

States are required by 23 CFR 490.105 to set pavement condition targets for the NHS that include its Interstate and non-Interstate inventory. Alaska's targets for the next four year performance period for Interstate pavement are 5 percent *Poor* and 20 percent *Good*; for non-Interstate NHS, the targets are 10 percent *Poor* and 15 percent *Good*. For bridges, the targets are 10 percent *Poor* and 40 percent *Good*. The cost to keep Alaska's infrastructure in a state of good repair meeting those targets is estimated at an average of **$208 million annually** over the next 10 years. This does **not** include funding needs for mobility, safety, reconstruction, and economic development projects.

DOT&PF staff will lead the coordination with Alaska's two Metropolitan Planning Organizations (MPOs) to evaluate the performance targets the MPOs plan to use for NHS pavements and bridges and to incorporate these targets into their transportation plans. DOT&PF staff will continue to enhance the process for prioritization of projects for the NHS system to help meet these targets.

One of the greatest risks identified is inadequate funding to preserve DOT&PF's assets in a state of good repair while building new facilities, modernizing existing ones, and supporting the ferry system. Additional risks include seismic activity, flooding, coastal erosion, permafrost, and aufeis impacts.

This is DOT&PF's second TAMP with all federally required elements. In the time since the previous TAMP was submitted in 2019, the Department has gained significant knowledge and experience with performance management and asset management. The Department intends to continue refining its practices with pavement and bridge assets as well as expanding this approach to include other asset classes in the future.

1 Introduction

The purpose of this Transportation Asset Management Plan (TAMP) is to describe how the Alaska Department of Transportation and Public Facilities (DOT&PF) will manage the National Highway System (NHS) roads and bridges in a state of good repair (SOGR) by achieving national goals and state-set targets while managing risks in a financially responsible manner. This plan documents the development of a long-term systematic approach for sustaining the NHS pavements and bridges owned and maintained by DOT&PF. Transportation Asset Management (TAM) is a cost-effective program of continuous, collaborative processes to "Keep Alaska Moving Through Service and Infrastructure" by making good infrastructure cost less.

The TAMP is one of a series of state plans required by federal rulemaking to achieve the Nation's transportation goals. In addition to this TAMP, state DOTs are required to develop plans for highway safety, freight, and congestion. Alaska's Strategic Highway Safety Plan was completed and approved on February 28, 2019. Alaska's Highway Safety Improvement Program handbook was updated in April 2022. Alaska's Freight Plan was completed in December 2017 and is currently being updated. Regulations do not require that Alaska have a congestion plan at this time. All these plans will influence the DOT&PF's Long-Range Transportation Plan (LRTP) and the short-term State Transportation Improvement Program (STIP).

The TAMP identifies DOT&PF's asset management practices and methods for assessing current asset conditions and analyzing future conditions. Using a risk-based approach, DOT&PF performed a life-cycle planning analysis for each asset class and a gap analysis between the desired SOGR and available funding. Finally, these steps define the Department's investment strategies for meeting the demands of ensuring the successful management of Alaska's transportation assets.

The DOT&PF's mission and vision for TAM is to support Alaska's surface transportation program through the streamlined and performance-based surface transportation program that was established in 2012 in the Moving Ahead for Progress in the 21st Century (MAP-21) Act. The mission and vision established in this program has continued and enhanced in each long-term federal transportation bill since.

1.1 ASSET MANAGEMENT MISSION, VISION AND GOALS

DOT&PF will manage highway assets using its asset management mission, vision, and goals. In this section, the TAM mission, vision, and its respective goals are described, including a detailed discussion of pavement and bridge assets. Keeping with the DOT&PF's TAM motto, "Start simple, grow smart, and show continuous improvement," only the required NHS bridges and pavement assets are included.

> The term "asset management" means a strategic and systematic process of operating, maintaining and improving physical assets, with the focus of both engineering and economic analysis based on quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the life cycle of the assets at a minimum practical cost [23 USC, Sec. 101(a)(2)].

Mission: TAM keeps Alaska moving through service and infrastructure by making good infrastructure cost less.

Vision: TAM provides a long term, systematic approach to cost-effectively sustain Alaska's infrastructure.

TAM supports the overall "One DOT&PF" vision by strengthening its efficiency and effectiveness at planning, designing, constructing, operating, and maintaining all modes of transportation by strengthening transparency and accountability and encouraging innovation and quality of service.

TAM depends on quality data for informed decision-making to keep infrastructure in a SOGR over the life cycle of the asset.

The principles and goals by which DOT&PF supports the Department's mission are provided.

Principles

- Integration of information systems—using a common language
- Informed decision-making
- Simple, achievable goals
- Measurement of what matters

Goals

- **Goal #1: Predictive Models to "Tell the Future"**—TAM promotes performance of state-owned transportation assets and facilities through performance metrics, risk management, and evaluation of progress. Historical data is collected and analyzed to predict the future condition.
- **Goal #2: Wise Investment Resources**—TAM provides for better access to quality data to support sound investment decisions across all

Considering Resilience in Asset Management Plans

In 2021, Congress passed the Bipartisan Infrastructure Law (BIL) which expanded federal funding and requirements related to resiliency planning and transportation asset management. The BIL requires each state DOT to consider resilience and extreme weather events within their life-cycle planning and risk management practices (23 USC 119(e)(4)(D)). Prior to this requirement DOT&PF had proactively incorporated resiliency planning into its asset management policies over the past several years. This TAMP addresses the new BIL requirements in the following ways.

- Vulnerabilities, such as scour and seismic risk, are considered to determine the appropriate life-cycle strategy for each bridge (Section 3.4.5).
- The influence of risk management and life-cycle planning on DOT&PF's investment strategies is described throughout Sections 5-1 and 5-2.
- DOT&PF uses a subgrade stability index to identify areas of unstable permafrost and determine the most appropriate life-cycle strategy for those locations (Appendix C).
- Life-cycle planning models are divided among five different regions, which allows DOT&PF to properly consider varying effects of storm frequencies and intensity, sea level rise, flooding, and melting/warming permafrost among several other climatological factors (Appendix F).
- The development processes and discussions incorporating extreme weather and resilience within the life-cycle planning section are described in Appendix F.
- DOT&PF manages risks due to seismic activity and flooding through two bridge funding programs: one targeting seismic retrofits, and another targeting scour critical bridges. Both are funded with $950,000 annually (Appendix G).
- The development processes and discussions incorporating extreme weather and resilience within the risk management section are described in Appendix G.

phases of transportation activity and all modes of transportation.

- **Goal #3: A Long-Term Comprehensive Network that Generates Actionable Information**—TAM will support One DOT&PF by maintaining strong, healthy communications internally and externally. TAM supports collaboration through the TAM structure and provides information for stakeholders and decision-makers. System integration is essential to combine data from disparate business systems into information to support decisions.
- **Goal #4: Credibility**—TAM will maximize the impact of every public dollar spent and will serve the needs of Alaskans through the National Performance Measures.
- **Goal #5: Transparency**—TAM will improve transparency by making information readily available and accessible for stakeholders and decision makers. TAM holds DOT&PF accountable through monitoring performance metrics and evaluating progress. TAM supports innovation through alternatives analysis and trade-off analysis.

1.2 FEDERAL REQUIREMENTS

The federal Asset Management Plan regulation (23 CFR 515) requires the Federal Highway Administration (FHWA) to conduct an annual consistency review no later than July 31 of each year to determine whether the state DOT has developed and implemented an asset management plan consistent with the federal rules. If it is determined that the state has not met the federal TAMP requirements, federal project funding will be reduced from the typical ninety percent not to exceed sixty-five percent. Additionally, if a state DOT has not established bridge and pavement targets on the NHS consistent with the National Performance Management Measures (23 CFR 490), FHWA will not approve any further projects using National Highway Performance Program (NHPP) funding.

The National Performance Management Measures legislation (23 CFR 490) requires states to establish targets for bridge and pavement asset conditions and report progress toward those targets. It also requires FHWA to assess biennially whether each state is showing significant progress in achieving the targets the state has established for the NHPP. State progress would be considered significant if the actual condition is equal to or better than the established target or better than the baseline condition.

Failure to meet the minimum Interstate pavement and NHS bridge conditions results in penalties, as described in 23 CFR 490.317(e) for pavement and 490.413(a) for bridge, which are summarized below.

For pavement condition, failure to meet the minimum Interstate condition level for two consecutive calendar years would subject a state to the following penalties:

- The state must obligate NHPP funds in an amount at least equal to the state's federal fiscal year (FFY) 2009 Interstate Maintenance apportionment of $31.7M. For each year after FFY 2013, the amount required to be obligated must increase by two percent over the amount required to be obligated in the previous federal fiscal year.
- The state must transfer Surface Transportation Program (STP) funds that are not sub-allocated based on population to the NHPP in an amount equal to ten percent of the amount of the state's FFY 2009 Interstate Maintenance apportionment, estimated at $3.17 million.

For bridge condition, failure to meet the minimum condition level for NHS bridges for three consecutive calendar years would subject a state to the following penalties:

- The state must obligate and set aside an amount equal to fifty percent of funds apportioned to the state for fiscal year 2009, estimated at $13,753,843 only for eligible projects on bridges on the NHS. The requirements will remain until less than ten percent of the bridges in the state on the NHS, by deck area, have been classified as Structurally Deficient.

1.3 TAM ORGANIZATIONAL STRUCTURE

The TAM Leadership Structure, as shown in figure 1-1, describes how TAM is organized within the DOT&PF. Appendix A further details this structure, coordination with FHWA, the Metropolitan Planning Organizations (MPOs), and the TAMP development for DOT&PF.

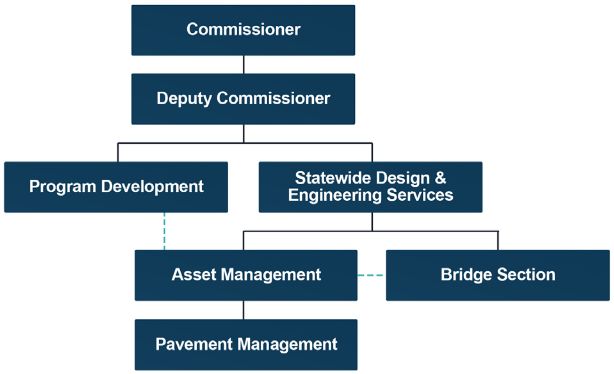


Figure 1-1. TAM organizational structure.

The TAMP provides a 10-year financial plan that describes the connection between the LRTP, which covers more than 20 years, and the STIP. Alaska's STIP currently provides 10 years of programming, but is only required to cover a 4-year period (23 CFR 450.218(a)). Figure 1-2 illustrates the connection between LRTP and STIP.

DOT&PF coordinated with MPOs during the development of the TAMP. The basis for this coordination was established via a Memorandum of Understanding (MOU) signed in 2018 between DOT&PF and the Anchorage Metropolitan Area Transportation Solutions and FAST Planning (formerly Fairbanks Metropolitan Area Transportation System). The MOU outlines data sharing, selection of performance targets and collection of data. Meetings were organized to provide an opportunity to comment on the draft TAMP and to provide condition data for pavement and bridges on the NHS system.

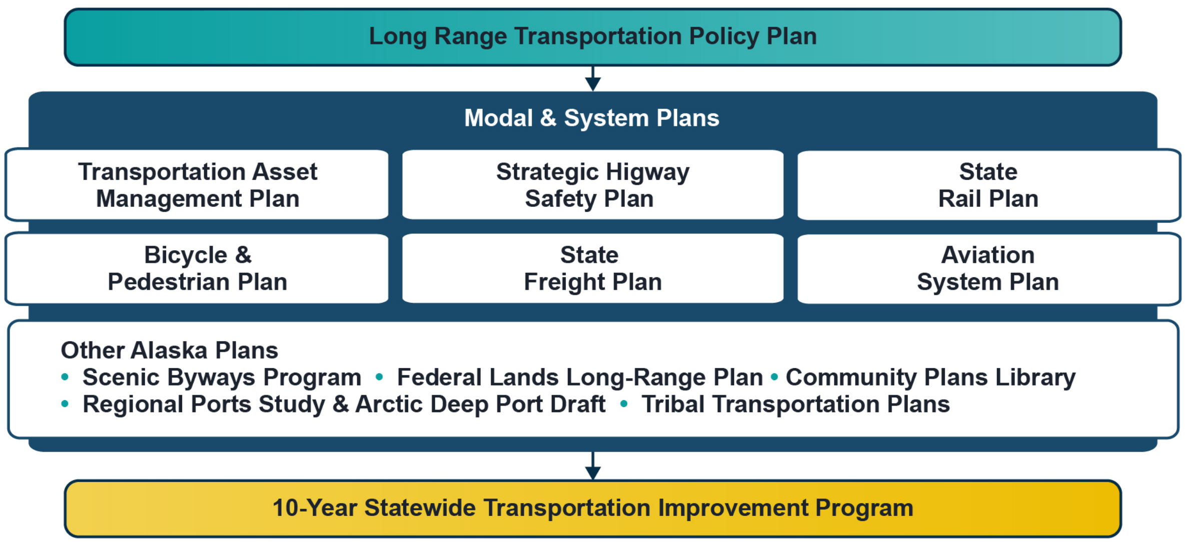


Figure 1-2. Connection between LRTP and STIP.

1.4 FEDERAL PERFORMANCE MANAGEMENT

The FHWA implemented Transportation Performance Management (TPM), which is a strategic approach that uses system information to make investment and policy decisions to achieve national performance goals. The application of the TPM approach ensures that investments are performance-driven and outcome based. See Appendix B for more information on Performance Management and state targets.

TPM encompasses the following national goal areas:

- Infrastructure Condition (National Highway System Bridges and Pavements)
- Congestion Reduction
- Safety
- Environmental Sustainability
- System Reliability
- Freight Movement and Economic Vitality
- Reduced Project Delivery Delays

States are required to set targets for performance in these performance areas. Only the infrastructure performance area carries a penalty for not making progress toward established targets, as described in the Penalties and Reporting section above.

1.4.1 National Goals for Pavement and Bridges

23 CFR 490.315(b) requires that the percentage of pavement rated as ***Poor* on Alaska's Interstate system not exceed 10 percent**. With a current condition of 0.9% of the Interstate system in *Poor*

condition, the State of Alaska continues to meet the 90 percent *Fair* or better national goal.

23 CFR 490.411(a) requires that the state maintain bridges so that the percentage of **bridges classified as structurally deficient does not exceed 10 percent, by deck area**.

From 2017 to 2021 the percentage of deficient bridges, by deck area, improved from 6.5 percent deficient to 5.7 percent, a trend of -0.2 percent annually. The State of Alaska meets the national goal of less than ten percent of bridge deck area in *Poor* condition.

1.4.2 Infrastructure Targets

23 CFR 490.105 requires that performance targets be set for both Interstate and non-Interstate NHS. Tables 1-1 and 1-2 present the performance targets established for NHS pavements and bridges for the second performance period which began on January 1, 2022 and will end on December 31, 2025. The percentage *Good* and percentage *Poor* targets for pavement and bridge condition were based on historical performance data.

DOT&PF has set declining targets for both pavements and bridges. These targets are equal to the desired state of good repair (DSOGR), which means the DOT&PF is not seeking to achieve better conditions than these targets. Since current conditions do exceed the targets, the DOT&PF's objective is to manage the system to sustain conditions above the targets indefinitely. This approach is reflective of the Department's need to balance competing demands for limited resources.

DOT&PF coordinated with MPOs during the development of the TAMP and target setting activities. Meetings were organized to review pavement and bridge data on the NHS system and to review current and proposed targets for the second performance period. DOT&PF targets can be seen on the Department's asset management website as well as FHWA's TPM Dashboard.

Although the target for the percentage of bridges in *Poor* condition is 10 percent, Alaska will strive to keep *Poor* bridges below 7.5 percent. This provides a buffer for additional deterioration as improvements are designed and programmed, since bridges are complex structures and require time for project development and design.

These targets will be the DSOGR for NHS bridge and pavement assets for the entire 10-year performance period 2022 to 2031.

1.4.3 Other Federally Required Performance Measures

Federal performance management legislation also requires states to set targets for the following programs:

- Safety Performance Measures
- Congestion Mitigation Air Quality Improvement Program (CMAQ)
- Travel Time Reliability
- Freight Movement

These additional targets and measures are discussed in detail in Appendix B.

Table 1-1. Performance targets for Interstate and non-Interstate NHS pavements.

Performance Measures	*2-year Target*	*4-year Target*	*10-year SOGR Target*
Poor Pavement Condition on the Interstate	5%	5%	5%
Good Pavement Condition on the Interstate	20%	20%	20%
Poor Pavement Condition on the NHS (excluding the Interstate)	10%	10%	10%
Good Pavement Condition on the NHS (excluding the Interstate)	15%	15%	15%

Table 1-2. Performance Targets for NHS Bridges.

Performance Measures	*2-year Target*	*4-year Target*	*10-year SOGR Ceiling*
Poor Condition of Bridges on the NHS (by area)	10%	10%	10%
Good Condition of Bridges on the NHS (by area)	40%	40%	40%

2 Pavement and Bridge Assets

The following section summarizes only those pavement and bridge assets that are on the NHS. All Alaska roads and bridges are important to consider for overall management of the transportation system, but for the purposes of the TAMP, the focus is only those on the NHS. More detailed information on DOT&PF's pavement and bridge assets and asset management processes is included in Appendix C for pavement and Appendix D for bridge.

2.1 NHS PAVEMENT INVENTORY

Table 2-1 summarizes Alaska's Interstate and non-Interstate NHS centerline miles based on data collected in 2021.

Table 2-1. Alaska's Interstate and non-Interstate NHS in centerline miles.

Facility Type	*Centerline Miles*
Interstate	1080.2
Non-Interstate NHS (paved)	822.4
Non-Interstate NHS (unpaved)	326.1
Total	**2228.4**

The entire 1080.2 miles of Interstate is owned and operated by DOT&PF. Of the 1148.5 miles of non-Interstate NHS, 21.8 miles are owned and operated by entities other than DOT&PF with 20.4 miles being owned and operated by the Municipality of Anchorage (MOA). The remaining 1.4 miles are intermodal links between the state highway system and a ferry, port, or airport.

2.2 PAVEMENT DATA COLLECTION

Pavement condition data is collected annually on the Interstate system by a third-party contractor. Although non-Interstate NHS data is only required to be collected every 2 years, DOT&PF's contractor collects all segments annually. Pavement condition data is collected using an automated/semi-automated method. A profiler equipped with a laser crack measurement system (LCMS), consisting of cameras and lasers, collects 3D profiles and images that are used for crack detection and to establish transverse profiles for calculations of rut depth. The profiler is certified (AASHTO R56) for data collection to establish longitudinal profiles to calculate the International Roughness Index (IRI). Patching and raveling data is also collected, although not required for reporting. Data is collected and reported to FHWA in 0.1-mile increments annually and is also loaded into the PMS. Faulting data is not collected and reported as DOT&PF does not have any Portland cement concrete roadways.

The only unpaved NHS mileage in the country is located on Alaska's Dalton Highway, which is the gravel haul road to the North Slope. This road required the data collection contractor to build a new 4x4 data collection vehicle to be able to safely navigate portions of the road through unstable permafrost.

Pavement data collection presents unique challenges in Alaska as 130 miles of NHS roadway is located on the Panhandle or on Kodiak Island. This requires the road profiler to be ferried from island to island to complete the condition assessment on the NHS. The collection season in Alaska is limited to between May and September due to seasonal rains and winter conditions.

The state collects pavement condition and other federally required Highway Performance Monitoring System data elements for the entire NHS regardless of ownerships and therefore does not require any special agreements to be put in place for data collection to comply with 23 CFR 515.7(f). DOT&PF and MPOs developed a memorandum of understanding (MOU) and a Performance Measure Target Setting Procedures document to guide coordination between the two entities related to sharing data, setting targets, and selecting projects in support of targets. DOT&PF will continue to coordinate with the Municipality of Anchorage, as needed, and notes that at only one percent of the overall system, the non-DOT&PF owned NHS is unlikely to affect national goals and state targets.

2.3 PAVEMENT CONDITION

The federal performance measures use the following metrics for asphalt pavements: IRI, cracking, and rutting. Figure 2-1 below shows examples of each of these metrics.

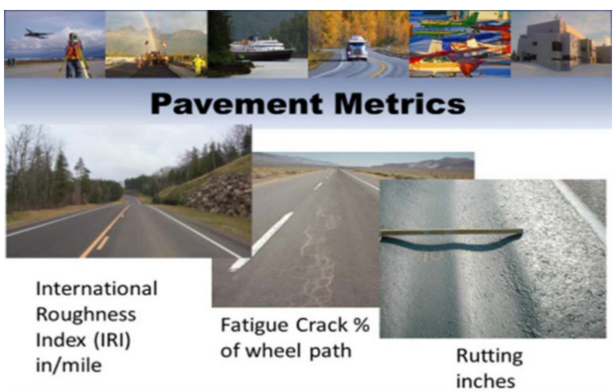


Figure 2-1. Federal pavement condition metrics for asphalt pavements.

Table 2-2 below outlines the values for each metric as *Good*, *Fair*, and *Poor*. Table 2-3 shows how to combine the three metrics to define an overall condition for each HPMS section (~0.1 miles).

Table 2-2. Pavement metrics thresholds.

Rating	IRI (in/mile)	% Cracking	Rutting (in)
Good	<95	<5%	<0.2
Fair	95-170	5-20%	0.2-0.4
Poor	>170	>20%	>0.40

Table 2-3. Pavement condition for HPMS section.

Segment Rating	Metric Ratings (International Roughness Index [IRI], Cracking, Rutting)
Good	All three metrics are *Good*
Poor	Two or more metrics are rated *Poor*
Fair	All other combinations

The final federal rule allows, but does not require, the use of Present Serviceability Rating (PSR) for roads with posted speeds less than 40 mph. This calculation does not include IRI. The State of Alaska is not using PSR at this time on the NHS.

Pavement condition data collected in 2021 and submitted to FHWA in 2022 represents the most current condition data. Figure 2-2 below shows Alaska's 2021 Interstate overall pavement condition with 0.9 percent of the Interstate network in *Poor* condition, 69.0 percent in *Fair* condition, and 30.1 percent in *Good* condition. Figure 2-3 shows historic Interstate conditions.

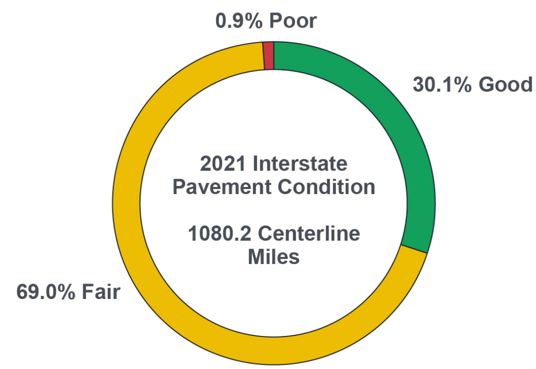


Figure 2-2. Alaska's 2021 Interstate pavement condition.

Alaska has 1,148.5 centerline miles of non-Interstate NHS based on 2021 inventory data. Most of these miles (822.4 miles) are paved. Figure 2-4 shows Alaska's non-Interstate NHS pavement condition in 2021 with 7.6 percent of the non-Interstate NHS in *Poor* condition, 67.0 percent in *Fair* condition, and 25.4 percent in *Good* condition. Figure 2-5 shows historic conditions for non-Interstate NHS pavements.

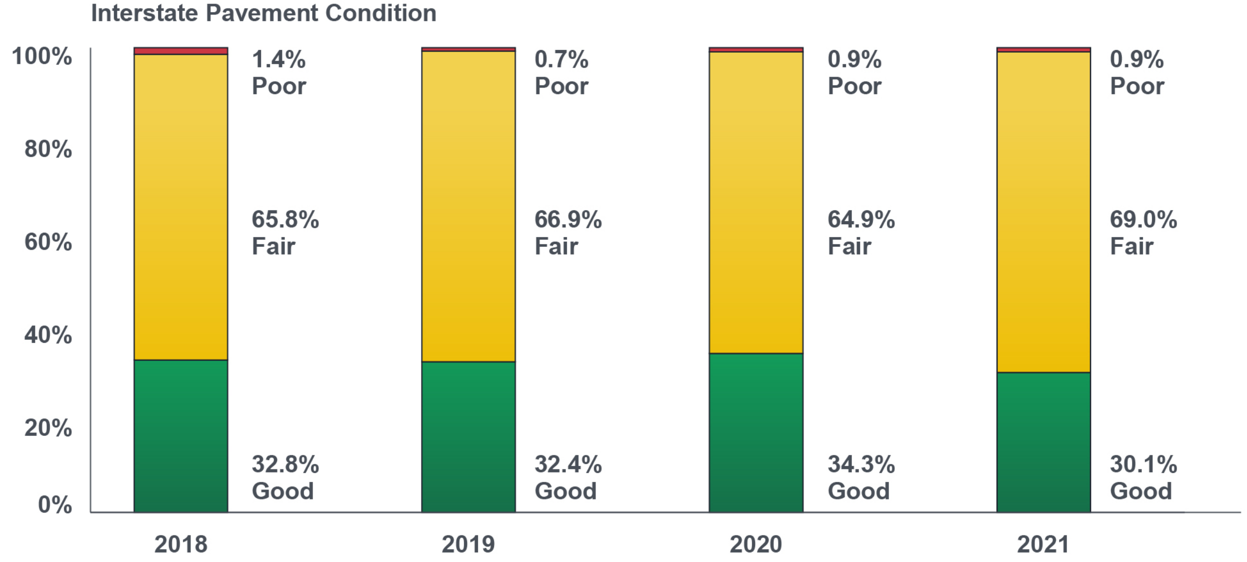


Figure 2-3. Historical overall pavement condition on Alaska's Interstate system.

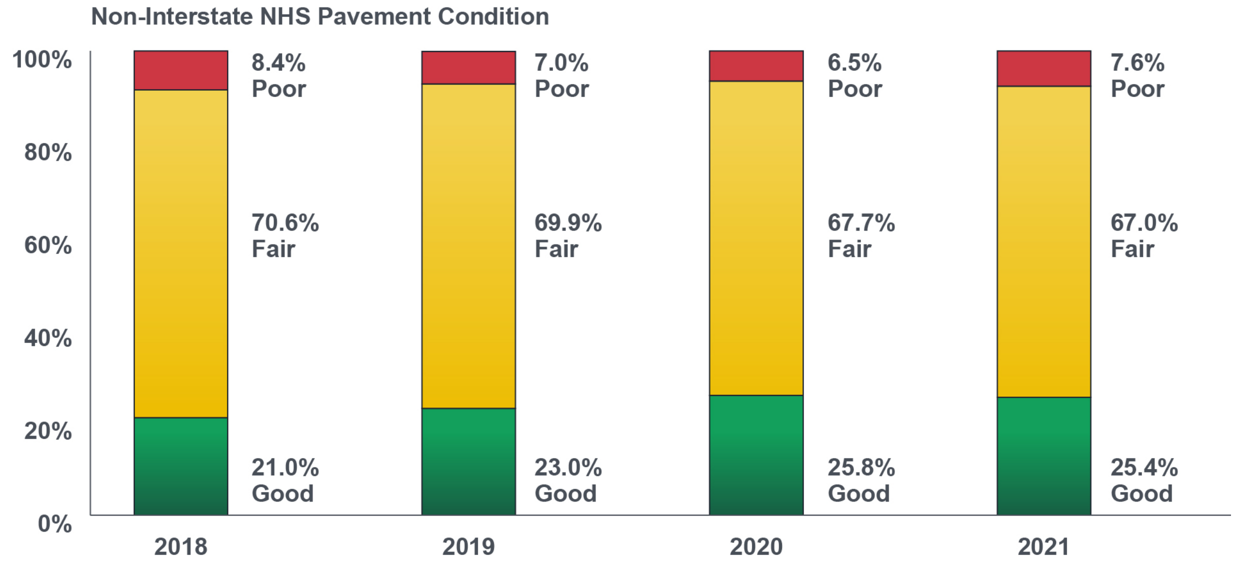


Figure 2-5. Historical overall pavement condition on Alaska's non-Interstate pavements.

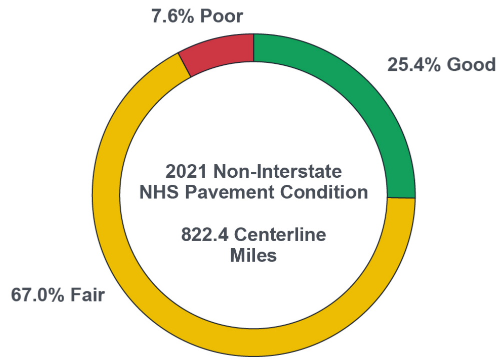


Figure 2-4. Alaska's 2021 non-Interstate NHS overall pavement condition.

The Department utilizes pavement condition data and the following pavement management objectives to effectively manage its pavement network.

- Treat pavements in *Good* and *Fair* condition before they deteriorate to save money over the pavement's life cycle.
- Provide information to allow effective selection and design of future surface treatments, rehabilitation, and reconstruction projects.
- Accurately estimate future conditions under varied funding scenarios to evaluate current pavement funding strategies.
- Display analysis results in understandable formats.

2.4 BRIDGE INVENTORY

In Alaska, the NHS bridge inventory has increased from 411 bridges in 2017 to 425 bridges in 2021. While all structures are referred to as bridges within this document, these bridges also include large culverts. Engineers biennially inspect bridges, and these inspections are subject to requirements established by FHWA. Bridge inventory changes year-to-year with bridge closures, bridge replacements, or changes in road functional class.

2.5 BRIDGE CONDITION

The bridge performance measure uses the following metrics for bridges: Deck Rating, Superstructure Rating, and Substructure Rating. Table 2-4 lists the condition thresholds in the final rulemaking. The lowest rating of all three metrics becomes the overall bridge condition.

Table 2-4. Bridge performance thresholds.

Bridge Metrics			
	Deck	Super	Sub
Good	9-7	9-7	9-7
Fair	6-5	6-5	6-5
Poor	<5	<5	<5

During biennial inspections, DOT&PF bridge inspectors assign a condition rating in accordance with the National Bridge Inspection Standards (NBIS). These ratings describe the existing, in-place condition of a bridge component compared to the bridge's original, or as-new, condition using a 0-9 scale, with 9 as excellent and 0 as failed.

A bridge is structurally deficient if inspection reveals that primary load-carrying elements are in *Poor* (or worse) condition. Primary load-carrying elements include the deck (driving surface), superstructure (the components supporting the deck such as the girders), and substructure (abutments and piers).

While the term "structurally deficient" can imply unsafe conditions, bridges with this classification are in safe operating condition to meet the required level of service, or the bridges are weight-restricted or lane-restricted (reduced to a single lane) to assure safe operation. When weight restrictions fall below 3 tons, the bridge is closed to traffic, in accordance with federal regulations. Closed bridges are considered in calculation of the performance measure. In the 2021 NBI data, there were two closed structures. One of these structures is now open and the other no longer carries NHS.

The DOT&PF measures bridge performance by calculating the ratio (percentage) of deck area of a given condition state (Good, Fair, or Poor/structurally deficient) compared to the total bridge deck area on the NHS. Table 2-5 shows how these condition states align with typical work needs. The percentage of structurally deficient deck area on the NHS became a congressionally mandated performance measure with the enactment of MAP-21. Figure 2-6 shows bridge condition data in 2021 from data collected in 2020.

Table 2-5. Bridge performance.

Condition Rating	*Typical Work Need*
Good	Maintenance or Preservation Candidate
Fair	Rehabilitation or Preservation Candidate
Poor	Rehabilitation or Replacement Candidate

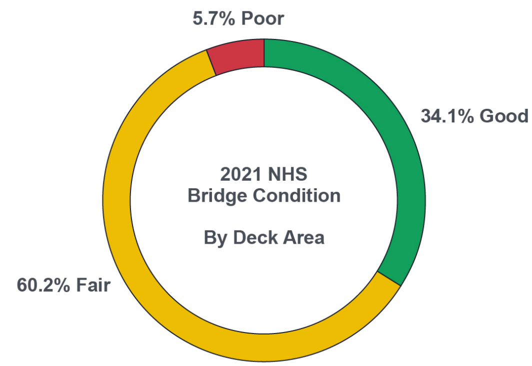


Figure 2-6. Overall bridge condition on NHS bridges in 2021 (by deck area).

MAP-21 contains a performance measure limiting *Poor* rated bridges to no more than 10 percent of all bridges on the NHS, by deck area. Since 2014, Alaska has met this criterion and has an improving downward trend of 0.2 percent annually.

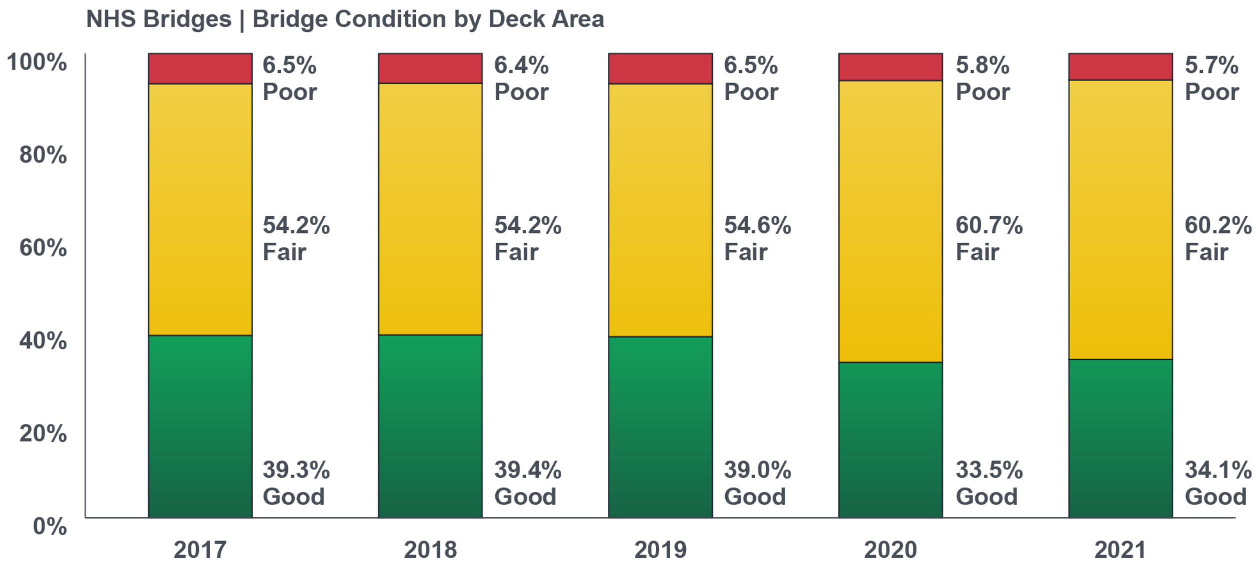


Figure 2-7. Overall bridge condition (by deck area) on NHS bridges.

Figure 2-7 depicts the percentage of NHS bridges in *Good*, *Fair*, and *Poor* condition from 2017 to 2021. Bridges in *Poor* condition decreased from 6.5 percent to 5.7 percent, consistent with the data presented earlier. While this decrease in bridges in *Poor* condition is encouraging, it is somewhat offset by the decrease in bridges in *Good* condition and the overall increase in bridges in *Fair* condition. This trend could be an indication of the need for more investment in preservation treatments aimed at maintaining bridges in *Fair* or better condition.

The 2017-2021 data includes on or off ramps, in accordance with the performance measures final rule, categorizing them as structurally deficient or not deficient. This is good information but is not used to calculate the federal performance measures. The Department uses bridge condition data and the following bridge management objectives to effectively manage its bridge assets.

- Design and construct bridges to last with minimal maintenance.
- Seal decks and expansion joints to protect bridges from road-salt laden runoff.
- Perform maintenance such as cleaning gutters and deck drains, removing debris from bottom chords and bearing seats, and removing drift from piers.
- Invest in preservative treatments for bridges in *Good* and *Fair* condition to slow deterioration. Preservative treatments might include deck seals, joint seals, and repainting structural steel elements.
- Provide information to allow effective selection and design of future maintenance, preservation (i.e., deck treatments), rehabilitation, and reconstruction projects.
- Accurately estimate future conditions versus funding scenarios to evaluate current bridge funding strategies.
- Display analysis results in an understandable format.

3 Performance Management

This section includes the DOT&PF process for assessing asset conditions and analyzing future conditions. DOT&PF, based on asset condition, calculates the funding needed to meet targets and the DSOGR by conducting life-cycle planning (LCP) using several scenarios described in more detail in Appendix F. Using a risk-based approach, a gap analysis is performed between DSOGR and available funding. The gap analysis process is further detailed in Appendix E. The amount of funding available is evaluated by developing a financial plan described in Section 4. Finally, these steps define investment strategies in Section 5 for ensuring the successful management of transportation assets.

3.1 PERFORMANCE GAP IDENTIFICATION

Although the TAMP focuses on infrastructure performance, there are other federal performance measures that affect bridges and pavement. Each of these performance areas contribute to the development of DOT&PF's capital program in support of the agency's LRTP. Several internal processes allow DOT&PF staff to manage delivery of the program to ensure the expected performance is delivered on time and within budget. These internal processes are connected to the TAMP development process to ensure that the TAMP is developed in full awareness of any gaps in the performance of NHS assets. These gaps are considered in the development of TAMP investment strategies which are described in more detail in Appendix I.

DOT&PF monitors and manages the performance of the NHS for all seven TPM National Goal areas:

- Safety
- Infrastructure condition
- Congestion reduction
- System reliability
- Freight movement and economic vitality
- Environmental sustainability
- Project delivery

Safety targets were set in May 2021 for fatalities, fatality rate, major injuries and major injury rate, and non-motorized fatalities. All modernization or expansion projects use safety data for funding prioritization. The HSIP for 2022 contained seven safety projects that will also improve pavement or bridge conditions. DOT&PF preservation projects also include a review of any safety deficiencies which can be corrected.

Alaska's freight transportation system is performing reasonably well today. Alaska's Freight Plan analysis identified the following performance risks that are expected to increase in coming years: congested truck routes and intermodal connectors; limited route and modal service choices, especially for rural communities; unreliability or unavailability of services due to seasonal effects, aging infrastructure, or other disruptions; overall cost of goods; and missing infrastructure links and facility improvements that are needed to serve new industries and population growth.

Measures for travel time and freight reliability represent a new data source for DOT&PF. State targets have been adopted, but DOT&PF is working to incorporate this data into project selection criteria.

Another resource for gap identification is the DOT&PF's LRTP, *Let's Keep Moving 2036*. The plan established the policy goals shown below. Understanding future state needs and visioning not only addresses condition targets but will also help identify system performance gaps.

- **New Facilities**—Develop new capacity and connections that cost-effectively address transportation system performance.
- **Modernization—**Make the existing transportation system better and safer through transportation system improvements that support productivity, improve reliability, and reduce safety risks to improve performance of the system.
- **System Preservation**—Manage the Alaska Transportation System to meet infrastructure condition performance targets and acceptable levels of service for all modes of transportation.

- **System Management and Operations**—Manage and operate the system to improve operational efficiency and safety.
- **Economic Development**—Promote and support economic development by ensuring safe, efficient, and reliable access to local, national, and international markets for Alaska's people, goods, and resources and for freight-related activity critical to the State's economy.
- **Safety and Security**—Improve transportation system safety and security.
- **Livability, Community, and the Environment**—Incorporate livability, community, and environmental considerations in planning, delivering, operating, and maintaining the Alaska Transportation System.
- **Transportation System Performance**—Ensure a broad understanding of the level, source, and use of transportation funds available to DOT&PF; provide and communicate the linkages between this document, area transportation plans, asset management, other plans, program development, and transportation system performance.

The 2022 LRTP update, *Alaska Moves 2050,* will not be finalized before the submission of the TAMP. The LRTP update is based on a performance-based planning framework. Performance-based planning means tailoring decisions to local context and using the best available data to inform them. The benefits of this approach include improved decision making, higher return on investment, better accountability, and improved performance. With the new transportation infrastructure bill[1], increased funding is projected for the next 5 years for all modes. The LRTP will be focused on investing funding strategically to reach transportation goals and to adequately fund maintenance and operations of any new transportation infrastructure.

3.2 PERFORMANCE GAP ANALYSIS

"Performance Gap" is defined in 23 CFR 515.5 to mean both the gaps between the current asset condition and a state DOT's target for asset condition as well as the gaps in system performance effectiveness that are best addressed by improving the physical assets. The gap analysis internal processes shown in figure 3-1 are further detailed in Appendix E. The results of the gap analysis are described in section 4.3 and are included in tables 4-1 to 4-4.

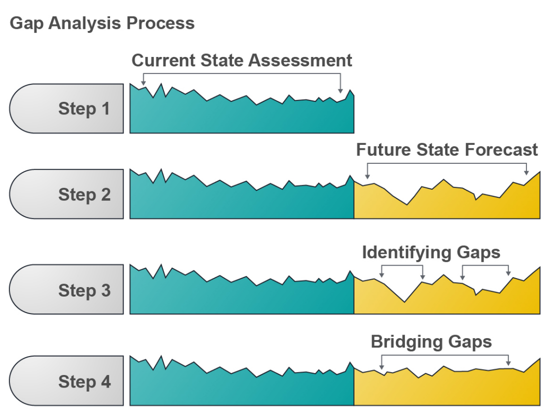


Figure 3-1. Performance gap analysis process.

To begin to identify performance gaps, the current state of assets was determined by reviewing historical data and trends. External factors that could affect the future state, such as a change in volume of heavy truck traffic or safety concerns, were also examined.

Historical data for pavement performance over the last 4 years indicates that conditions are fairly stable on the Interstate with 1 percent of the network in *Poor* condition and 30-34 percent in *Good* condition. The non-Interstate NHS pavement in *Poor* condition remains fairly stable between 7 and 8 percent while the percentage of pavement in *Good* condition has been steadily increasing from 21 percent in 2018 to 25 percent in 2021. The gap analyses for the NHS pavement subnetworks indicate that current and forecasted pavement conditions for both subnetworks exceed all established performance targets, which are also considered the desired states of good repair. DOT&PF is in the fortunate situation that the current and forecasted percentage of pavement in *Good* condition exceeds the NHPP performance targets and the DSOGR. This allows the Department to actively monitor this pavement performance measure and consider reallocating valuable funding resources to other performance areas to improve performance in those areas and better meet state performance management objectives consistent with the LRTP.

Looking at historical bridge structural deficiency revealed that conditions are relatively stable or

1 U.S. Congressional Legislation - H.R.3684 - Infrastructure Investment and Jobs Act

hover around the 10 percent structurally deficient. The gap analysis shows that the percentage of bridges in *Poor* condition at 5.7 percent achieves the target and desired SOGR of a maximum of 10 percent *Poor*. The percentage of bridges in *Good* condition at 34.1 percent does not meet the target of 40 percent. Although the percentage of bridges in *Poor* condition does not exceed the ceiling of the ten percent target that was established, the Department needs to continue programming reconstruction and rehabilitation of bridges to keep bridges at less than 10 percent *Poor*. The Department strives to meet the 10 percent target by using 7.5 percent *Poor* as its internal benchmark level of performance. The Bridge Section submits a prioritized list to Program Development staff for consideration when the bridges require major rehabilitation.

Additionally, the Bridge Section has completed simple retrofits to improve bridge performance during a seismic event. Approximately twenty-five percent of the total bridges in Alaska need improvement to perform better in a seismic event. The Bridge Section provides regional planners with a list of bridges that do not meet seismic standards.

3.3 PERFORMANCE MANAGEMENT AND PROGRAM DEVELOPMENT

DOT&PF is substantially meeting its pavement and bridge targets and expects to be able to continue to do so; however, there are trade-offs related to funding availability and remaining performance gaps both on and off the NHS. For example, as funding is focused on preservation and rehabilitation of pavement and bridges, it will be more difficult to fund modernization-focused improvements and other priorities described in the LRTP. Additionally, funding is needed for the non-NHS routes, Alaska Marine Highway System ferry purchases, high-cost mobility improvement projects such as Sterling Highway: Sunrise to Skilak (aka Cooper Landing Bypass), Dalton Highway paving and gravel road preservation, geo-technical assets, culverts and other highway related appurtenances, and other improvements that will not contribute toward meeting targets. DOT&PF considers alternatives and trade-offs when making funding decisions related to meeting targets and closing or minimizing these performance gaps.

3.4 LIFE-CYCLE PLANNING: ANALYSIS AND MANAGEMENT

The process for conducting LCP required by 23 CFR 515.7(b) is described in Appendix F, and the steps are shown in figure 3-2. This section provides an overview of DOT&PF's LCP capabilities and objectives and summarizes the results of the LCP analysis performed to support and validate the investment strategies described in Section 5.

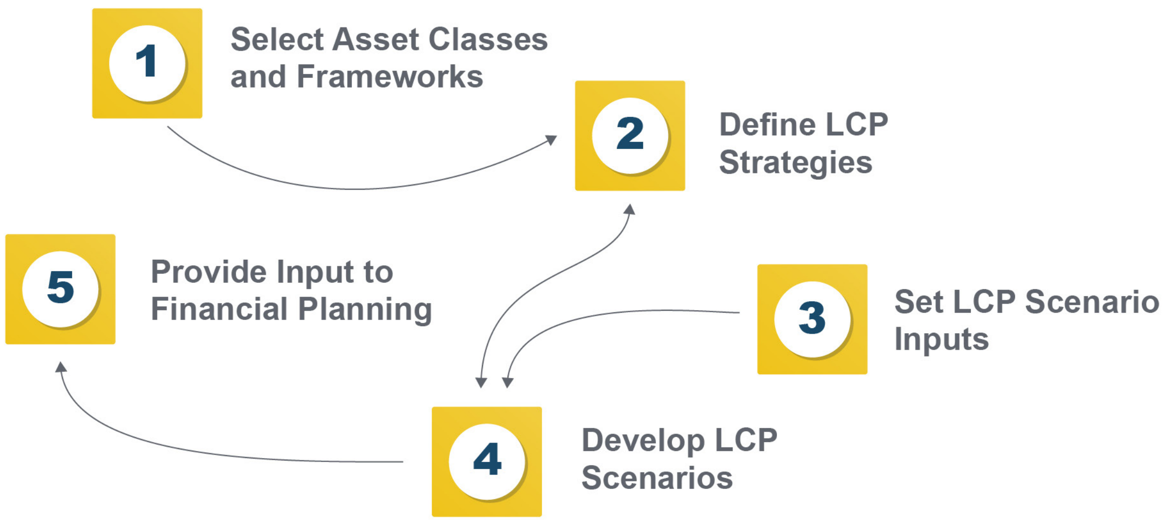


Figure 3-2. Life-cycle planning process.

3.4.1 Background

LCP involves long-term analysis of pavement and bridge performance under different budget and strategy scenarios. As described in Appendix F, this analysis is performed using asset management systems.

In 2020, the DOT&PF completed implementation of its pavement management system (PMS) and bridge management system (BMS). The PMS and BMS that DOT&PF implemented each meet the analysis capabilities required for LCP and are compliant with the federal requirements. The analyses and life-cycle plans described below were developed using the newly implemented PMS and BMS.

3.4.2 Objectives

Staying with the TAM motto to "start simple and grow smart," DOT&PF's LCP objectives are to:

- Continually refine deterioration models to predict future conditions more accurately.
- Refine life-cycle strategies that focus on cost effective preservation on Alaska's connected road system and, when it makes sense, for remote rural communities.
- Develop a plan for every NHS bridge and road segment using age, condition, and demand as the primary criteria.
- Educate internal and external stakeholders on why the preferred LCP strategies are the most efficient use of public funds and how budget changes affect asset condition over time.
- Determine the funding needed in each work type to meet established targets and the DSOGR.
- Reduce the cost of annual expenditures without negatively impacting asset condition using management system outputs and professional judgment.
- Integrate resilience into transportation LCP strategies and the risk management plan.

3.4.3 LCP Analysis Results and Preferred Strategies

Following the procedures described in Appendix F, the DOT&PF used these systems to determine the best overall approaches to managing its pavements and bridges for the long term. Highway assets in Alaska must withstand cold-weather and marine environments that are not typical in other states. As such, each of these management systems has been configured to consider the unique designs, materials, and performance characteristics of Alaska's highway assets.

3.4.4 Pavement Life-Cycle Planning

The PMS was used to model network pavement conditions under different budget scenarios and following different strategies for prioritizing potential work. The LCP process was used to evaluate different strategies and investment levels to ensure long-term pavement performance.

In this analysis, the PMS's approach to maximizing benefit was used to determine the budget necessary to achieve and sustain the DSOGR through the TAMP period. The system's approach represents an ideal set of investments and does

Considering Extreme Weather and Resilience in Pavement Life-Cycle Planning

Thawing permafrost is a significant risk to pavement performance as it compromises the stability of the pavement subgrade. DOT&PF accounts for this risk in life-cycle planning by including subgrade stability in PMS decision trees (Appendix F).

DOT&PF is developing processes for integrating data from other data systems, including twice-damaged emergency repair locations and GAMS high risk locations, to further integrate extreme weather risks and resilience into the LCP analysis process (Appendix G).

DOT&PF considers risk throughout all phases of a pavement's life cycle, from planning through maintenance and operation, including impacts due to extreme weather events and resilience. DOT&PF has developed a design strategy (ACE) to address roadways susceptible to damage due to thawing permafrost (Appendix G).

not consider project or program constraints other than budget. A series of analyses were run for budgets between $110 million and $150 million per year to determine the funding needed to sustain the desired SOGR. This needs analysis assumes that all pavement work would be selected based on PMS recommendations, following the preferred life-cycle strategy. Figures 3-3 and 3-4 compare pavement conditions resulting from various investment levels for the Interstate and non-Interstate NHS, respectively. Based on this analysis, the current budget of approximately $130 million per year is sufficient to sustain the desired SOGR through the TAMP period. However, it should be noted that the percentage of *Poor* pavement is increasing in these scenarios from it's current levels of 0.9 percent on the Interstate NHS and 7.6 percent on the non-Interstate NHS. At these funding levels, the most cost-effective strategy is to maximize preservation and rehabilitation and postpone reconstruction. This would not allow DOT&PF to work through the backlog of pavements needing reconstruction.

The effectiveness of DOT&PF's PMS is demonstrated in figure 3-5. This figure compares the conditions resulting from investing the anticipated $130 million per year according to two different life-cycle strategies. One strategy is triggered by system benefits for different work types and the other strategy places a priority on pavements in the worst condition first. Figure 3-5 shows that a worst-first strategy does not maintain the desired SOGR for the TAMP period and leads to significantly more pavements in *Poor* condition over the long term.

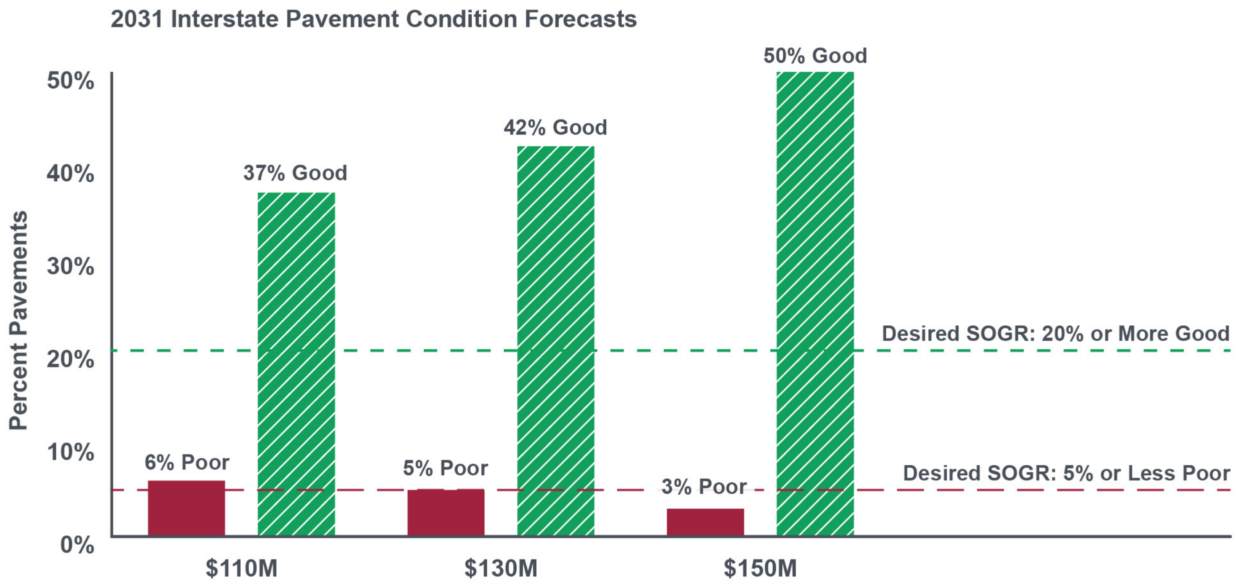


Figure 3-3. Interstate pavement condition forecasts at various investment levels.

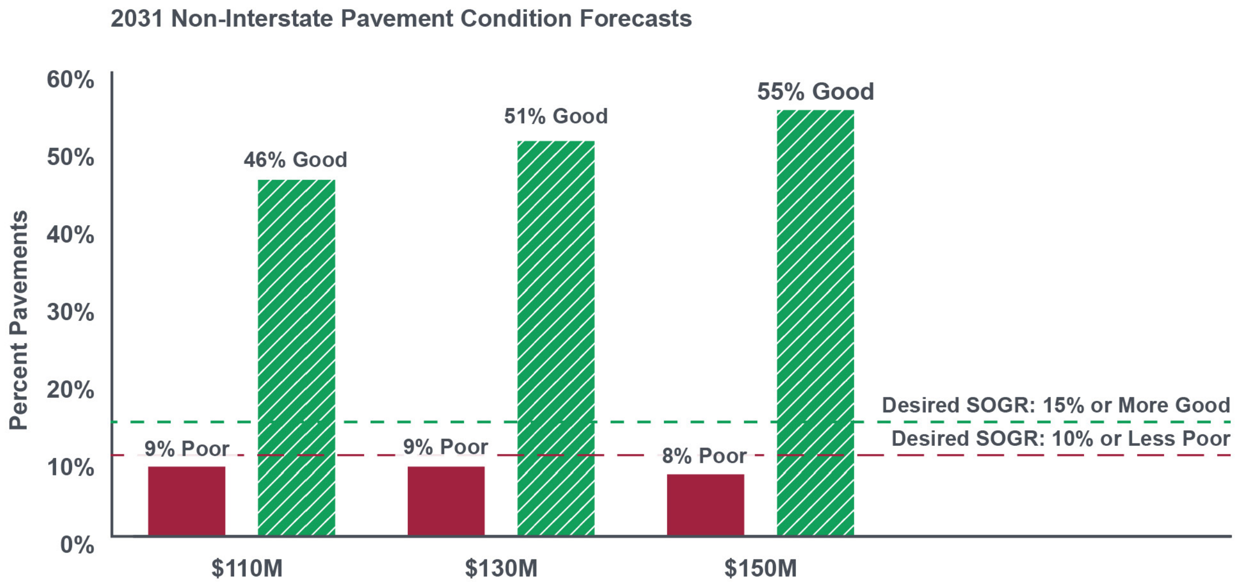


Figure 3-4. Non-Interstate NHS pavement condition forecasts at various investment levels.

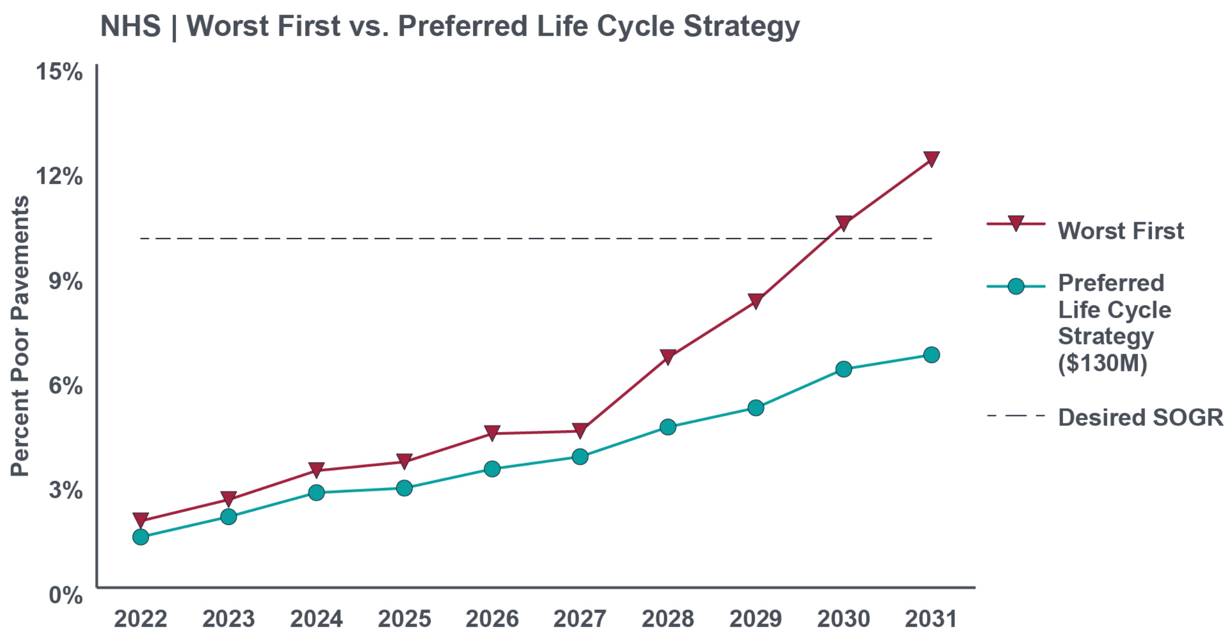


Figure 3-5. Comparison of TAMP investment strategy to worst-first strategy.

Considering Extreme Weather and Resilience in Bridge Life-Cycle Planning

Extreme weather and resilience are considered within the BMS modeling framework for seismic risks and hydraulic risks including scour, channel protection, and waterway adequacy.

Candidate bridge treatments identify locations where infrastructure can be hardened through the seismic retrofit program, scour protection, and channel improvements (Appendix F, G).

3.4.5 Bridge Life-Cycle Planning

The BMS was used to model system performance under different budget scenarios and following different strategies for prioritizing potential work. The LCP process was used to evaluate different strategies and investment levels to ensure long-term bridge performance. The BMS has a multi-objective decision-making framework and uses a utility function that combines condition and risk and life-cycle cost to address bridge needs in all aspects.

Preservation plays a major role in the DOT&PF's preferred life-cycle strategy for bridges. Effective bridge preservation actions are applied while bridges are still in *Good* or *Fair* condition and before the onset of serious deterioration. These early treatments delay the need for more costly rehabilitation or replacement. Bridge preservation includes cyclical and condition-based maintenance activities. Some examples of cyclical maintenance include cleaning drains, cleaning joints, deck sealing and sealing concrete. Some examples of condition-based maintenance include joint repair, concrete deck repair, steel member repair, bearing restoration, pile preservation, and scour countermeasures.

Figure 3-6 shows forecasted 10-year *Good* and *Poor* bridge conditions for the preferred life-cycle planning strategy at budget levels of $48-75 million per year for NHS bridges. The preferred strategy is expected to maintain the desired SOGR through 2031 for *Poor* condition and higher budgets provide better performance. However, the extended analysis in figure 3-7 shows deteriorating conditions over a 20-year period. The 20-year analysis is used in bridge LCP analysis due to the very long service lives, and slow deterioration rates, of bridges. This analysis period provides enough time to trigger at least one significant action on the majority of bridges in the inventory. Figures 3-6 and 3-7 show that the desired SOGR for *Good* condition cannot be achieved throughout either a 10- or 20-year period, even with increased funding. This is not as critical as the desired SOGR for *Poor* condition. More significantly, figure 3-7 shows that the desired SOGR for *Poor* cannot be maintained over 20 years, even with additional funding. While this is not an immediate issue, it is a concern for long term planning. The preferred life-cycle planning strategy is described in further detail in Appendix F.

3.5 RISK MANAGEMENT

Risk is the positive or negative effect of uncertainty or variability upon agency objectives. Risk management is the process and framework for identifying, analyzing, evaluating, and addressing risks to both assets and system performance. Using the processes described in Appendix G, as required by 23 CFR 515.7(c), DOT&PF has identified, assessed, evaluated, and prioritized relevant asset management risks. Risks identified as being beyond the agency's risk tolerance have been documented and addressed through risk mitigation strategies. A risk management team, made up of staff from multiple program areas, reviews and reaffirms agency risks and mitigation strategies annually. The results of the process are detailed in Appendix G. The most significant risks identified in the register are summarized on the following pages.

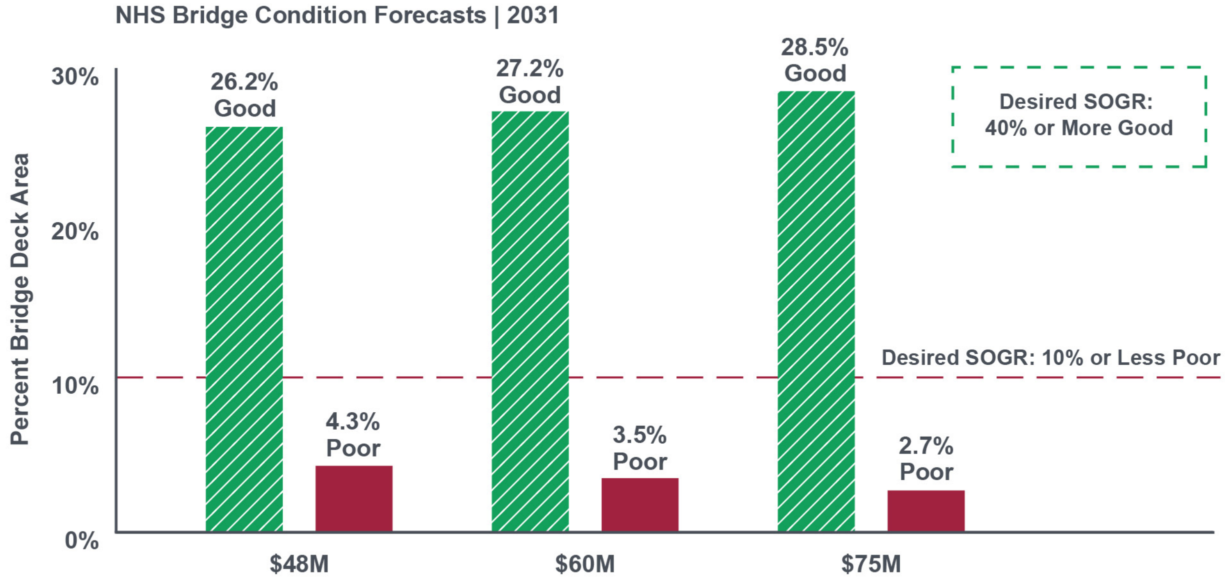


Figure 3-6. Comparison of forecasted bridge conditions at various funding levels for 10-year analysis period.

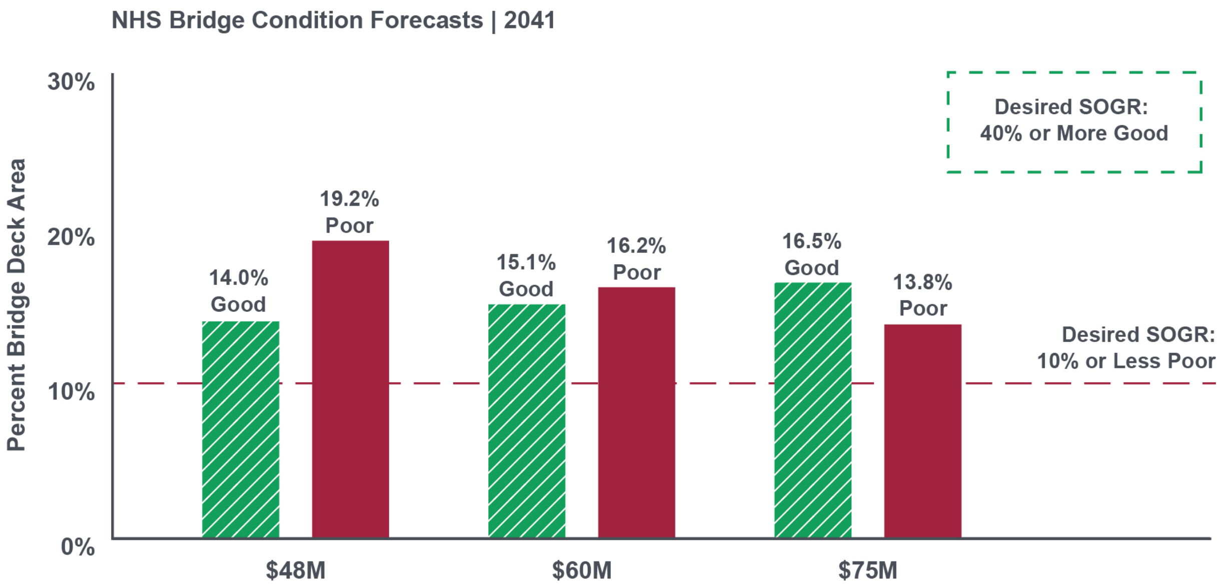


Figure 3-7. Comparison of forecasted bridge conditions at various funding levels for 20-year analysis period.

3.5.1 Funding

A decrease in funding would force some projects to be constructed later, delaying the project benefit to the traveling public and Alaska's economy. The recently passed Bipartisan Infrastructure Law (BIL) has provided significant mitigation of this risk, and the State of Alaska is committed to providing state funds to match all available federal aid.

This category also includes the risk of adding more assets than Maintenance and Operations (M&O) resources can maintain. To mitigate this risk, the DOT&PF is employing a number of strategies, such as considering future maintenance costs in the planning and programming process and optimizing designs to minimize future maintenance costs.

3.5.2 Delivery of the Program

Lack of trained Department staff and other resources can put the delivery of the program at risk. Mitigation strategies include training, succession planning, and knowledge management to help new staff quickly obtain the knowledge they need to perform their duties. Additionally, cost increases from planning to construction were identified as a significant risk. The DOT&PF is continually working to strengthen the connections among financial planning, long-range planning, STIP development, and project delivery to mitigate this risk.

3.5.3 Data and IT Systems

Information systems can be difficult to implement for any agency. Getting the information to Department staff and the public is labor intensive. The DOT&PF is working with the Office of Information and Technology to establish data governance and information system reviews will help to make sure no systems are redundant and free up resources to implement improvements.

3.5.4 Natural Risks

3.5.4.1 Seismic Activity

Alaska is a highly seismic state. DOT&PF is working to change the approach for development of projects. In addition to condition, the life-cycle planning process considers seismic vulnerabilities and recommends treatments to mitigate this risk, rather than postponing improvements until they are warranted based solely on the asset condition.

DOT&PF bridge designers are using a ductility-based approach to bridge design. A ductile bridge moves during a seismic event to avoid collapse. Repair techniques are designed to be rapidly implemented from readily available materials. Utilizing this strategy helps avoid collapse of the bridge, which preserves life and safety. Developing repair techniques prior to a seismic event helps to both respond to and recover from disruptions. In addition, the seismic retrofit program is set up to evaluate, examine, and design enhancements to bridges that are determined to be insufficient in earthquake zones. A seismic database is used to prioritize bridge needs and the program was established to help mitigate risk.

3.5.4.2 Extreme Weather and Climate Change

Alaska has other natural risks besides seismic events. Permafrost is thawing in many areas of the state. In addition, both landslides and rockfall events continue to take place. Extreme weather events are increasingly producing flooding, erosion, and avalanches that cause infrastructure damage and impact system mobility. DOT&PF considers resilience in several ways, including design guidance for roadways susceptible to damage due to thawing permafrost as well as for vulnerable bridges and roadways located in floodways. The Department has implemented enhanced hydraulic modeling and a condition rating system for rock slopes, soil slopes, and retaining walls. DOT&PF is also planning to develop a resiliency workplan for identifying, evaluating, and prioritizing improvements to locations vulnerable to environmental hazards. Appendix G includes more information on resilient infrastructure and DOT&PF's mitigation strategies for extreme weather, such as:

- Roadway design for thawing permafrost
- Material selection for bridge design
- Scour critical program
- Bridge and culvert design for flooding
- Roadway design for flooding
- Unstable slopes
- Research
- Emergency Funding and Part 667

Another mitigation strategy for extreme weather and climate change that the Department has adopted is tracking **Twice-Damaged Assets** as required under 23 CFR 667. FHWA requires that state transportation departments conduct evaluations to determine if there are reasonable alternatives at road, highway, and bridge locations that have required repair and reconstruction activities on two or more occasions due to emergency events. DOT&PF performed an initial identification of twice-damaged assets (TDAs) in compliance with 23 CFR 667 and DOT&PF Policy and Procedure No. 07.05.100 (P&P).

DOT&PF's twice-damaged assets 2021 report provides a list of locations where Emergency Relief (ER) funding was spent on both NHS and non-NHS routes between January 1, 1997 and December 31, 2019. Appendix G provides a list of these locations. Figure 3-8 shows a summary of these locations in a map format. According to 23 CFR Part 667, an evaluation must consider the risk of recurring damage and cost of future repairs under current and future environmental conditions. The P&P requires each region to complete an Alternatives Evaluation (AE), documented in an Alternatives Evaluation Report (AER), for each TDA location in their respective Region. DOT&PF Program Development assures that an AER is complete before putting a project in the STIP that contains a TDA location. ER expenditures are updated annually and analyzed for new TDA locations. A new TDA list is published annually by January 31. The Regions are responsible for reviewing and updating AEs, as necessary, and completing AEs and AERs for new TDA locations on a quadrennial basis.

Figure 3-8 on the following page shows locations that utilized ER program funds. ER funding is used for the repair or reconstruction of federal aid highways and roads on federal lands that have suffered serious damage. Twice damaged assets are shown in blue.

The Department's Guidance on Emergency Funding and Documentation was completed in 2022. The guide provides contextual information and procedural guidelines for DOT&PF employees to prepare the documentation needed to respond to, and recover from, emergencies/disasters that effect the operations of the Department.

DOT&PF Resilience Mapping Project

The DOT&PF created a risk and resilience storymap to provide extreme weather information for pavement and bridge planning. The storymap includes data from the FEMA Risk Assessment, information about known geohazards, permafrost data, seismic risk information, and flood data related to bridges. The map was created to increase the DOT&PF's ability to anticipate and plan for disruptive events which may affect pavements or bridges.

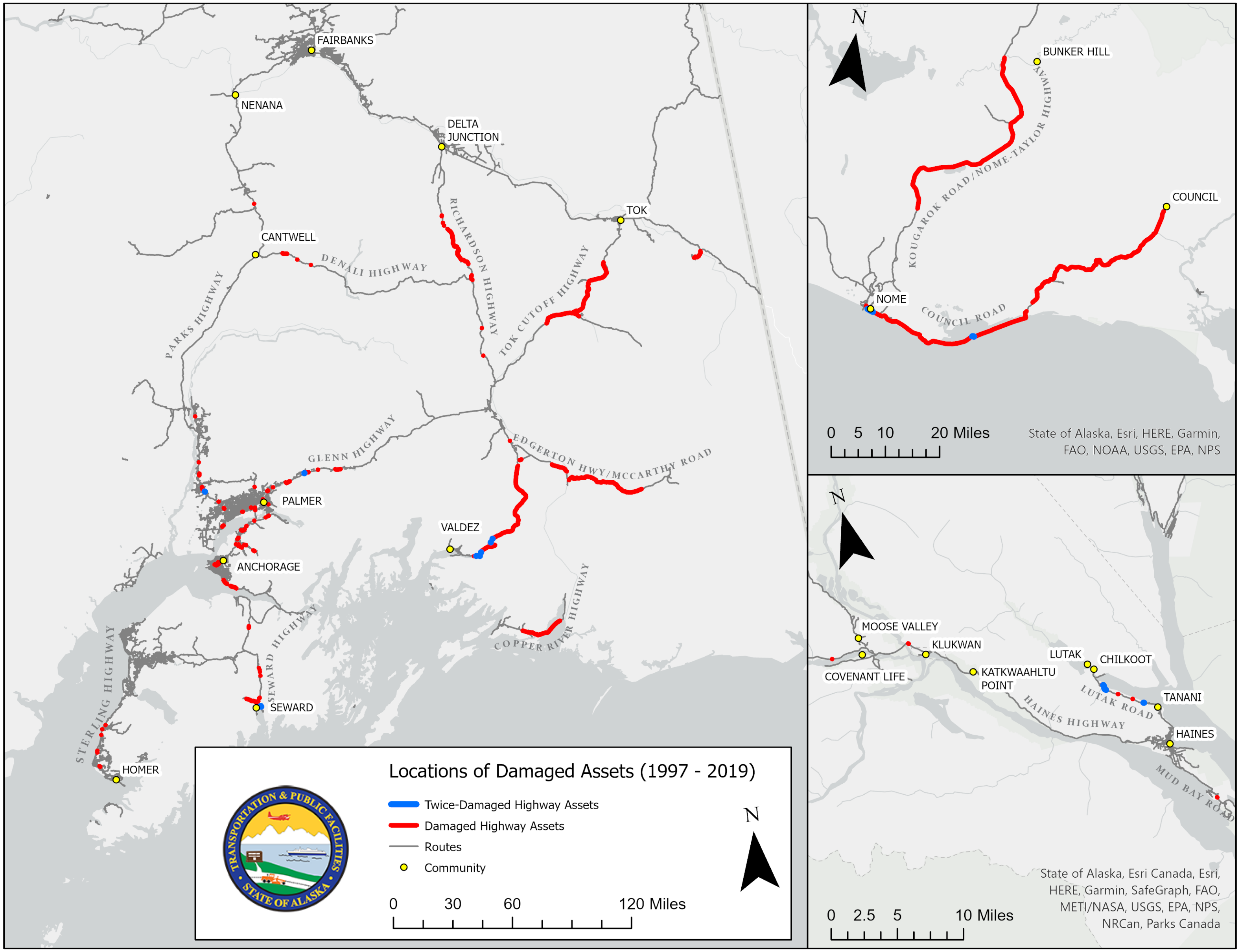


Figure 3-8. Locations of damaged assets.

4 Financial Plan

The following financial plan provides an overview of the resources required to meet the needs of pavements and bridges on the NHS and the resources available to meet those needs. The plan considers:

- Funding needs to adequately manage NHS pavements and bridges
- Funding availability to address pavement and bridge conditions
- The quantity and implications of gaps between needed and available funding levels
- The value of DOT&PF pavement and bridge assets on the NHS

The financial plan provides context for identifying and comparing potential investment strategies for the TAMP period, which are described in Section 5. The processes that DOT&PF followed to develop this financial plan are described in greater detail in Appendix H.

4.1 CURRENT AND FUTURE FUNDING NEEDS

As described in Section 3, DOT&PF uses condition and cost data on pavements and bridges to establish long-term strategies for maintaining and improving asset conditions at the lowest practicable costs. These analyses allow the Department to assess the long-term funding needs. The following subsections provide an overview of the level of resources needed over the next 10 years to achieve the Department's pavement and bridge condition targets and DSOGR while still managing other infrastructure needs and accounting for critical risks.

The connection between system performance and asset condition is discussed in further detail in Section 3.2. Critical risks are explained in Section 3.5, Risk Management, and Appendix G, Risk Management Analysis.

4.1.1 Pavement and Bridge Performance Gap Assessment

The following graphs compare the performance anticipated for pavement and bridge conditions over the TAMP period to the DSOGR for pavements (figure 4-1) and bridges (figure 4-2). Figure 4-1 shows that the pavement network is expected to sustain conditions better than the DSOGR for the entire TAMP analysis period. Figure 4-2 shows that bridge conditions will continue to meet and exceed the DSOGR for *Poor* condition, but the percentage of *Good* condition falls throughout the analysis period and will no longer meet the desired SOGR after the first several years. DOT&PF will work towards improving bridge condition by increasing its selected investment strategy and updating its BrM models.

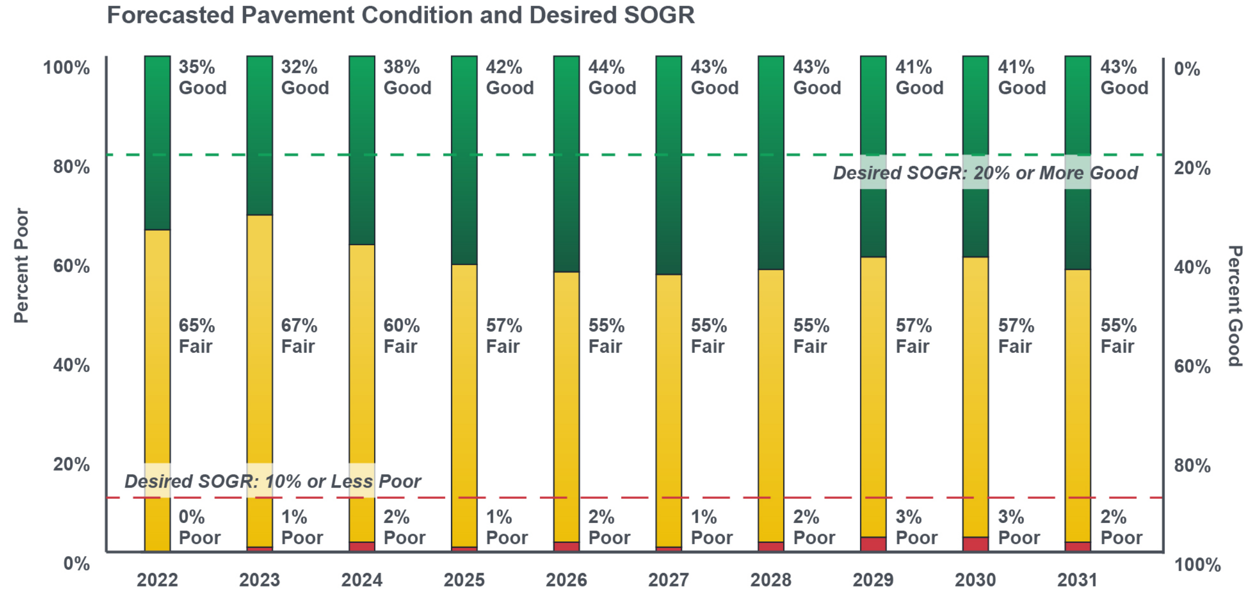


Figure 4-1. Forecasted pavement conditions v. desired SOGR.

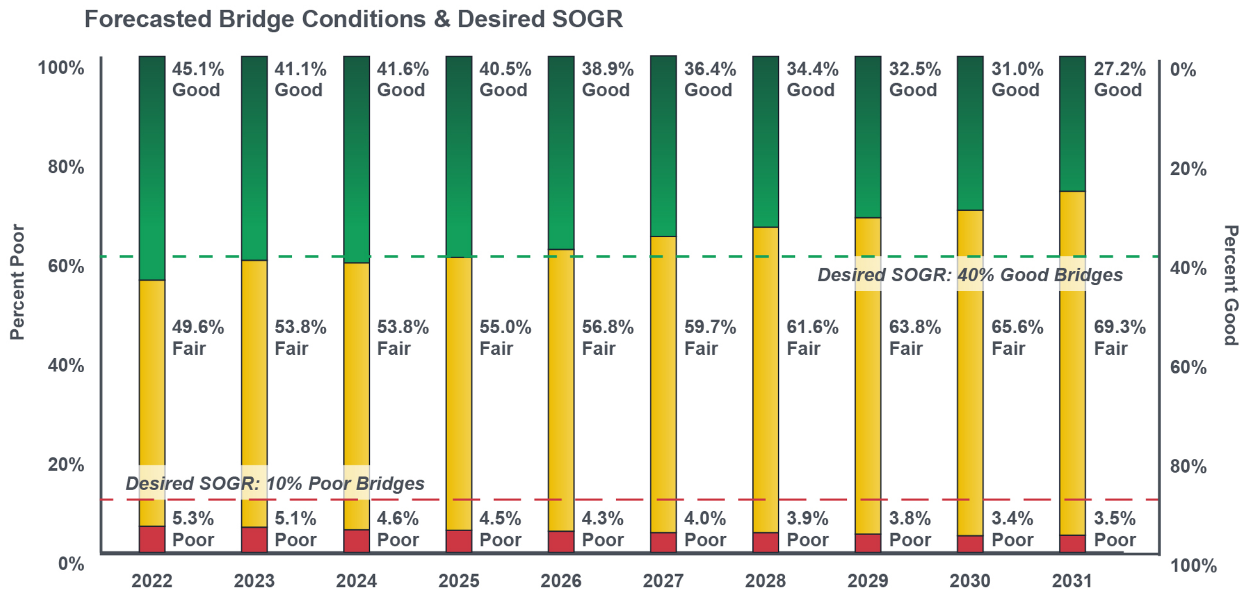


Figure 4-2. Forecasted bridge conditions v. desired SOGR.

4.1.2 Addressing Other Needs

Pavements and bridges on the NHS are the focus of this TAMP but are not the only assets that the Department manages with highway funding. Likewise, pavement and bridge conditions are not the only factors that contribute to safe and efficient highway operations. The following sections describe how other assets, risks, and overall system performance are considered in establishing funding needs. The balance of investments to achieve the Department's various objectives are described in further detail in Section 5, which provides information on the Department's actions to optimize outcomes across asset classes and programs through tradeoff analysis.

4.1.2.1 Other Assets

In addition to pavements and bridges, the Department manages many other infrastructure assets that are necessary to keep the highway system safe and operable, such as guardrails, culverts, signs, walls, and traffic signals. The agency also manages non-highway assets. While aviation and transit assets have separate dedicated funding streams, ferries rely heavily on highway funding, primarily NHPP funding. Funding needed to address other infrastructure assets are identified from review of the STIP and highway maintenance budgets. These funds are subtracted from the revenue sources described in Section 4.2 before comparing the funding needs for pavements and bridges to available revenue.

4.1.2.2 Risk

Section 3.5 and Appendix G provide details on critical risks that must be managed to minimize threats to system performance and maximize the Department's ability to take advantage of future opportunities. Addressing some of these risks requires investing in ways that are counter to the life-cycle strategies described in Section 3.4, Life-Cycle Planning. An example of this is the Department's investment in retrofitting bridges and other facilities that may be in *Good* condition but are not adequately resilient to damage from potential seismic events. The risk of serious or catastrophic damage from the possible seismic event may be more important than maintaining or improving the condition of other assets.

4.1.2.3 System Performance

DOT&PF monitors and manages the performance of the NHS in regard to all seven TPM National Goal areas outlined in Section 3.1. Each of these performance areas requires investment through capital projects and maintenance activities. The costs of these actions are accounted for by review of the STIP and maintenance budgets. These funds are subtracted from the revenue sources described in Section 4.2 before comparing the funding needs for pavements and bridges to available revenue.

4.2 FUNDING ASSET MANAGEMENT

Transportation funding in Alaska is a combination of federal funds, state General Funds, and Alaska Marine Highway System revenues. Of these, the Federal Highway Program funds represent the majority of the available funds for managing pavements and bridges on the NHS. State funds are used as federal match money at a rate of typically 9.03 percent and also support maintenance activities.

4.2.1 Federal Funds

On average over ninety percent of the funding of projects on the NHS in Alaska are federal aid. The Bipartisan Infrastructure Law (BIL) provides Alaska with a stable source of funding for transportation infrastructure for the next 4 years. Overall, the DOT&PF expects over $3.8 billion in federal revenue to be available for projects on the NHS during the TAMP period, with the NHPP expected to make up the majority of federal funds for NHS projects. Additionally, the DOT&PF expects to use some earmarked and special funds. For example, the Seward Highway 17-22 project received approximately $11 million in Rural Bridge Grant funding to replace bridges over Victor Creek and the Snow River.

4.2.2 State Funds

State funding relevant to the TAMP is estimated as the level of funding needed to provide matching funds for the federal funds shown in table 4-1 and the amount in the annual highway maintenance and operations budget.

The highway maintenance and operations budget is expected to remain constant, based on historical performance at a level of $6.7 million per year. This funding is used to manage the routine maintenance and operations of the state highway system and does not improve asset conditions but is required to keep assets in a SOGR.

Table 4-1 details the expected state and federal revenue for NHS assets. This is based on funding allocations from the BIL. DOT&PF expects over $4.9 billion in total revenue to sustain and improve these assets. Since the BIL includes only 4 years of federal funding levels from federal fiscal years 2022 to 2025, DOT&PF used a 2.0 percent growth rate to estimate federal funding past federal fiscal year 2025.

Table 4-1. Funds available for managing NHS assets (millions).

Fund Source	*2022*	*2023*	*2024*	*2025*	*2026*	*2027*	*2028*	*2029*	*2030*	*2031*	*Total*
NHPP	$313.7	$319.9	$326.3	$332.9	$339.5	$346.3	$353.2	$360.3	$367.5	$374.8	$3,434.4
NHPP Freight Program	$17.0	$17.4	$17.7	$18.1	$18.4	$18.8	$19.2	$19.6	$20.0	$20.4	$186.6
NHPP Exempt	$7.7	$7.8	$8.0	$8.2	$8.3	$8.5	$8.7	$8.8	$9.0	$9.2	$84.1
Highway Infrastructure Bridge Replacement (HIP)	$29.9	$30.5	$31.1	$31.7	$32.3	$33.0	$33.6	$34.3	$35.0	$35.7	$327.1
Highway Infrastructure Bridge (Formula)	$38.3	$39.0	$39.8	$40.6	$41.4	$42.2	$43.1	$43.9	$44.8	$45.7	$418.8
Apportionment Total	$406.5	$414.6	$422.9	$431.4	$440.0	$448.8	$457.8	$466.9	$476.3	$485.8	$4,451.1
State Matching Funds*	$40.4	$41.2	$42.0	$42.8	$43.7	$44.6	$45.4	$46.4	$47.3	$48.2	$441.8
Total Funds Available to NHS	**$446.9**	**$455.8**	**$464.9**	**$474.2**	**$483.7**	**$493.4**	**$503.2**	**$513.3**	**$523.6**	**$534.0**	**$4,893.0**
***State Matching Funds are estimated as 9.93% of the Total Funds Available to NHS based on historical averages.**											

4.3 FUNDING GAPS

Table 4-2 summarizes the total needs for NHS assets based on the current Alaska STIP. The total need for preservation, rehabilitation, and reconstruction of NHS pavements and bridges is summarized as the "TAMP Total," and is estimated to be $4.1 billion. The total need for all programmed work on the NHS is over $7.2 billion.

Table 4-2. Total projected programmed funding for NHS asset needs ($ millions).

Need	*2022*	*2023*	*2024*	*2025*	*2026*	*2027*	*2028*	*2029*	*2030*	*2031*	*Total*
System Preservation	$254.6	$243.9	$341.0	$229.9	$204.2	$169.5	$274.1	$169.5	$169.5	$169.5	$2,225.7
Bridge Rehabilitation	$34.2	$41.1	$33.6	$7.5	$8.2	$8.2	$7.5	$7.5	$7.5	$7.5	$163.1
Bridge Replacement	$20.9	$11.9	$37.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$70.4
Reconstruction	$71.3	$302.3	$874.1	$299.6	$84.5	$43.4	$2.0	$2.0	$2.0	$2.0	$1,683.1
TAMP Total Programmed	**$381.0**	**$599.2**	**$1,286.3**	**$537.0**	**$296.9**	**$221.1**	**$283.6**	**$179.0**	**$179.0**	**$179.0**	**$4,142.3**
Initial Construction	$211.6	$135.7	$473.0	$51.0	$0.0	$39.5	$0.0	$36.6	$33.3	$0.0	$980.7
Safety	$66.9	$60.4	$60.4	$60.4	$60.4	$60.4	$60.4	$60.4	$60.4	$60.4	$610.2
Planning	$23.1	$21.3	$17.1	$16.6	$16.7	$17.3	$16.2	$16.2	$16.2	$16.2	$177.0
Ferry Boats	$17.9	$20.5	$255.8	$17.7	$17.7	$17.7	$17.7	$17.7	$17.7	$17.7	$418.0
Transit	$26.9	$27.0	$27.0	$27.0	$27.0	$27.0	$27.0	$27.0	$27.0	$27.0	$269.7
ITS	$11.4	$11.0	$5.9	$5.9	$5.8	$5.8	$5.7	$5.7	$5.7	$5.7	$68.8
Congestion	$8.7	$8.7	$8.8	$8.8	$8.8	$6.9	$6.9	$6.9	$6.9	$6.9	$78.3
Railroad	$63.0	$37.1	$32.7	$30.3	$38.5	$36.5	$37.1	$36.6	$36.6	$36.6	$384.9
Research	$2.6	$2.6	$2.7	$2.7	$2.8	$2.8	$2.9	$3.0	$3.0	$3.0	$28.0
Training	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$5.8
Other	$20.9	$5.4	$5.1	$5.4	$4.8	$5.0	$4.8	$4.8	$4.8	$4.8	$65.4
Total Programmed	**$834.5**	**$929.4**	**$2,175.4**	**$763.3**	**$479.9**	**$440.5**	**$462.8**	**$394.4**	**$391.1**	**$357.8**	**$7,229.1**

Two funding gap analyses are summarized in tables 4-3 and 4-4. As shown in table 4-3, there is sufficient funding for management of NHS pavements and bridges ("Total Funds Available to NHS" compared to "TAMP Total Programmed"). However, as shown in table 4-4, there is a total funding gap of $2.3 billion over the TAMP period when considering all Department needs ("Total Programmed"). This over-programming is currently concentrated in the first 4 years of the STIP. DOT&PF will manage this funding gap by prioritizing projects for delivery within the available resources based on the greatest overall benefit to the highway system, consistent with the process outlined in Appendix I.

Table 4-5 summarizes the investment levels in four of the five federal work types needed to sustain the DSOGR for pavements and bridges. Initial construction is not considered in this evaluation as it does not contribute to achieving the DSOGR. Pavement reconstruction is included in the federal work types that contribute to SOGR, however DOT&PF does not include it in the SOGR budget since it has a limited impact on the network condition and is rarely recommended by the pavement management system as a cost-beneficial treatment (further described in the pavement life-cycle planning section). Comparing the *TAMP Total Need* to the *Total Programmed,* in table 4-5, shows that the programmed funding exceeds the needed funding in the first 5 years, but the opposite is true in the last 5 years. Overall, the total programmed funding exceeds the TAMP need for the 10-year period.

DOT&PF does not manage a specific asset management allocation. The Department prioritizes projects that deliver investments in accordance with the maintenance, preservation, rehabilitation, and (bridge) replacement work types to ensure asset conditions are maintained and to facilitate the annual TAM investment consistency review, per 23 CFR 515.13(b). Initial construction and highway reconstruction are balanced with other transportation system needs, per the process outlined in Appendix I.

Table 4-3. Projected funding gap for NHS assets ($ millions).

	2022	***2023***	***2024***	***2025***	***2026***	***2027***	***2028***	***2029***	***2030***	***2031***	***Total***
Total Funds Available to NHS(1)	$446.9	$455.8	$464.9	$474.2	$483.7	$493.4	$503.2	$513.3	$523.6	$534.0	$4,893.0
TAMP Total Programmed	$381.0	$599.2	$1,286.3	$537.0	$296.9	$221.1	$283.6	$179.0	$179.0	$179.0	$4,142.3
TAMP Funding Gap	**$65.9**	**($143.4)**	**($821.4)**	**($62.8)**	**$186.8**	**$272.3**	**$219.6**	**$334.3**	**$344.5**	**$355.0**	**$750.9**

(1) From table 4-1

Table 4-4. Projected funding gap for total needs ($ millions).

	2022	***2023***	***2024***	***2025***	***2026***	***2027***	***2028***	***2029***	***2030***	***2031***	***Total***
Total Funds Available to NHS(1)	$446.9	$455.8	$464.9	$474.2	$483.7	$493.4	$503.2	$513.3	$523.6	$534.0	$4,893.0
Total Programmed	$834.5	$929.4	$2,175.4	$763.3	$479.9	$440.5	$462.8	$394.4	$391.1	$357.8	$7,229.1
Total Funding Gap	**($387.6)**	**($473.6)**	**($1,710.5)**	**($289.1)**	**$3.8**	**$52.9**	**$40.4**	**$118.9**	**$132.5**	**$176.2**	**$(2,336.1)**

(1) From table 4-1

Table 4-5. Detailed NHS pavement and bridge needs by Work Type to attain desired SOGR.

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Total
Pavement Maintenance	$18.0	$18.4	$18.7	$19.1	$19.5	$19.9	$20.3	$20.7	$21.1	$21.5	$197.1
Pavement Preservation	$52.0	$53.0	$54.1	$55.2	$56.3	$57.4	$58.6	$59.7	$60.9	$62.1	$569.4
Pavement Rehabilitation	$60.0	$61.2	$62.4	$63.7	$64.9	$66.2	$67.6	$68.9	$70.3	$71.7	$657.0
Pavement Reconstruction	$67.0	$68.3	$69.7	$71.1	$72.5	$74.0	$75.5	$77.0	$78.5	$80.1	$733.6
Pavement Subtotal	**$197.0**	**$200.9**	**$205.0**	**$209.1**	**$213.2**	**$217.5**	**$221.9**	**$226.3**	**$230.8**	**$235.4**	**$2,157.1**
Bridge Maintenance	$1.4	$1.4	$1.5	$1.5	$1.5	$1.5	$1.6	$1.6	$1.6	$1.7	$15.3
Bridge Preservation*	$17.8	$18.2	$18.5	$18.9	$19.3	$19.7	$20.0	$20.4	$20.9	$21.3	$194.9
Bridge Rehabilitation	$9.0	$9.2	$9.4	$9.6	$9.7	$9.9	$10.1	$10.3	$10.5	$10.8	$98.5
Bridge Replacement	$31.8	$32.4	$33.1	$33.7	$34.4	$35.1	$35.8	$36.5	$37.3	$38.0	$348.2
Bridge Subtotal	**$60.0**	**$61.2**	**$62.5**	**$63.7**	**$64.9**	**$66.2**	**$67.5**	**$68.8**	**$70.3**	**$71.8**	**$656.9**
TAMP Total Need	$257.0	$262.1	$267.5	$272.8	$278.1	$283.7	$289.4	$295.1	$301.1	$307.2	$2,814.0
Total Programmed	$381.0	$599.2	$1,286.3	$537.0	$296.9	$221.1	$283.6	$179.0	$179.0	$179.0	$4,142.3
TAMP Funding Balance	**$124.0**	**$337.1**	**$1,018.8**	**$264.2**	**$18.8**	**$(62.6)**	**$(5.8)**	**$(116.1)**	**$(122.1)**	**$(128.2)**	**$1,328.3**

* Includes funding for scour countermeasures

4.4 ASSET VALUE

DOT&PF uses straight-line depreciation as the standard method for the valuation of infrastructure assets. Many state transportation departments use the Government Accounting Standards Board 34 modified approach, but the DOT&PF prescribed the straight-line depreciation method for state use.

DOT&PF financial statements dated August 31, 2021, show infrastructure assets valued at $10,571,122,084. The book value after depreciation is $3,923,859,287. The infrastructure assets can be broken down as follows:

- Airports Runways: $2,427,181,718
- Bridges: $623,348,757
- Marine Structures: $163,465,511
- Roadways: $7,357,126,097

Table 4-6 and figure 4-3 provide historical values for each of these asset classes, demonstrating the value of the DOT&PF's assets has steadily increased. This suggests the level of investment is sufficient.

Table 4-6. Historical asset valuations.

	2017	2018	2019	2020	2021
Airport Runways	$1,897,078,198	$2,091,567,333	$2,107066,230	$2,291,209,484	$2,427,181,718
Bridges	$411,165,270	$463,294,617	$573,305,737	$591,920,597	$623,348,757
Marine	$317,961,625	$120,839,034	$162,178,683	$164,858,184	$163,465,511
Roadways	$5,798,671,789	$,6,273,102,720	$6,308,433,035	$6,694,108,914	$7,357,126,097
Total	$8.424,876,882	$8,948,803,704	$9,150,983,684	$9,742,097,179	$10,571,122,084
Percentage increase compared to previous year	—	6.2%	2.3%	6.5%	8.5%

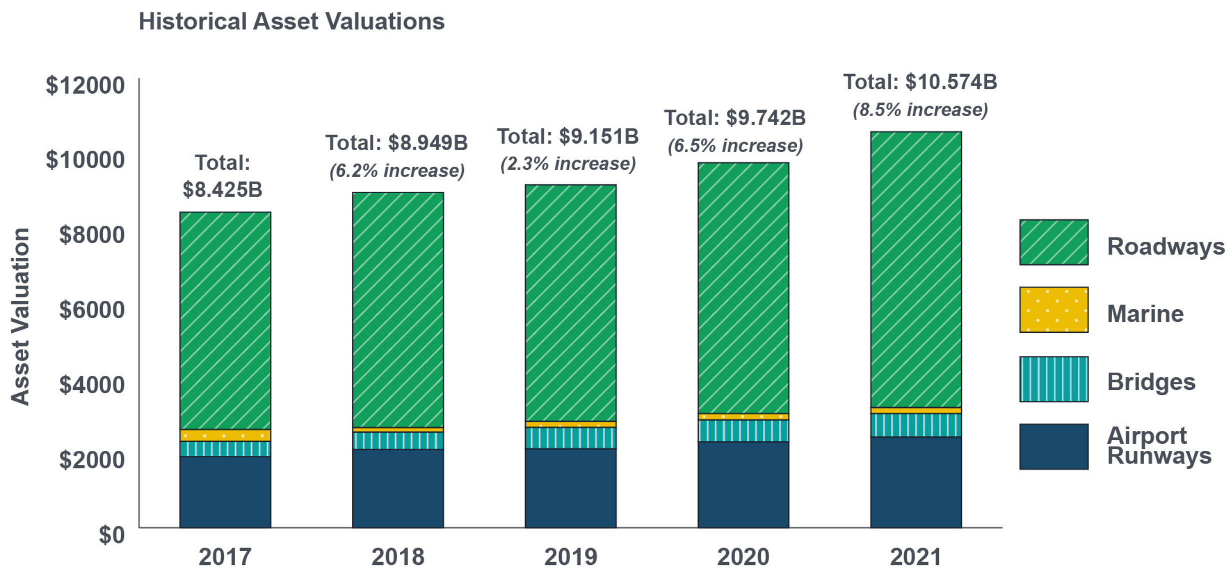


Figure 4-3. Historical asset valuations.

5 Asset Management Investment Strategies

This section describes the investment strategies needed to achieve and sustain the DSOGR of NHS bridges and pavements based on LCP. The DSOGR correlates to preserving the assets, meeting the condition, and performance targets and national goals described in Section 3.

The investment strategies described in this chapter consider the DSOGR for NHS pavement and bridge assets. These investment strategies were developed based on the preferred life-cycle strategy identified in Section 3, *Performance Management,* and the available funding identified in Section 4, *Financial Plan*. Programming projects that match the selected investment strategies will ensure treatments are applied at the appropriate time to minimize the asset life-cycle costs.

The STIP will be the primary mechanism for programming and tracking investments in NHS pavements and bridges. The STIP will identify the asset class and work type associated with each project so it can be correlated to the appropriate investment strategy.

The following subsections provide details on the investment plan for NHS pavements and bridges from state fiscal years 2022 to 2031.

5.1 SUPPORTING LONG-TERM OBJECTIVES

The LCP, risk management, and financial planning processes described in this TAMP, and in consideration of the LRTP, contribute to the investment strategies used to achieve national goals, statewide targets, and the desired SOGR.

- **Continue to invest at historical funding levels:** As described in earlier sections of this document, Alaska's NHS is currently close to meet national infrastructure targets and statewide goals. This suggests that historical investments have been sufficient, and that investment at similar funding levels will continue to keep Alaska's NHS system in the desired SOGR. The Department may have historically been overinvesting in pavement since current conditions exceed performance expectations for all measures, resulting in declining targets. However, forecasted performance at the current funding level, while still meeting or exceeding the SOGR and target requirements, does predict declining conditions. The Department will continue to monitor whether this funding level is sufficient or needs adjustment. Additionally, the Department strives to meet its asset management objectives for each asset class and will continue to balance pavement and bridge investments and performance.
- **Implement LRTP goals and policies:** The Department's investment strategies will consider all policy areas and, as detailed in section 3.1, with an understanding that available funding resources will need to be balanced to target an appropriate level of investment in each area.
- **Select projects using a data- informed approach:** Asset management systems (such as PMS and BMS) and processes will primarily be used to select preservation-focused projects, with the intent of achieving the system preservation policies and actions included in the LRTP, as well as the pavement and bridge condition performance measure areas. A more nuanced approach will be used to select projects on the NHS that are intended to achieve the remaining policy and performance measure areas, such as safety and mobility. For the current STIP, a data-informed approach was used to guide decisions for programming NHS projects. This process is outlined in Appendix I. This process will be further refined and may include multiple sets of criteria and standards related to the various policy areas and/or national performance measures for which a project will primarily contribute.

- **Show how projects contribute to performance management in the published STIP document:** Project work types (system preservation, reconstruction, etc.) included in the STIP will also aid in linking programmed projects to both performance management goals and LRTP policy areas.

Appendix I details the process used to develop this investment plan as required by 23 CFR 515.7(e) and (f).

5.2 INVESTMENT PLAN FOR 2022-2031

The investment plan shown in table 5-1 identifies the annual level of investment expected for pavements and bridges on the NHS. These investment levels reflect decisions made according to the life-cycle strategies described in Section 3.4, in consideration of overall system performance and risk, as described in the financial plan. The planned investments shown in table 5-1 vary from the preferred life-cycle strategies described in section 3.4. This is because the investment plan has been developed in consideration of all system needs and project constraints. Despite these differences, the investment plan is expected to deliver a performance similar to, or exceeding, the DSOGR investment strategy. Figure 5-1 shows a comparison of pavement conditions from the investment strategy needed to meet the DSOGR to the selected investment strategy. The selected investment strategy includes consideration of modernization and capacity needs, which results in a higher investment.

Table 5-1 includes an expected level of investment in initial construction. This estimate has not been separated into pavements and bridges, as the determination of how the funding is spent between asset classes is not made by the pavement or bridge management systems. As that work is completed, the newly constructed assets will be included in the asset inventories and will factor into life-cycle planning analyses. It should be noted that there are currently no expected investments in initial construction in the years 2026, 2028, or 2031.

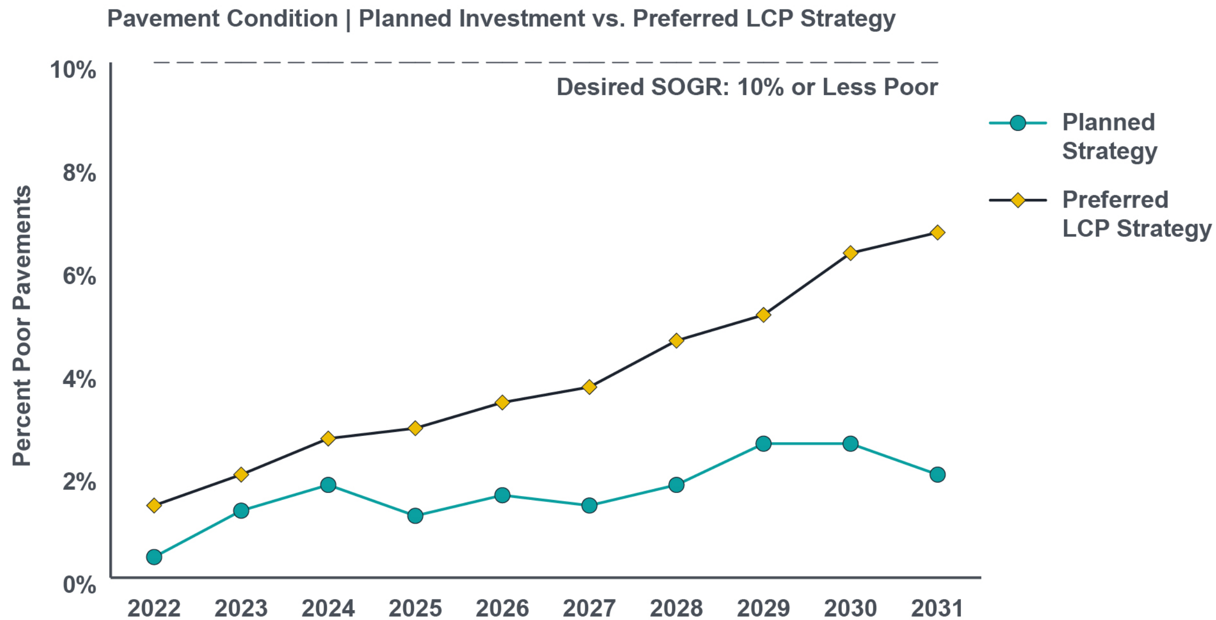


Figure 5-1. Comparison of planned pavement investments to preferred life-cycle strategy.

Table 5-1. Selected investment strategy for NHS pavements and bridges.

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Total
Pavement Maintenance	$10.0	$10.0	$10.0	$10.0	$10.2	$10.4	$10.6	$10.8	$11.0	$11.3	$104.3
Pavement Preservation	$45.0	$45.0	$45.0	$45.0	$45.9	$46.8	$47.8	$48.7	$49.7	$50.7	$469.5
Pavement Rehabilitation	$56.0	$56.0	$56.0	$56.0	$57.1	$58.3	$59.4	$60.6	$61.8	$63.1	$584.3
Pavement Reconstruction	$67.0	$70.4	$73.7	$73.7	$75.2	$76.7	$78.2	$79.8	$81.4	$83.0	$759.0
Pavement Subtotal	**$178.0**	**$181.4**	**$184.7**	**$184.7**	**$188.4**	**$192.2**	**$196.0**	**$199.9**	**$203.9**	**$208.0**	**$1,917.2**
Bridge Maintenance	$1.4	$1.4	$1.5	$1.5	$1.5	$1.5	$1.6	$1.6	$1.6	$1.7	$15.3
Bridge Preservation*	$17.8	$18.2	$18.5	$18.9	$19.3	$19.7	$20.0	$20.4	$20.9	$21.3	$194.9
Bridge Rehabilitation	$9.0	$9.2	$9.4	$9.6	$9.7	$9.9	$10.1	$10.3	$10.5	$10.8	$98.5
Bridge Replacement	$31.8	$32.4	$33.1	$33.7	$34.4	$35.1	$35.8	$36.5	$37.3	$38.0	$348.2
Bridge Subtotal	**$60.0**	**$61.2**	**$62.5**	**$63.7**	**$64.9**	**$66.2**	**$67.5**	**$68.8**	**$70.3**	**$71.8**	**$656.9**
Planned TAMP Total	**$238.0**	**$242.6**	**$247.2**	**$248.4**	**$253.3**	**$258.4**	**$263.5**	**$268.7**	**$274.2**	**$279.8**	**$2,574.1**
Initial Construction	$ 211.6	$ 135.7	$ 473.0	$ 51.0	$ 0.0	$ 39.5	$ 0.0	$ 36.6	$ 33.3	$ 0.0	$ 980.7

*Includes funding for scour countermeasures

For bridges, the BMS's approach to maximizing overall system utility was used to determine the budget necessary to achieve and sustain the desired SOGR through the TAMP period. A series of analyses were run for budgets between $48 million and $75 million per year to determine the overall need to sustain the DSOGR for NHS bridges. This needs analysis assumes that all bridge work would be selected based on the BMS's recommendation, following the preferred life-cycle strategy. Figure 5-2 and figure 5-3 show percent *Poor* and percent *Good* bridges, respectively, based on analysis results. The current budget of approximately $60 million per year for NHS bridges is sufficient to keep the network at less than 10 percent *Poor* but does not sustain the 40 percent *Good* condition to meet desired SOGR through the TAMP period. Alaska plans to increase spending on bridges for the next ten years. Several reasons for the increase were reviewed by the asset management team, the bridge management team and program development. Preliminary findings from the 2022 summer bridge inspection season show that Alaska will have an increase in poor bridges for the 2023 reporting year. BrM models show a jump in *Poor* bridges in the next 10-20 years. Models for $48 million per year in spending and $75 million per year in spending were reviewed. A calculated $60 million annual spending level was selected to decrease the percentage of *Poor* bridges in the next ten years. From past consistency reviews, four-year total bridge investment amounts show a lower investment level ($124 million) than the recommended TAMP level ($189 million), therefore an increase in annual investment for the next ten years will help mitigate this gap.

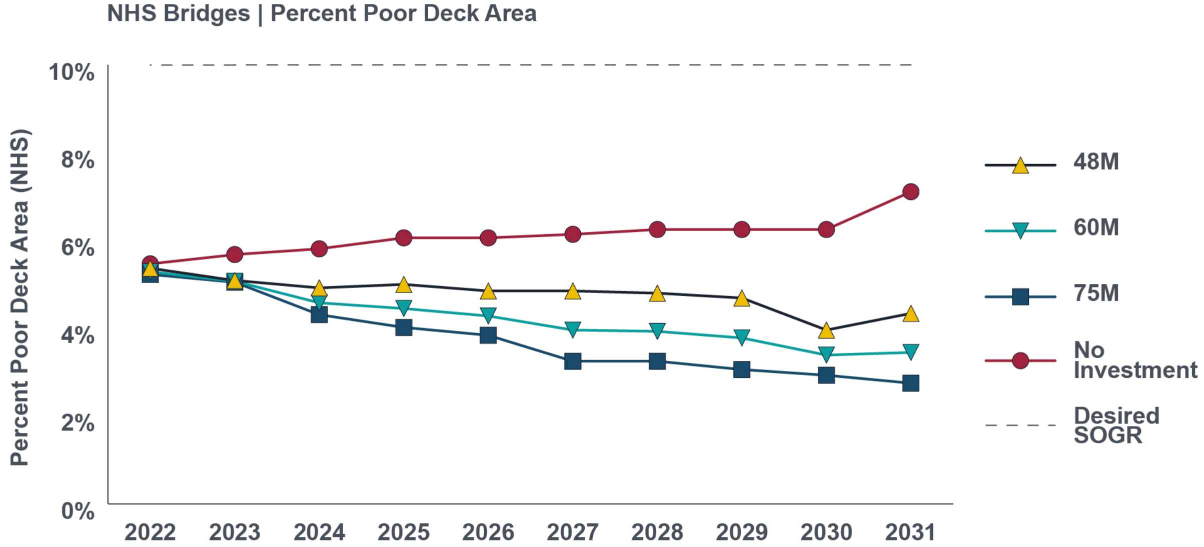


Figure 5-2. Comparison of bridges in Poor condition (by deck area) for different investment levels.

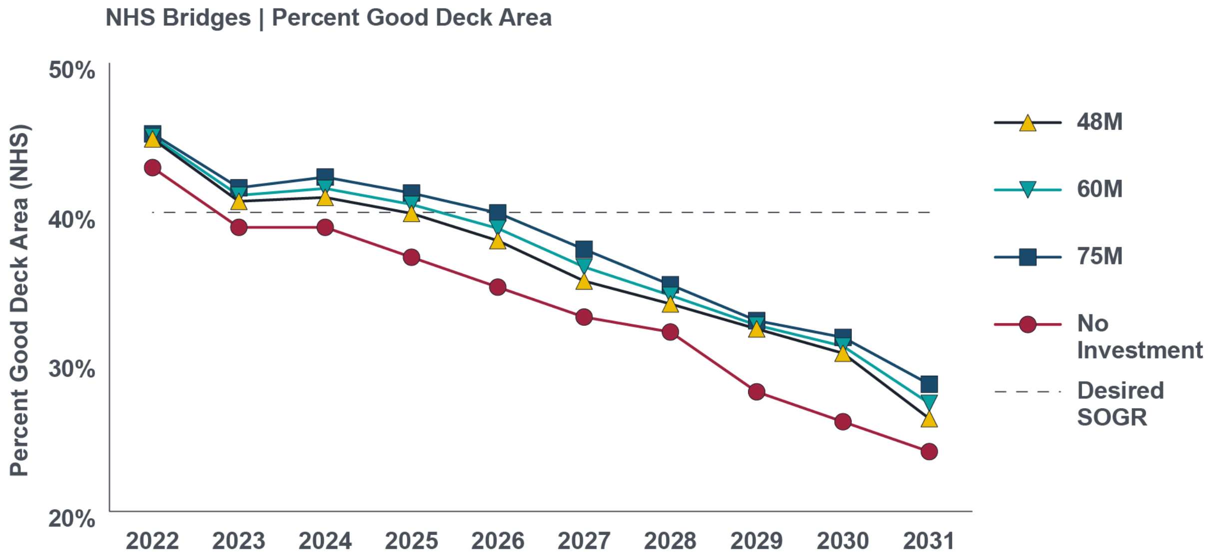


Figure 5-3. Comparison percent of bridges in Good condition (by deck area) for different investment levels.

6 Improvement Plan

6.1 ASSET MANAGEMENT IMPLEMENTATION—BACKGROUND

DOT&PF's TAM implementation started with an FHWA Asset Management Readiness workshop in 2010. In 2013, DOT&PF reviewed the state of its asset management data and systems. DOT&PF started with pavements and bridges first—in the spirit of DOT&PF's motto: Start Simple, Grow Smart, and Show Continuous Improvement.

At that time, DOT&PF was described as being in the "awakening" stage of asset management maturity, as defined in the AASHTO Transportation Asset Management Guide: A Focus on Implementation (AASHTO 2011). This stage is defined as including a "recognition of a need and basic data collection. There is often a heroic effort of individuals" (AASHTO 2011). For DOT&PF, there was a basic set of capabilities in place for a few types of assets, but these were not yet integrated into department-level decision making.

A team of multi-division staff assisted in developing a Request for Proposals (RFP) to procure a contractor for Pavement and Maintenance Management software. The contract is managed by Asset Management staff with a technical co-project manager from Information Systems and Services Division. The staff leads for pavement and maintenance are the Statewide Pavement Management Engineer and a Northern Region Maintenance and Operations District Superintendent, respectively. The PMS was implemented in January 2020. DOT&PF has been continuously refining the models since.

The Division of Program Development & Statewide Planning coordinated with the MPOs to evaluate performance targets used for NHS pavements and bridges within the MPOs and incorporated these targets into MPO transportation plans. Planning and Program Development staff have also worked on a process for prioritization of projects for the NHS system.

Since the last TAMP was prepared, DOT&PF has made significant improvements in the implementation of asset management. The PMS and BMS provide data to track asset condition and performance against their respective targets and national goals. Both systems produce the best available data as required by 23 CFR 515.7(g). The software has been adopted and configured to provide a much more robust pavement management system. Similarly, the current BMS, which utilizes the AASHTOWare BrM software, has been enhanced to provide modeling and forecasting capabilities instead of solely an inventory and condition database. Additionally, changes were made to the organizational structure at the Department to better facilitate the coordination required for effective asset management, and business processes have been modified to promote more data-driven decision-making.

6.2 ASSET MANAGEMENT IMPLEMENTATION—FUTURE IMPROVEMENTS

There are two major types of asset management functions performed by a state Department of Transportation (DOT). The first is single asset management, which focuses on the strategic management of a single asset class such as pavements or bridges. The second is cross asset management, where performance of multiple asset classes are monitored and managed to maximize the performance of the system. The following section describes additional improvements that DOT&PF is pursuing to continue to advance its asset management implementation in both areas.

6.2.1 Single Asset Analysis

DOT&PF is working on expanding asset-specific processes by continuing to enhance the newly implemented PMS and the current BMS. Additionally, the goal is to implement asset management for other asset classes. The Department is also working on developing risk-based project selection criteria to enhance risk mitigation activities.

6.2.1.1 Pavement Management

To better meet the new risk and resiliency requirements included in the BIL, DOT&PF is updating the subgrade stability data in the PMS to reflect the locations of unstable permafrost more accurately. This update is being performed by working with the Northern Region Materials Engineer and will be reviewed by Maintenance and Operations. Other future updates, including updates to the Alaska Pavement Condition Index (APCI), used within the Pavement Management System are described in Appendix C.

6.2.1.2 Bridge Management

DOT&PF uses the AASHTOWare BrM BMS (previously known as PONTIS) for inventory and inspection results. Since 2017, the Department has customized the BMS modeling framework, including deterioration and cost models, to perform life-cycle analysis. The Department has a custom structure criticality formula and utility function that was developed based on Alaska data and bridge asset management priorities. BMS network policies are also customized to reflect bridge management practice and Department objectives. The Department is planning to initiate a research project to develop element deterioration models to update the current models that are based on expert elicitation. Improving cost models is also a continuous effort by the Department, through the collaboration of multiple offices such as planning, design, and bridge. Bridge asset management, national performance goals, and state-established targets are only required on the NHS, which is prioritized in the BMS, but are also critical to keep non-NHS bridges at a condition that meets customer expectations. The Department therefore also uses BMS analysis as input for non-NHS bridges.

6.2.1.3 Other Assets

There are several other assets that the Department is evaluating to further expand its implementation of asset management principles and practices beyond pavement and bridge assets. The following are the assets under consideration:

- **Geotechnical Assets**—The Department has developed a Geotechnical Asset Management System (GAMS) and is currently using it for rockfall mitigation and slope stability improvements at the project level.
- **Americans with Disabilities Act compliance infrastructure**—The Department has developed an inventory database to support regional compliance upgrade contracts.
- **Culverts less than 20' and other drainage structures**—The Department has developed a database of inventory and condition that is based on inspection data.
- **Tunnels**—The Department has developed an inventory and condition database.

6.2.1.4 Strengthen Information Systems and Improve Data

The Department will continue to leverage the AASHTOWare software package which enables data management for cost estimation, proposal preparation, letting bids, and construction and material management. AASHTOWare will help to standardize the project management processes and improve accessibility and consistency of data for use by other management systems. The Department will also continue to improve system maturity by linking the capital investments back to the condition data for improved calculation of asset life-cycle cost.

The STIP is a tool for managing long-term programmatic investment strategies. The STIP relies on accurate coding of projects to indicate the contribution of the project to different agency objectives. The Planning Chiefs are working to improve this coding system to improve the accuracy with which project spending can be linked to the achievement of various agency objectives. There is also an effort to develop an electronic STIP (eSTIP) to provide improved access to the most current STIP data.

6.2.2 Cross Asset Analysis

It is the Department's goal to develop multiple individual asset evaluation processes and then utilize the data from these individual asset management systems to support cross asset evaluation. These analyses support overall asset management decisions that lead to desired outcomes, promote wise investment of resources, and promote credibility and transparency of investment decisions. The following types of asset management decisions benefit from cross asset evaluation processes:

- **Programming**—Conducting tradeoff analysis to allocate funds to program areas and establish performance targets
- **Strategy**—Evaluating activities within asset groups (e.g., maintenance)
- **Project**—Prioritizing assets and/or projects
- **Project Development**—Designing projects and evaluating project alternatives (e.g., conducting life-cycle cost analysis)
- **Policy**—Evaluating TAM policy issues (e.g., understanding the implications of increasing truck weight limits)

6.2.2.1 FUTURE IMPROVEMENTS

Modernize Performance Based Project Scoring: Program Development is working with a consultant to evaluate and potentially implement a Multi-Objective Decision Analysis (MODA) tool to enhance data driven program investment decision making. The criteria for comparing projects are increasingly data-driven, outcomes-based, and focus on long term costs and benefits. MODA can help DOT&PF justify decisions by evaluating projects of all types on a level playing field. Optimization techniques can further help inform the final selection process giving financial, performance, equity, and other varying constraints. Project nomination forms can trigger this process and ensure projects are assessed based on their comprehensive benefits given work scope descriptions.

Appendix A: TAM Structure and Processes

TAM LEADERSHIP STRUCTURE

The TAM leadership structure shown in figure 1-1 of the Introduction section displays the initial organizational framework for DOT&PF Asset Management. Once the Department has gained more experience in establishing asset management and life-cycle planning for NHS bridges and pavement, this decision-making process will be extended to other assets in order of importance.

The Asset Management framework provides a rationale and structure for certain workflows, meetings, and working relationships that may or may not already exist but are necessary for the Department to effectively accomplish its mission.

The organizational leadership structure for TAM is meant to be dynamic and collaborative in nature. The Asset Management team was established as part of the Department's Design and Engineering Services division and leads TAM implementation at DOT&PF. Each of the other teams involved in the TAM structure includes several people familiar with TAM principles and practices and at least one subject matter expert who coordinates with the Asset Management team and the other team subject matter experts to advance TAM development and implementation. A representative of the FHWA Alaska Division provides critical input and guidance in the Department's evolving TAM implementation. The Department also collaborates with representatives from Alaska's two MPOs to share asset management strategies and coordinate on performance targets and goals. Asset performance, asset funding needs, and recommendations for TAM enhancements are then communicated to the Executive Leadership for their consideration.

TAM PROCESS

In 2013, the Department's TAM maturity level was characterized as "awakening" (TAM Guide, 2011), which means that a basic set of capabilities were in place for a few types of assets, but they were not integrated into department-level decision-making. Since then, the Department's pavement and bridge asset management capabilities have significantly increased and now routinely support data-driven decision making at the department level.

Through the process of developing the initial and current TAMP, submitting annual consistency determination reports, and setting and monitoring progress toward NHPP targets for NHS pavement and bridges, the Department has steadily increased its asset management maturity level where there is now a department-wide shared understanding, motivation, and coordination in developing asset management processes and tools. DOT&PF will continue to enhance its asset management program consistent with its motto "Start simple, grow smart, and show continuous improvement."

Figure A-1 shows the continuous collaborative improvement process that is a strategic, integrated, and systematic approach to asset management.

Figure A-1. TAM process.

The TAM Process consists of:

- **TAM Policy Goals & Objectives:** These are clearly defined, based on the DOT&PF's Mission and Strategic Plan.
- **TAM Data Collection:** DOT&PF identifies information and data collection needs and communicates that information with the Data Integration team.
- **TAM Planning & Programming:** DOT&PF optimizes planning and programming processes to improve program delivery, identify gaps, and establish investment strategies through a financial plan.
- **TAM Program Delivery:** Measurable performance-based standards and forecasting processes are developed.
- **TAM Performance & Progress:** DOT&PF monitors performance and reports on progress toward both goals and objectives.

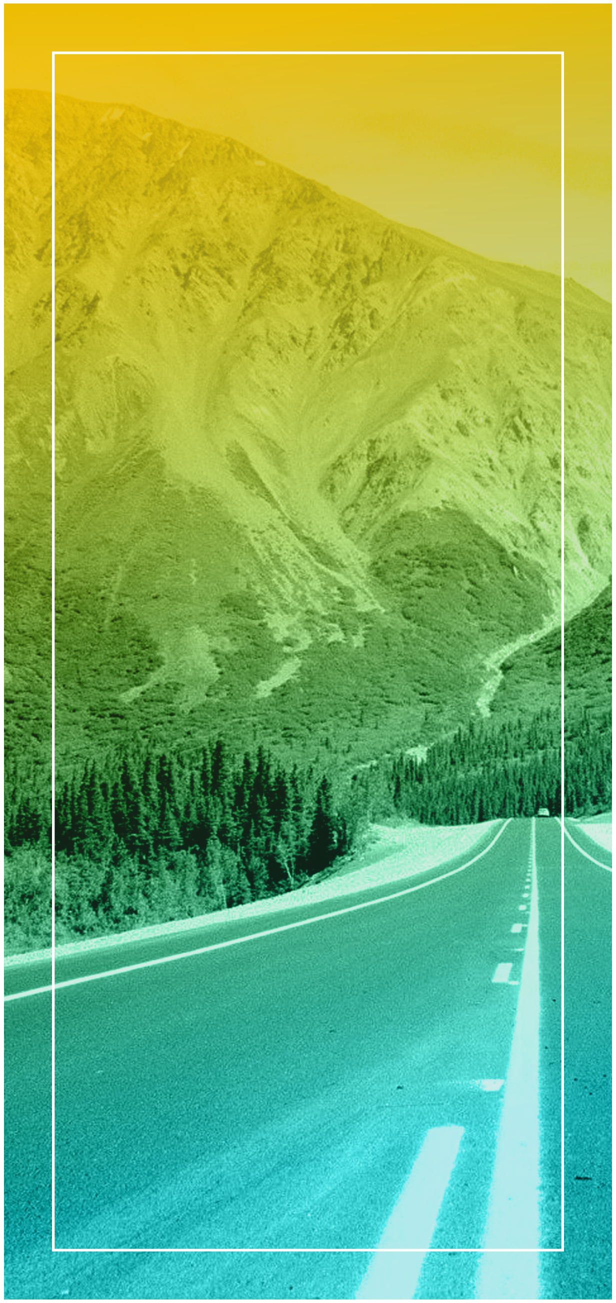
TAMP Development within DOT&PF

The initial TAMP was developed in 2017 and 2018 by a TAM team composed of a coordinator and members from Pavement Management, Bridge Management, Planning, and the MPOs. This team used guidance provided by FHWA, Planning, and the financial office to build the TAMP. At that time, the Pavement Management and Bridge Management systems were not yet implemented, and a spreadsheet tool was used for life-cycle planning.

In 2021 DOT&PF started updating the TAMP. By this time, the asset management systems had been implemented for both pavement and bridge life-cycle planning analysis. Agile Assets Pavement Analyst was implemented in 2020 for pavement management and AASHTOWare BrM was implemented for bridge management

The Asset Management Team has taken the lead in preparing the 2022 TAMP in close coordination with the Bridge and Pavement teams, the Planning and Program Development Division. Guidance on TAM and key TAMP components published by FHWA and AASHTO was referenced, and the recently implemented bridge management and pavement management systems were used for the data analysis to support the development of the 2022 TAMP. Updates to the Risk Management section were based on the most recent annual Risk Management Workshop which was held in August of 2021.

The TAM Lead provided an executive briefing where comments were received and addressed prior to approval by the Commissioner and transmission to the FHWA Division office.



Appendix B: Performance Management

SUMMARY OF TRANSPORTATION PERFORMANCE MANAGEMENT

Transportation and planning agencies apply TPM principles in making decisions about where to invest resources. Management plans developed for the various programs document these processes and investment strategies. All management plans are then used in the performance-based planning and programming process to make investment trade-off decisions. Figure B-1 illustrates the TPM approach.

TPM ensures performance targets and measures are developed in cooperative partnerships based on reliable data and objective information and aligned with the national goal areas. DOT&PF considers the following measures when making investment decisions in developing the STIP and capital program:

- Infrastructure Condition (TAM)
- Congestion Mitigation and Air Quality Improvement (CMAQ)
- Safety (HSIP/HSP)
- Travel Time Reliability
- Freight Movement

The TPM program performance measures are set by FHWA, and program targets are set by states.

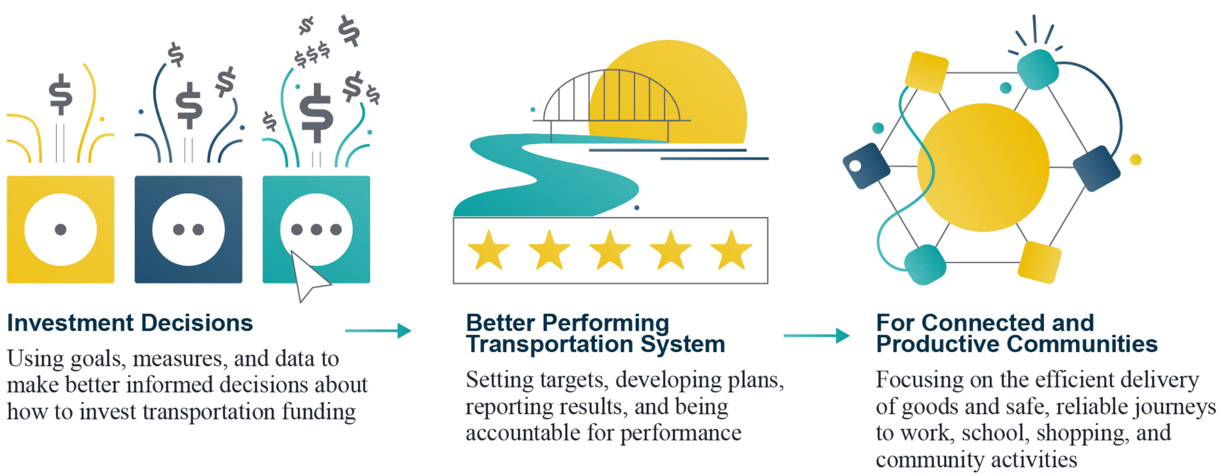


Figure B-1. TPM approach.

Targets are a quantifiable level of performance, expressed as a value for the measure, to be achieved within a time period required by FHWA. The federal TPM rule requires targets to be set for 2- and 4-year time periods within a 4-year performance period. The first performance period for TPM (except CMAQ) began January 1, 2018, and ended on December 31, 2021. The performance period for CMAQ's emissions reduction measure began on October 1, 2017, and ended on September 31, 2021.

Each of these programs competes for funding to improve the overall performance of the transportation system. Below is a summary of each of the five TPM programs, the associated performance measures for each, and the DOT&PF targets and funding levels for each.

TAM—TRANSPORTATION ASSET MANAGEMENT—BRIDGE AND PAVEMENT

Asset Management is the application of the TPM approach to manage the condition of the infrastructure assets that are needed to provide mobility and safety on the nation's transportation system.

Asset management plans such as this one are the framework for developing the investment strategies to address infrastructure condition targets, as well as addressing risk and managing assets for their whole life at the lowest practicable cost.

Section 2, Inventory and Condition, and Section 3, Performance Management, detail the performance measures and targets for pavements and bridges.

The recommendations for pavement and bridge funding levels can be found in Section 4, Financial Plan, table 4-4.

CONGESTION MITIGATION AND AIR QUALITY IMPROVEMENT PROGRAM

The CMAQ program provides a flexible funding source to the state for projects and programs to help meet the requirements of the Clean Air Act. The goal for these projects is to reduce congestion and improve air quality for areas that do not meet the National Ambient Air Quality Standards for ozone, carbon monoxide, or particulate matter (nonattainment areas) and for former nonattainment areas that are not in compliance (maintenance areas). Table B-1 shows the CMAQ targets established in May of 2018 for the initial performance period. These targets will be reviewed and revised as appropriate for the next performance period.

Table B-2 shows the CMAQ STIP funding for projects around the state for the next 4 years.

Table B-1. CMAQ performance targets (Daily Kilogram).

Performance Measures	*Baseline*	*2-Year Target*	*4-Year Target*
Total Emission Reductions: PM2.5	400.600	0.050	0.050
Total Emission Reductions: NOx	4663.000	0.050	0.050
Total Emission Reductions: VOC	None	None	None
Total Emission Reductions: PM10	1943.000	2.000	4.000
Total Emission Reductions: CO	5023.000	20.000	40.000

All units are daily kilograms

Table B-2. CMAQ 4-year STIP funding.

FFY22	*FFY23*	*FFY24*	*FFY25*
$15.5 million	$12.7 million	$13.0 million	$13.3 million

SAFETY

The Safety Performance Measures are established for the HSIP and are used to assess fatalities and serious injuries on all public roads.

The Safety PM Final Rule establishes five performance measures as the 5-year rolling averages including:

- Number of fatalities
- Rate of fatalities per 100 million Vehicle Miles Traveled (VMT)
- Number of serious injuries
- Rate of serious injuries per 100 million VMT
- Number of non-motorized fatalities and non-motorized serious injuries

The State of Alaska has a vision of zero fatalities and serious injuries but is required by federal law to set “targets” for these metrics. The target shown in table B-3 is not a metric the state is trying to meet but one it is required to forecast—namely the accident rate that will most likely occur based on historical data and trends. The performance measures are included in the HSIP, HSP or both. Table B-3 shows the performance targets set annually by June 30 for the following calendar year.

Table B-3. Targets for forecasting fatalities and injuries.

Metrics	2022	2021	2020	HSIP	HSP
Date Target Set	5/20/21	4/30/20	3/1/19		
Fatalities	≤ 70	≤ 75	≤ 80	✓	✓
Fatality Rate	≤ 1.3	≤ 1.4	≤ 1.5	✓	✓
Serious Injuries	≤ 325	≤ 330	≤ 400	✓	✓
Serious Injury Rate	≤ 5.9	≤ 6.0	≤ 7.5	✓	
Non-motorized Fatalities and Serious Injuries (combined)	≤ 58	≤ 60	≤ 70	✓	

Table B-4 includes Safety STIP from Amendment 2 approved January 30, 2019. This is the level of funding for projects around the state for the next 4 years:

Table B-4. 4-year safety STIP funding.

FFY22	FFY23	FFY24	FFY25
$69.3 million	$74.0 million	$75.5 million	$77.0 million

TRAVEL TIME RELIABILITY

Travel time reliability measures the extent of unexpected delay. A formal definition for travel time reliability is the consistency or dependability in travel times, as measured from day-to-day and/or across different times of the day.

Travel time reliability is significant to many transportation system users, whether they are vehicle drivers, transit riders, freight shippers, or even air travelers. Personal and business travelers value reliability because it allows them to make better use of their own time. Shippers and freight carriers require predictable travel times to remain competitive. Reliability is a valuable service that can be provided on privately financed or privately operated highways. Because reliability is so important for transportation system users, transportation planners and decision-makers should consider travel time reliability a key performance measure.

Level of Travel Time Reliability (LOTTR)[2] is defined as the ratio of the 80th percentile travel time of a reporting segment to a "normal" travel time (50th percentile), using data from the FHWA National Performance Management Research Data Set (NPMRDS) or equivalent. Data is collected in 15-minute increments during all time periods other than 8 p.m.-6 a.m. local time. The measures are the percent of person-miles traveled on the relevant NHS areas that are reliable. Table B-5 shows the LOTTR targets that were set in May 2018. These targets will be reviewed and updated as needed in the fall of 2022 for the next performance period.

Table B-5. LOTTR performance targets.

Travel Time Reliability	2-year Target	4-year Target
Interstate (LOTTR)	92%	92%
Non-Interstate NHS (LOTTR)	N/A	70%

LOTTR performance measures are a federal requirement but do not drive Alaska projects. Alaska projects need capacity improvements from areas with a growing population. Reconstruction and other projects support capacity improvement projects.

FREIGHT MOVEMENT

The FAST Act established a new National Highway Freight Program to improve the efficient movement of freight on the National Highway Freight Network (NHFN) and support several goals, including:

- Investing in infrastructure and operational improvements that strengthen economic competitiveness, reduce congestion, reduce the

2 FHWA TPM FAQs on Travel Time Reliability

cost of freight transportation, improve reliability, and increase productivity

- Improving the safety, security, efficiency, and resiliency of freight transportation in rural and urban areas
- Improving the SOGR of the NHFN
- Using innovation and advanced technology to improve NHFN safety, efficiency, and reliability
- Improving the efficiency and productivity of the NHFN
- Improving state flexibility to support multi-state corridor planning and address highway freight connectivity
- Reducing the environmental impacts of freight movement on the NHFN

Freight movement is assessed by the truck travel time reliability (TTTR) Index which is a subset of the Travel Time Reliability index that shows only freight travel times. Reporting is divided into five periods: morning peak (6-10 a.m.), midday (10 a.m.-4 p.m.) and afternoon peak (4-8 p.m.) Mondays through Fridays, weekends (6 a.m.-8 p.m.), and overnights for all days (8 p.m.-6 a.m.). The TTTR ratio will be generated by dividing the 95th percentile time by the normal time (50th percentile) for each segment. Then, the TTTR Index will be generated by multiplying each segment's largest ratio of the five periods by its length, then dividing the sum of all length-weighted segments by the total length of Interstate. Table B-6 shows TTTR targets set in May 2018. These targets will be reviewed and updated as needed in the fall of 2022 for the next performance period.

Table B-6. TTTR Performance Targets.

Freight Travel Time Reliability	2-year Target	4-year Target
Interstate TTTR Index	2.0	2.0

Table B-7 includes TTTR STIP funding for projects around the state for the next 4 years, which were outlined in the Implementation Guidance.

*Table B-7. 4-year TTTR STIP funding.**

FFY22	FFY23	FFY24	After 2024
$70.0 million	$70.0 million	$70.0 million	$70.0 million

*The amounts for TTTR STIP funding will be finalized after public review of the State Freight Plan.

Appendix C: Asset Overview—Pavements

Only NHS pavement assets are considered for the purposes of the TAMP, and these pavement assets are categorized as Interstate and non-Interstate. DOT&PF owns and operates the entire 1080.2 miles of the Interstate network and 1126.6 of the 1148.5 miles of the non-Interstate NHS in Alaska. In addition, DOT&PF maintains an additional 3475.2 miles of non-NHS roadways. Alaska is unique to the rest of the United States because 325 miles of the Dalton Highway, which is part of the Alaska non-Interstate NHS, is unpaved. The Dalton Highway is the haul road to the North Slope that parallels the Trans-Alaska Pipeline System where large portions of the road are constructed over unstable permafrost. This unstable permafrost is not cost-effective to stabilize and pave over, so large portions of the road remain gravel or receive other maintenance treatments, such as high float surfacing. When these sections of road deteriorate to where they are unable to be addressed through maintenance, a gravel resurfacing project may be performed. Figure C-1 to the right is of the Dalton Highway in an area of stable embankment near Coldfoot.

Figure C-1. Dalton highway stable embankment. Source: Fugro.

Table C-1. NHS total centerline miles.

Facility Type	Total	DOT&PF	Municipality of Anchorage	Other Entities
Interstate	1080.2	1080.2	0	0
Non-Interstate NHS (paved)	822.4	800.8	20.4	1.2
Non-Interstate NHS (unpaved)	326.1	325.8	0	0.3

NHS INVENTORY

Table C-1 includes the centerline mileage inventory of Interstate and non-Interstate NHS roads in the state based on data collected in summer of 2021.

Table C-2 lists NHS sections owned/operated by other entities beside DOT&PF. Because the percentage of the NHS that is owned by others is so small, it does not affect the state's overall condition.

Table C-2. NHS sections owned/operated by other entities.

Route	Jurisdiction	Intermodal Type	Surface
Bragaw Street (Anchorage)	County	NA	Paved
Abbott Road (Anchorage) (Hillside)	County	NA	Paved
36th Avenue (Anchorage)	County	NA	Paved
Lake Otis Parkway (Anchorage)	County	NA	Paved
Ocean Dock Road (Anchorage)	County	NA	Paved
Northern Lights Boulevard (Anchorage)	County	NA	Paved
15th Avenue (Anchorage)	County	NA	Paved
Old Seward Highway (Anchorage)	County	NA	Paved
Debarr Road (Anchorage)	County	NA	Paved
Providence Drive (Anchorage)	County	NA	Paved
Dowling Road (Anchorage)	County	NA	Paved
Nenana Street (Nenana)	City or Municipal	Port Terminal	Unpaved
Nenana Street (Nenana)	City or Municipal	Port Terminal	Paved
Front Street (Nenana)	City or Municipal	Port Terminal	Paved
Dock Road (Nenana)	City or Municipal	Port Terminal	Unpaved
Sixth Street (Nenana)	City or Municipal	Port Terminal	Paved
Church/2nd Street (Wrangell)	County	Ferry Terminal	Paved
Wrangell Avenue (Wrangell)	County	Ferry Terminal	Paved
Yandukin Drive (Juneau)	County	Airport Terminal	Paved
Shell Simmons Drive (Juneau)	County	Airport Terminal	Paved
Marine Way (Kodiak)	City or Municipal	Ferry Terminal	Paved

NON-NHS INVENTORY

Although the focus of the TAMP is on the NHS pavement inventory, DOT&PF is also responsible for maintaining a significant network of non-NHS roadways. These roadways are also critical to the Alaska transportation system and in supporting the goals in the LRTP. They also require regular maintenance, rehabilitation, and modernization and therefore compete with NHS facilities for limited funding resources. DOT&PF nominates projects for inclusion in the STIP as needed.

Figure C-2 illustrates the breakdown of DOT&PF's total pavement network including NHS and non-NHS pavements in addition to the NHS pavements owned by others.

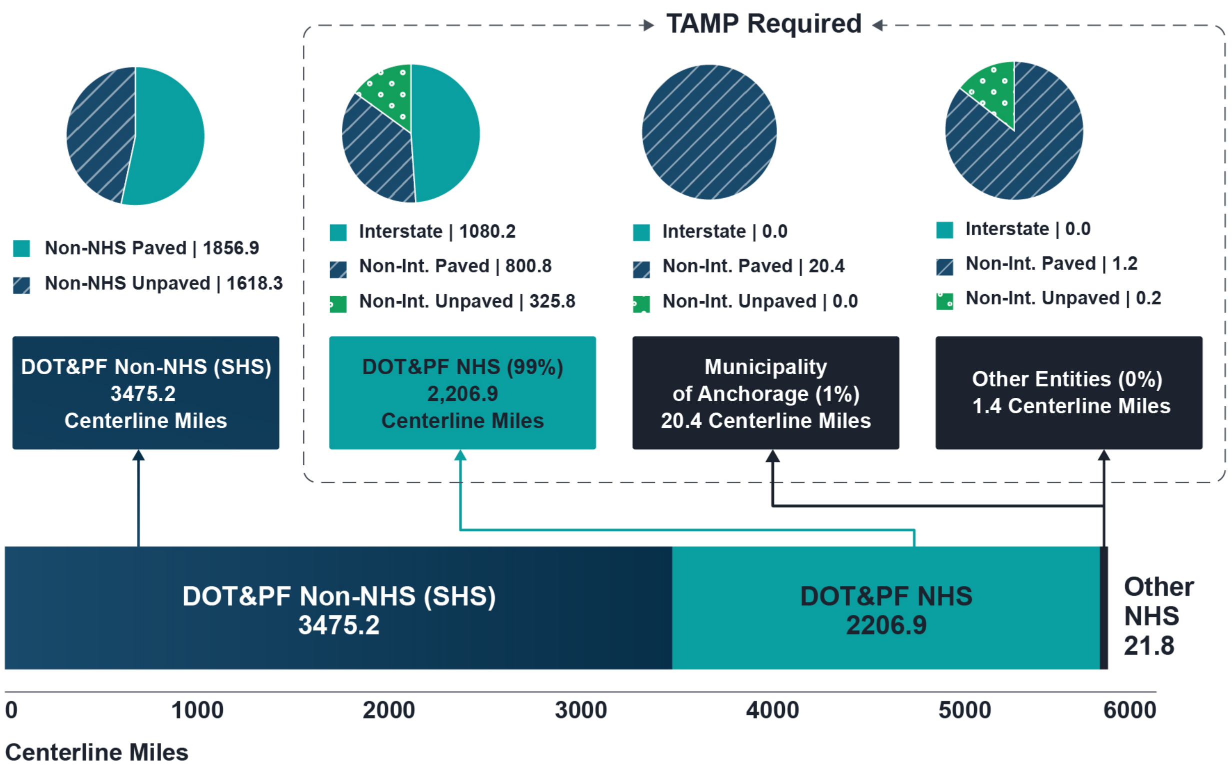


Figure C-2. NHS and DOT&PF non-NHS pavements by centerline miles, category, and owner.

FEDERAL PERFORMANCE MEASURES

As described in Section 2, the federal performance measures use IRI, fatigue cracking, and rutting as metrics for assessing asphalt pavement conditions. As required by FHWA, DOT&PF collects pavement condition data on NHS paved roads annually for rutting and roughness and for longitudinal, transverse, and fatigue cracking.

The DOT&PF has collected many years of rutting and roughness data but began collecting full extent cracking data beginning in 2014. DOT&PF changed data collection contractors in 2018 and now uses Fugro to collect rut, roughness, and cracking data on all paved DOT&PF and NHS roads.

DOT&PF plans to use the federal overall pavement rating defined in the TPM rules and described in Section 2 to classify pavement condition until Alaska develops its own index that better represents its pavement conditions and treatment thresholds. FHWA final rules allow the use of PSR in lieu of IRI for roads with posted speed limits less than 40 mph. DOT&PF does not intend to use PSR on NHS routes.

PAVEMENT CONDITION SUMMARY

Based on the federal metrics, Alaska's NHS and SHS network conditions are summarized in figures C-3 and C-4. The non-NHS was analyzed using the same federal metrics even though non-NHS is not required for inclusion in the TAMP. DOT&PF will continue to track the state non-NHS network by the federal metrics since these routes are included in the PMS, which uses the federal performance measures and the same modeling and decision trees. Figure C-3 shows that in 2021 all three of DOT&PF's pavement networks are performing similarly, with a slightly larger portion of the non-Interstate NHS in *Poor* condition and a lower percentage in *Good* condition as compared to the Interstate and non-NHS networks. Figure C-4 shows that the historical pavement performance of these three networks remained fairly constant over the last 4 years, with a slightly improving trend in pavement condition on the non-Interstate NHS. The non-Interstate NHS shows the largest percentage of pavement in *Poor* condition due to DOT&PF Northern Region NHS that goes through so much of the unstable permafrost regions.

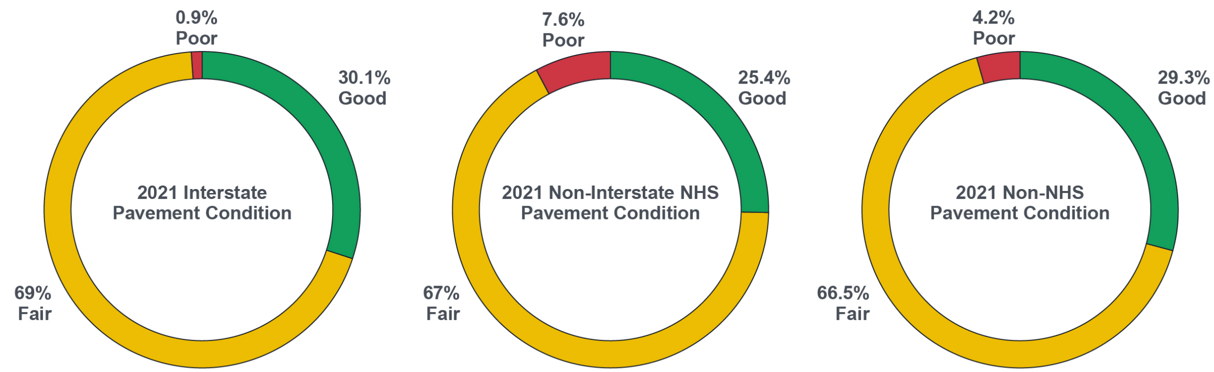


Figure C-3. 2021 Pavement conditions for Interstate NHS, Non-Interstate NHS and Non-NHS DOT&PF roadways.

PAVEMENT MANAGEMENT SYSTEM IMPLEMENTATION

As stated in Section 2, DOT&PF has established the following pavement management objectives:

- Treat pavements in *Good* and *Fair* condition before they deteriorate to save money over the pavement's life cycle.
- Provide information to allow effective selection and design of future surface treatments, rehabilitation, and reconstruction projects.
- Accurately estimate future conditions versus funding scenarios to evaluate current pavement funding strategies.
- Display analysis results in understandable formats.

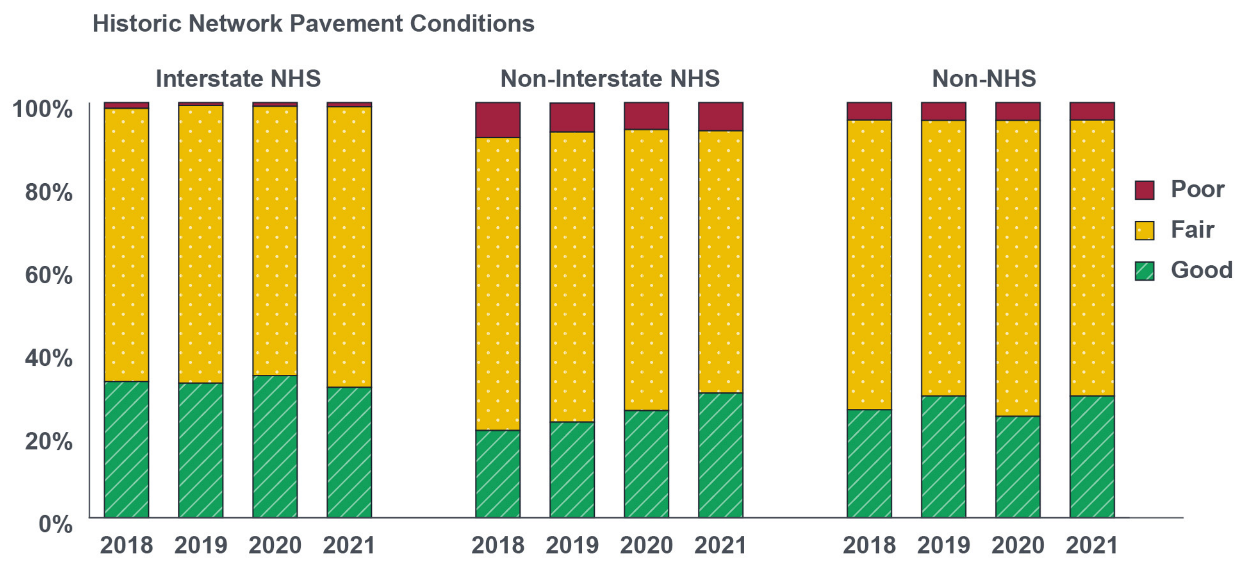


Figure C-4. Historic pavement network conditions for Interstate NHS, Non-Interstate NHS and Non-NHS DOT&PF roadways 2018-2021.

When MAP-21 was signed into law, DOT&PF did not have a PMS that could forecast pavement conditions or track where money was historically spent on the road network relative to pavement condition to fully assist in meeting its pavement management objectives. DOT&PF procured its PMS in May 2016 and implemented the system in January 2020. The Maintenance Management System (MMS) is also being replaced. These systems will provide more accurate data on where the Department is spending money and which maintenance and preservation treatments are most effective.

DOT&PF has implemented AASHTOWare Project, Preconstruction, Civil Rights, and Labor modules and will be implementing Construction and Materials over the next few years. The AASHTOWare system tracks bids, construction costs, time, certified payroll, items, material testing, and more to help analyze patterns and increase the accuracy of project cost estimates and decisions making.

When the Pavement Management System was initially being developed, other states' frameworks were being evaluated. The initial decision trees in the system used by Washington State DOT were used as an outline. The first model was set up using IRI as the main controlling factor, but after discussions with several states, including Washington, the model was changed to use fatigue cracking as the first level of classification. The reasoning was that fatigue cracking could indicate there are some base/embankment failures that preservation techniques will not correct. The next level was IRI since it can also indicate structural issues but can show artificial high values in urban sections. The last item was rutting. Rutting is caused by heavy loads at intersections or studded tires and can be improved by resurfacing and is the last "limb" of the tree for pavement treatment options.

A Pavement Preservation workshop and Peer Exchange was held February 21-22, 2019, in Anchorage with Department of Transportation representatives from Washington, Idaho, Montana, and Minnesota. Pavement decision trees and deterioration modeling were discussed, as well as preservation techniques. At this peer exchange it

Pavement Management System Improvements Since 2019

DOT&PF continues to make technical advances in pavement management since publication of the 2019 TAMP. The most notable change is a migration away from spreadsheet tools and towards robust systems of record which meet the current business needs of DOT&PF and its partners.

The new Pavement Management System can account for condition and serviceability through an assortment of distresses and deterioration curves including rutting, cracking, and IRI. The previous pavement management spreadsheet tool was only capable of condition group models *(Very Good/Good/Fair/Poor/Very Poor)*.

Using these distress models, the PMS can forecast pavement conditions and utilize complex decision trees to identify work candidates. The new decision trees consider costs for each specific treatment type and asset properties, such as subgrade stability. Through these configurations, work planning estimates have a much higher level of precision than before.

On a network level, the PMS can optimize pavement management funds throughout the state. Multiple constraints (typically budgets, performance targets, and currently planned projects) are used within the system to maximize the quality of investments over an analysis period.

The system is customizable, with room for models that improve both accuracy and precision of DOT&PF's pavement management programs. Despite the increased level of effort needed to configure these models, DOT&PF will continue to make improvements to the PMS in the future.

was learned that Alaska's PMS implementation will be an iterative process, where updates to the decision trees and deterioration models will need to annually take place as the system grows and the recommendations provided to the regions are reviewed and feedback is received.

The peer exchange provided an opportunity for regional experts and out of state representatives to review preliminary recommendations from the decision trees and methods being used in DOT&PF's PMS implementation. It was learned that additional weighting factors are needed when making recommendations to prioritize higher functional classification routes over lower ones and the management section length of approximately three miles is a good starting point for the system. It was also learned that there are many more preservation techniques that should be evaluated in Alaska. These include ultra-thin bonded overlays, scrub seals, and cape sealing. These preservation treatments will be considered for use in the following years.

In 2020 a thin inlay was placed on Fireweed Avenue in Anchorage to evaluate the performance compared to a traditional mill and fill treatment. Another preservation treatment currently being evaluated is microsurfacing, which was placed on the ramps of Minnesota Drive, also in Anchorage.

Adjustments have been made to the Pavement Management System since it was implemented in 2020. These include revisions to the decision trees, deterioration models, and evaluations of weighting factors for prioritization of higher functionally classed roads.

Due to the permafrost and other embankment conditions, the Subgrade Stability Index was added to the decision trees. The index comes from Northern Region Maintenance staff and the rating is classified as A, B, or C. Level A indicates a *Good* stable embankment, Level B represents *Fair*, and Level C is a *Poor* condition indicating the presence of unstable permafrost. Any missing data from M&O defaults to a Level of Service A. In 2021, an update to the subgrade stability index was started, with input from the Northern Region Materials Section, that will be implemented in 2022 after additional review.

The intent of PMS is to maintain the network at a desirable performance level with a minimum cost. With the exception of unstable foundation areas, such as permafrost, the PMS uses measured surface condition and pavement performance models to select an appropriate action for each section of paved roadway. In the areas of unstable foundations, it is difficult to model pavement performance as Maintenance and Operations (M&O) performs so many repairs to level out roads from thawing permafrost. Because of this, M&O performs annual field inspections to identify areas of safety concerns which require repair. Tracking of annual maintenance costs in the MMS will identify high-cost maintenance locations where benefit-cost analysis can be performed to verify what repair methods are most efficient for unstable foundation area (routine annual patching, more frequent low-cost short life overlays, or reconstruction). That information will be tracked in the PMS after MMS goes live.

ALASKA PAVEMENT INDEX (IN DEVELOPMENT)

Until 2013, DOT&PF used the PSR as an index only to assess pavement health. PSR computations were completed using rutting and IRI only. DOT&PF has developed a new pavement index (Alaska Pavement Condition Index—APCI) to measure pavement using rutting, IRI, and fatigue cracking data. Each of these three distresses is converted to a 0 to 100 measure where 100 is perfect condition, 50 is the *Poor* value from the federal metrics, and below 50 is a degree of failure. These three measures are then averaged together into the APCI, which is used within the Pavement Management System to assist with project selection.

The APCI is being updated to include a deduct value based on longitudinal and transverse cracking, patching, and raveling. These distresses have a major impact on roads throughout Alaska. Thermal and frost cracks are prevalent across Alaskan roads due to extremely cold temperatures and M&O performs significant patching repairs across roads that need to be accounted for.

Fugro assisted in the development of the updated APCI and built a spreadsheet tool to model rut, IRI, cracking, and the updated APCI using historically collected pavement data. Pavement condition data can be added to the spreadsheet in the future to continue updates to deterioration

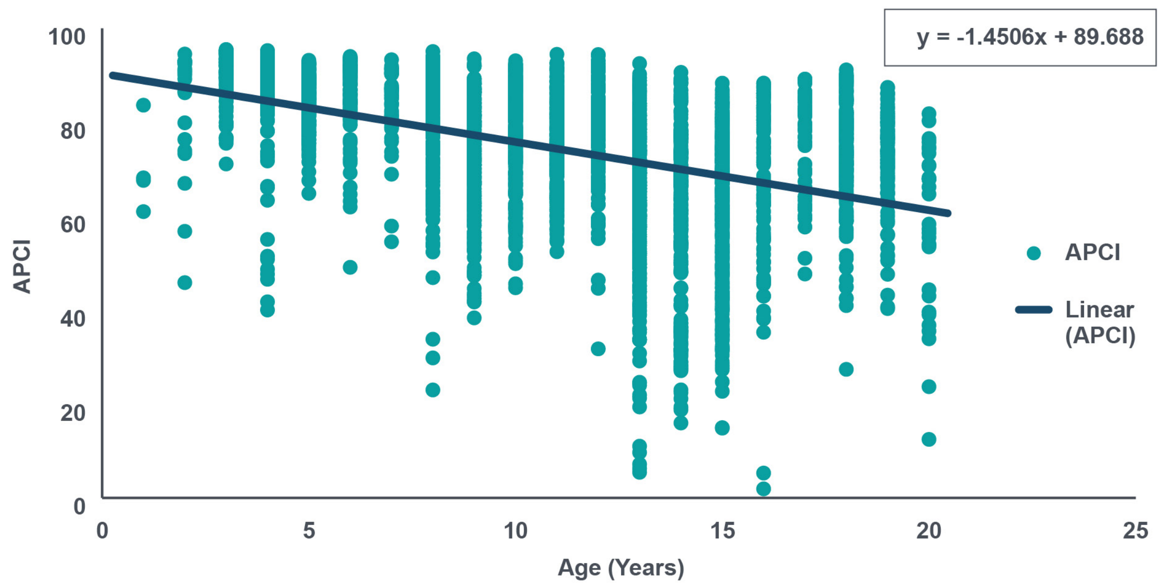


Figure C-5. Deterioration model for APCI.

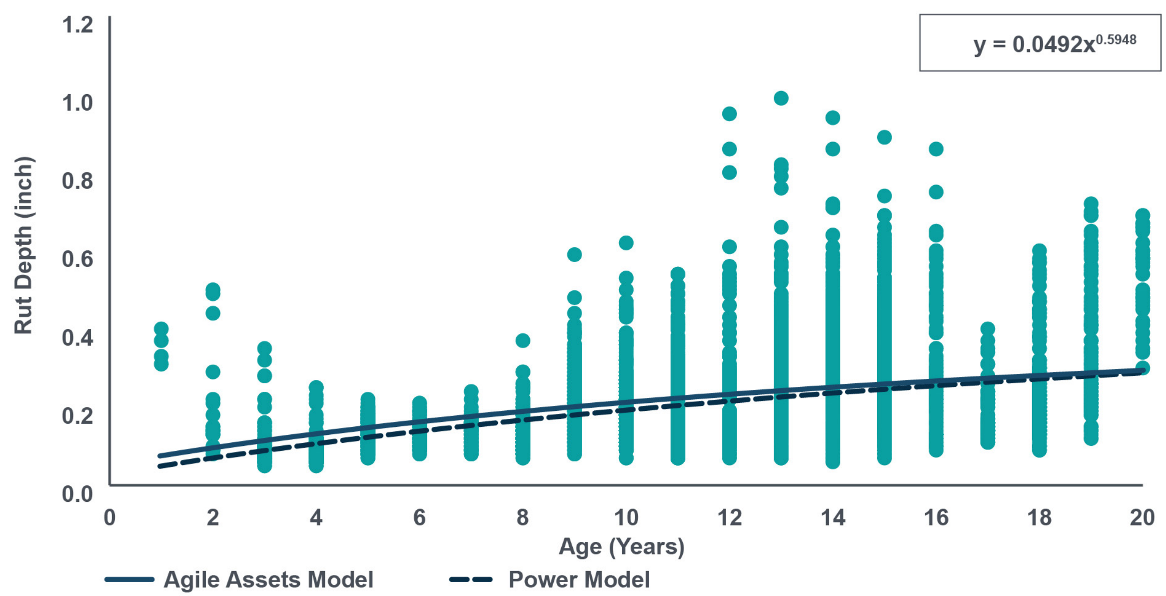


Figure C-6. Deterioration model for rutting.

models. An example of the updated APCI is shown below in figure C-5. This method was used to create deterioration models for the updated APCI in the Pavement Management System and to verify existing deterioration models. Figure C-6 is an example of the verification of the rutting deterioration model from the PMS.

Triggers in the PMS were determined for different treatment categories that include preservation (preventive maintenance and minor rehabilitation), major rehabilitation, and reconstruction. Preventive maintenance treatments include fog sealing, chip sealing, microsurfacing, or other treatments to keep a *Good* road in *Good* condition. Minor rehabilitation includes thin overlays or mill/fill type treatments with possible isolated structural improvements. Major rehabilitation includes full depth reclamation, base stabilization, and structural overlays greater than a 2-inch thickness. It is recommended that reconstruction be triggered upon a road's reaching or passing end of service life. Figure C-7 illustrates these decision points.

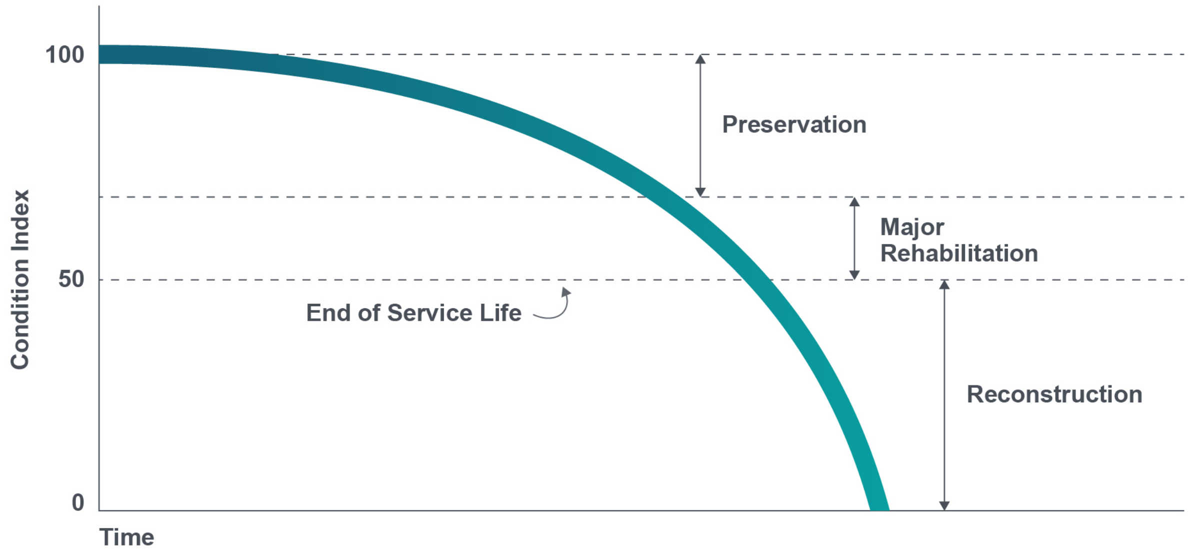


Figure C-7. Condition Index model.

Table C-3. Non-NHS pavement targets.

Performance Measures	*2-year Target*	*4-year Target*	*2021 Condition*
Poor Pavement Condition on the non-NHS	<15%	<15%	4.2%
Good Pavement Condition on the non-NHS	<15%	<15%	29.3%

STATE PERFORMANCE MEASURES FOR PAVEMENT CONDITIONS

In addition to the performance measures for the NHS described in Section 1.4, Alaska has set performance measures for the non-NHS for Pavement Management staff to use as a guide, but they are not required for or included in the TAMP. Table C-3 shows the non-NHS pavement targets set by DOT&PF and the current pavement network conditions.

PERFORMANCE GAP IDENTIFICATION

The goal of pavement management is to meet the established pavement condition targets for both the NHS and non-NHS pavement networks. The NHS gap analysis is described in Section 3.1 and Appendix E. For the non-NHS network (table C-8), pavement conditions currently exceed both established performance goals, with 4.2 percent of the network in *Poor* condition falling below the maximum percent *Poor* goal of 15 percent and 29.3 percent of the network in *Good* condition exceeding the desired goal of 15 percent *Good* pavement.

PAVEMENT ASSET MANAGEMENT STRATEGIES

As part of the DOT&PF's asset management approach, maintenance staff actively performs preventive maintenance on all DOT&PF maintained roadways. The pavement deterioration models include the effects of surface maintenance; therefore, maintenance is considered a critical component of a pavement's life-cycle costs.

Maintenance work is performed by contractors and in-house staff and includes crack sealing, patching, banding, chip seals, and high floats. Without this work the pavement would have a short life expectancy; therefore, it is critical to maintain the current level of effort in the maintenance budget.

PAVEMENT PRESERVATION

Pavement preservation is a program of activities aimed at preserving the nation's highway system, enhancing pavement performance, extending pavement life, and meeting customer needs[3]. It includes work that is planned and performed to improve or sustain the condition of the transportation facility in a state of good repair. It often excludes structural improvements (such as an overlay), capacity improvements, major rehabilitation, and reconstruction.

The DOT&PF's pavement preservation program includes the following actions:

- Review the road system
- Select the road
- Determine the cause of the problem
- Select the appropriate treatment
- Identify the right time to apply the treatment

The Pavement Management System has been used since 2020 to provide annual pavement preservation recommendations to the three DOT&PF Regions. Projects under this program fall in the scope of preventive maintenance or minor rehabilitation. The regions internally evaluate the recommended pavement preservation projects during their annual preservation plan development. During this process, the regions review the recommended projects, evaluate other known needs, and ensure the preservation program is able to adequately address the distresses on the roads. Each region sends their selected projects and feedback regarding the recommendations back to the Pavement Management Engineer. These projects are combined into an annual pavement preservation plan that is reviewed and then approved by a statewide steering committee composed of regional and statewide directors.

Once the Maintenance Management System is live it will send performed maintenance activities to the Pavement Management System to track cost and work performed over the road network. A future enhancement of the system will be to track a 3-year average for expended maintenance cost over sections of road to identify areas requiring high levels of maintenance.

MAJOR REHABILITATION/ RECONSTRUCTION

Project needs from the Pavement Management System beyond the scope of pavement preservation are sent to Planning for review and possible inclusion in the STIP. Selected projects are nominated into categories based on the identified need. These project scopes may include SOGR, Modernization, or Capacity. SOGR projects are pavement-focused to repair pavements and maintain them in a state of good repair. There are no modernization or capacity needs within the project area. Modernization projects may include shoulder widening, turn lanes or passing lanes, and have a broader focus than SOGR projects. Capacity projects are those which focus on expansion. Nominated projects compete for the available funding within the categories. Additional details are outlined in the Highway Pavement Maintenance, Preservation, and Rehabilitation Policy and Procedure #07.05.020.

INNOVATIVE MATERIALS FOR PAVEMENT PRESERVATION

To combat rutting and optimize life-cycle costs on certain roadways, DOT&PF began incorporating hard aggregates in surface course hot-mix asphalt on various roads in the Central and Southcoast regions in 2013 using a hard aggregate policy. Hard aggregates are those with a Nordic Abrasion value of less than 8. As defined in the hard aggregate policy, it must be used in the wearing surface of high-volume roadways ($\geq$ 5,000 AADT/lane) exhibiting studded-tire wear. To determine its cost-effectiveness, DOT&PF evaluated the life-cycle cost on Tudor Road in Anchorage, where one direction was paved with aggregates meeting the hard aggregate policy and the other was paved with locally sourced aggregates in 2005.

3 FHWA Asset Management Program

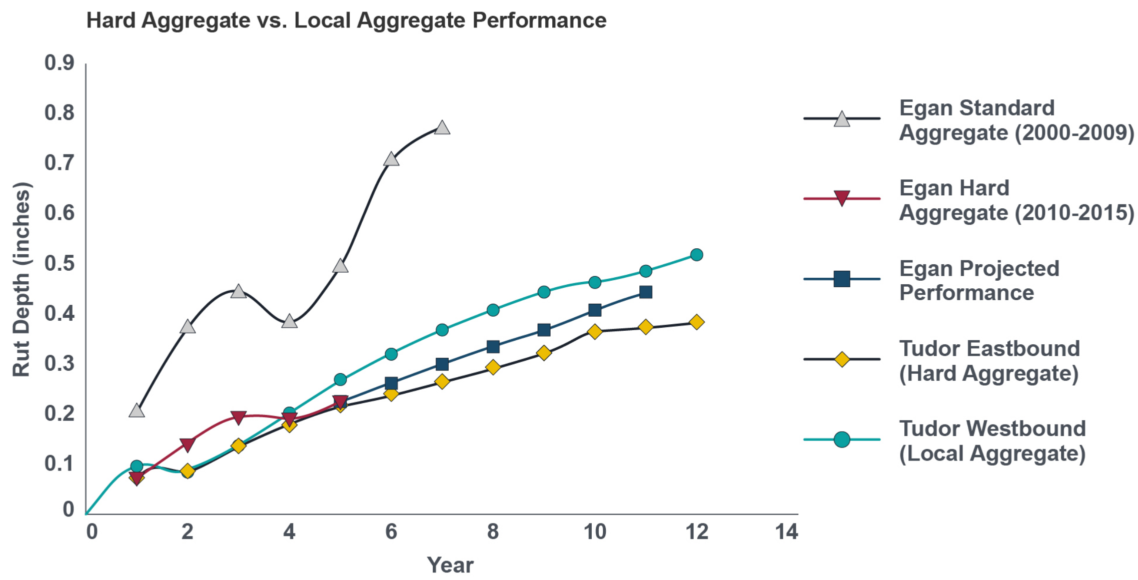


Figure C-8. Initial evaluation of hard aggregates on rut conditions.

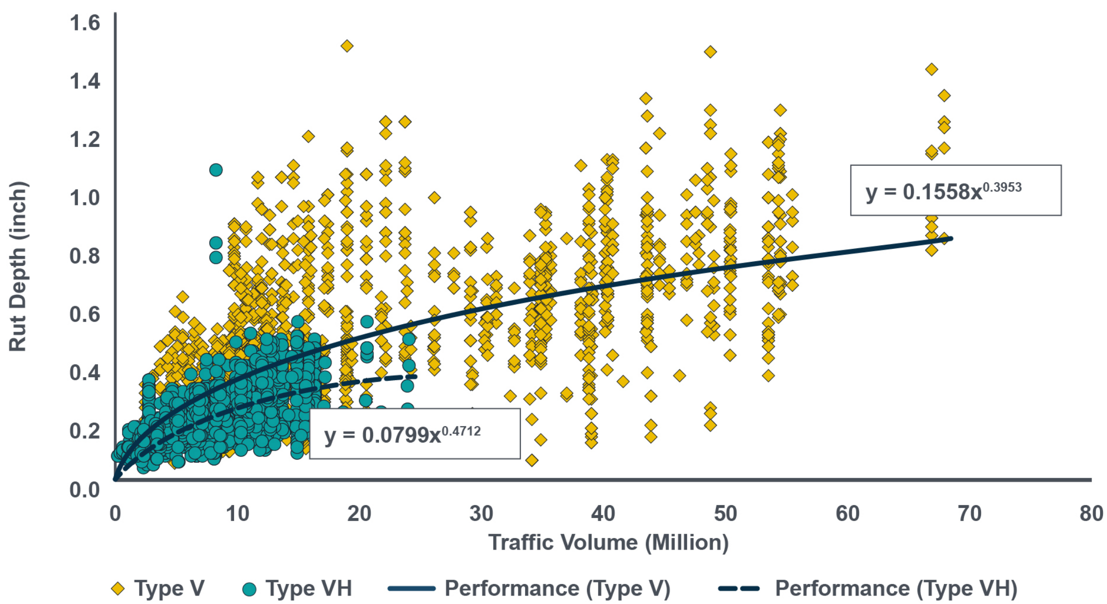


Figure C-9. Impact of hard aggregates on rutting performance in Central Region.

Figure C-8 compares the rut conditions between local and hard aggregates on Tudor Road between 2005 and 2017 and on Egan Drive between 2000 and 2015.

- Tudor Road Project Cost with Local Aggregate Asphalt Mix = $7,500,000 provides 11-year life to ½" rut, cost per year = approx. $682,000/ year.
- Tudor Road Project Cost with Hard Aggregate Asphalt mix = $9,200,000 provides 18-year life to ½" rut, cost per year = approx. $507,000 / year.

The effectiveness of this hard aggregate policy was reviewed in 2021 by comparing collected data on Superpave mixes across the Central Region to evaluate the performance of hot mix asphalts with and without the incorporation of hard aggregates. In figure C-9, the green data displays the performance of roads with hard aggregates (Type VH) while the yellow data indicates the performance of those without (Type V). The X axis is the number of vehicle passes on the lane of the road where the rut depth is measured, and the Y axis is the rut depth in inches. The results verify that the mixes incorporating hard aggregates clearly provide better rut performance than those without.

While the use of hard aggregates has reduced the rate of rutting on highly trafficked roads, in 2014 DOT&PF began evaluating if modifying binders can further improve hot mix asphalt's resistance to studded tire wear. Prall testing, a test used to simulate the effects of studded tire wear on pavements, was performed on a variety of binders modified with polymers and extenders in different ways. This testing indicated that both raising the polymer level within the binder and lowering the bottom end (softening the asphalt binder) improved studded tire resistance.

This testing led to the development of a binder that grades out to PG64-40 and typically incorporates seven percent polymer. This binder is now used in hot mix asphalt with hard aggregates on high traffic volume roads within the Central Region. Figure C-10 displays its performance compared to the previously used PG58-34 binder in Superpave mixes incorporating hard aggregates on roads with speeds less than 55mph.

EXTERNAL FACTORS

External factors are the outside forces, some of which are beyond an agency's control, that can impact the ability to achieve its strategic goals. Each factor impacts the pavement program differently. External factors were identified and considered during pavement target setting.

In summary, twenty external factors were identified that can influence pavement condition forecasting, and they are summarized in table C-4. Pavement condition was anticipated to remain steady based on no changes in funding.

The external factors that may influence pavement negatively are poor drainage, higher precipitation based on extreme weather events, and changing temperatures that increase the number of freeze thaw cycles. Alaska is experiencing warming temperatures, increased precipitation during events, and thawing of permafrost. DOT&PF designs for permafrost, and as long as it remains frozen it will support the roads. However, when the temperatures rise, the permafrost thaws, and the road embankment will fail. This is an area that needs close attention because it is changing rapidly, and treatment selection needs to change to adapt as needed. Additional information on this issue is included in Appendix G.

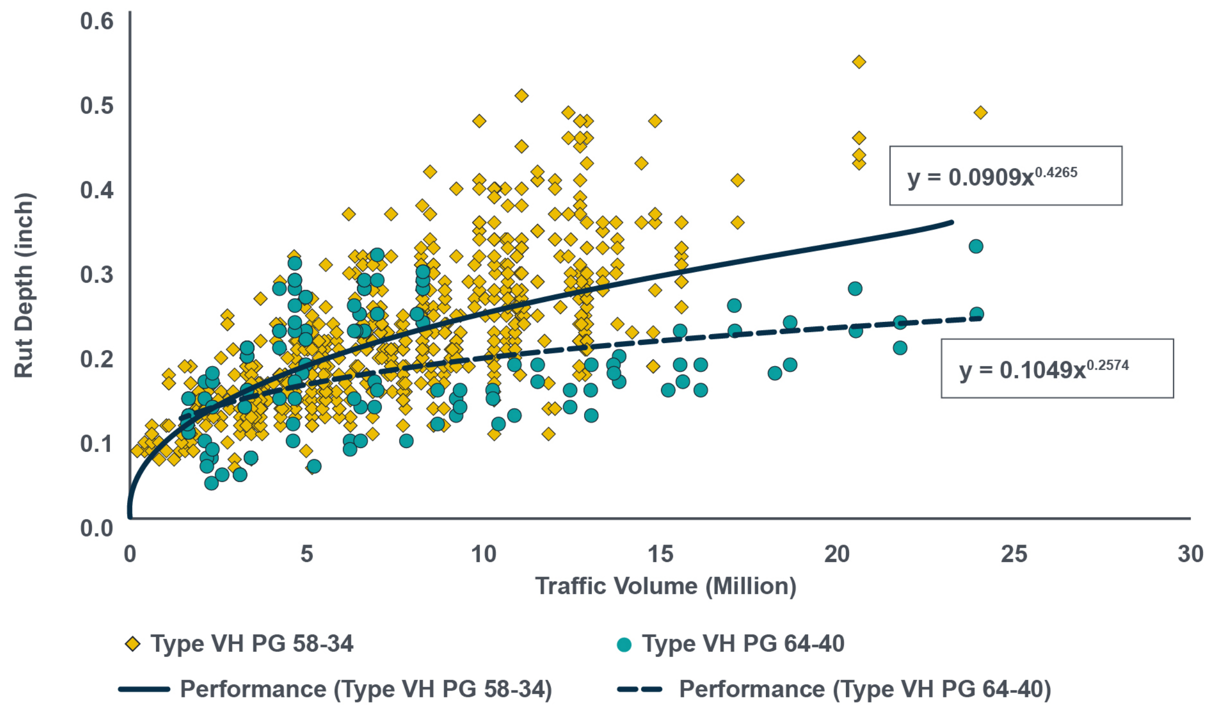


Figure C-10. Impact of PG64-40 binder on rutting performance.

Table C-4. External factors influencing pavement condition forecasting.

Factors	*Expected Condition Outcome with Factor Increase*	*Current Experience with Factor*	*Notes*	*2018-2021 Condition Forecast*
Pavement Loading				
Overloaded Vehicles/Axel Configuration and Wheel Load/Repetition of Loads	↓	↔	**Forecast:** No change **Weight:** High Pavement design, certain vehicles exempt for permitting Spring thaw with loaded vehicles	↔
Rutting—Studded Tires/Poor Subbase	↓	↑	**Forecast:** Decrease with new non-studded tire options, hard aggregates, and improved binders **Weight:** High for rutting	↔
Traffic Volume (Heavy Trucks %)	↓	↔	**Forecast:** No change **Weight:** Medium	↔
Tire Pressure	↓	↔	**Forecast:** No change **Weight:** Low High tire pressure buses	↔
Environmental, Hydraulic and Base Considerations				
Poor Drainage	↓	↓	**Forecast:** Increase **Weight:** Low	↓
Freeze/Thaw	↓	↓	**Forecast:** Increase **Weight:** Low Extreme temperature and differential transverse cracks	↓
Temperature	↓	↓	**Forecast:** Increase **Weight:** Low Low temp cause cracks; high temp loses stiffness	↓
Susceptible Foundation (Permafrost)/ Subgrade Type	↓	↔	**Forecast:** No change **Weight:** Low Wheel load on thin pavements causes deformation of subbase	↔
High Precipitation	↓	↓	**Forecast:** Increase **Weight:** Medium Groundwater <1 m pavement. Water intrusion. Caused by extreme weather events	↓
Construction Quality- Substandard Material	↓	↔	**Forecast:** No change **Weight:** Low In some areas, quality material is hard to get/localized	↔

Factors	*Expected Condition Outcome with Factor Increase*	*Current Experience with Factor*	*Notes*	*2018-2021 Condition Forecast*
Inadequate Design or Change in Conditions	↓	⇔	**Forecast:** No change **Weight:** Low	⇔
Load Factors	↑	⇔	**Forecast:** No change **Weight:** Medium If Alaska moves to actual loads instead of axels, load factors would be more accurate and could produce more efficient designs	⇔
Design Mix	↑	⇔	**Forecast:** Increase **Weight:** High Continued IR use will improve embankment quality and pavement life. Hard aggregate policy extends pavement life. Rut treatment research	↑
Geometric Considerations				
Unsafe Curves, Steep Hills Stopping Vehicles at Creep Speeds	⇔	⇔	**Forecast:** No change **Weight:** Low Low speed. Turning and stop conditions. Elevated grade. Change localized areas	⇔
Intersections (Stops/Starts)	⇔	⇔	**Forecast:** No change **Weight:** Low Low speed. Turning and stop conditions. Urban areas	⇔
Other Factors				
Funding	↑	⇔	**Forecast:** No change **Weight:** High	↑
Aging Infrastructure	↓	↑	**Forecast:** No change **Weight:** High	⇔
Maintenance	↑	⇔	**Forecast:** Increase **Weight:** High Programmatic M&O activities are eligible for federal funding	↑
Rough Roads	↓	↓	**Forecast:** Increase **Weight:** Low Rough roads (high IRI) damage vehicles, fatigue cracks, breakdown base. Localized	↓
New Cracking Data	↑	⇔	**Forecast:** Increase **Weight:** Medium New cracking data	↑

Appendix D: Asset Overview—Bridges

As of the last report to FHWA on March 15, 2021, the DOT&PF Bridge Program manages 1,036 bridges (including large culverts) on public roads in Alaska. The Department owns 839 of them; thirty-two are owned by other state agencies, and 165 are owned by local governments. The Department also inspects forty-one ramps to ferry docks, four tunnels, and 87 culverts (single culvert diameter of 20' or greater, or multiple culverts that are spaced no greater than one-half the diameter of the smaller and a combined length along centerline of the roadway greater than 20'). Fourteen of these bridges are closed to the public. Of those 1,036 structures, 425 are on the NHS. Five of these bridges are owned by other local agency entities and three by Anchorage International Airport. The eight non-DOT&PF bridges will not affect the overall state target or national goals.

Relative to the calculation of the National Bridge Performance Measures, there are two classes of bridges based on the functional class of the road the bridges serve.

- NHS-Bridges: bridges that carry the NHS (Interstates, principal arterials, and intermodal connectors including ramps) are included in calculation of the national measure.
- Non-NHS Bridges: bridges that carry highways of all other functional classifications are not included in calculation of the national measure.

INSPECTION PROGRAM

Bridges are inspected at least once every 24 months by DOT&PF bridge inspectors/engineers. Bridge inspectors examine four main components: the substructure, the superstructure, the deck, and waterway characteristics. The substructure includes the foundation, piers, and abutments of the bridge. The superstructure is the overlying framework (trusses or girders) that rest on the piers and abutments. The deck is the portion of the bridge that is visible by the driver. Inspection of waterway characteristics includes inspection of scour and any changes to the waterway since the previous inspection.

Department engineers classify the condition of Alaska bridges according to three different bridge condition categories:

- Structurally Deficient / *Poor* (National Bridge Inventory [NBI]≤4)
- Not Deficient (NBI ≥ 5)

Bridges are "rated" using NBI General Condition Ratings on a scale of 1 to 9. Bridges are considered deficient if they receive an NBI rating of 4 or lower (table D-1). Bridges are considered structurally deficient if their decks, superstructures, *or* substructures are found to be in *Poor* condition.

NBI numbers are used to report the condition of deck, superstructure, or substructure. NBI ratings are a constituent of the bridge condition rating and recommended work type (table D-2). If the deck, superstructure, or the substructure has an NBI rating below 4, then the bridge will require rehabilitation or replacement.

The deck, superstructure, and substructure are considered critical elements of a bridge. Inspections follow the AASHTO Manual for Bridge Element Inspection, 2nd edition, published in 2022.

Table D-1. NBI general condition rating scale.

Scale		***Description***
N		Not Applicable (railroad underpass and private pedestrian overcrossings of public roads).
Good	9	Excellent Condition.
	8	Very Good Condition—no problems noted.
	7	Good Condition—some minor problems.
Fair	6	Satisfactory Condition—structural elements show some minor deterioration.
	5	Fair Condition—all primary structural elements are sound but may have minor section loss, cracking, spalling, or scour.
Poor	4	Poor Condition—advanced section loss, deterioration, spalling, or scour.
	3	Serious Condition—loss of section, deterioration, spalling, or scour may have seriously affected primary structure components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
	2	Critical Condition—advanced deterioration of primary structural elements.
		Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.
Closed	1	Imminent Failure Condition—major deterioration or section loss present in critical structure components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put bridge back into light service.
	0	Failed Condition—out of service—beyond corrective action.

Table D-2. NBI rating.

Performance Target	***NBI Rating***	***Recommended Work Type***
Good	9	No Work Needed
	7-8	Preservation Candidate
Fair	6	Preservation
	5	Minor Rehabilitation/Repair Candidate
Poor	4	Rehabilitation or Replacement Candidate
	≤ 3	Replacement Candidate

The Deck Area Bridge Condition Performance measure uses the following calculation:

$$\frac{100 \times \text{Total Deck Area of } \textit{Good} \text{ or } \textit{Fair} \text{ or } \textit{Poor} \text{ Bridges}}{\text{Total Deck Area of Bridges in the State}}$$

Under MAP-21, all state transportation agencies need to collect element condition data on NHS bridges. Superstructure element data includes each beam, stringer, truss, arch, and main cable. DOT&PF will also use this more detailed information to prioritize projects. In 2021, all 1,036 DOT&PF managed bridges were submitted with element-level data.

Bridge element data is being collected for the deck, superstructure, and substructure as well as culverts, bridge rail, joints, bearings, and wearing surfaces[4]. Depending on the bridge type, different element reporting is used. The deck is the structural system that supports traffic and does not include non-structural wearing surfaces such as timber running planks and asphalt, as those are sacrificial. The superstructure includes the girders, beams, or truss that support the deck. The substructure is the foundation of the bridge and includes abutments, piles, pier caps, pier walls, and columns that support the superstructure. The deck, superstructure, and substructure include material types for steel, pre-stressed concrete, reinforced concrete, timber, masonry, and others. The other material type is anything that does not fit into one of the specified material types.

A detailed description of the element inspection can be found in the FHWA Specification for the National Bridge Inventory Bridge Element report dated 01-21-2014.

All NBI and element data collected during inspection are stored in AASHTOWare BrM BMS. This system was previously known as PONTIS Bridge Management System. DOT&PF started using PONTIS for data collection in April 2002 and transitioned to BrM in October 2014.

Prior to PONTIS, data was collected and stored in a DOT&PF programmed Microsoft Access database. In 2018, DOT&PF upgraded to a new version that satisfies 23 CFR 515.17. Those regulations require that management systems have procedures for collecting, processing, storing, and updating bridge inventory on the NHS. DOT&PF Policy and Procedure (P&P) 07.05.025 fulfills this requirement.

The BMS contains an out of the box deterioration model for bridge assets. The standard deterioration model is based on expert elicitation and collaboration of several different states. A future planned research project will develop an agency-specific model to replace the default software model.

DOT&PF developed life-cycle planning scenarios, including a no action scenario and a non-funding restrained option that were configured in the BrM. The system provides a 1-year short term as well as a 10-year long term budget needs estimate for NHS Bridges.

BrM prioritizes bridge work based on bridge condition (a combination of NBI and element condition data), utility, life-cycle cost, risk, and mobility. Utility is how much a treatment improves the condition based on the cost and the criticality of that bridge. Bridge criticality calculation includes traffic volume and detour route if the bridge is closed. Life-cycle cost calculates how deferring work now will cost more later since the structure will continue to deteriorate and will need a more costly treatment to improve condition. Risk considers bridge age, detour length, whether it is fracture critical bridge, has a load posting, does not meet seismic standard, has scour, or other concerns that do not show up in condition. Mobility considers geometric issues and average daily traffic (ADT). Mobility is usually a small factor for bridge prioritization.

FEDERAL PERFORMANCE MEASURES

The bridge performance measure is based on three metrics including Deck Rating, Superstructure Rating, and Substructure Rating. All three ratings are based on a scale of 1-9 and carry the same condition rating thresholds. *Good* is defined as a value of 7-9, *Fair* is 5-6, and *Poor* is less than 5. The lowest rating of all three metrics becomes the overall bridge condition.

The calculation for bridge deck area includes the following:

- Length = Corresponding value of NBI Item 49 (structure length for every applicable bridge)
- Width = One of the two widths described below
- Corresponding value of NBI Item 52 (deck width)
- Value of Item 32 (Approach roadway width for culverts where the roadway is on a fill [i.e., traffic does not directly run on the top slab or wearing surface of the culvert] and the headwalls do not affect the flow of traffic for every applicable bridge)

The NBI bridge deficient deck area is the sum of the bridge deck area and the culvert deck area.

4 FHWA Specification for the National Bridge Inventory Bridge Elements

The two areas are calculated using the calculations below.

Bridge Deck Area=Structure Length*Deck Width Out to Out
Culvert Deck Area=Structure Length*Approach Roadway

Bridge deck area includes culverts, typically box culverts, where traffic is driving on the top of the culvert. Culvert deck area includes culverts where traffic is driving on fill carrying the roadway.

A national goal that was part of the MAP-21 legislation requires structural deficiency of deck area to be less than 10 percent. Figures D-1 to D-3 summarize bridge conditions on the three subnetworks of bridges that DOT&PF manages.

3-year Average *Poor* = 6 percent (TARGET 10 percent)

3-year Average *Good* = 35.5 percent

3-year Average *Fair* = 58.5 percent

PERCENTAGE OF NON-NHS AND OFF SYSTEM BRIDGES—BRIDGE CONDITION BY DECK AREA

Non-NHS and off system bridges are not required to meet federal performance measures and are not included in the TAMP. However, their performance is tracked in the BMS (figure D-2 and figure D-3).

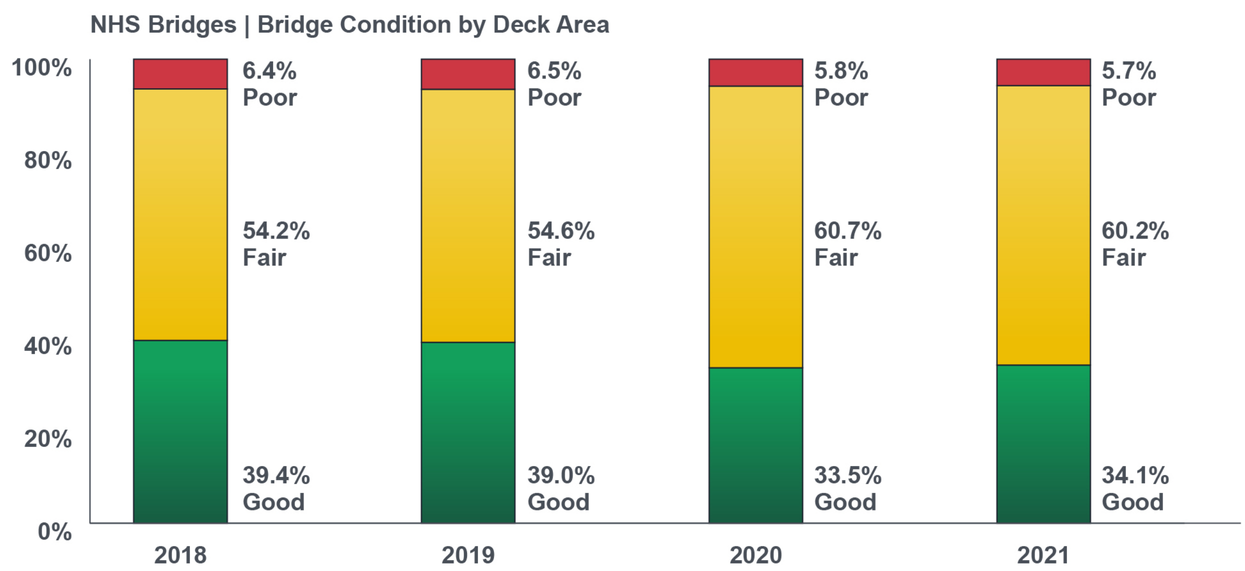


Figure D-1. Average overall NHS bridge conditions (by deck area) 4-year trend.

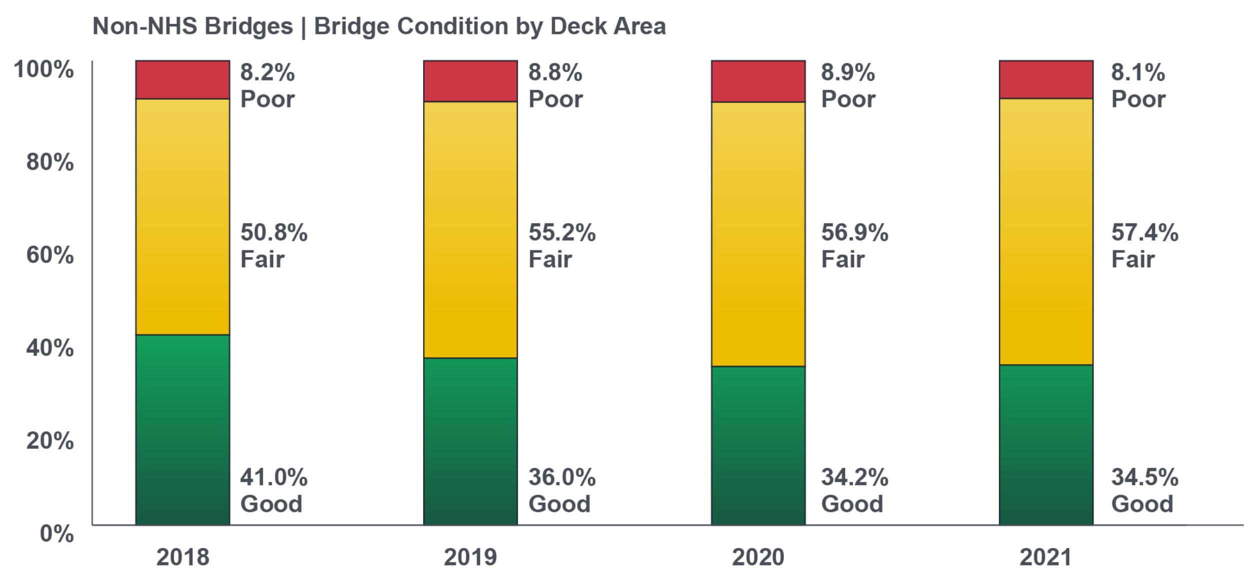


Figure D-2. Non-NHS overall bridge conditions (by deck area) 4-year trend.

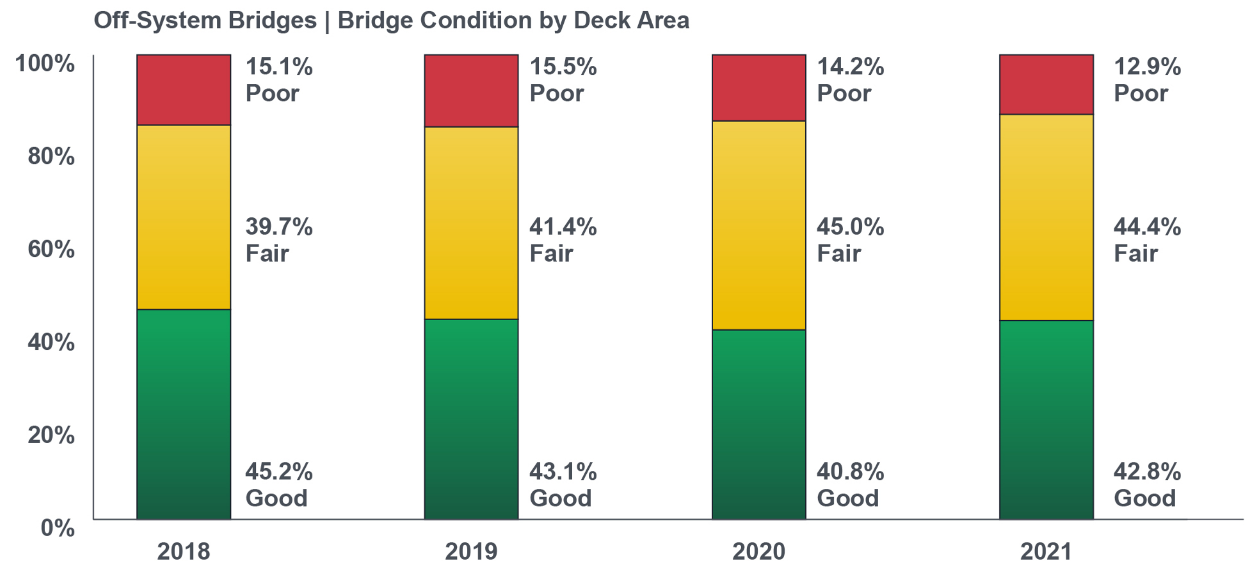


Figure D-3. Off-system overall bridge condition (by deck area) 4-year trend.

Figures D-2 and D-3 do not include closed bridges, which would be classified as *Poor*.

As shown in figure D-2, the percentage of *Poor* bridges, by deck area, on the state non-NHS system declined between 2017 and 2021 but so did the percentage of *Good* bridges. This increase in *Fair* bridges will require work in coming years to avoid a future increase in *Poor* bridges. Non-NHS off-system bridges have had relatively stable conditions, with a slight decrease in *Poor* bridges, by deck area, since 2019.

PERFORMANCE MEASURES

Federal law requires that no more than 10 percent of the total bridge deck area may be designated Structurally Deficient for all NHS bridges.

DOT&PF's goal is to maintain NHS bridges designated as Structurally Deficient at or below 10 percent, which means 90 percent of NHS bridges would be in *Fair* or better condition. Non-NHS bridges have a goal of eighty percent *Fair* or better. The goal coincides with the DOT&PF's Strategic Plan to provide for the safe and efficient movement of people and goods. It is important to keep the deck, joints, and paint in *Good* condition since that is what will keep the super-structure and bearings in *Good* condition. *Good* pavement condition on bridges can help protect the deck and super-structure from water and chemical infiltration.

BRIDGE MANAGEMENT SYSTEM IMPLEMENTATION

The DOT&PF utilizes AASHTOWare BrM, formerly known as Pontis, for the state's BMS. DOT&PF has continued to utilize newer features of the BMS since the 2019 TAMP. While the system itself is not new to DOT&PF, it is serving a much larger role in bridge management planning than in previous years. Alaska's BrM environment contains a foundation of historical bridge inventory and condition data, which has been collected through bridge inspections over many years. Working with this data, BrM is capable of performing the following activities:

- Forecasting deterioration and providing performance forecasts of the bridge inventory at different funding levels
- Determining the cost/benefit of projects and preservation activities over a bridge's service life to evaluate alternatives
- Identifying short-term and long-term budget needs for sustaining current bridge conditions
- Determining investment strategies for identifying potential bridge projects and programs

The 2019 TAMP utilized a spreadsheet tool for estimating the needed funding levels for sustaining bridges in a state of good repair (table 4-4) that met DOT&PF's needs at the time. For the development of the 2022 TAMP, the bridge section and the asset management section have worked collaboratively to utilize BrM's more advanced capabilities, configuring models to specifically meet Alaska's bridge management needs. Additional data has been incorporated into BrM to further enhance DOT&PF's capacity for bridge management. These include:

- Custom deterioration models for concrete, steel and timber bridges which are more accurate than national average models
- Average project costs from recently awarded bridge projects which allow for more accurate project estimates
- Project data from existing plans (including the STIP and the 12-year plan) which account for already-allocated projects and funds

BrM's predictive modeling helps to forecast future conditions of the state's bridge inventory. While DOT&PF are satisfied with the current deterioration models used, further refinement of element models is an area of need which should be considered for future research. Similarly, the refinement of utility trees, project recommendation criteria, and cost models within BrM is expected to continue throughout the next several years.

BRIDGE GAP ASSESSMENT

The State's bridge inventory continues to age, and the median bridge age is 34 years, past the midpoint of their 50- to 75-year design life. Almost 17 percent are 50 years old or older. It is critical to address the existing inventory of structurally deficient bridges.

The majority of publicly owned bridges in Alaska have been constructed using steel girders, followed by pre-stressed concrete bridges, then timber bridges, which typically compose the older and shorter spans. Because of their relatively low maintenance requirements and relatively low cost, pre-stressed concrete girders are the preferred choice for new construction.

As part of continuous improvement, the bridge section proposes a route-based analysis for project selection by reviewing NHS routes such as the Alaska Highway or the Parks Highway and the sufficiency ratings for each bridge along that route. Maintaining a high-level sufficiency rating on important routes would be a strategy to maintain a high level of access and connectivity. The route analysis strategy is not currently being used by DOT&PF for project selection but could be analyzed further using the BMS.

Bridge Asset Management Goals

- Have a maximum 7.5 percent structural deficiency in bridges in the NHS system.
- Replace or rehabilitate one to three structurally deficient bridges every year.
- Continue the Seismic Bridge Retrofit program.
- Introduce a Bridge Preservation program that is managed through the statewide bridge section.
- Provide a bridge list and coordinate statewide rehabilitation/replacement efforts with regional planners.
- Provide a seismic retrofit candidate list to regional field office planners.
- Coordinate statewide bridge preservation program with regional maintenance crews to plan a systematic maintenance strategy with federal participation.
- Prioritize maintenance work recommendations in Bridge Inspection Reports by assigning high, medium, or low priority where:
  - High—ideally repair within a year
  - Medium—ideally repair within 2 years
  - Low—repairs can wait more than 2 years

Bridge Asset Management Objectives

- Design and construct bridges to last with minimal maintenance.
- Seal decks and expansion joints to protect bridges from road salt laden runoff.
- Perform maintenance such as cleaning gutters and deck drains, removing debris from bottom chords and bearing seats, and removing drift from piers.
- Invest in preservative treatments for bridges in *Good* and *Fair* condition to retard deterioration. Preservative treatments might include deck seals, joint seals, and repainting structural steel elements.
- Provide timely information to allow effective selection and design of future maintenance, preservation (e.g., deck treatments), rehabilitation, and reconstruction projects.

BRIDGE PRESERVATION

Bridge Preservation[5] is defined as the actions or strategies that prevent, delay, or reduce deterioration of bridges or bridge elements, restore function of existing bridges, keep bridges in *Good* condition, and extend their life. Preservation actions may be preventative or condition-driven (Source: FHWA Bridge Preservation Expert Task Group).

Effective Bridge Preservation actions are intended to delay the need for costly reconstruction or replacement actions by applying preservation strategies and actions on bridges while they are still in *Good* or *Fair* condition and before the onset of serious deterioration.

Preservation activities may include bridge washing, sealing deck joints, facilitating drainage, sealing concrete, painting steel, removing channel debris, protecting against scour, and lubricating bearings. For more information on Bridge Rehabilitation and Preservation techniques, see the FHWA Bridge Preservation Guide.

MAJOR REHABILITATION/ RECONSTRUCTION

DOT&PF identifies and programs bridge rehabilitation and replacement projects in several different ways, as described below. A bridge treatment strategy is identified using life-cycle cost analysis.

- Highway projects per the Alaska Highway Preconstruction Manual:
  - Bridge maintenance work is allowed for Preventive Maintenance projects.
  - Specific bridge criteria are presented for projects that resurface, restore, or rehabilitate (an existing roadway on the same alignment, modified alignment, or relocated alignment). These are referred to as 3R projects.
  - New road and major realignment projects
- Bridge Prioritization List is a function of:
  - Structurally deficient bridges
  - NBI values for deck, superstructure, and substructure
  - Normalized traffic volume
  - NHS or Non-NHS
  - Functional class
  - Available detour length
- Other:
  - A local agency nominates a project.
  - State Maintenance & Operations staff requests a project to address either load limits or on-going high maintenance costs.
  - Legislature writes legislation that results in a bridge project.
  - Extreme events (earthquake, flood, etc.) result in the need for replacement.

PERFORMANCE TARGETS AND EXTERNAL FACTORS

As noted above, the performance target for bridges was revised to a target of no more than 10 percent of the deck area being structurally deficient (for both NHS and non-NHS bridges). The current target was determined through meetings of DOT&PF staff and as part of a TAM team workshop with the MPOs in August 2017. DOT&PF's target setting memo of September 2022 adopted the same bridge performance targets for the new performance period. The workshop identified and evaluated external factors that would influence future conditions and affect the targets. Those factors are summarized in table D-3.

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Table D-3. External factors influencing bridge condition forecasting.

Factors	*Expected Condition Outcome with Factor Increase*	*Current Experience with Factor*	*Notes*	*2018 Condition Forecast*
Bridge Attributes				
Fracture Critical	⬇	⬇	**Forecast:** Increasing pressure **Weight:** Medium Inspection of fracture critical bridges have increased costs, which contribute to the overall long-term cost of the bridge. Widening, modifications, or repairs to fracture critical bridges are more involved and have increased costs. In a remote site, a fracture critical bridge may seem like a preferred option until future inspection or repair costs are included	⬇
Vulnerable Foundation (Shallow Pile Embedment, Brittle 3-Rail Piles, etc.)	⬇	⬇	**Forecast:** Increasing pressure **Weight:** Medium A vulnerable foundation does not affect the condition, but the potential for issues after a seismic event is significantly higher. An increase in vulnerable foundations results in increased costs due to increases in required inspections and scrutiny by FHWA. As DOT or local agencies acquire bridges due to development or land exchanges, many bridges are not designed or constructed to code standards, which results in an increase in vulnerable foundations	⬇
Load Posting (Reduction Below Legal Loads)	⬇	⬇	**Forecast:** Increasing pressure **Weight:** High Load postings are installed as a result of bridge condition deterioration. More posted bridges mean that the condition of bridges is deteriorating. Bridges deteriorate with time. As DOT or local agencies acquire bridges due to development or land exchanges, many bridges are not designed or constructed to code standards, which results in posting	⬇
Permits (Overweight Vehicles, Above Legal Loads)	⬇	⬇	**Forecast:** Increasing pressure **Weight:** High As commerce and development increase so does overweight vehicle permits. More permits means the condition of bridges is deteriorating	⬇
Seismic Retrofit	⬇	⬅➡	**Forecast:** Neutral pressure **Weight:** Medium The need for seismic retrofit does not affect the condition, but the potential for issues after a seismic event is significantly higher. Many bridges have been retrofitted, so it is not expected that this number will increase	⬅➡
Liquefaction Vulnerability	⬇	⬅➡	**Forecast:** Increasing pressure **Weight:** High As DOT or local agencies acquire bridges due to development or land exchanges, many bridges are not designed or constructed to code standards, which results in an increase in liquefaction vulnerability	⬅➡

Factors	*Expected Condition Outcome with Factor Increase*	*Current Experience with Factor*	*Notes*	*2018 Condition Forecast*
Lead Paint	↔	↔	**Forecast:** Neutral pressure **Weight:** Medium Lead paint does not affect the condition, but it does affect the repainting costs of older bridges due to containment costs. As bridges are repainted, the number of bridges with lead paint is expected to decrease	↑
Hydraulic Considerations				
Scour Critical	↓	↓	**Forecast:** Increasing pressure **Weight:** High More scour critical bridges result in increased costs due to increases in required inspections and scrutiny by FHWA	↓
Channel Infilling / Aggradation	↓	↓	**Forecast:** Neutral pressure **Weight:** Low As the channel infills, material has to be removed from the channel to maintain flow	↓
River Ice Jams	↓	↓	**Forecast:** Neutral pressure **Weight:** Medium Exceedingly high flow as a result of an ice jam may result in overtopping of the bridge, erosion of approach fill, or in an extreme case knocking the bridge off of the foundation	↓
Aufeis Flow (Water Flowing on Ice)	↓	↓	**Forecast:** Neutral pressure **Weight:** Medium Aufeis flow is water flowing on top of ice that can refreeze increasing the thickness of the ice and thereby blocking the channel	↓
Fish Culvert	↑	↔	**Forecast:** Neutral pressure **Weight:** Medium Ongoing need to improve fish passage conditions where blockages have been identified	↔
Tsunami Risk	↔	↔	**Forecast:** Increasing pressure **Weight:** Medium Exceedingly high flow as a result of an earthquake may result in overtopping of the bridge or knocking the bridge off of the foundation	↔
Log / Debris Jams	↔	↔	**Forecast:** Increasing pressure **Weight:** Medium Exceedingly high flow as a result of a log / debris jam may result in overtopping of the bridge, erosion of approach fill, or in an extreme case knocking the bridge off of the foundation	↔
Geometric Considerations				
Over-height Collisions (Superstructure)	↓	↓	**Forecast:** Neutral pressure **Weight:** High As bridges are replaced and vertical clearance restrictions removed (trusses), vertical under clearances are increased (overpasses), or more advanced warnings are installed at lower vertical clearance bridges, as most recently occurred at Eklutna Overcrossing #1374	↓

Factors	*Expected Condition Outcome with Factor Increase*	*Current Experience with Factor*	*Notes*	*2018 Condition Forecast*
Pier Collisions (substructure—Vehicle or Marine Craft)	↓	↓	**Forecast:** Neutral pressure **Weight:** Low Many overpass abutments and piers are protected by traffic safety features. The condition of the bridge with a collision would worsen until repaired. However, the repaired areas are often the source of future spalling and deterioration	↔
Navigation Clearance	↔	↔	**Forecast:** Increasing pressure **Weight:** Low As bridges are replaced, navigation clearances are increased (overpasses). Navigation clearance does not affect the condition, but an increase in clearance may result in lower collision risk at an increase in initial installation cost	↑
Animal Crossing	↔	↔	**Forecast:** Increasing pressure **Weight:** Low More animal crossings are being installed to decrease collisions between animals and cars. Animal crossings do not affect the condition, but they do increase the long-term maintenance costs of the inventory	↑
Pedestrian Crossing	↔	↔	**Forecast:** Increasing pressure **Weight:** Low As bridges are replaced there is an increased demand for pedestrian facilities both over and under the bridge. Pedestrian crossings do not affect the condition, but they do increase the initial installation costs as well as the long-term maintenance costs of the inventory	↑
Other Factors				
Funding	↔	↔	**Forecast:** Increasing pressure **Weight:** High Funding levels fluctuate from year to year, but overall the condition of Alaska's bridges has not significantly changed as a result of current funding levels	↓
Aging Infrastructure	↓	↓	**Forecast:** Increasing pressure **Weight:** High Bridge condition deteriorates with time unless preventative, preservation, or maintenance activities are performed regularly	↓
Railing Collisions	↓	↓	**Forecast:** Increasing pressure **Weight:** Medium Minor railing conditions that result in damage to railing or posts do not affect the condition of the bridge. Significant collisions that result in damage to the deck have a negative impact on condition until repaired. The repaired areas are often the source of future spalling and deterioration	↓

Factors	*Expected Condition Outcome with Factor Increase*	*Current Experience with Factor*	*Notes*	*2018 Condition Forecast*
Detour Length	↔	↔	**Forecast:** Neutral pressure **Weight:** Medium Detour length does not affect the condition, but it does increase the initial installation costs as a result of the requirement for a detour bridge during construction. There is also an impact to the public and commerce for a bridge with a large detour length being posted or closed due to damage or deterioration	↔
Remote Location	↔	↔	**Forecast:** Neutral pressure **Weight:** Low Remote location does not affect the condition, but it does increase the initial installation costs, long-term inspection costs, and long-term maintenance costs of the inventory	↔
Evacuation Routes	↔	↔	**Forecast:** Increasing pressure **Weight:** Medium An evacuation route does not affect the condition, but it does increase the initial installation costs as a result of additional requirements to maintain during construction. There is also an impact to the public and commerce for an evacuation route bridge to be posted or closed due to damage or deterioration	↔
Coast Guard Permitting	↔	↔	**Forecast:** Increasing pressure **Weight:** Medium Permitting does not affect the condition, but it does increase the lead time involved with bridge replacement, rehabilitation, or retrofit work	↔
Historic Bridge	↔	↔	**Forecast:** Increasing pressure **Weight:** Medium Being historic does not affect a bridge's condition, but it does increase the lead time involved with bridge replacement, rehabilitation, or retrofit work due to increased paperwork and documentation requirements	↔
Mobilization Cost	↔	↔	**Forecast:** Increasing pressure **Weight:** Medium Mobilization cost does not affect the condition, but it can increase the cost when equipment not regularly used in Alaska must be mobilized from the lower forty-eight to an urban area, much less a remote location	↔
Climate Change	↔	↔	**Forecast:** Increasing pressure **Weight:** Medium Changing conditions may influence design selection processes	↔
Extreme Events	↔	↔	**Forecast:** Increasing pressure **Weight:** Medium Projects may be delayed as a result of earthquake damage, road washouts, or other damage that leads to a bridge's need to be repaired prior to another project	↔

Appendix E: Gap Analysis

This appendix describes the process that DOT&PF uses for conducting the performance gap analysis [GAP 515.7(a)] as defined in 23 CFR 515.5 and depicted in figure 3-1.

GAP ANALYSIS—IDENTIFYING PAVEMENT AND BRIDGE CURRENT STATE AND FUTURE NEEDS

DOT&PF identified the current state for asset conditions by reviewing historical data and trends for pavement and bridges using the federal rulemaking standard for *Good*, *Fair*, and *Poor* conditions. Figures 2-3, 2-5, and 2-7 (Section 2) depict recent pavement and bridge condition history. Both pavement and bridge conditions are fairly stable and meet the current SOGR criteria.

Future needs were identified as the DSOGR and the 2-year and 4-year NHPP targets for bridge and pavement conditions. New NHPP targets were developed using knowledge gathered from the NHI Effective Target Setting training in March 2017, performance data from the previous 4-year TAMP period, and planned STIP investment levels. NCHRP 23-07 target setting web-based workshops were held in July 2022. For pavements, the targets for the percentage of *Poor* pavements on both the Interstate and non-Interstate NHS subnetworks were lowered from 10 percent to 5 percent and 15 percent to 10 percent respectively. For bridges, the intent was to keep the performance target flat from historical levels because it is an acceptable condition performance level for the NHS assets and represents a state of good repair for the system.

GAP ANALYSIS FOR PAVEMENT AND BRIDGE

Performance gaps for pavement and bridges were evaluated by comparing current conditions and condition forecasts from the PMS and BMS to the DSOGR and 2-year and 4-year targets for each asset.

Pavement Gap Analysis—10-Year Forecast

Figures E-1 through E-3 display the current and projected 10-year pavement conditions on the Interstate, non-Interstate NHS, and non-NHS pavements compared to the DSOGR, which are also the NHPP targets. These forecasts were run using an anticipated annual pavement budget of $185 million. This represents the total pavement budget, which includes the SOGR funding that was used in the LCP analyses as well as the pavement reconstruction budget, which provides additional funding for other capital projects that include pavement work but is initiated to address other performance areas such as safety and capacity. These additional projects will have a marginal impact on overall pavement condition. They are not selected or prioritized by the pavement management system, but they are included in the gap analysis to capture the impacts of this additional investment on the pavement network.

These figures show that the Department does not have a performance gap. It should be noted that in forecasting conditions in terms of the federal pavement performance measures, the PMS models data differently than is done by FHWA for HPMS reporting. HPMS stores pavement condition data for IRI, rutting, cracking, and faulting for each tenth-mile section of NHS pavement and calculates the pavement condition measure for each section. The PMS models store pavement condition data based on project-length sections, typically 3-5 miles long. This is because the PMS is being used to produce recommendations for future project locations, where it is not economical to construct unless the project is of a sufficient length. This difference in length between HPMS sections and PMS segments leads to a different result for the percentage of *Good*/*Fair*/*Poor* pavement between the two systems. The reason for this is that many *Good* and *Poor* HPMS sections are averaged together in the same PMS segment. As a result, the PMS will tend to show the system having more *Fair* pavement, with less *Good* and less *Poor* overall than HPMS. Using 2021 as an example, instead of the 7% percent *Poor* on the non-Interstate NHS that is reported for HPMS, the

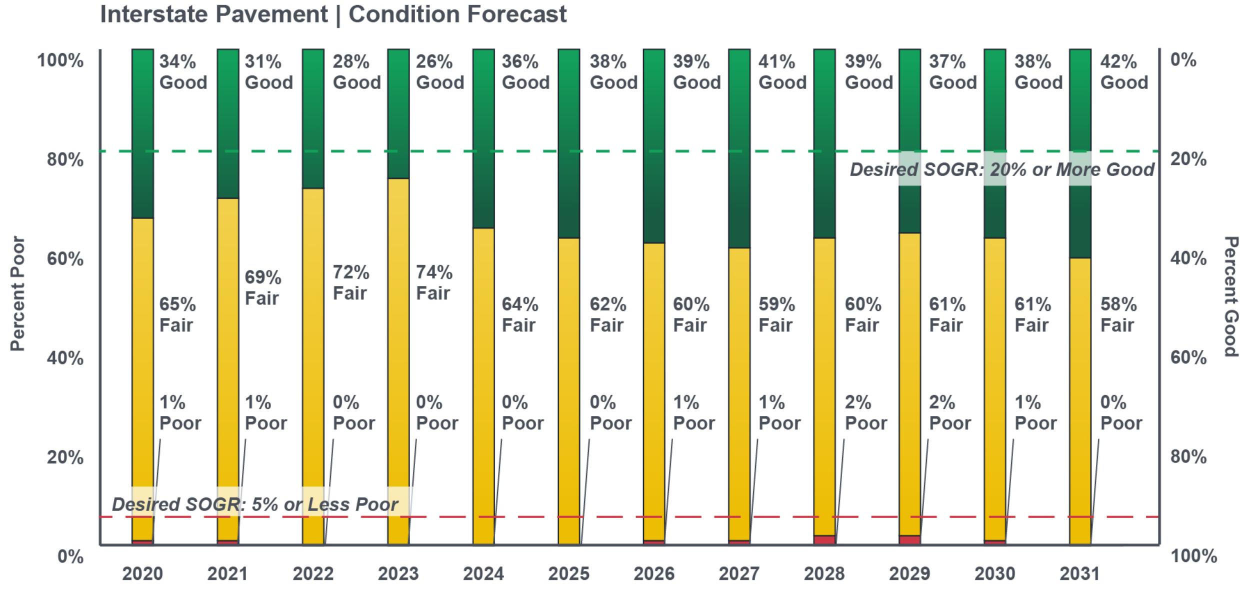


Figure E-1. 10-year pavement condition forecast on Interstate NHS pavements.

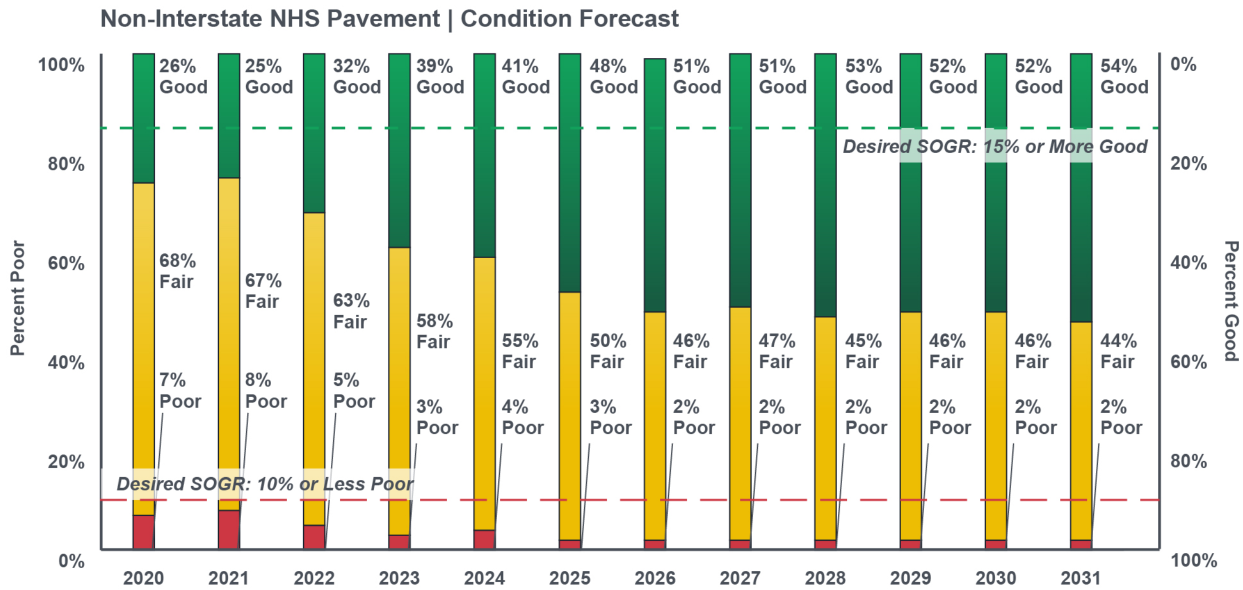


Figure E-2. 10-year pavement condition forecast on non-Interstate NHS pavements.

value shown in figure E-2 is 4.5% percent *Poor*. The same is true for sections of road being reported as *Good* in HPMS.

As described in Appendix C, DOT&PF also maintains a significant non-NHS pavement network primarily using Surface Transportation Block Grant Program (STBGP) funding. Figure E-3 shows the predicted performance of the non-NHS network based on an estimated budget of $165M annual investment of STBGP funding.

Bridge Gap Analysis—10-Year Forecast

Figures E-4 and E-5 display current and projected 10-year bridge conditions on NHS and non-NHS bridges compared to the DSOGR, which are also the NHPP targets.

These figures indicate that the Department does not currently have a gap on NHS *Poor* bridge condition but needs to continue programming reconstruction and rehabilitation of bridges to keep bridges at less than 10 percent *Poor*. NHS bridge conditions do not currently meet the percent *Good* target, but increased investment for NHS bridges will help to mitigate this gap for the next performance period through 2025. Non-NHS bridge conditions do not currently meet the DSOGR and are also predicted to decline throughout the analysis period. Asset Managers strive to meet the target by using 7.5 percent *Poor* as their internal benchmark level. The Bridge Section submits a prioritized list to the field planning staff for consideration when the bridges require major rehabilitation or replacement.

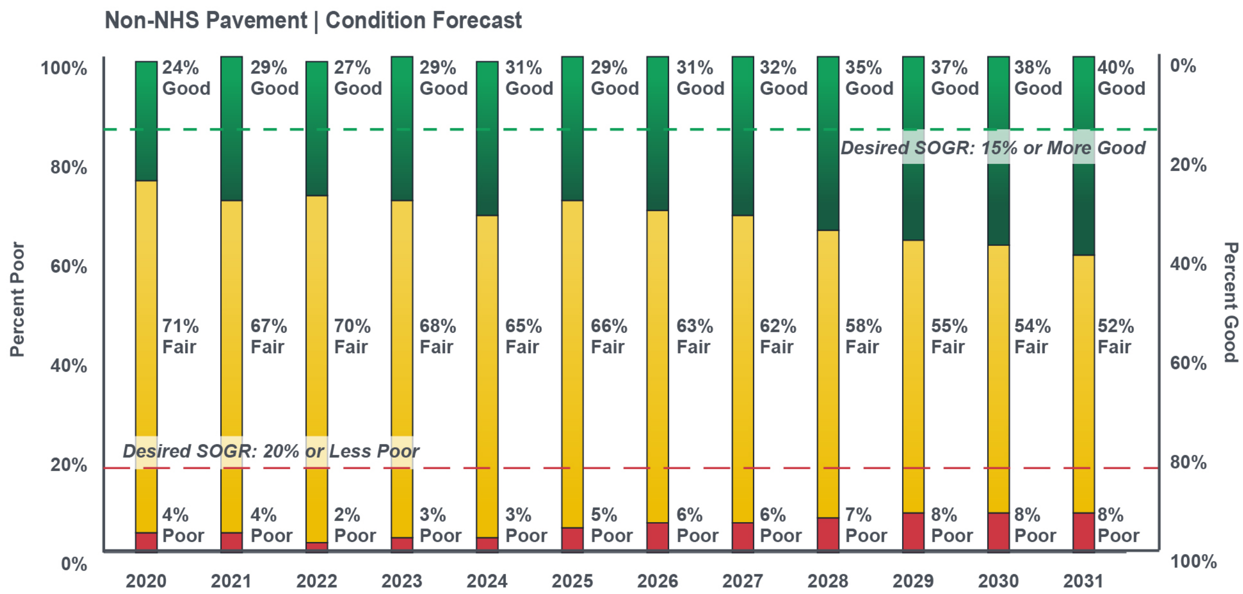


Figure E-3. 10-year pavement condition forecast on non-NHS pavements.

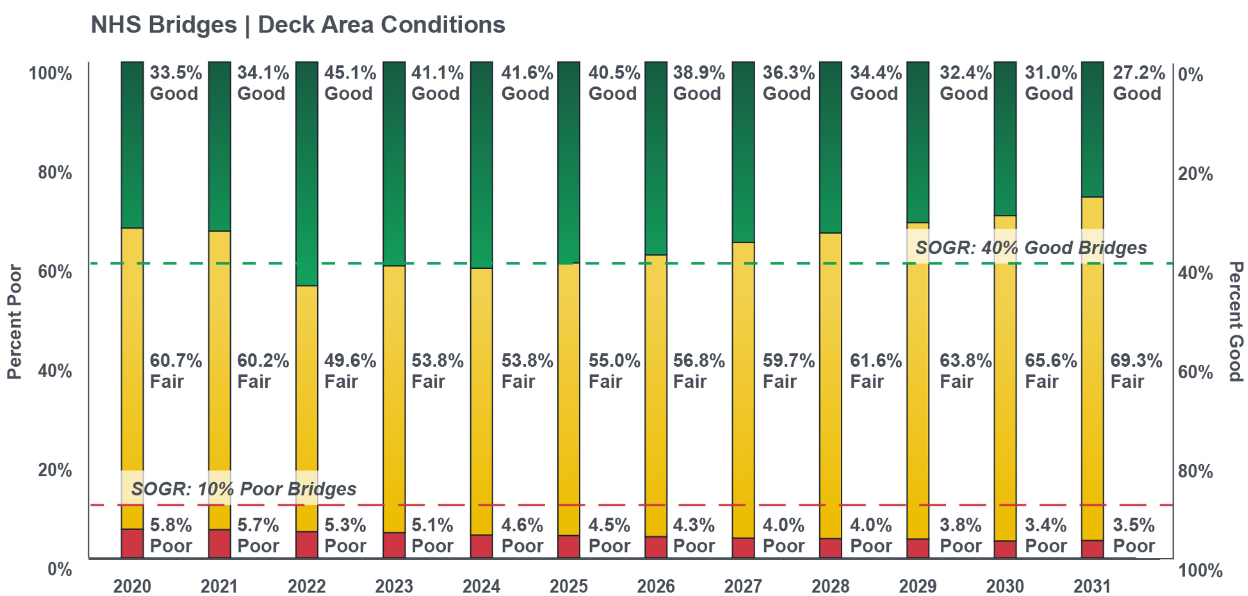


Figure E-4. 10-year bridge condition forecast on NHS bridges.

Considering Risk

Department and MPO staff identified external factors that could improve or worsen physical asset conditions. These factors are listed in Appendix C for pavements and Appendix D for bridges.

Considering Extreme Weather and Resilience in Infrastructure Gap Analysis

Changing climate patterns also pose a high, and almost certain, risk to the transportation system. For example, thawing permafrost causes major settlement to roads that requires frequent reconstruction and expensive mitigation measures. Earthquakes pose seismic risks to bridges and require preemptive mitigation to reduce seismic risk. These risks affect system performance and require significant resources for mitigation. They are discussed in more detail in section 3.5 and Appendix G covering risk management.

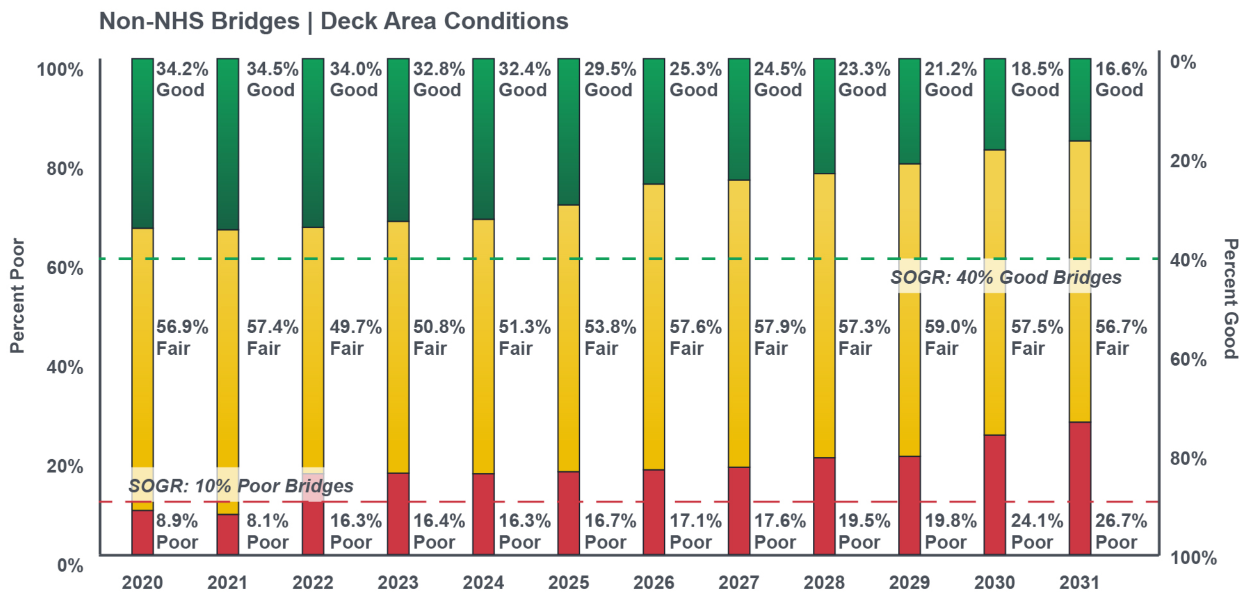


Figure E-5. 10-year bridge condition forecast on non-NHS bridges.

GAP ANALYSIS—SYSTEM PERFORMANCE

DOT&PF monitors and manages the performance of the NHS in regard to all seven TPM National Goal areas: safety, congestion, system reliability, freight movement and economic vitality, environmental sustainability, and project delivery. Each of these performance areas contribute to the development of DOT&PF's capital program, in support of the agency's LRTP. Appendix I describes the internal processes DOT&PF utilizes to manage delivery of the program and ensure the expected performance is delivered on time and within budget.

Using asset management principles and systems, DOT&PF strives to minimize costs to keep assets at target conditions to focus on other assets and new expansion needs. DOT&PF recognizes that in recent years a significant amount of project off-set and de-obligation funding was re-invested to the NHS to maximize funding opportunities.

DOT&PF is meeting pavement and bridge targets and expects to be able to continue to do so; however, there are trade-offs related to funding availability and remaining performance gaps as well as investments in other priorities both on and off the NHS as described in Section 3.1.

The LRTP and this TAMP recognize that the Department must distribute limited funding resources among these multiple priorities. Projects may be categorized as new construction, modernization, capacity, or system preservation. The PMS and BMS will be used to determine system preservation priorities while project selection criteria will be used to select modernization, and to a limited extent, new construction projects.

Modernization of the transportation system to address safety, capacity, and other user expectations represents a significant performance gap that will likely always exist and require resources. For modernization projects on the NHS, the Department will use the strategies listed in Section 5, Asset Management Investment Strategies and Appendix I.

Additionally, the Department is beginning to use Planning and Environmental Linkage (PEL) studies to help identify performance gaps and refine alternatives to cost effectively modernize the transportation system.

Finally, as travel time and freight travel time data are analyzed and compared to targets, more refined performance gap information will need to be integrated into project selection and funding decisions.

Appendix F: Life-Cycle Planning

In conducting its life-cycle analysis, DOT&PF used the following references as guidance for this appendix:

- Using an LCP Process to Support Transportation Asset Management: A Handbook on Putting the Federal Guidance into Practice. FHWA-HIF-19-006. Federal Highway Administration, January 2019
- AASHTO TAM Guide

The LCP processes described in this appendix use the PMS and BMS to determine the benefit/cost ratio of alternate treatment strategies over an analysis period to determine the optimal strategy for maintaining DOT&PF's bridge and pavement networks. The strategies developed through this process are used to support a needs assessment, performance gap analysis, and the development of investment strategies for pavements and bridges. These same strategy inputs are then used annually in the development of DOT&PF plans and programs. The following sections summarize DOT&PF's LCP analysis process and provide analysis results relevant to this TAMP.

Table F-1. DOT&PF Asset class subgroups.

Asset Class	*Subgroups*		
Pavement	Stable Subgrade	AADT<2000	Very Low Traffic
		2000≤AADT<5000	Low Traffic
		5000≤AADT<25000	Moderate Traffic
		AADT≥25000	High Traffic
	Unstable Subgrade	No Traffic Levels	All Very Low Traffic
Bridge	Steel		
	Concrete		
	Timber		

STEP 1. SELECT ASSET CLASSES AND NETWORKS

DOT&PF performed an LCP on NHS bridges and pavement. To support analysis in the management systems, DOT&PF identified asset subgroups and subnetworks that represented different performance characteristics. The asset classes and networks are described below and summarized in table F-1.

Pavements

Under federal regulations 23 CFR 490, DOT&PF must set 4-year condition targets for pavements in two subnetworks: Interstate and non-Interstate NHS highways. These targets are described in Section 1 of the TAMP. While DOT&PF tracks and reports conditions for pavements separately for these two subnetworks, the subnetworks are not separated when making pavement LCP or investment decisions.

For LCP Analysis, pavements are grouped into five subgroups—four groups based on AADT stable subgrades and a separate group for unstable subgrades containing thawing permafrost. These subgroups are defined in table F-1.

Bridges

Due to differences in performance, the bridge inventory was divided into three asset subgroups based on materials and design attributes: concrete, steel, and timber. DOT&PF uses the bridge elements as defined in AASHTO Manual for Bridge Element Inspection for separating deterioration and cost models for these subgroups.

STEP 2. DEFINE LCP STRATEGIES

Before 2019, the DOT&PF applied a "worst first" strategy for identifying projects. This strategy resulted in a *Good* overall condition of the state's Interstate and non-Interstate NHS network pavement and a low percentage of *Poor* bridges and Interstate IRI around less than 10 percent *Poor*.

As described in the LCP objectives, DOT&PF desires to move away from worst-first to maximize the potential of maintaining conditions with projected funding. With few assets currently in *Poor* condition, the DOT&PF is in an excellent position to maintain *Good* infrastructure for a longer period using preservation strategies.

Pavements

DOT&PF evaluated the following LCP pavement strategies:

- **Worst First**—This strategy applies the available budget to pavement segments prioritized based on condition, with pavement segments in the worst condition receiving the highest priority. The PMS is used to model a worst first strategy by applying this prioritization approach to the anticipated budget.
- **Current Strategy**—This strategy is modeled by loading project information for major rehabilitation and reconstruction projects from the current 10-year STIP into the PMS. The system is allowed to select treatments for any remaining budget amounts. It primarily consists of heavy reconstruction treatments and is divided between the treatment categories as follows:
    - » 40 percent reconstruction
    - » 25 percent minor rehabilitation (preservation program)
    - » 30 percent major rehabilitation
    - » 5 percent preventive maintenance treatments (preservation program)
- **Optimized Preservation**—This strategy prioritizes treatments based on the PMS recommendations for maximizing the benefit/cost ratio of improved pavement conditions over the analysis period. The benefit is calculated by the PMS as a function of condition improvement from a potential treatment over the analysis period. This approach recognizes the additional benefit of treatments that not only improve conditions but lead to a sustained improvement. Treatment cost is also considered in the analysis, as the system seeks to maximize the total benefit of the pavement over the analysis period within the available budget.

Bridges

AASHTOWare BrM uses a multi-criteria utility function for resource allocation. DOT&PF considered alternative LCP strategies with alternative utility functions in previous analyses and settled on the following LCP bridge strategy as defined below, aligned with agency bridge management objectives:

- **Current Strategy**—Higher Weight for Condition: In this strategy, the BMS uses a utility function that weighs condition at forty-five percent and life-cycle cost at thirty-five percent. Weight for risk is fifteen percent and mobility is five percent. The condition utility gives element condition twice the weight of the General Condition Rating (GCR) condition. Under this strategy, the average percentage of annual expenditures by treatment category are:
    - » 15 percent major rehabilitation
    - » 30 percent preservation
    - » 53 percent replacement
    - » 2 percent scour

STEP 3. SET LCP SCENARIO INPUTS

This section summarizes the LCP scenario input source data, the data variability, and any sensitivity issues.

Current Conditions

The initial pavement conditions used for LCP analysis were based on DOT&PF's 2021 collection cycle data. The initial bridge conditions were determined based on the NBI data set, collected in 2020-2021, and submitted to FHWA in March of 2021.

Desired State of Good Repair

DOT&PF targets are the DSOGR, and there is no differential between urban and rural. DOT&PF's targets are summarized in table F-2.

Table F-2. DOT&PF targets for desired SOGR.

Asset	% Good	% Poor
Interstate pavements	20%	5%
Non-Interstate NHS pavements	15%	10%
NHS and non-NHS bridges	40%	10%

For LCP analysis, the performance target for bridges was revised to a target of no more than 10 percent of the deck area being structurally deficient (SD), as per the federal definition, for both NHS and non-NHS bridges. This target was determined through conversations with DOT&PF staff and as part of TAM team workshop with MPOs in August 2017 and was adopted again in DOT&PF's target-setting memo of September 2022. The workshop identified and evaluated external factors that would influence future conditions and effect the targets.

Analysis Period

The following analysis periods were used for initial LCP analysis. The use of longer analysis terms provides the DOT&PF with a better understanding of the long-term implications of each potential LCP strategy and funding scenario. As the DOT&PF gains additional experience with the PMS and BMS, longer analysis terms will be considered.

- Pavements—10 years
- Bridges—20 years (50 years for long-term life-cycle cost calculations)

Treatment Definitions and Unit Costs

PAVEMENT TREATMENTS

DOT&PF uses a variety of treatments that consist of different materials and techniques to construct, maintain, preserve, rehabilitate, and replace pavements. For the purposes of pavement management and LCP, those treatments are summarized into a set of budget groups. Each budget group represents a treatment that can be used to repair pavements at a given condition. Table F-3 lists budget groups used for LCP analysis and their unit costs.

Table F-3. Pavement treatment unit costs.

	Unit Cost ($ per square yard)		
Treatment	Average	Urban	Rural
Preservation	$15	$15	$15
Minor Rehabilitation	$78	$78	$78
Major Rehabilitation	$186	$276	$125
Reconstruction	$622	$738	$448

The pavement treatment unit costs were determined using historic bid data and asphalt price data. This information is reviewed annually, and unit costs are updated as appropriate.

BRIDGE TREATMENTS

Table F-4 shows the bridge treatment unit costs developed by DOT&PF based on past project data. The unit costs were further refined based on analysis results. The number of bridge projects per treatment category and allocated budget amounts were reviewed to assess whether the estimated costs led to an accurate amount of work. Some unit costs were then updated or customized to achieve better accuracy. DOT&PF will continue refining and updating the unit costs based on project data and future analysis results.

Table F-4. Bridge treatment unit costs.

Treatment	Treatment Category	Unit Cost
Place RipRap	Scour	$6,518 * (bridge deck width / cos(bridge skew))
Paint First Time	Preservation	$35/sq. ft (element)
Repaint Superstructure	Preservation	$67/sq. ft (element)
Substructure Spall Repairs	Preservation	$15,000/column OR $400/ ft (element)
Deck Preservation	Preservation	$162/sq. ft (deck area)
Strengthening	Major Rehab	$500,000/bridge
Bridge Rehab	Major Rehab	$486/sq. ft (deck area)
Culvert Rehab	Major Rehab	$250,000/bridge
Replace Running Planks	Preservation	$50/sq. ft (element)
Add Guide Banks	Preservation	$500,000 / bridge
Substructure Timber Repairs	Preservation	$2500/pile (element)
Bridge Replacement	Replacement	$1454 sq. ft (deck area)
Culvert Replacement	Replacement	$450/sq. ft
Seismic Retrofit Phase 1	Major Rehab	$300,000/bridge
Seismic Retrofit Phase 2	Major Rehab	$250,000/bridge

Inflation Rate

Inflation is the rate at which the prices for goods, products, and services increase over time. For LCP, the term inflation rate is used to describe an assumed average rate of annual cost increases for treatments. DOT&PF assumes an annual inflation rate based on historic trends. For the purposes of the analyses, and in alignment with the TAMP Financial Plan, inflation is assumed to be 2.25 percent and is accounted for with corresponding assumed increases in available funding and is accounted for with corresponding assumed increases in available funding (per Alaska Department of Revenue, Tax Division).

Assumed Funding

The DOT&PF's LCP processes aim to identify the best overall strategy or strategies to support sustainable long-term achievement of the DSOGR. The process allows for multiple budgets to be used as scenario inputs to determine the sensitivity of strategy effectiveness to funding levels. This approach allows the agency to determine the most effective strategy for budget levels close to the actual anticipated funding as well as identifying strategies that are likely to be more effective should the agency's funding increase or decrease.

The base funding for LCP analysis is assumed at the approximate level of funding identified in the current STIP. Additional scenarios can be run at increased and decreased levels of funding to evaluate the potential impacts on performance. The funding levels used for the analyses are shown in section 3.4.

Strategy Rules and Details

The following subsections describe the strategy rules and details for pavement and bridge LCP analysis.

PAVEMENTS

The PMS uses data on pavement conditions related to rutting, cracking, ride quality, and subgrade stability relating to permafrost to select appropriate treatments. The system uses decision trees with trigger values based on these three distresses and subgrade condition to ensure that appropriate treatments are recommended to address the causes of pavement distress and to not simply cover up those distresses. The PMS compares the expected future conditions with and without treatment for each section to determine which recommended treatments will provide the greatest benefit for prioritization.

The PMS uses a multi-constraint optimization analysis to optimize investment strategies by simulating future conditions using deterioration models and maximizing an observed "benefit" given a constrained budget. The benefit being used is based on the overall pavement APCI as defined by rut, IRI, and cracking metrics. More information on APCI is available in Appendix C, Alaska Pavement Index. This is used within the PMS as a value to maximize the overall improvement to sections of the road.

To support LCP, the system is run without consideration for programmed projects. This allows the PMS to evaluate the impacts of different treatment rules, changes in performance models, and changes in costs on overall life-cycle performance. However, the system can also run scenarios that consider planned or programmed projects to forecast expected conditions.

Considering Extreme Weather and Resilience in Pavement LCP Analysis

DOT&PF has identified thawing permafrost as a significant risk in that it compromises the stability of the pavement subgrade. DOT&PF accounts for this risk in pavement life-cycle planning by including subgrade stability in PMS decision trees. Where the subgrade stability indicates the presence of unstable permafrost, the PMS will not recommend a treatment beyond minor rehabilitation. This is because even a major rehabilitation or reconstruction project may not be able to cost effectively address the underlying subgrade. It may remain more cost effective to resurface the road at a more frequent interval or allow M&O crews to place temporary surfacing (high floats, chip seals, etc.) through these areas. The regions evaluate these areas on a project-by-project basis to determine if they are able to address the unstable subgrade issues, and if they are, they may choose to initiate a major rehabilitation or reconstruction project to stabilize the embankment.

BRIDGES

AASHTOWare BrM selects bridge projects using multi-objective analysis and incremental benefit-cost ratios. Within the BMS prioritization algorithm, multiple performance measures (e.g., condition, life-cycle cost, risk) can be combined into an overall utility function, by applying different weights to the performance measures as aligned by the agency's bridge management goals. For this analysis, DOT&PF chose condition, life-cycle cost, risk, and mobility as performance measures.

Within the BMS, each performance measure is converted to a unitless 0-100 index by scaling or a formula. Every treatment alternative has predefined benefits (e.g., set all GCR to 9, set vertical clearance to 19-feet, and set scour rating to 7 after bridge replacements). DOT&PF's Bridge LCP Team defined their treatments by relevant costs and benefits in the BMS modeling framework. Table F-4 summarizes the treatments that are applied to bridges, along with the treatment unit costs. The BMS prioritization process calculates potential utility improvements for alternative treatments, based on treatment benefits and the relative weight of performance measures in the utility function (e.g., forty-five percent condition, thirty-five percent life-cycle cost, fifteen percent risk, and five percent mobility). DOT&PF's network policies define which treatment alternatives can be considered for structures with different conditions or characteristics. For example, deck preservation can only be considered for structures with deck GCRs of 6 to 9.

DOT&PF's BMS can also apply a criticality weight to structures to account for their relative importance (figure F-1). DOT&PF's criticality formula includes deck area, detour length, NHS designation, and traffic volume as variables. This formula was developed as an index to have a value between 0-100. For the bridges in Alaska inventory, the criticality formula weight values vary between 10 and 100, with a median of 54.8.

Deterioration Models

Deterioration models provide predictive capability to forecast future pavement and bridge conditions. DOT&PF has developed deterioration models for pavements and bridges based on actual condition data. Additional details are provided below.

PAVEMENT DETERIORATION MODELS

DOT&PF models pavement performance in terms of the federal performance metrics for cracking, rutting, and ride quality as defined in 23 CFR 490. Performance curves have been developed using historical performance data. The agency will routinely update performance curves as determined necessary from the review of annual performance data.

DOT&PF is continually evaluating new treatments and materials for improved pavement performance. To evaluate a new treatment, an experimental feature is initiated to document the construction methods and post construction performance. The agency is currently following this process for Microsurfacing by evaluating installations in the Anchorage area. If the treatment is not considered experimental, but needs to be modeled within the PMS, then the treatment location will be documented and monitored for performance.

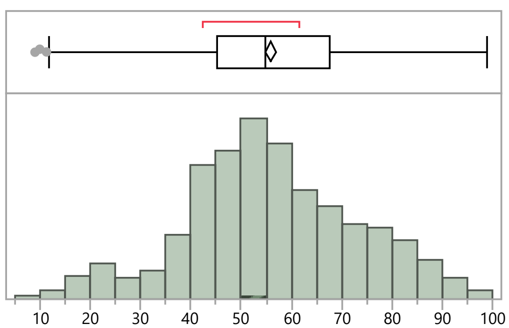
In either case, when a new treatment is to be modeled the pavement distresses including rut, IRI, and cracking will be tracked for a minimum of 3 years to develop performance curves for treatment performance. If the treatments are being constructed in different conditions, then location, existing pavement condition, and traffic volumes will be considered when developing performance curves for the treatment.

BRIDGE DETERIORATION MODELS

DOT&PF's BMS can perform deterioration modeling for both components and elements. Users may choose using element deterioration models for their analysis and then convert forecasted element conditions to component conditions using an NBI conversion profile, which can be customized. DOT&PF uses element deterioration models for LCP and uses a custom conversion profile to convert forecasted element conditions to GCR condition. The custom conversion profile was modified iteratively to reach a conversion profile with sufficient predictive accuracy for Alaska bridges.

Element deterioration models consist of median transition times that specify how long that element

NEWWEIGHT



Quantiles

100.0%	maximum	98.705326935
99.5%		96.72889848
97.5%		88.904017163
90.0%		79.635919843
75.0%	quartile	67.521675489
50.0%	median	54.784130728
25.0%	quartile	45.214542325
10.0%		36.642747799
2.5%		20.027673706
0.5%		12.382085369
0.0%	minimum	9.0248683669

Summary Statistics

Mean	55.930337
Std Dev	16.952998
Std Err Mean	0.5420971
Upper 95% Mean	56.994146
Lower 95% Mean	54.866528
N	978

Figure F-1. Alaska structure criticality weighting statistical distribution.

stays at each condition state (CS1-CS4). The element models also have a Weibull shaping parameter to control the slower CS1 to CS2 transition rate. DOT&PF reviewed and customized default element models to reflect Alaska deterioration rates. DOT&PF plans to reevaluate the deterioration models based on future analysis results and would like to incorporate different deterioration models by environment to more accurately model regional deterioration. DOT&PF would like to initiate a research project in the future to further develop these models.

RISKS & RESILIENCE

LCP uses historic data and performance models to forecast future performance. This involves numerous assumptions and uncertainties that represent risk, or the likelihood that actual performance will vary from the forecast. Additionally, there are many unknowns that cannot be directly modeled. To account for these risks, DOT&PF performs multiple variations of LCP analyses varying both strategy and budgets. This helps inform the agency on the sensitivity of current or desired strategies to unforeseen events. For example, including analysis runs at lower investment levels informs the agency of the potential impact on pavement and bridge conditions should the budget be reduced, regardless of the reason for that reduction.

Pavement Risks

Beside risks due to extreme weather and climate change, an additional risk to pavement conditions is the increase in system size over time. Increases in the pavement inventory lead to greater future need for maintenance, preservation, and eventual rehabilitations and replacements. The current STIP includes approximately 90 lane-miles of new pavement, which represents approximately a 2.5 percent increase over the current inventory. This increase will not impact pavement needs during the STIP period, as this pavement will be new, but it will create a need for additional investment in later years.

Based on the recent economic climate, increasing inflation became a concern as a potential risk to sustaining the DSOGR and achieving NHPP targets. The pavement management group ran an inflation analysis modeling a sustained eight percent inflation rate compared to the original two percent inflation rate that was used for the LCP analyses. This scenario was run for the 10-year analysis period at the anticipated total pavement budget of $185M. Although the percent of pavement in *Poor* condition increased from 1.1 percent to 3.3 percent over the 10-year period, it was still significantly lower than the target of 10 percent. These results are shown in figure F-2 and demonstrate that although inflation at first appeared to be a significant risk, even at a sustained elevated level, it did not significantly jeopardize the achievement of NHPP targets or DSOGR.

Considering Pavement Risks Due to Extreme Weather and Climate Change

In addition to incorporating unstable subgrade due to thawing permafrost into the PMS decision trees, DOT&PF considers risk throughout a pavement's life cycle—from planning through design, construction, and maintenance and operation, including impacts due to extreme weather events and climate change. The Department has developed a data set for twice-damaged emergency repair locations and geotechnical asset management system (GAMS) sites. DOT&PF is developing processes for using these data sets to incorporate risks into the analysis process. Additionally, DOT&PF has developed a design strategy to address roadways susceptible to damage due to thawing permafrost. Both risk mitigation strategies are described in greater detail in Appendix G. DOT&PF will continually improve the risk data identification, data quality, and incorporate future identified risks.

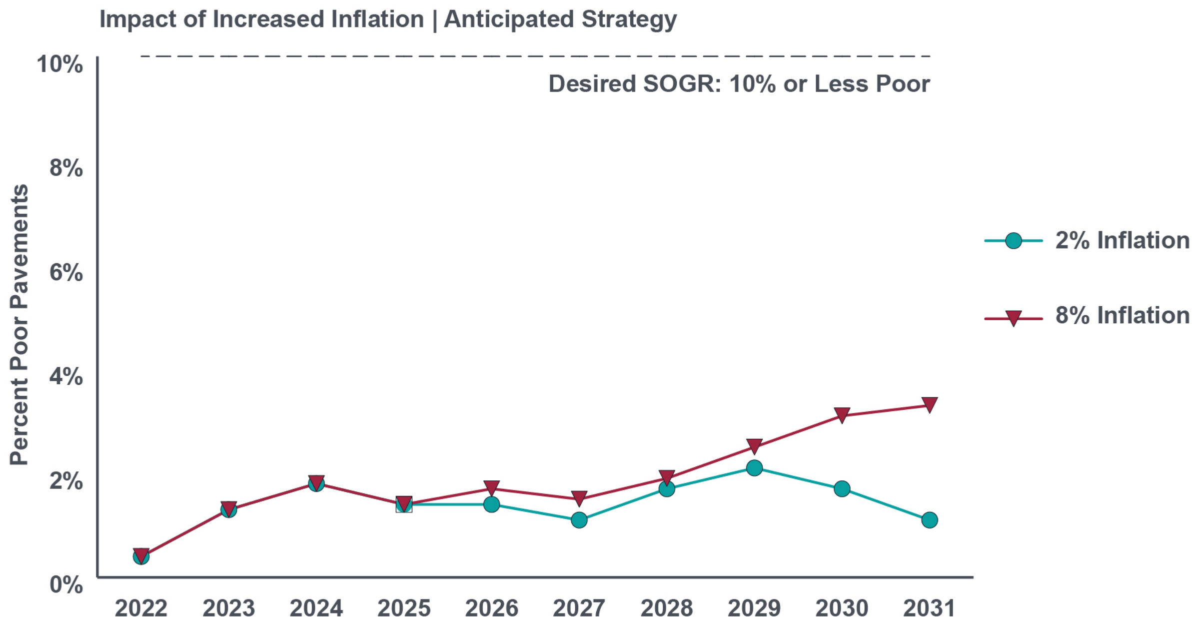


Figure F-2. Impact of increased inflation on pavement condition.

> **Considering Bridge Risks Due to Extreme Weather and Climate Change**
>
> The bridge management system has been configured to take risks due to extreme weather and climate change into consideration within its modeling algorithm. Among other risks, it considers seismic risk by coding a location attribute into a custom data table to be used for seismic risk calculations. Seismic retrofit and bridge replacement treatments can be selected to reduce the seismic risk. Scour risks are considered in the utility function and scour work can be selected to reduce this risk.

Bridge Risks

Risks are addressed in the BMS through the multi-criteria utility function. Risks contribute to fifteen percent of the overall utility. Risks included in the utility function are:

- Seismic (age, location, and seismic appraisal)
- Scour (channel protection, scour appraisal, scour rating, waterway adequacy)
- Underclearances
- Load rating (posting)
- Fracture criticality

Within the BMS modeling framework, candidate bridge treatments improve the bridge characteristics within the analysis and, as a result, improve the utility function value. Bridge treatments are associated with these risks through treatment benefits, which enables the system to identify treatments to reduce these risks. For example, bridge rehab, replacement, and strengthening reduce load rating and fracture criticality risks.

STEP 4. DEVELOP LCP SCENARIOS

Step 4 involves the development of LCP scenarios using the strategies defined in Step 2 and the inputs from Step 3. By evaluating a mix of strategies and funding levels, the DOT&PF can determine:

- The best strategy to optimize pavement and bridge conditions with the anticipated funding, and those resulting conditions
- The combinations of funding and strategy that could allow the agency to achieve and sustain the DSOGR
- The changes in strategy that will best allow the agency to accommodate increases or decreases in budget

Pavement LCP Scenarios

Table F-5 provides a summary of the scenarios included in LCP for pavements.

Table F-5. Pavement life-cycle scenarios.

Strategy	*Annual Budget Levels ($ millions)*
Preferred	$110, $130, $150
Worst-First	$130

Bridge LCP Scenarios

Figure F-3 provides a summary of the scenarios included in LCP for bridges. In addition to the current budget level of $60 million per year, the bridge LCP scenarios also considered budgets of $48 million and $75 million per year. The current strategy at $60 million provides the DSOGR for *Good* and *Poor* bridges for the next performance period through 2025. The DSOGR for *Poor* bridges is maintained for the 10 year TAMP planning period through 2031, however the 20-year analysis results indicate that additional funding is required to sustain the DSOGR for both *Good* and *Poor* bridge conditions through 2041.

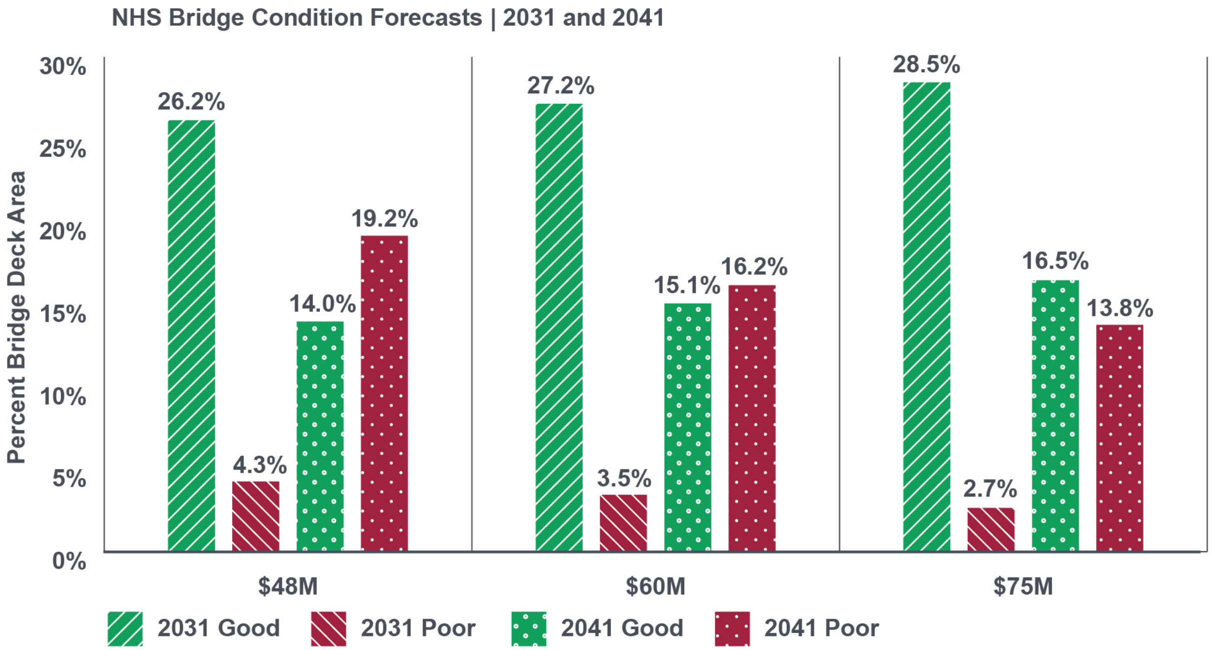


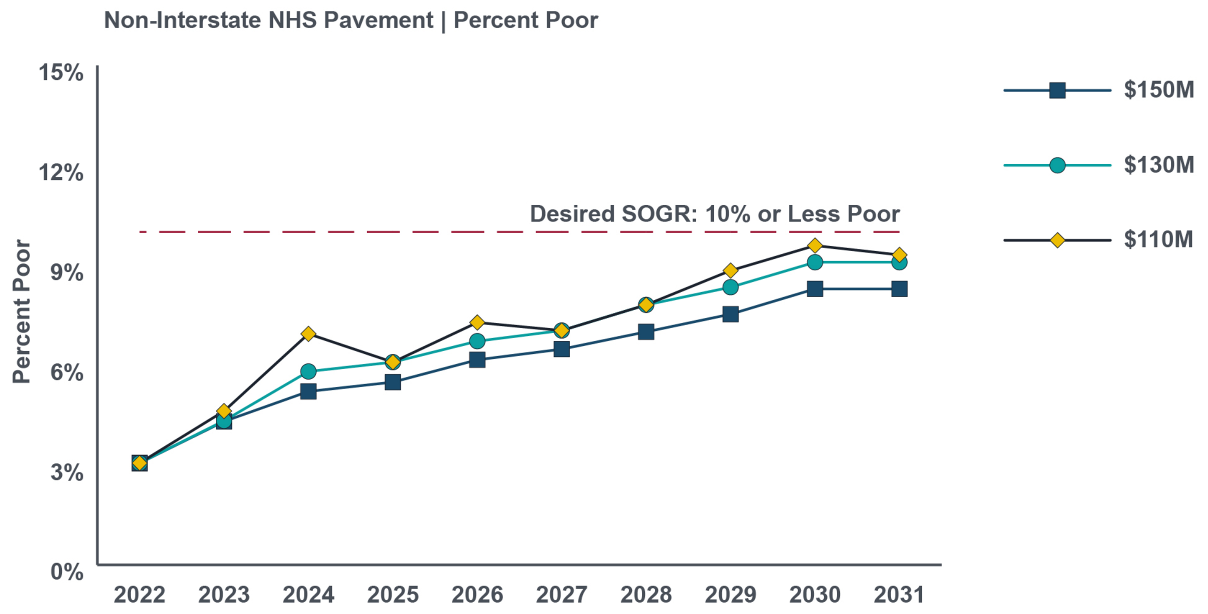
Figure F-3. 10- and 20-year Good and Poor NHS bridge deck area by scenario.

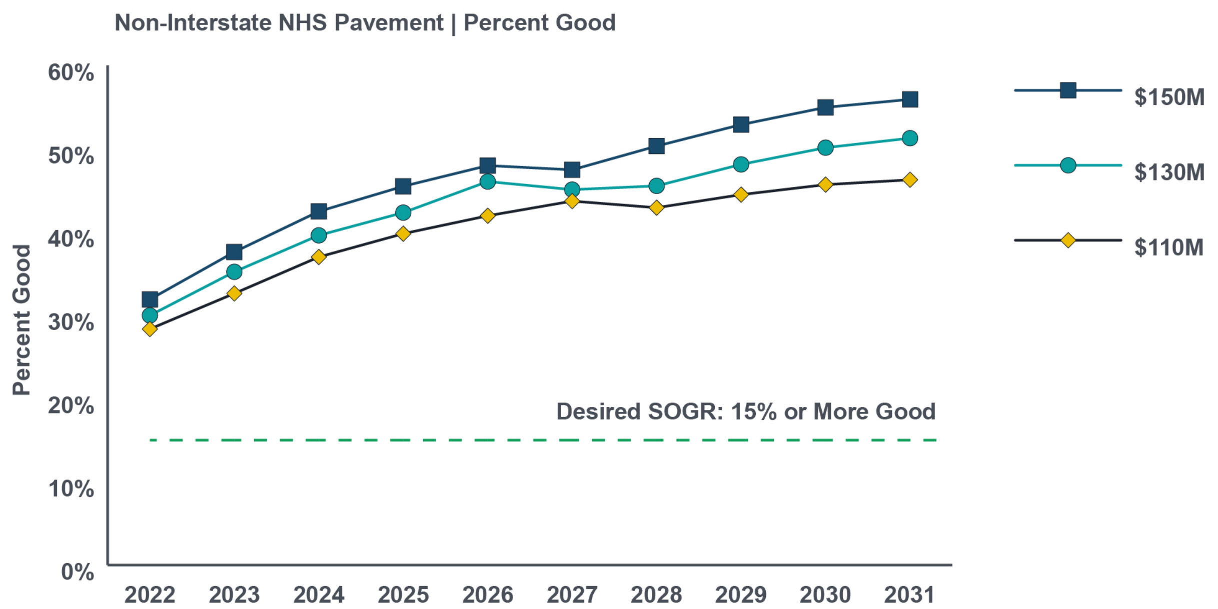
STEP 5. PROVIDE INPUT TO FINANCIAL PLANNING (10-YEAR ANALYSIS SUMMARIES)

Pavement Analysis Results

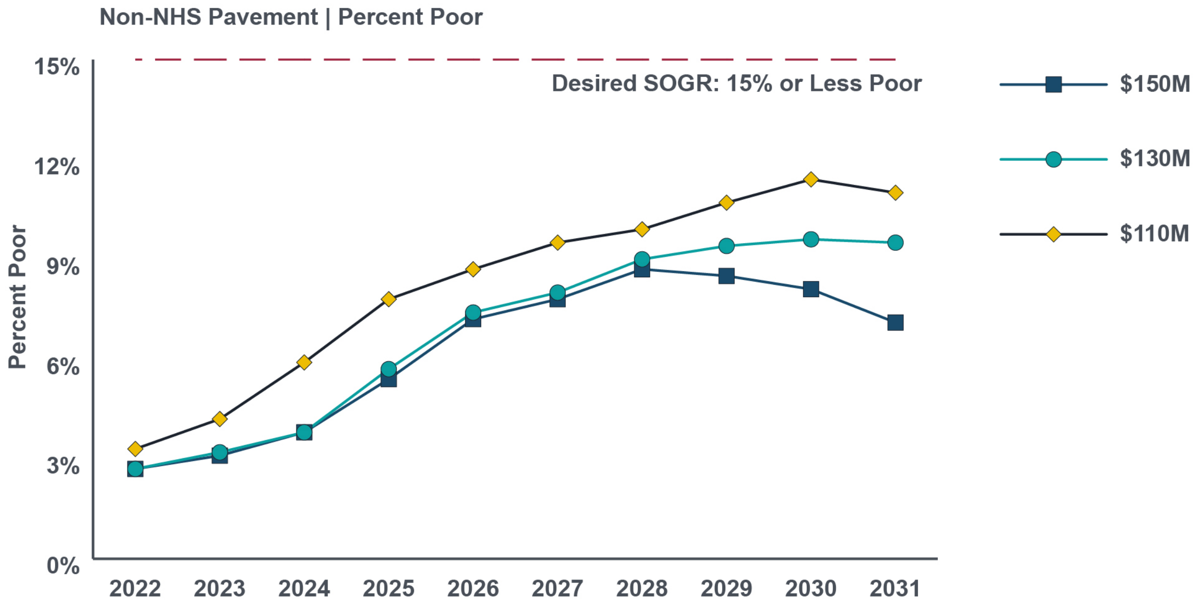
Figures F-4 through F-9 show forecasted pavement conditions using the preferred life-cycle strategy at different annual budget amounts, ranging from $110 million to $150 million. The results are presented showing the percentage of pavements, by lane-miles, in *Good*, *Fair*, and *Poor* condition for each year of the TAMP. These graphs demonstrate the impact of varying investment levels on future pavement conditions. Section 4 contains graphs showing the impact of varying treatment strategies on forecasted pavement conditions at the same investment level.

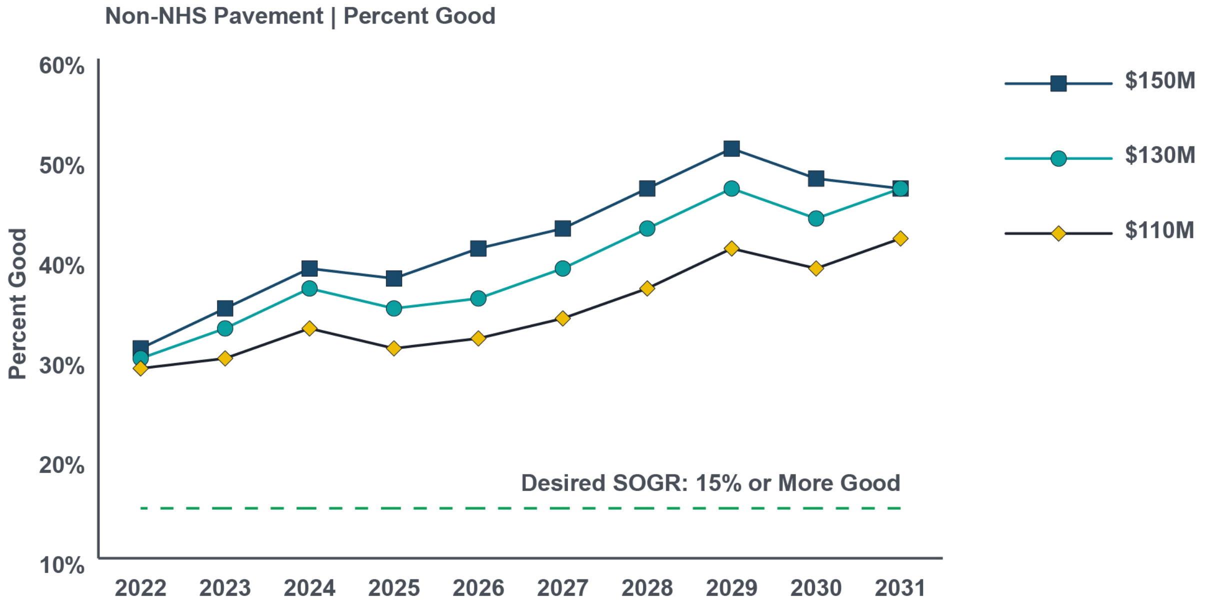
Figures F-4 and F-5. Forecasted Interstate pavement condition.





Figures F-6 and F-7. Forecasted non-Interstate pavement condition.





Figures F-8 and F-9. Forecasted non-NHS pavement condition.

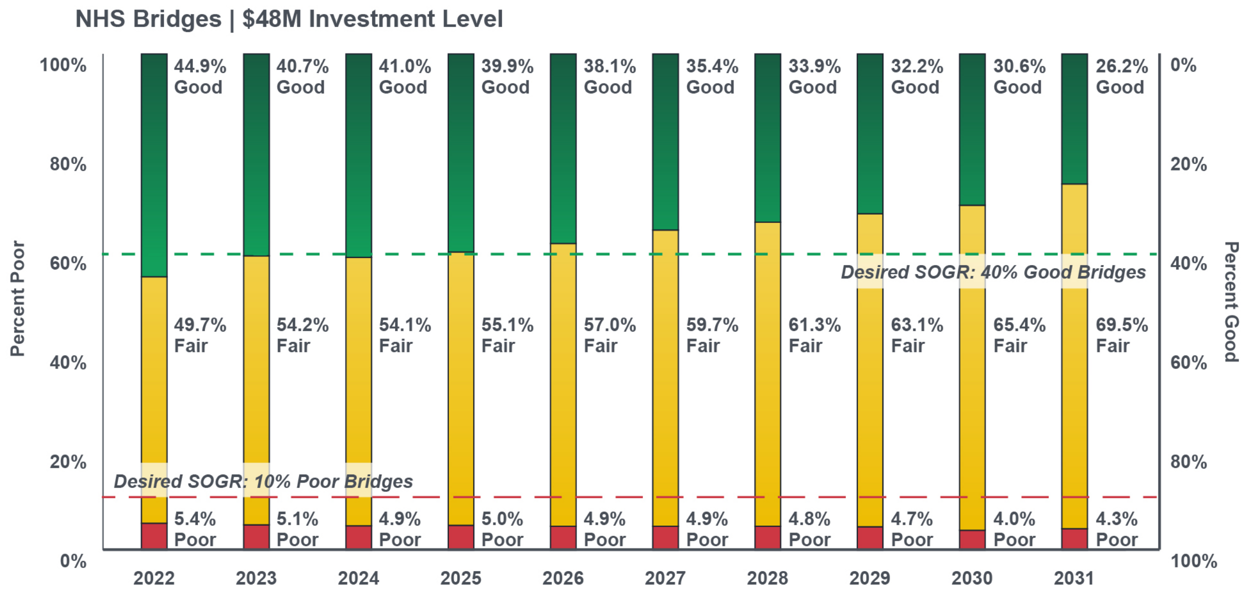


Figure F-10. Forecasted bridge conditions—$48 million annual budget.

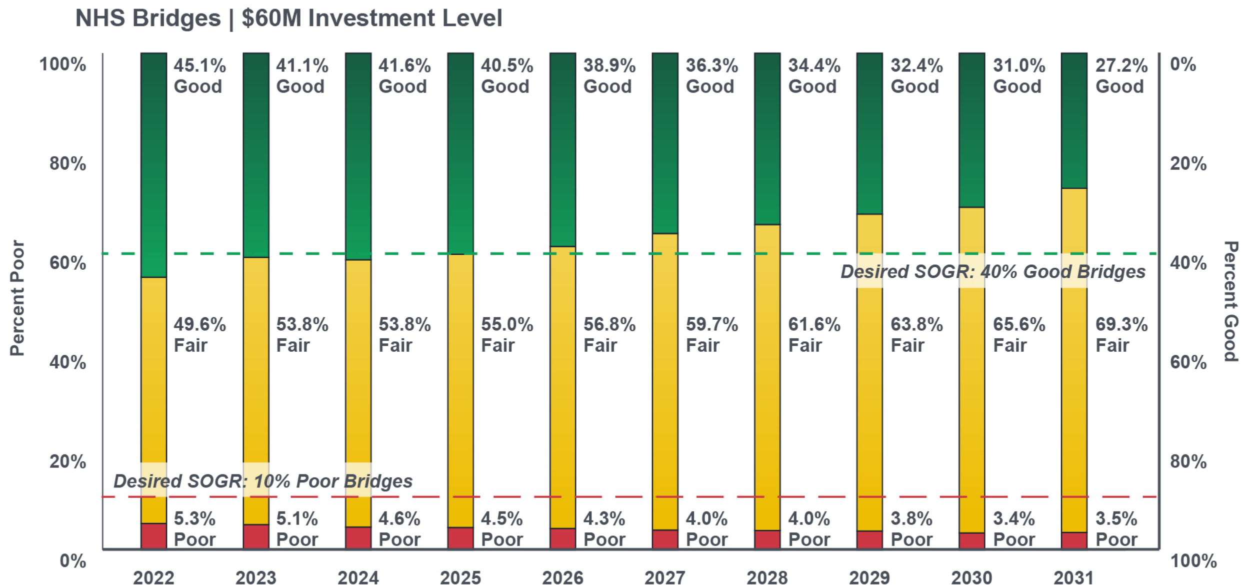


Figure F-11. Forecasted bridge conditions—$60 million annual budget.

Bridge Analysis Results

Figures F-10 through F-13 show forecasted bridge conditions using the preferred life-cycle strategy at different annual budget amounts, ranging from $48 million to $75 million. The results are presented showing the percentage of bridges, by deck area, in *Good*, *Fair*, and *Poor* condition for each year of the TAMP. These graphs demonstrate the impact of varying investment levels on future bridge conditions.

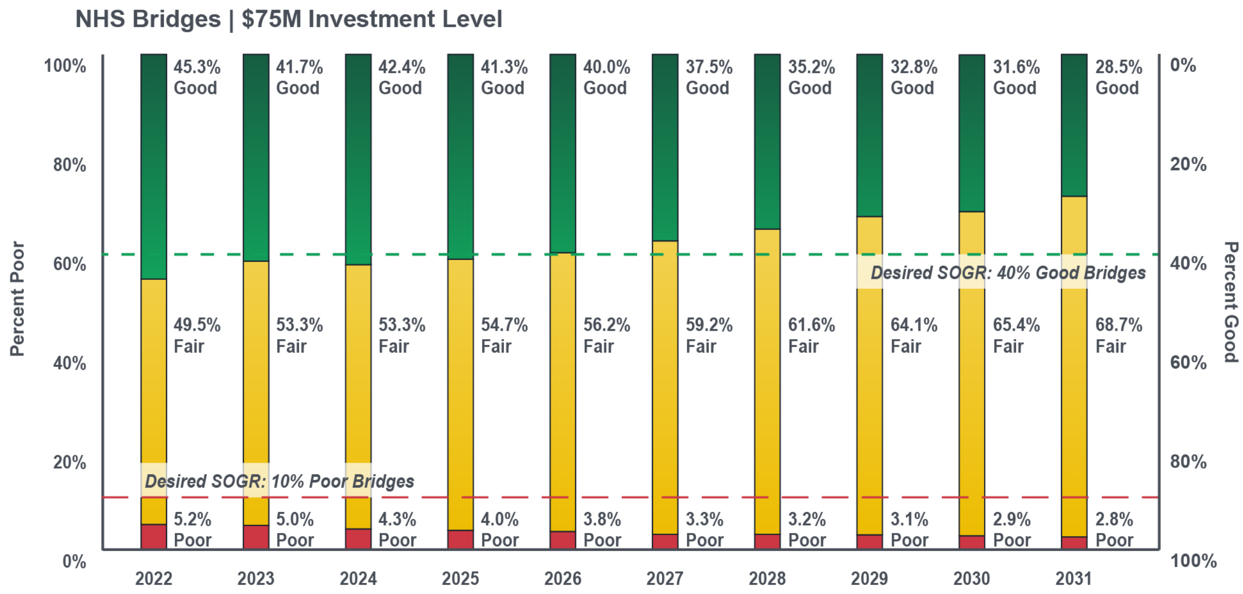


Figure F-12. Forecasted bridge conditions—$75 million annual budget.

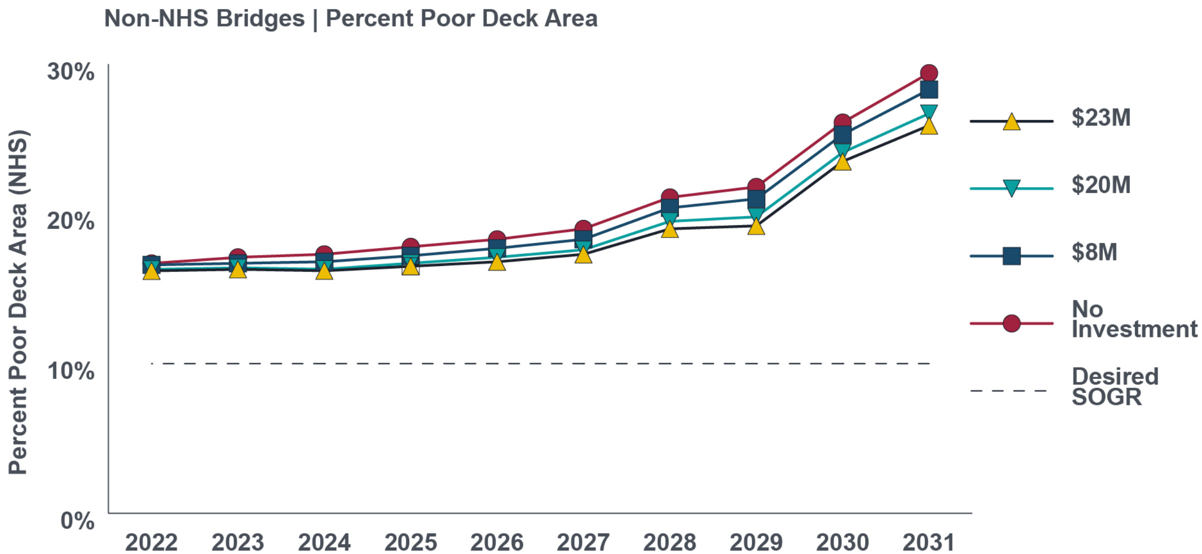


Figure F-13. Forecasted non-NHS bridge conditions at varied budgets.

Appendix G: Risk Management

Risk management is a systematic process that involves the identification, assessment, planning, and management of threats and opportunities faced by programs, processes, and projects. To develop a 10-year TAMP with investment strategies to sustain a SOGR, DOT&PF must identify and evaluate risks to these investment strategies. Figure G-1 provides an overview of the five-step risk management process that DOT&PF follows to manage risks related to investments in, and the performance of, pavements and bridges on the NHS in Alaska.

The agency follows the first four steps of this process to develop a risk register (shown in table G-7), which documents the highest priority risks and identifies the strategies and actions the agency will take to mitigate those risks. The risk register is used as a management tool in the fifth step, Manage Risks, to support and track execution of the risk mitigation strategies and actions. To support this, the risk register identifies individuals responsible for tracking and reporting on the implementation of each mitigation strategy or action.

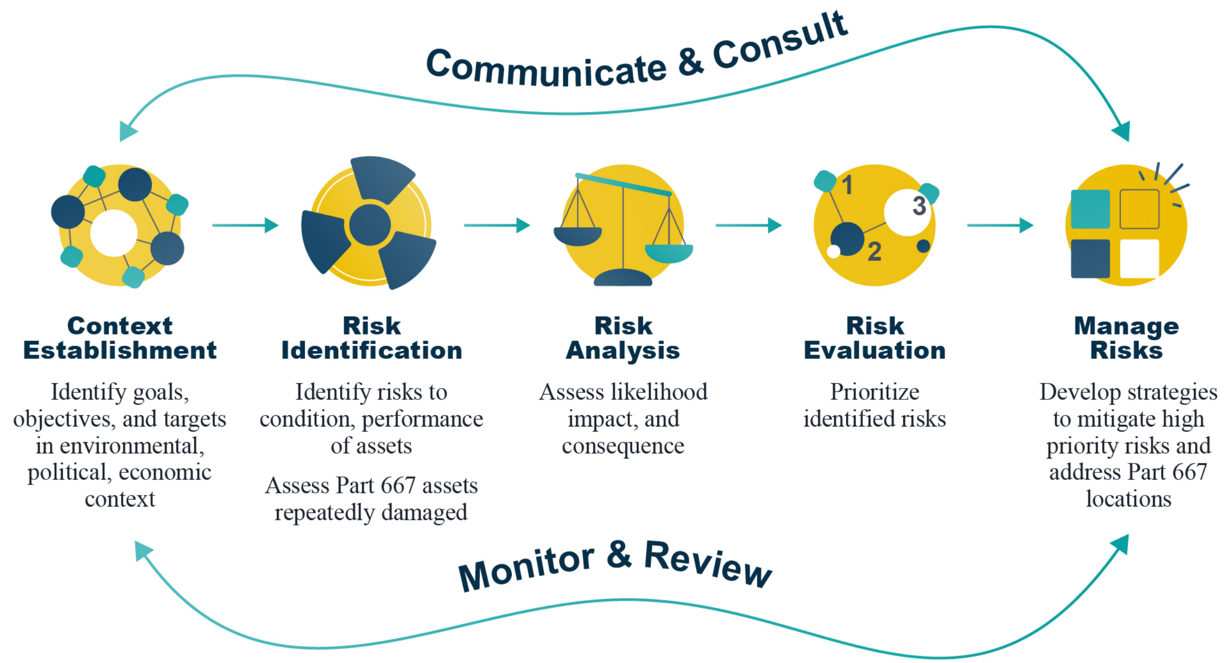


Figure G-1. The risk management process.

The DOT&PF management process includes two cycles for periodic development, review, updating, and replacement of the risk register. Once every 4 years, in support of updating the agency's TAMP, DOT&PF will conduct a workshop with the full risk management team. This workshop will guide the development of a new risk register that is updated to meet the needs of the agency as they have changed over the past 4 years. Annually, the TAM Coordinator will work with individuals identified to track each strategy to update the risk register as needed. An annual meeting (virtual or in-person) of the full Risk Management Team (see Step 1) is held to develop an updated risk register.

STEP 1. ESTABLISH RISK CONTEXT

An agency must manage many aspects of uncertainty to deliver its mission. This step in the process identifies the aspects of uncertainty that could impact asset management, narrowing the scope of the effort so that it can be effectively managed. Establishing the risk context involves:

- Establishing a Risk Management Team
- Defining asset management objectives and targets to be considered

- Identifying the levels of risk to be considered

The effort under this step started with information from Alaska's LRTP that is referenced in several sections of the TAMP. During development of the LRTP, DOT&PF formed the Transportation Stakeholders group and asked it to consider various scenarios. The elements of each scenario ranged from system preservation to travel demand and finance. As part of this effort, the group was asked to consider policies it would recommend and future risk areas for the plan's policy. The Transportation Stakeholders group identified the following risk areas: safety and cost, uncertainty, ramifications, capacity, culture, staffing levels, reliability, public opinion, and benefit. These risk areas were considered in later steps of the TAM risk management process.

Risk Management Team

Because risks can come in many forms, it is important to have a diverse and representative team to identify and prioritize them. The DOT&PF Risk Management Team consists of managers and technical experts from Finance, Pavement Management, Bridge Management, Geographical Information Systems, Regional Maintenance & Operations, Environmental Management, Construction, Safety, TAM Coordination, Planning, and Programming. Representatives from the FHWA Division Office also participate in many Risk Management Team activities.

Asset Management Objectives and Targets

Asset management objectives and targets are developed every 4 years as part of updating the agency's TAMP. The Risk Management Team uses these objectives and targets to establish the scope of the TAM risk management effort, identifying the most important trends or issues that could impact their achievement. The following subsections lists the objectives and targets used in development of the 2021 Risk Register, presented in table G-7. Each of these objectives and targets are described in further detail in other sections of the TAMP.

The following are the objectives that were used to develop the 2021 risk register.

- Treat pavements and bridges in *Good* and *Fair* condition before they deteriorate to save money over the asset life cycle.
- Manage pavement and bridge data and analysis systems centrally to make recommendations through coordination with regional planning, preconstruction, and maintenance.
- Provide information to allow effective selection and design of future preservation, rehabilitation, and reconstruction projects, including:
  - » Accurate estimates of future conditions versus funding scenarios
  - » Displays of analysis results in understandable formats
- Perform appropriate preservation on all NHS roadways maintained by DOT&PF.
- Develop preservation strategies for all pavement types, such as:
  - » A gravel road preservation program
  - » A disinvestment strategy that converts extremely low-volume roads to gravel
- Continue to implement a two-phase seismic retrofit program:
  - » Phase 1 = most critical bridge deficiencies
  - » Phase 2 = vulnerabilities in bridge columns and foundations
- Continue to support the seismic bridge retrofit program.
- Address scour-critical bridges in a prioritized manner.
- Develop a geotechnical and vulnerable assets mitigation plan.
- Explore adding assets in future TAMPs:
  - » Road embankments
  - » Retaining walls
  - » Culverts
  - » Rock slopes
  - » Soil slopes
  - » Material sites
  - » Drainage structures
  - » Tunnels
  - » ADA

Below are the targets that were considered when developing the 2021 risk register.

- Condition targets:
  - » Interstate pavement:
    - ▸ Less than 5 percent*: *Poor* (*Currently 10 percent—Anticipate revising to five percent in next target setting cycle)
    - ▸ At least 20 percent: *Good*
  - » Non-Interstate NHS:

    - ▸ Less than 10** percent: *Poor* (**Currently 15 percent—Anticipate revising to ten percent in next target setting cycle)
    - ▸ At least 15 percent: *Good*
- » NHS and non-NHS bridges:
    - ▸ Less than 10 percent: *Poor*
    - ▸ At least 40 percent: *Good*
    - ▸ Internal benchmark is less than 7.5 percent *Poor*
- » Replace or rehabilitate 1 to 3 *Poor* bridges per year.

Levels of Risk

As shown in Figure G-2, there are three primary levels of risk that DOT&PF manage to deliver their mission. The TAMP risk management process is concerned with the two highest levels of risk: agency and program. These risks represent areas of uncertainty that could impact multiple projects or business areas. Project risks are better managed during program delivery processes such as STIP development, design, and construction.

STEP 2. RISK IDENTIFICATION

Risk identification is the process of identifying and describing aspects of uncertainty and their potential impacts on the organization. Risks are documented in a risk statement, composed in two parts. The first part of the risk statement is referred to as the *if* clause. An *if* clause identifies the potential event or occurrence that poses a threat or opportunity related to one or more of the TAM objectives and goals at the agency or program level. The second portion of the risk statement is called the *then* clause. *Then* clauses describe the possible, probable, or expected impacts should the *if* clause come to pass. Often there are multiple *then* clauses for each *if* clause, as each risk event is likely to result in multiple impacts. The risk register (table G-7) is organized with separate columns for ***if*** and *then* clauses.

Quadrennial Risk Workshop

For development of TAMP updates, the Risk Management Team will identify risks during an in-person risk workshop. During this workshop, participants will seek to identify as many risks as possible for consideration during risk analysis and evaluation.

Annual Review and Update

During annual review, risk identification is handled by individual managers and members of the Risk Management Team. At least annually, the Chief Engineer or their designee will hold an in-person or virtual meeting with the Risk Management Team to assess the need to identify new risks in, or remove risks from, the risk register. This information will be used as described in step 5, Manage Risks.

Responsibility: Executives

Type: Risks that impact achievement of agency goals and objectives and involve multiple functions

Strategies: Manage risks in a way that optimizes the success of the organization rather than the success of a single business unit or project

Responsibility: Program Managers

Type: Risks that are common to clusters of projects, programs, or entire business units

Strategies: Set program contingency funds; allocate resources to projects consistently to optimize the outcomes of the program as opposed to solely projects

Responsibility: Project Managers

Type: Risks that are specific to individual projects

Strategies: Use advanced analysis techniques, contingency planning, and consistent risk mitigation strategies with the perspective that risks are managed in projects

Figure G-2. Risk levels.

STEP 3. RISK ANALYSIS

Risk analysis is the process of determining and documenting the likelihood and impact of each risk statement. To ensure this is done consistently for all risks and by all Risk Management Team members, DOT&PF developed the risk matrix shown in table G-1. The risk matrix is used during the Quadrennial Risk Workshop to analyze all identified risks and during annual updates. This allows for analysis of any new risks that have been identified for inclusion in the risk register. The results of this analysis are used as inputs in step 4, Risk Evaluation.

Table G-1. DOT&PF risk matrix.

Risk Matrix with Impact and Likelihood Definitions			*Likelihood*				
			Rare (0-10%) < once per 10 years	*Unlikely (10-30%) < once per 10 years,> once per 3 years*	*Likely (30-70%) Once per 1-3 years*	*Very Likely (30-70%) Once per year*	*Almost Certain (90-100%) Several times per year*
Impact	Catastrophic	Potential for multiple deaths and injuries, substantial public and private costs	Medium	Medium	High	Very High	Unacceptable
Impact	Major	Potential for multiple injuries, substantial public or private cost, and/or foils agency objectives	Low	Medium	Medium	High	Very High
Impact	Moderate	Potential for injury, property damage, increased agency cost, and/or impedes agency objectives	Low	Medium	Medium	Medium	High
Impact	Minor	Potential for moderate agency cost and impact to agency objectives	Low	Low	Low	Medium	Medium
Impact	Insignificant	Potential impact that is low and manageable with normal agency practices	Low	Low	Low	Low	Medium

STEP 4. RISK EVALUATION

Risk Evaluation is the process of prioritizing risks. This is similar to risk assessment, but it considers the agency's risk threshold, or appetite to tolerate uncertainty, as well as the agency's capacity to mitigate risks. The DOT&PF's risk tolerance or risk appetite refers to how much risk an organization is willing to accept. Table G-2 shows DOT&PF's appetite for different levels of risk:

Table G-2. DOT&PF Risk Tolerance.

Level of Risk	*Response*
Unacceptable	Coordinate immediate response
Very High	Coordinate response with stakeholders
High	Work with stakeholders on a long-term solution
Medium	Review risk with stakeholders, may be acceptable
Low	Acceptable risk, does not require review

During this step of the Quadrennial Workshop, the Risk Management Team identifies potential risk mitigation strategies or actions that could serve to reduce the likelihood or impact of threats, improve the agency's ability to respond should a threat come to pass, or allow the agency to take advantage of opportunities. Following the workshop, the team works by web meeting and conference call to finalize the list of mitigation strategies to be implemented during the TAMP time frame. These selected mitigation strategies are shown in the right-hand column of the risk register in table G-7. During its annual review of risks, the Risk Management Team will consider changes to the risk mitigation strategies based on recommendations by the individuals assigned to track and report on each risk. The annual review of mitigation strategies is discussed further in step 5, Manage Risks.

STEP 5. MANAGE RISKS

Risks are managed through implementation of the selected mitigation strategies. The following subsections describe the identified risks, document the groups primarily responsible for managing the assets included in the TAMP, and list strategies for managing risks to those assets and the related TAM objectives and targets.

RISK REGISTER

The risk register in table G-3 documents the risks identified within the context of risk management and beyond the agency's risk tolerance. Each of the identified risks has at least one mitigation strategy that the Department will pursue and track through its asset management implementation. DOT&PF does not have an enterprise risk plan but does address enterprise risk in different areas of the Department The organizational unit responsible for implementing and reporting on each mitigation strategy is identified in the register.

Table G-3 summarizes the matrix developed as the result of the August 6, 2021, Risk Workshop and follow up meetings to finalize risks, assign responsible unit, mitigation strategies, and risk mitigation plans.

Table G-3. Risk and mitigation strategy matrix.

If …	Then …	Applicable Mitigation Strategies	Responsible Unit	Risk Mitigation Plan
funding is below current projections,	increase M&O costs, delay existing projects, and decrease staff. take full advantage of federal funds. shift in function / programs / services.	Implementing PMS & BrM optimized investments to related systems such as ESRI, MRS, and AASHTOWare.	Pavement & Bridge	Systems are implemented—currently optimizing the systems.
increases in the number of assets without an increase in maintenance resources,	there will be a net reduction in maintenance and maintenance level of service (LOS) across all assets.	Stop acquiring *Poor* assets from other agencies.	Regional Directors / Planning	Asset Managers/M&O Continuous Communication with Regional Directors, Planners, and other staff.
		Maintenance cost as part of the project development process. Project criteria STIP projects. Existing Policy & Procedure 09.01.010 requires local maintenance for a local expansion project.	Planning	Scoring criteria already in CTP for STP funds. STIP criteria for NHPP funds is being implemented as part of new STIP criteria.
		Transfer assets to other agencies.	Regional Directors / Planning	Current process to work with legislative liaison and community leaders. Goal—one transfer per year.
		Look at design for maintenance savings, e.g. bridge already optimizing design.	Design/Bridge	Update Design Manuals with M&O savings in mind.
		Tolerate and communicate to the public how increased infrastructure reduces the LOS for maintenance on all assets.	Public Information Officers	Continuous communication already in place.

If …	*Then …*	*Applicable Mitigation Strategies*	*Responsible Unit*	*Risk Mitigation Plan*
the agency cannot deliver the program,	infrastructure that would improve performance and safety would not be constructed or improved.	Keep sufficient number of trained project delivery staff (e.g., Engineering / ROW / Enviro).	Regional Directors/ Division Directors with Admin and HR staff	Core competency plan. Knowledge Management Initiative with succession planning.
		Take advantage of materials cost decreases by having contingency projects on hand, and if costs increase, use Advanced Construction (AC).	Planning, Regional Directors	Selecting shelf ready projects is a continuous process in place using AC in the STIP.
		Improve scoping practices to improve schedule and financial planning accuracy.	Planning, Environmental, Preconstruction Regional Directors	Develop a scoping standard operating procedure (SOP) with detailed initial planning estimates.
		Create connections between spending or policy plans (10-year plan, STIP, HSIP, SHSP).	Planning	Internal 10-year extended STIP and capital review meetings.
		Ensure initial construction quality so asset performs as expected over the anticipated timeline and does not require premature investment.	Construction	Quality Assurance Program provided in specifications, QC/QA plans.
		Bundle bridge projects in rural areas to save on mobilization and material costs.	Regional Directors, Bridge and Planning	Currently bundling projects to take advantage of the cost savings.
the use of studded tires is reduced,	the damage to roads that causes unreasonably short pavement life will be reduced, resulting in longer pavement lives, allowing funding to be used for other assets.	Research completed on studded tire impacts. Work with leadership to explore options.	Research/Pavement/ Central Region	Research project deployment activities, continue research efforts, and educate public on this and its alternatives.
		Change the dates between which studded tires are allowed. Enforcement if current dates are adequate.	Legislative liaison/ enforcement	Work on implementing. Research project with deployment activities.
		Educate public on road damage and other travel options available to them (e.g., non-studded snow tires, walking, biking).	Public Information Officers and MPO liaisons	Research project deployment activities.
		Charge fees for studded tire users.	Legislative liaison	This is not DOT&PF authority.

If …	*Then …*	*Applicable Mitigation Strategies*	*Responsible Unit*	*Risk Mitigation Plan*
natural events occur impacting infrastructure (excluding seismic),	mobility, public health, and safety will be impacted. funds would be rerouted from the existing operating budget, causing project delays. specific risks include flooding, ice falls, coastal flooding, avalanches, and rock falls.	Design new bridges to a 50-year flood event and floodway areas to a 100-year flood event.	Current Practice—Bridge	Current practice.
		Statewide coordination of hydrologists. Quick rapid repair technique and seismic repair, deployable.	Bridge	Current practice.
		Implement a GAM plan to support project selection and scoping and integrate available data with selection/scoping.	GAM	Statewide materials developed work plan. Condition ratings for rock slopes, soil slopes, and retaining walls as well as letter grades of risk (A-F) that are available through ArcGIS Online (AGOL) maps. M&O activities (rockfall, landslide, avalanche) are being included in GAM slopes and condition ratings. Beginning to use M&O rockfall cleanup activities to estimate risk to roads.
		Implement a system or process for identifying, evaluating, and prioritizing environmental hazards improvement for resiliency and vulnerable assets (example avalanches, icefall, and extreme weather events).	Planning with M&O, Design, Bridge	Planning to develop a Resiliency work plan; can use index similar to avalanche hazard index being worked on by avalanche group.
		Engage with other agencies for research monitoring and predictive modeling. Current modeling effort to adjust hydraulic models.	Research/CR Hydraulics	Current Research Project "Precipitation Projections for Alaska."
		Develop hazard index and mitigation strategies for vulnerable or high-value assets.	GAM for Geotechnical Planning and Research	Completed research project—need implementation.
we continue to have warmer winters with more thawing permafrost,	we will see more settlement, decreased pavement ride quality, and shorter pavement service lives. increased M&O costs.	Identify vulnerable areas and prioritize treatments to increase resiliency. Pavement Management foundation stability A, B, C.	Planning & NR Pavement	Included in Resiliency work plan. *Updated* unstable subgrade locations have been added to the Pavement Management System for consideration in analysis and recommendations. Modifying design standards, aka Pave Design policy, waivers.
		Develop a mitigation plan for unstable embankments within the GAM mitigation plan.	GAM	Update GAM mitigation plan for unstable embankments.

If …	*Then …*	*Applicable Mitigation Strategies*	*Responsible Unit*	*Risk Mitigation Plan*
the Office of Information and Technology (OIT) organization is unable to support DOT&PF's technology needs,	the agency data may not be secure and any breach may disrupt agency operations.	Develop a joint IT and data governance plan between OIT and DOT&PF.	Admin Services or Executive Team	Follow current DOT&PF data governance plan.
	the agency may not be able to purchase, upgrade, or replace software and hardware as needed.	Communicate the criticality of IT services to executives.	All Directors via data and IT work group	Completed a presentation to Executive Leadership.
	the agency's ability to make informed decisions may be reduced.	Develop a specific Technology Risk Register.	All Directors via data and IT work group	No mitigation plan.
	expenditures to collect data will not yield the anticipated benefits.	Document current LOS.	All Directors via data and IT work group	No mitigation plan.
		Department of Administration (DOA) transfers risk back to DOT&PF.	Commissioner	No mitigation plan.
DOT&PF leadership changes,	they may not have a complete understanding of recent federal initiatives such as TAM, TPM, and performance-based planning.	Develop briefings on key priorities for new leaders.	Asset Management Executive Management Transition Book	Executive briefings.
		Schedule NHI and other educational opportunities for new leaders.	Asset Management	Executive training opportunities.
there is a moderate seismic event of 6–7 magnitude,	structural damage may occur, and some bridges may need to be inspected for structural soundness.	Deploy Response Team to inspect and evaluate affected structures, then develop plan to fix detected issues.	M&O, Design, Construction & Bridge, adding others as needed	Develop a Lessons Learned from November 2018 earthquake.
there is a major seismic event of 8–9 magnitude,	isolated bridges may collapse or become structurally unsound.	Treat and tolerate the risk for collapse and continue the Seismic Retrofit Program to improve resiliency.	Bridge, with others as needed	Fully program and administer the Seismic Retrofit Program.
	major structural damage may occur to multiple bridges and a significant number of bridge projects would need to be added to the program.	Update existing preliminary seismic analysis and schedule replacement of seismically vulnerable bridges.	Bridge	Fully program and administer the Seismic Retrofit Program.
		Coordinate with Regions to design and construct new seismically resilient bridges.	Bridge	Fully program and administer the Seismic Retrofit Program.
		Provide public service information after a seismic event (emergency action plan) and include it in Alaska 511.	Public Information Officers (PIO)s	Develop a Lessons Learned from November 2018 earthquake.
		Update Field Operations Guide (FOG).	CR Safety	Review and Update Field Operations Guide as needed.

DISCUSSION OF KEY RISKS AND MITIGATION STRATEGIES

While preparing the risk register, many risks were discussed and prioritized. All the risks included in the risk register are categorized as medium or higher. Low risks were not included in the risk register. The highest risks are discussed in more detail in Section 3. The following sections provides additional details of key risk mitigation strategies and efforts listed in the risk register (table G-3).

Funding

ENTERPRISE RISK: PROGRAM PLANNING AND DEVELOPMENT

A funding increase is an opportunity to invest more into Alaska's transportation assets. The Infrastructure Investment and Jobs Act (IIJA) was passed in November 2021. Some funding opportunities included in IIJA are Surface Transportation block grants, HSIP and other safety programs, as well as a dedicated bridge program, new apportionments for carbon reduction, and a protection of funding to improve resiliency and Electric Vehicle (EV) infrastructure.

Delivery of Program

ENTERPRISE RISK: PROGRAM PLANNING AND DEVELOPMENT

The Alaska STIP is the state's 4-year program for transportation system preservation and development. It includes Interstate, state, and some local highways, bridges, ferries, and public transportation but does not include airports or non-ferry-related ports and harbors.

PLANNING FOR BRIDGE RISK

Scoring criteria was developed for program planning. A utility factor is used for bridge projects in the planning process. The utility factor includes four components: condition, life-cycle, risk, and mobility. Condition includes two components: 1) NBI condition for the deck, the superstructure, and the substructure, and 2) element weights to account for preservation. Life-cycle includes preservation treatments based on bridge element data. Risk includes fracture critical, which is posted for load and affects freight and mobility; under clearance; scour critical; channel protection; waterway adequacy; and seismic risk. Scour critical bridges have a higher risk rating. Finally, the last criteria is mobility, which includes deck geometry, detour length, and approach roadway alignment as defined in the FHWA bridge data dictionary.

Data and IT Systems

ENTERPRISE RISK: IT

DOT&PF utilizes a comprehensive set of activities to assess enterprise risk for information technology. The first step involves gathering all information related to the system. The next steps involve identifying the potential threats, levels of vulnerability, and identifying the current and planned controls related to the proposed system. Mitigation includes prioritizing, evaluating, and implementing the appropriate controls to reduce the risk to the proposed system. Next, determinations are made on the likelihood of vulnerabilities being exercised as well as any related adverse impact of the exercises by known threats.

Once the activities listed in figure G-3 on the following page are completed, a risk determination is made. The risk determination will identify the likelihood of a given threat source, the magnitude of the impact, and the adequacy of the current and/or planned security controls in place to reduce or eliminate risk. After identifying the risk level through a developed matrix, the control recommendations are suggested to reduce the level of risk to the IT system.

The final step in the risk assessment process is to document the results in a report or briefing.

System Performance

ENTERPRISE RISK: PLANNING

The current LRTP 'Let's Keep Moving 2035,' addresses risk by analyzing trends impacting future performance using a risk-based approach. Trends affecting the physical condition of the transportation system and its operational performance are analyzed. Four broad categories of trends are considered during the planning process: 1) Travel Demand, 2) Delivery/Supply, 3) Public Policy and Financial Capacity, and 4) Climate Change & Extreme Weather Events. The

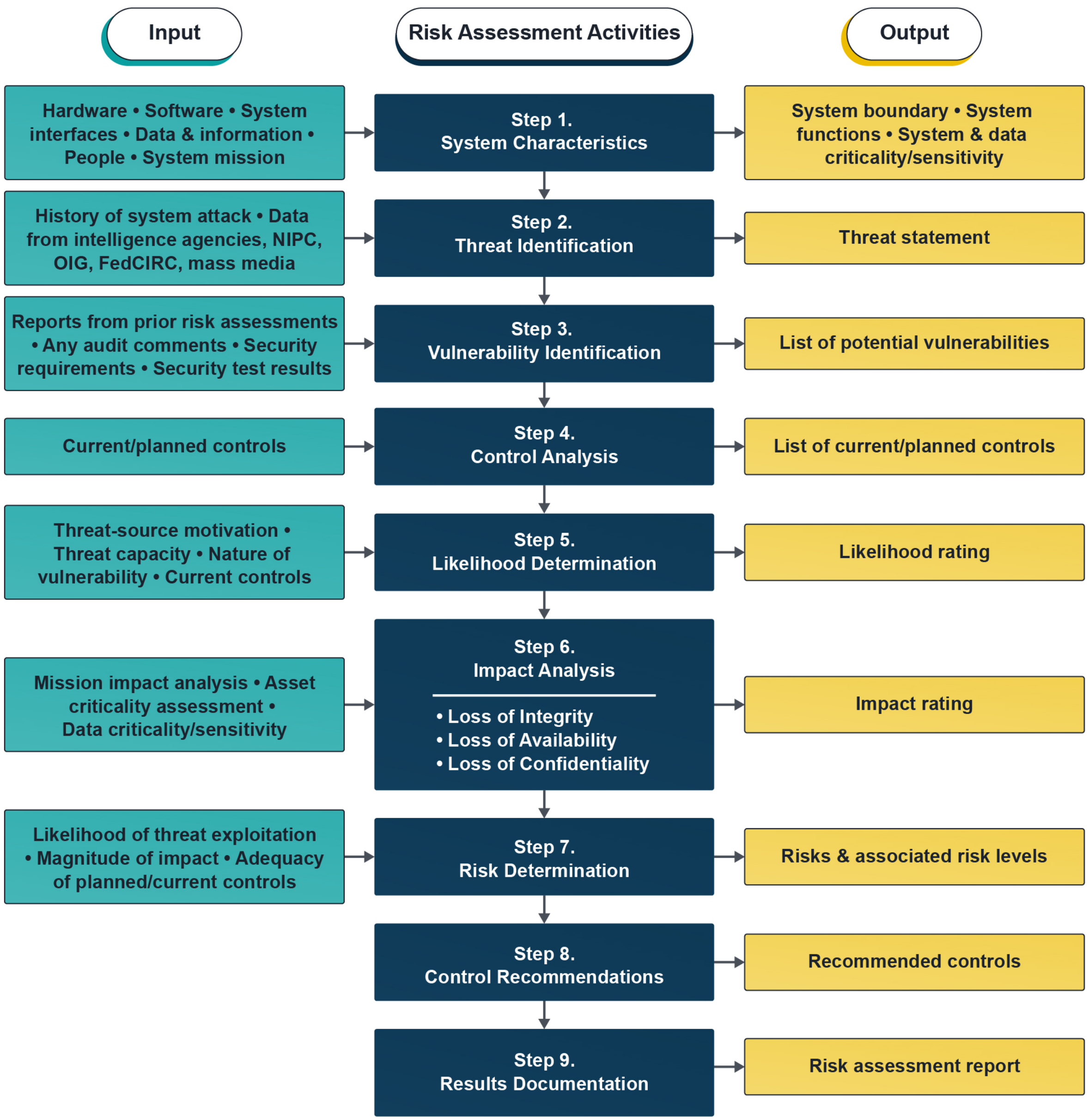


Figure G-3. Risk assessment for information technology (Risk Assessment Tool—Department of Commerce).

information for the current LRTP can be found here: Let's Keep Moving 2035.

The Statewide LRTP/Financial Plan (FP) update that is now underway is conducting an infrastructure assessment, a freight assessment, and a financial assessment to understand existing system strengths, weaknesses, needs, and opportunities. Scenario planning was conducted around the key drivers of economic/resource development, funding, and workforce to identify areas of greatest risk and emphasis for policy direction and performance management. The draft plan releasing in May of 2022 will provide policies and action steps aimed to better enable functionality and interoperability of the transportation system by areas of greatest priority. It will also establish key indicators and protocols for assessing system performance and progress towards goals. More information about the updated LRTP can be found here: Project Home—Alaska Moves 2050.

Seismic Activity

RESILIENT INFRASTRUCTURE: BRIDGE DESIGN

Alaska is the most seismically active state in the United States. The earth's most active seismic feature, the circum-Pacific seismic belt, brushes Alaska and the Aleutian Islands, where more earthquakes occur than in the other forty-nine states[6] combined.

6 USGS Alaska Earthquake and Tsunami Hazards

In 1995 the Department implemented a seismic retrofit program for bridges using hazard data from the U.S. Geological Survey. This data, together with a seismic vulnerability assessment of bridges and determination of priority highway routes, have resulted in the prioritization of bridges for seismic retrofit.

The Department retrofits bridges in an attempt to prevent collapse during an earthquake. Phase 1 of the program addresses the most critical bridge deficiencies that can be accomplished for the least cost. Phase 2 of the program is intended to address vulnerabilities in the bridge columns and foundations, which are typically much more expensive to correct. The STIP includes $950,000 per year for the seismic retrofit program (for FFY22–FFY23 and after).

INCLUDING BRIDGE RISKS IN LIFE-CYCLE PLANNING

The bridge management system is being configured for risk through the BrM enterprise system. Seismic information and hydraulic parameters are being included in scenario planning. The hydraulic parameters included in this analysis are channel protection, water adequacy, and scour as defined in the FHWA bridge data dictionary. Preservation weighting is also being included in life-cycle planning network policies in BrM. Preservation is a big component of the life-cycle planning process. Work to configure an enterprise level implementation of risk as part of the life-cycle planning process is ongoing.

Resiliency

CLIMATE CHANGE

Alaska's diverse climates can be classified into five general climate regions: maritime, west coast, south central, interior, and arctic. The regions correspond to different climate-related impacts on temperature and precipitation. Weather events show changes in the timing, frequency, form, and intensity of precipitation, which may cause related and increasing natural processes. Impacts also include:

- Melting/warming permafrost
- Increased storm frequencies and intensity
- Increased coastal erosion due to lack of sea ice
- Increased river and shore erosion
- Sea level rise
- Increasing temperatures
- Debris flows
- Avalanches
- Floods
- Aufeis

For DOT&PF, this means that construction costs will be higher to maintain frozen permafrost as temperatures rise, and maintenance and operations costs will increase if the warming trend continues.

Extreme Weather Events

Alaska has 6,640 miles of coastline, which is more than all 49 other states combined. Facilities in coastal areas include roads, airports, harbors, and docks. Alaska has twenty coastal airports and twelve coastal highways. Coastal areas are vulnerable because they could be affected by land-based changes in patterns of precipitation and temperature increases, as well as increases in sea level and the number of storm-driven tides[7]. Diminishing sea ice has reduced the natural coastal protection along Alaska's northwestern coast. Coastal erosion is causing some shorelines to retreat at rates averaging tens of feet per year[8].

Flooding presents another significant risk to the Alaska infrastructure. In 2015, Dalton Highway[9] had major flooding events due to ice buildup that caused water to flow over the highway, and spring breakup caused another round of flooding that washed sections of the gravel road away. This flooding caused road closures and resulted in $17 million in emergency repair costs.

To mitigate for extreme events, DOT&PF addresses infrastructure resilience in all phases of an asset's life cycle, including planning, design, construction, and maintenance and operations. Itemized below are actions that have been adopted to incorporate resilience into the asset management process, followed by more detailed examples of how these strategies have been implemented.

7 Landscape Conservation Cooperative LCC Network—A High-Resolution Coupled Tide and Storm Surge Model for the Gulf of Alaska, Bering Sea, Chuckchi Sea, and Beaufort Sea

8 USGS Climate Impacts to Arctic Coasts

9 Alaska DOT&PF Dalton Highway Updates 2015 Flooding Response

- Incorporate potential impacts of extreme events into long term planning through vulnerability assessments and adaptation plans (erosion, flooding, sea level rise, extreme weather events).
- Identify and inventory external risks to existing infrastructure (e.g., seismic evaluations, bridge scour program).
- Perform infrastructure inspection, replacement, or retrofit to mitigate risks.
- Implement operational and an emergency response program to minimize impacts of asset failures because of extreme events (e.g., staff training and planning, staging resources for response).
- Establish programs to review and evaluate construction standards and new technologies to ensure reasonable incorporation of resiliency to extreme events.
- Perform periodic re-evaluations of the system for vulnerabilities.
- Monitor mitigated locations over time.
- Prioritize locations with high risk.

Resilient Infrastructure

DOT&PF has implemented a number of mitigation strategies to enhance the resilience of its infrastructure and reduce risks associated with climate change and extreme weather events. Below are descriptions of a number of measures the Department has taken to protect its infrastructure and the public who relies on it.

THAWING PERMAFROST: ROADWAY DESIGN

For thawing permafrost, the ACE (Air Convection Embankment) is a mitigation technique to prevent thaw settlement in permafrost-rich soils. The ACE chimney effect acts as a one-way heat transfer device. When coarse material is placed on the side slope, the movement of cold air through the material cools the embankment adjacent to the side slope and transfers the heat to the air. The air is warmed slightly by the warm embankment and then escapes up through the rock. The ACE treatment is an effective mitigation technique to prevent thaw and was constructed in the following locations:

- Alaska Hwy MP 1354-1364 (figure G-4)
- Thompson Dr, Fairbanks (figure G-5)
- Taylor Hwy, MP 70 Lost Chicken Creek
- Elliott Hwy, MP 0-12
- Dalton Hwy, MP 219—FDL Realignment

More information can be found at Alaskan Transportation Spring 2020.

Figure G-4. ACE on the Alaska highway.

Figure G-5. ACE on Thompson Drive, Fairbanks

MATERIAL SELECTION: BRIDGE DESIGN

Bridges are designed in Alaska with materials that provide the most longevity. Building in resilience through design has been the most effective tool to anticipate, prepare for, and adapt to changing bridge conditions. The bulb tee girder is designed to have zero tension so that the moment and shear in the girder are the same. The waterproof membrane is designed to provide longevity by keeping water from penetrating into cracks, reducing the freeze/thaw effect. In addition, rebar is used to strengthen concrete. The protective coating used on rebar is plant fabricated and designed to help prevent oxidation (rusting).

SCOUR CRITICAL PROGRAM: BRIDGE DESIGN

The Statewide Hydraulics section implements the Bridge Scour Monitoring and Retrofit Program. Tasks for this program include installation of monitoring and telemetry data collection equipment, inspection of bridges for scour, and implementation of the DOT&PF Plan of Action (POA) for scour-critical bridges. Other tasks include coordination with local agencies on NBIS compliance and designing and constructing physical scour countermeasures on bridges identified as scour critical according to NBIS. The STIP includes $950,000 each year for FY22 and FY23 and beyond.

FLOODING: BRIDGE DESIGN

Bridges are designed to a 50-year flood event and a 100-year flood event for floodway areas. Bridges are designed so that they do not create a backwater situation. The capacity of the hydraulic feature is designed to protect the asset and existing infrastructure. Some rivers have large, braided channels with existing bridges, and the river can change direction. Maintenance crews work hard to maintain the river in its current location. Some risk is accepted by the Department for certain infrastructure.

FLOODING: BRIDGE AND CULVERT DESIGN

DOT&PF worked with the University of Alaska Fairbanks on precipitation forecasting. The Projections of Precipitation for Alaska Infrastructure research report provided analysis for the statistical probability of extreme precipitation events across all locations in Alaska. Hydraulic structures, such as bridges and culverts, designed with careful assessment and interpretation of the new databases will better meet the standards for sound hydraulic methodologies and best available science as recommended by FHWA (Future Projections of Precipitation for Alaska Infrastructure Final Report).

Figure G-6. Mendenhall River Bridge, Juneau, Jokulhlaup (Glacial Melting) Event 2016.

FLOODING: ROADWAY DESIGN

To mitigate flooding due to extreme weather events, raising the roadway and increasing the culvert size is an effective mitigation technique to prevent road closures. The raised roadway acts as a collection area for debris, flows, or flooding events, and equipment can be used to clear the inside of large culverts when large events occur. The following locations used this technique:

- Dalton Highway MP 362-414 (figure G-6)
- Haines Highway MP 1-4
- Haines Highway MP 19 (figures G-8 and G-9)

Figure G-7. Dalton Highway—2015 flooding.

Figure G-8. Haines Highway MP19 project with elevated roadway.

Figure G-9. Haines Highway MP19.

UNSTABLE SLOPES: PLANNING

The Statewide Materials Geotechnical Services group is completing research to guide development of a GAM plan for four primary asset classes that provide critical function and whose deterioration can negatively affect fiscal scenarios, road user mobility, and safety. The geotechnical asset types considered in this research effort are:

- Rock slopes
- Unstable embankments and soil slopes
- Material sites
- Retaining walls

Inventory and condition surveys have commenced for each of these key geotechnical asset classes. Slopes and embankments have been inventoried along all NHS routes statewide, while retaining walls have been inventoried along select NHS and Alaska Highway System (AHS) routes. The existing statewide Material Site Inventory (MSI) supplied a wealth of information for identifying service areas with a scarcity of quality materials.

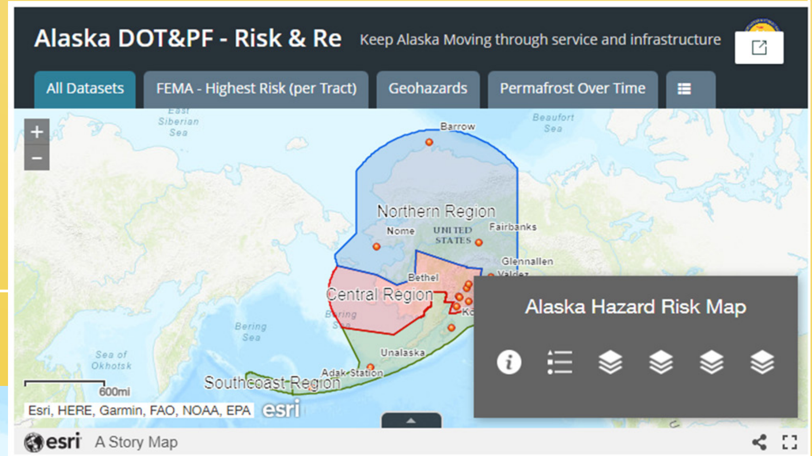
DOT&PF has created a new mapping tool to assist the Department in managing data sets related to infrastructure risk and resilience including FEMA Risk Assessment, geohazards, permafrost, seismic, and flood related data. Figure G-10 shows examples of the Risk and Resilience Storymap tool.

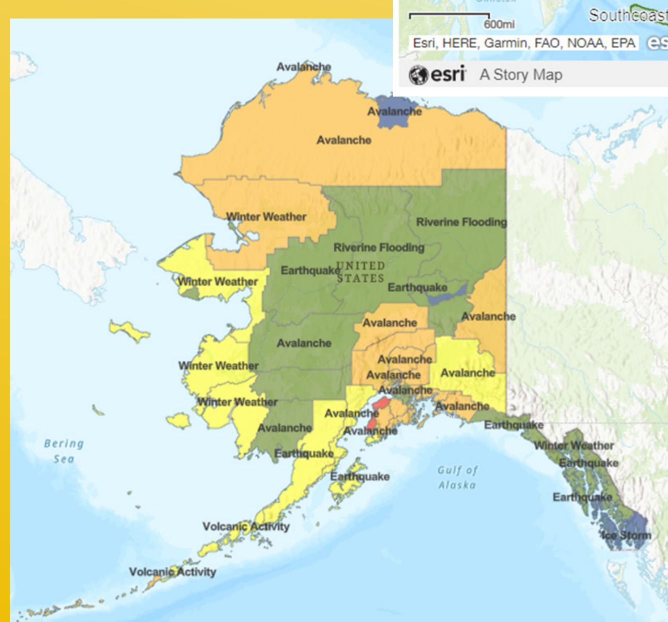
RESILIENCE RESEARCH

DOT&PF incorporates research into the design process for roadways, bridges, and culverts. The following research projects include resilience topics:

DOT&PF Resilience Mapping Project

The DOT&PF created a risk and resilience storymap to provide extreme weather information for pavement and bridge planning. The storymap includes data from the FEMA Risk Assessment, information about known geohazards, permafrost data, seismic risk information, and flood data related to bridges.





The map was created to increase the DOT&PF's ability to anticipate and plan for disruptive events which may affect pavements or bridges.

Figure G-10. Alaska DOT&PF Risk and Resilience Storymap tool.

Impacts of Climate Variability and Change on Flood Frequency Analysis for Transportation Design

University of Alaska, Fairbanks (UAF)

Abstract: Planning for construction of roads and bridges over rivers or floodplains includes a hydrological analysis of rainfall amount and intensity for a defined period. Infrastructure design must be based on accurate rainfall estimates—how much (intensity), how long (duration), and how often (frequency or probability). UAF and the National Oceanic and Atmospheric Administration are updating this important design tool with support from AUTCD and DOT&PF. The quality of reported precipitation data varies due to gauge location, type, and whether or not a rain or snow gauge shield is present.

Report Date: September 2010

Estimating Future Flood Frequency and Magnitude in Basins Affected by Glacier Wastage

University of Alaska, Fairbanks

Abstract: The report presents field measurements of meteorology, hydrology, and glaciers. It also features long-term modeled projections of glacier mass balance and stream flow informed by downscaled climate simulations.

Report Date: March 2015

Estimating Flood Magnitude and Frequency at Gaged and Ungaged Sites on Streams in Alaska and Conterminous Basins in Canada, Based on Data through Water Year 2012

US Geological Survey

Abstract: Estimates of the magnitude and frequency of floods are needed across Alaska for engineering design of transportation and water-conveyance structures, flood-insurance studies, flood-plain management, and other water-resource purposes. This report updates methods for estimating flood magnitude and frequency in Alaska and conterminous basins in Canada.

Report Date: 2016

Repair of Reinforced Concrete Bridge Columns via Plastic Hinge Relocation

North Carolina State University

Abstract: The goal of this report is to present a repair procedure for seismically damaged reinforced concrete bridge columns via plastic hinge relocation.

Report Date: September 2018

Volume 1

Volume 2

Volume 3

Identification of Seasonal Streamflow Regimes and Streamflow Drivers for Daily and Peak Flows in Alaska

US Geological Survey

Abstract: Alaska is among northern high-latitude regions where accelerated climate change is expected to impact streamflow properties, including seasonality and primary flow drivers. Evaluating changes to streamflow, including flood characteristics, across this large and diverse environment can be improved by identifying the distribution and influence of flow drivers. These results provide a spatially comprehensive perspective on seasonal streamflow drivers across Alaska from historical data and serve as an important historical basis for analysis.

Report Date: December 2020

Future Projections of Precipitation for Alaska Infrastructure

International Arctic Research Center, University of Alaska, Fairbanks

Abstract: The goals of this project were to use the best available climate change models and data to create more accurate projections of the severity and frequency of extreme precipitation events and to present these projections in useful, accessible, site-specific formats for hydrologic and engineering applications.

Report Date: April 2021

Low Temperature Performance of Friction Pendulum Bearings Inundated with Ice

University of Nevada, Reno

Abstract: Research the effects of ice in base isolators. Determine the effects of movement during an earthquake if ice is present in the bearing and compare to bearing without ice.

Report Date: December 2022

Monitoring Aufeis under Bridges

University of Alaska, Fairbanks

Abstract: Determine the usefulness of using drone aircraft to fly under bridges in Alaska in order to capture precise data about the interactions between bridge structures and abutments with seasonal aufeis.

Report Date: December 2022

Permafrost Protection using Air Convection Embankment Shoulders

University of Alaska, Fairbanks

Abstract: Analyze temperature data to characterize the cooling effectiveness of the ACE, ventilated shoulder, and hairpin thermosyphon cooling feature.

Report Date: December 2022

Investigating Extreme Floods and the Influence of Selected Flood-Generating Processes for Alaska

US Geological Survey

Abstract: Changes in flood-generating processes have critical implications for engineering design, public safety, and ecosystems. Characterizing historical streamflow patterns and their underlying drivers creates an important basis for understanding the distribution and magnitude of floods, especially extreme floods, and planning for the impacts of climate change.

Report Date: Research in progress

Incorporating Extreme Weather Event Considerations into the Alaska Highway Drainage Manual

Alaska Department of Natural Resources—Division of Geological & Geophysical Surveys

Abstract: Alaska's climate is changing rapidly, affecting environmental assumptions pertinent to design and maintenance of infrastructure and travel corridors. This manual helps organize and present up-to-date climate science as it relates to infrastructure and engineering challenges. Additionally, it provides a reference guide and tools that can be used by engineers attempting to integrate this information into their designs. This reference guide is a summary of current research, models, datasets, and analytical tools related to climate change and extreme weather events in Alaska.

Report Date: Research in progress

EMERGENCY FUNDING AND PART 667

ER funding is available through the FHWA to restore essential travel, minimize the extent of damage, or protect remaining facilities. Eighty-seven projects required emergency funding in Alaska from 1998 through 2018. ER funding is utilized on NHS and non-NHS routes. Table G-4 shows the repair projects required for different emergency categories.

Table G-4. Repair project costs required per Emergency category.

Repair Category	Extent	Cost of Repair
Earthquake Repairs	15%	$8.4 million
Storm Repairs	42%	$24.4 million
Flood Repairs	43%	$24.9 million
Total	100%	$57.7 million

Fifty percent of emergency funding is spent on projects in recurring places. Some of these reoccurring projects are tabulated in table G-5. Table G-6 shows the number the projects by cost category.

Table G-5. List of reoccurring projects.

Project Location	Number of Projects
Richardson Highway	4 projects
Parks Highway	3 projects
Glenn Highway	3 projects
Nash Road	3 projects
Council Road	3 projects
Front Street Nome	2 projects
Lutak Road	2 projects

Table G-6. List of the projects categorized based on cost.

Cost Range	*Number of Projects*	*Total $ in Each Category*
$250,000 or less	2	$0.3 million
$1.0 million or less	4	$2.3 million
$10.0 million or less	10	$33.9 million
Over $10.0 million	2	$21.1 million
Total	18	$57.7 million

The major emergency event in Alaska is flooding: $24.9 million, or 43 percent, of emergency funding was used for flooding. $24.4 million, or 42 percent, was used for emergencies from storms and $8.4 million, or 15 percent, was spent on emergencies resulting from earthquakes.

The Department conducted a statewide evaluation to determine if there are reasonable alternatives to roads, highways, or bridges[10] that have required repair/reconstruction[11] on two or more occasions due to emergency events[12] (Alaska DOT&PF Twice Damaged Assets Report 12/1/21).

Assets that have been damaged on two or more occasions since January 1, 1997, are defined as "Twice Damaged Assets." Section 667 supports

10 Defined in 23 USC 101(a)(11) that is open to public but excludes tribal and federally owned infrastructure

11 Excludes emergency repairs under 23 CFR 668.103

12 Natural Disaster declared by the Alaska's Governor or the President of the United States

Table G-7. List of the locations twice damaged for the period of January 1, 1997, to December 31, 2019.

Facility	*Emergency Events*	*TDA Locations [Specific Emergency Events]*
Glenn Highway (Central Region)	2006 Flooding	MP 70.524–70.675 [2006 & 2012 Flooding]
	2012 Flooding	–
	2018 Earthquake	–
Richardson Highway (Northern Region)	2000 Avalanches	MP 14.789–14.829 [2006 & 2012 Flooding]
	2006 Flooding	MP 16.608–16.628 [2006 & 2012 Flooding]
	2012 Storm/Flood	MP 18.696–18.782 [2006 & 2012 Flooding]
	2018 Earthquake	MP 31.328–31.368 [2006 & 2012 Flooding]
		MP 33.412–33.452 [2006 & 2012 Flooding]
Parks Highway (Central Region)	2006 Flooding	30.97 to 31.06 [2006 & 2012 Flooding]
	2012 Storm/Flood	–
	2018 Earthquake	–
Lutak Road (Southcoast Region)	1998 Storm	MP 0.276 to 0.324 [1998 & 2005 Storms]
	2005 Storm	MP 3.83 to 3.84 [1998 & 2005 Storms]
Nash Road (Seward) (Central Region)	2002 Flooding	MP 2.013 to 2.033 [2002, 12 & 18 Flooding]
	2012 Flooding	MP 2.193 to 2.471 [2012 & 18 Flooding]
	2018 Flooding	–
Council Road (Nome) (Northern Region)	2004 Storm	MP 20.951 to 21.330 [2004, 11 & 13 Storms]
	2011 Storm	–
	2013 Storm	–
Front Street (Nome) (Northern Region)	2004 Storm	MP 0.00 to 1.116 [2004 & 2011 Storms]
	2011 Storm	–

long-term investment decision-making in a manner that results in the conservation of federal resources and protection of public safety and health. Table G-7 summarizes the locations that meet the requirements in Section 667. These locations have been twice damaged for the period of January 1, 1997, to December 31, 2019.

Process for Identifying Twice Damaged Assets for Emergency Repair or Reconstruction

Figure G-11 illustrates the process for identifying assets that have been damaged twice since 1997 and have needed reconstruction or repair.

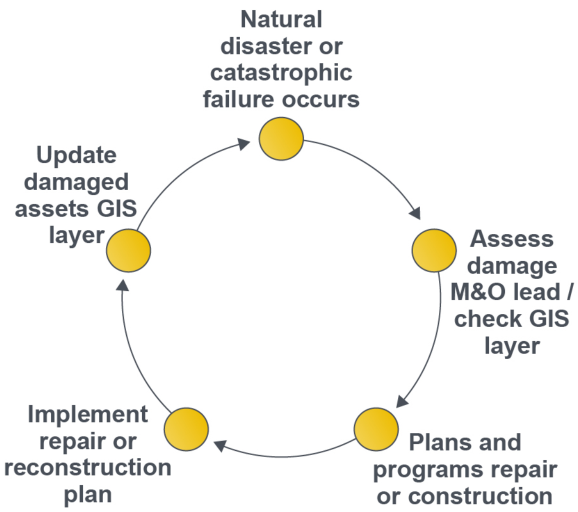


Figure G-11. Identification of assets in need of repair or reconstruction.

The Statewide Transportation Geographic Information Section (TGIS) maintains an inventory of public roadways through its mapping database. TGIS includes a GIS layer in its database to locate twice damaged assets.

Assets that have been damaged twice need an Alternatives Evaluation prior to spending federal aid (excluding the emergency funding). Each region will conduct this evaluation on a 4-year cycle. The evaluation includes an asset characterization, a review of threats and consequences, and an alternative evaluation. Reasonable alternatives include options that could partially or fully achieve the following:

- Reduce the need for federal funds to be expended on emergency repair and reconstruction activities.
- Mitigate or partially/fully resolve the root cause of the recurring damage to assets.
- Better protect public safety and health and the human and natural environment.
- These alternatives need to be evaluated in the project design prior to construction activities.

Further information on the twice damaged asset evaluation can be found in the Policy & Procedure 07.05.100, Highway Twice Damaged Asset Evaluation.

Process For Evaluating Alternatives

The GIS layer used to locate pavement and bridge assets on the NHS and non-NHS damaged by natural disasters or catastrophic failure includes the date of the event, declaration type, Route ID, and beginning/end mile points. A description of event or disaster, repair/reconstruction date, description of the repair/reconstruction, cost of the repair/reconstruction, and alternative evaluations are also available.

The twice damaged asset locations are compared to the current STIP locations. The list of projects that need an alternatives evaluation are projects that are in the extended 10-year STIP plan, with years 6-10 to be evaluated next. A report on twice affected areas will be prepared every 4 years.

For non-DOT&PF, non-NHS assets, the Department will compare all locations included in the project with its records of locations damaged by qualifying emergency events using the GIS database prior to requesting federal aid for any highway or bridge project. DOT&PF considers the outcomes of these evaluations during the development of transportation plans and programs, including TIPs and STIPs, and during the environmental review process under 23 CFR Part 771.

Appendix H: Financial Planning

BACKGROUND

Federal rulemaking published October 2016 requires state DOTs to prepare a 10-year financial plan as part of their TAMP. Both MAP-21 and 23 CFR 515 state that the TAMP is one of a series of plans required as part of a TPM.

The TAMP is the connection between long-term planning LRTP and short-term programming STIP, in addressing how the Department will manage pavement and bridges on the NHS to achieve its overall performance goals. The TAMP financial plan, described in Section 5 of the TAMP, describes how the agency manages the STIP to achieve the transportation goals established in the LRTP.

This appendix describes the process DOT&PF completed to develop the TAMP financial plan. The following resources were used in development of the plan.

- DOT&PF used the FHWA November 2017 guidance document *Developing TAMP Financial Plans* as a basis for the process described in this appendix.
- DOT&PF participated in a gap analysis completed by a FHWA contractor in January 2018.
- DOT&PF participated in an FHWA Asset Management Workshop on LCP, Risk Management, and Financial Plan to Support the Implementation of Asset Management Plans on March 29, 2018.
- DOT&PF hosted a session of the National Highway Institute Course 136002, Financial Planning for TAM on February 13-14, 2019.

The process for developing the financial plan consists of four steps leading to selection of investment strategies. The following sections describe these four steps, including the data sources and stakeholders that were involved in developing the financial plan.

STEP 1. IDENTIFY AVAILABLE FUNDING FOR ASSET MANAGEMENT

Transportation funding in Alaska is a combination of federal funds, state general funds, and Alaska Marine Highway System revenues. The Federal highway program funds form the majority of the available funds. The following subsections describe the process DOT&PF uses to estimate available funding for asset management.

Data Sources

The primary data source for forecasting future transportation funding is the current federal transportation act. The BIL provides a stable source of funding for transportation infrastructure from 2022 through 2025. Figure H-1 shows how the funding from the BIL to Alaska is allocated between the highway programs in Federal Fiscal Year 2022 in millions.

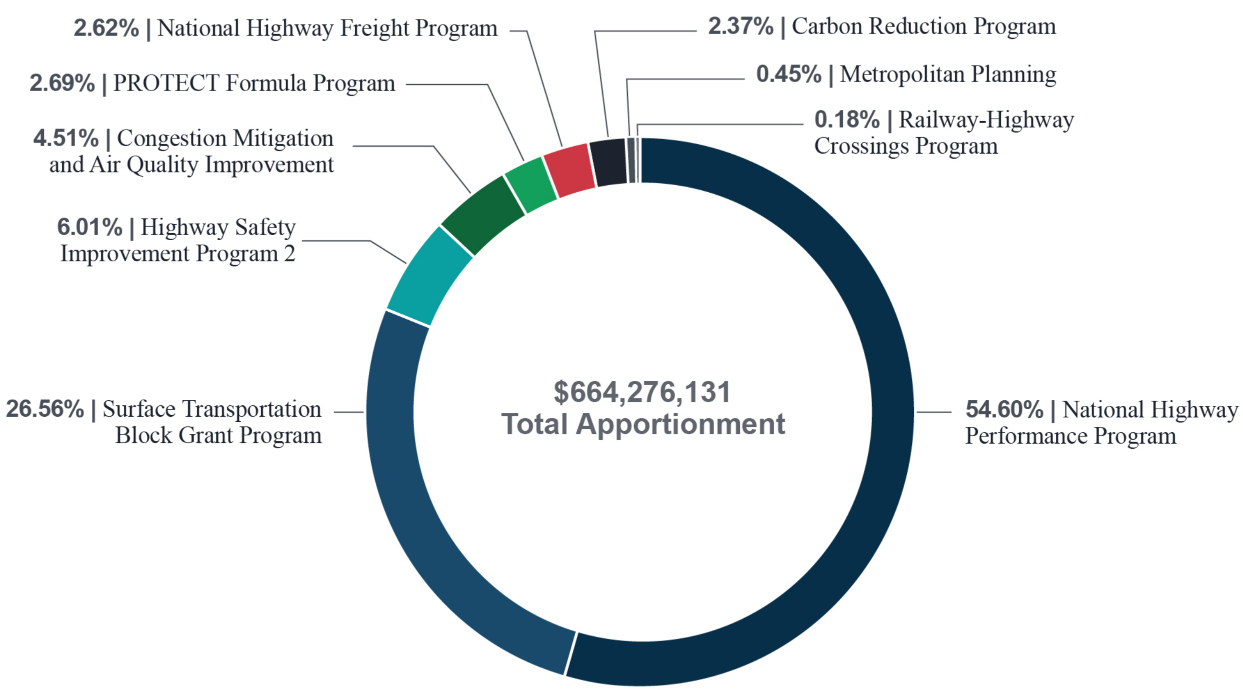


Figure H-1. BIL funding for Alaska fiscal years 2022-2025[13].

DOT&PF has projected funding beyond federal fiscal year 2025 to increase annually at a rate of 2 percent. This assumption is included in table 4-1 of the TAMP.

Alaska does fund some highway projects without federal funding, and state-funded projects are not included in the STIP but can be found in the legislature's approved budget for each state fiscal year. These are normally state-funded bonds that are connected to infrastructure that support resource development.

These projects often do not have a significant impact on current infrastructure conditions and are not considered as funding available for asset management or included in the financial plan.

Stakeholders

The following organizational units contribute to the estimation of funds available for asset management.

- The STIP Manager provides information from the STIP.
- The Capital Improvement Program Manager:
  - Provides information on the purpose of any state-funded projects in the legislature's approved budget.
  - Contributes to the determination of anticipated future federal funding.
- The TAMP Coordinator develops the funding estimate for SOGR.

STEP 2. ESTIMATE FUNDING NEEDS

Funding needs are the estimated expenditures required to achieve condition targets and the DSOGR for pavement and bridges on the NHS. Funding needs are forward looking and estimated based on predictions of asset performance under different investment scenarios. The following subsections describe the processes established to estimate funding needs for NHS pavements and bridges, other assets, risks to the transportation network, and system performance.

Funding Needs for Pavements and Bridges

To develop funding needs for the TAMP, performance models are used based on the

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historical performance of pavement and bridges in the state. To develop the models, the average rate of change in condition over the life of a pavement section or bridge was calculated and combined with data from other assets of similar design (which are referred to as a "family"). The average rate of change for the entire family is used to predict the future condition of all asset sections that meet the family criteria.

The performance models are combined with unit cost data from DOT&PF construction projects to model the impacts of investment in different types of treatments over a 10- year period to predict the amount of work that can be accomplished, the impact of that work on asset conditions, and the annual deterioration of asset conditions due to use and exposure to the environment. The performance models have been incorporated into the Department's PMS and BMS, which were implemented in October 2019. These new management systems provide the Department with expanded capabilities to evaluate asset performance.

The following subsections elaborate on DOT&PF's procedures for estimating funding needs by describing the data sources used, the stakeholders involved, and their roles in the analysis. The final subsection provides information on how to improve the estimation of funding needs for the next TAMP update.

STAKEHOLDERS

Several internal units contribute to the estimation of funding needs, as described below.

- The Pavement Manager:
  - Develops the pavement performance curves
  - Determines pavement treatment unit costs
  - Applies the performance models, unit costs, and funding scenarios to determine the future cost to achieve the asset management objectives for NHS pavements
- The Bridge Management Engineer:
  - Develops the bridge performance curves
  - Determines the bridge treatment unit costs
  - Applies the performance models, unit costs, and funding scenarios to determine the future cost to achieve the asset management objectives for NHS bridges
- The Statewide Planning Chief provides investment scenario inputs.
- The TAMP Coordinator provides oversight and information on TAM goals and objectives.

Funding Needs for Other Assets and System Performance

Funding needs for other assets and system performance are largely determined based on investment in the current STIP. DOT&PF has developed a 10-year STIP with committed projects to achieve long-term goals according to the performance-based plans developed under the TPM effort established by MAP-21. The following subsections provide details on the data sources used to develop the estimates, the roles of stakeholders involved, and opportunities to improve the process in the future.

DATA SOURCES

The primary data sources for estimating future needs for managing other assets and performance areas are the 10-year STIP and historic maintenance and operations budgets.

STAKEHOLDERS

Several stakeholder units within DOT&PF contribute to the estimation of funding needs for other assets and performance areas, as described below.

- The Statewide Planning Chief provides information from the 10-year STIP, including obligation amounts and fund sources by year.
- The Regional Maintenance and Operations Chiefs provide information on their annual expenditures outside of the STIP.

Funding Needs for Mitigating Risks to the Transportation System

As described in section 3.5 of the TAMP and Appendix G, DOT&PF actively invests to mitigate significant risks to the transportation system. These investments are made to reduce the likelihood that threats to the system performance will occur, to reduce their impact if they do occur, or to maximize the agency's opportunities to improve performance.

Data Sources

Implementing risk mitigation comes at a cost. These costs are typically included in the treatment unit costs in pavement and bridge management systems and are then reflected in the performance modeling run by the management systems. Some of the costs of risk mitigation strategies, such as seismic retrofitting of bridges, are difficult to distinguish from work done to improve bridge conditions. Further complicating such estimates is that mitigation features, such as improved bridge design, which may be incorporated into work done to improve bridge conditions. This type of work may increase project costs but cannot be separated out from preservation, rehabilitation, and reconstruction funds.

For risk-related needs that could not be estimated from STIP data, the TAMP Risk Management Team provides estimates to the level of NHPP funding and state match that is expected to be programmed for each risk mitigation strategy.

STAKEHOLDERS

The following stakeholders contribute to developing estimates of needs for transportation risk mitigation:

- The Statewide Planning Chief provides and analyzes 10-year STIP data.
- The TAMP Risk Management Team provides estimates on the impact of risk mitigation efforts on available NHPP funding.

STEP 3. QUANTIFY FUNDING GAPS

Funding gaps exist when the forecasted needs exceed the amount of anticipated funding. Funding gaps may occur in any year of the financial plan. If available funding is significantly greater than the needs, it may be determined that there is a surplus of funding. When they occur, surpluses are typically only in one portion of the financial plan. For example, due to specific circumstances, there may be few candidates for work in a specific year of the plan. This could lead to a surplus in funds for one asset class.

Surpluses in one program are offset by funding gaps in other programs. This section describes the processes for quantifying funding gaps or surpluses. The processes described in Appendix I explain how the agency uses cross-asset tradeoff to develop an investment plan that balances needs and funding across assets and programs to best achieve the agency’s objectives.

Data Sources

The data sources for quantifying funding gaps are the outputs of steps 1 and 2, as described in this appendix. Needs and available funding are estimated for each year of the TAMP. Those estimates are compared to determine whether funding is adequate to address the needs in each year for all asset classes, performance areas, and risks.

Stakeholders

The Asset Managers lead the effort to quantify funding gaps with assistance from the Statewide Planning Chief and Chief Financial Officer. The Capital Program Review Team provides support to the process.

STEP 4. SELECT INVESTMENT STRATEGIES

If funding gaps are identified, DOT&PF will conduct a review of options to best address its needs across asset classes and programs. DOT&PF will select investment strategies using the process described in the bullets below.

- Review the risk management strategies, life-cycle cost scenarios, and funding distributions that cover the state of good repair or federal performance targets and national goals.
- Prioritize preservation before more costly rehabilitation and reconstruction projects.
- Anticipate funding gaps to reach goals. We plan to use innovative techniques for maintaining pavements over unstable subgrades and to respond to high level of surface rutting.
- Improve efficiency to free up money for additional preservation or other priorities.
- Communicate this funding level to external and internal stakeholders who have the opportunity to comment on this funding level.
- Develop an agency self-assessment to implement the investment strategies and any risks to that implementation. Risks may include changes in management, lack of organizational support for asset management objectives and performance management or LCP, knowledge or technology gaps, or proven inaccurate assumptions.

Additional information on establishing the selected strategies as an investment plan and managing the implementation of that plan are provided in Appendix I.

Appendix I: Investment Strategies

INTRODUCTION

“Investment Strategy” is defined in 23 CFR 515.5 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 risks.

The policies and goals laid out in the LRTP and the LCP, as well as risk management and financial planning processes described in this TAMP, contribute to the investment strategies DOT&PF will use to achieve national goals, statewide targets, and a state of good repair.

PROCESS FOR DEVELOPMENT OF INVESTMENT STRATEGIES

The following sections outline the steps used to develop the cross-asset analysis process.

Review Policies and Objectives

- Review existing DOT&PF goals, policies, and actions, including the LRTP.
- Review internal processes related to programming decisions, particularly the 10-year STIP.

Step 1. Acquire Scenarios from Asset Management Systems

- DOT&PF used the pavement management system and bridge management system described in Appendix F to develop several scenarios for both pavements and bridges.
- Scenarios varied in terms of both strategy and total budget.
- The LCP scenarios were run in PMS and BMS, which allowed a comparison of resulting conditions for each asset at varied investment levels.

Step 2. Assess Available Funding

The Department assessed funds available for the NHS, including an analysis of federal NHPP apportionments, state matching funds, and other state or federal funds that are reasonably expected to be available over a 10-year period. The Department displayed funds available by fund type.

- The Statewide Planning Chief provided an assessment of the available NHPP funding as well as the level of current programming in the STIP dedicated to performance needs other than pavement and bridge conditions.

ASSUMPTIONS:

- NHPP apportionment: FFY2022 NHPP apportionment after set-asides and penalties, 2 percent annual growth. Includes NHPP Freight and Exempt (This is a conservative assumption, predicated on growth keeping pace only with inflation).
- State matching funds: Equal to NHPP Funds apportionment divided by 0.9097, assuming a match ratio of 9.03 percent (This is a generous assumption, because some NHPP funds are 100 percent of total project costs).
- Other state or federal funds reasonably expected to be available: Limited to those included in the current approved STIP (This is a conservative assumption as other funds may become available in the years beyond the STIP period).
- Obligation Limitation: Over a 4-year period, 100 percent of NHPP funds will be used (other funds would be allowed to lapse), therefore 100 percent of NHPP funds will be assumed to be available to the NHS annually with regard to the TAMP financial plan. No obligation limitation will be factored in (This is a generous assumption because sequestration and rescission may still occur).
- Total funds available to the NHS: The total of NHPP funds, state matching funds, and other

state or federal funds reasonably expected to be available.
- Funds needed for planning, ITS, Alaska Marine Highway System (AMHS) ferries, and similar NHS needs that do not impact pavement or bridge conditions will be deducted from the total funds available to the NHS.

The remaining funds will be available for projects that result in construction projects and can be categorized into the five work types as defined below.

- **Initial Construction:** Includes all projects in the STIP coded to work type New Construction. New Construction is used for projects that construct new roads, new interchanges, or add capacity by constructing new lanes. Passing lanes are not considered added capacity.
- **Maintenance:** Includes all force account work completed by the regions and Whittier Tunnel Maintenance and Operations.
- **Preservation:** Includes each region's Pavement and Bridge STIP Needs items with the amount needed for maintenance work deducted.

The BMS and PMS will aid staff in the evaluation and selection of road segments or bridges for optimal preservation treatment and timing.

- **Rehabilitation:** Includes all STIP projects coded to work type System Preservation and Bridge Rehabilitation with the amounts needed for preservation work deducted.
- **Reconstruction:** Includes all STIP projects coded to work type Reconstruction and Bridge Replacement.

Step 3. Compare Scenarios

Alaska selected the following life-cycle planning scenarios for each asset type (pavement and bridges) for further analysis:

- **Pavement**
  - **Varied Funding Scenarios**—Multiple pavement budget scenarios ranging from $110M-$150M for SOGR funding were modeled utilizing the preferred life-cycle strategy. This range was selected as a reasonable variation on the anticipated SOGR funding amount of $130M for pavement. These scenarios would provide information on the impact of realistic variations in pavement funding on the forecasted condition of the pavement network. The $130M and $150M scenarios meet the SOGR for the percentage of *Good* and *Poor* NHS pavements. The $110M scenario meets the SOGR for *Good* pavements on the NHS; however, while it is forecasted to reach six percent *Poor* on the Interstate network by the end of the analysis period, it slightly exceeds the proposed SOGR of five percent. It is still under the federally mandated maximum of ten percent *Poor* on the Interstate NHS.
  - **Sustained Inflation Scenario**—A scenario was run to demonstrate the effect that sustained elevated inflation would have on the forecasted network condition to quantify the impact of inflation as a potential risk. It was determined that this risk had minimal impact on the pavement network condition during the analysis period.
  - **Varied Life-Cycle Strategy Scenarios**—A "worst first" scenario was run to demonstrate the impact of delaying treatments based on the lowest condition thresholds rather than applying the preferred life-cycle strategy that promotes timely preservation treatments to prevent severe and costly deterioration. This analysis indicated that at the same funding level, the worst first strategy resulted in a five percent increase in the percentage of NHS pavements in *Poor* condition by the end of the analysis period. The increase in the percentage of *Poor* pavements from 7 percent to 12 percent clearly demonstrates the benefit of the preferred life-cycle strategy.
- **Bridge**
  - **Do Nothing**—No funding spent on NHS bridges.
  - **Low Budget Scenario**—This scenario meets the *Poor* target of the DSOGR with 4 percent *Poor* bridges in 2031 but fails to meet the *Good* target with 26 percent *Good* bridges in 2031.
  - **Medium Budget Scenario**—This scenario meets the *Poor* target of the DSOGR with 4 percent *Poor* bridges in 2031 but fails to meet the *Good* target with 27 percent *Good* bridges in 2031.
  - **High Budget Scenario**—This scenario meets the *Poor* target of the DSOGR with 3 percent *Poor* bridges in 2031 but fails to meet the *Good* target with 29 percent *Good* bridges in 2031.

Step 4. Recommend Acceptable Scenarios

Pavement and bridge budget scenario runs were reflective of variations on the planned investment scenario that validated the funding assumptions and planned investment strategy.

Step 5. Determine Funding Risks

The TAMP Team identified the following risks to implementing the selected scenarios.

- Implementing scenarios in the first 3 to 4 years of the TAMP period along with current STIP projects will be challenging.
- Cost increases could impact the number of deliverable projects and therefore the forecasted asset conditions based on the various budget scenarios.
- Annual programing can vary considerably, so DOT&PF will incorporate both an annual and running-average review to analyzing the agency's consistency regarding implementing the TAMP investment strategies.
- Potential increases in program funding based on increases in the BIL apportionments could present a challenge for the Department to deliver a larger program.

Step 6. Finalize Input to TAMP Investment Strategies

The TAMP Team prepared a summary of the TAMP analysis results for executive review. During the review, executive staff provided feedback on the TAMP processes, analysis, and resulting investment strategies. The executive input was used to finalize the investment strategies included in the TAMP.

MANAGING INVESTMENT STRATEGIES WHILE ADDRESSING SYSTEM NEEDS

DOT&PF monitors and manages the performance of the NHS using all seven TPM National Goal areas: safety, congestion, system reliability, freight movement and economic vitality, environmental sustainability, and project delivery.

Each of these performance areas contribute to the development of the capital program in support of the agency's LRTP. Several internal processes allow staff to manage delivery of the program to ensure the expected performance is delivered on time and within budget. These internal processes are connected to the TAMP development process, as outlined below, to ensure that the TAMP is developed in full awareness of any gaps in the performance of NHS assets and that the gaps are considered in the development of TAMP investment strategies.

- DOT&PF holds a monthly Planning Chiefs meeting to discuss issues related to delivery of the capital program, including STIP projects. This meeting addresses the needs of programmed projects to remain on schedule and budget. If project schedules or budgets change, this group determines the impact on the overall program, decides on actions to balance program delivery, and determines accomplishments to best achieve the agency's objectives, as described in the LRTP and including all TPM goal areas.
- In addition to the Planning Chiefs meeting, DOT&PF convenes a Capital Program Review Team (CPRT) meeting at least twice per year. This is a cross- disciplined group that discusses and resolves issues in delivery of specific projects and program objectives, including the achievement of TPM goals and targets.
- The TAMP Steering Team and Technical Teams include participants in both the Planning Chiefs and CPRT meetings. As DOT&PF engages in the update of its TAMP, these members will share performance gaps in areas other than pavement and bridge conditions to the attention of the larger teams. As these issues are discussed and understood, they are included in the risk analysis and are considered when developing gap analysis scenarios in the PMS and BMS.

The Department will maintain a 10-Year Extended STIP for allocation of funds available by work type for asset management and performance management.

The Extended STIP will be informed by the current approved STIP, project delivery schedules, Planning Chief meetings, and CPRT meetings. Additionally, PMS and BMS will affect greater influence over time of project priorities and fund allocation to further asset management goals.

The Extended STIP will be used to estimate the cost of expected future work, by work type, to implement investment strategies contained in the asset management plan by state fiscal year and work type (23 CFR 515.6(d)(1)). Most of the Department's capital program planning is by federal fiscal year due to the state's reliance on federal funds, but to meet the regulation for state fiscal year, an assumption will be made that the total funds available to the NHS are the same for a state fiscal year as they are for a federal fiscal year. This assumption is sufficient given that there will remain 12 months represented, and a similar amount of work will be obligated within the state fiscal year (July 1st to June 30) as would be within the federal fiscal year (October 1st to September 30th).

For the Consistency Review, the Department will use FFY22 obligated/awarded funds and show that there is alignment between actual and planned levels of investment. The Department will assess funds available for the NHS. The Department will display funds available by fund type.

CONSISTENCY REVIEW

The investment strategies shown in the TAMP provide a simplified view of how investments are made on an annual basis to improve or sustain asset conditions. In practice, projects may be accelerated, delayed, or take multiple years to deliver. As a result, it is nearly impossible to precisely predict the amount of investment to be made in a specific future year. This is recognized in several related FHWA policies, such as the policy to provide states up to 4 years to obligate funding after allocation.

DOT&PF will follow the process below to provide a consistent means of assessing whether the agency's investments are consistent with the TAMP investment strategies in a way that accounts for this natural variation in annual programming and project delivery.

- DOT&PF will compare FFY22 obligations/awards to the amounts included in the investment strategy for the same year.
  - » This comparison will be made for each asset (pavement and bridges) and work type (new construction, maintenance, preservation, rehabilitation, and reconstruction) included in the TAMP investment strategy, resulting in a total of ten comparisons for each year.
- A consistency determination will be made for each asset-work type combination (e.g., maintenance of NHS pavements or reconstruction of NHS bridges). Each asset-work type combination is referred to as a "component" of the TAMP investment strategy.
- A set of investments will be considered consistent with the relevant component of the TAMP investment strategy if all the following criteria are met:
  - » The sum of those investments equals an amount between 50 percent and 150 percent of the value of the TAMP investment strategy component for the year of analysis.
  - » The sum of those investments for the year of analysis and the 3 previous years either do not:
    - ▸ Exceed 125 percent of the value of the TAMP investment strategy components for their respective years of analysis
    - ▸ Fall short of 75 percent of the value of the TAMP investment strategy components for their respective years of analysis
- DOT&PF will investigate and explain any components of the TAMP strategy for which actual investments are inconsistent.
- The Capital Program Review Team will recommend corrective actions as needed to address inconsistencies between actual investments and the TAMP investment strategies by:
  - » Updating the TAMP investment strategy
  - » Modifying future programming

Appendix J: Glossary of Acronyms

Acronym	Definition
AC	Advanced Construction
AASHTO	American Association of State Highway and Transportation Officials
AADT	Annual Average Daily Traffic
ACE	Air Convention Embankment
ADT	Average Daily Traffic
AE	Alternatives Evaluation
AER	Alternatives Evaluation Report
AGOL	ArcGIS Online
APCI	Alaska Pavement Condition Index
AUF	Alaska University Fairbanks
AUTC	Alaska University Transportation Center
BrM	AASHTO BMS
CPRT	Capital Program Review Team
CS	Condition State
CMAQ	Congestion Mitigation Air Quality Improvement Program
DOA	Department of Administration
DOT&PF	Alaska Department of Transportation and Public Facilities
DOT	Department of Transportation
DSOGR	Desired State of Good Repair

Acronym	Definition
DDIR	Disaster Damage Inspection Report
ER	Emergency Relief
EMS	Equipment Management System
FHWA	Federal Highway Administration
FFY	Federal Fiscal Year
FOG	Field Operations Guide
FAST Act	Fixing America's Surface Transportation
GCR	General Condition Rating
GIS	Geographic Information System
GAMS	Geotechnical Asset Management System
HSIP	Highway Safety Improvement Plan
HSP	Highway Safety Plan
IIJA	Infrastructure Investment and Jobs Act
ITS	Intelligent Transportation System
IRI	International Roughness Index
LM	Lane-miles
LOS	Level of Service
LOTTR	Level of Travel Time Reliability
LCP	Life-cycle Planning

Acronym	*Definition*
LRTP	Long-Range Transportation Plan
MAP-21	Moving Ahead for Progress in the 21st Century Act
M&O	Maintenance and Operations
MMS	Maintenance Management System
MPO	Metropolitan Planning Organization
MP	Mile Points
MOA	Municipality of Anchorage
MSI	Material Site Inventory
NBI	National Bridge Index/Inventory
NBIS	National Bridge Inspection Standards
NHFN	National Highway Freight Network
NHPP	National Highway Performance Program
NHI	National Highway Institute
NHS	National Highway System
NPMRDS	National Performance Management Research Data Set
NCDOT	North Carolina Department of Transportation
OIT	Office of Information and Technology
PMS	Pavement Management System

Acronym	*Definition*
PEL	Planning and Environmental Linkage
P&P	Policy and Procedure
PSR	Present Serviceability Rating, Pavement Serviceability Rating
PIO	Public Information Officers
SOGR	State of Good Repair
STBGP	Surface Transportation Block Grant Program
STIP	Statewide Transportation Improvement Program
SD	Structurally Deficient
STP	Surface Transportation Program
TAM	Transportation Asset Management
TAMIS	Transportation Asset Management Information System
TAMP	Transportation Asset Management Plan
TGIS	Statewide Transportation Geographic Information Section
TPM	Transportation Performance Management
TTTR	Truck Travel Time Reliability
TDA	Twice-damaged Assets
VMT	Vehicle Miles Traveled