District Department of Transportation

TRANSPORTATION ASSET MANAGEMENT PLAN

d.

October 2022

Intentionally left blank

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Intentionally left blank

GLOSSARY

AASHTO	American Association of Highway and Transportation Officials
AC	Asphalt Concrete
AOC	Architect of the Capitol
ASI	Asset Sustainability Index
BIL	Bipartisan Infrastructure Law
BrM	Bridge Management Software
BFF	Bridge Formula Fund
CIP	Capital Improvement Program
CM	Construction Management
CRCP	Continuously Reinforced Concrete Pavement
CR	Condition Rating
DC	District of Columbia
DC STIP	DC Statewide Transportation Improvement Program
DDOT	District Department of Transportation
DQMP	Data Quality Management Plan
EAMS	Enterprise Asset Management System
EFLHD	Eastern Federal Lands Highway Division
FAST	Fixing America's Surface Transportation
FERP	Flood Emergency Response Plan
FHWA	Federal Highway Administration
FPP	Full Performance Period
FY	Fiscal Year
GI	Green Infrastructure
HPMS	Highway Performance Management System
IH	Interstate Highway
IRI	International Roughness Index
JCP	Jointed Concrete Pavement
KPI	Key Performance Indicator
LCP	Life Cycle Planning
MAP-21	Moving Ahead for Progress in the 21st Century
MPO	Metropolitan Planning Organization
MPP	Midpoint Performance Period
MWCOG	Metropolitan Washington Council of Governments
NBI	National Bridge Inventory
NBIS	National Bridge Inspection Standards
NHPP	National Highway Performance Program
NHS	National Highway System
NPS	National Park Service
NTIS	National Tunnel Inspection Standards
PCC	Portland cement concrete
PCI	Pavement Condition Index
PM	Preventative Maintenance

PM2	Performance Measures - Pavement and Bridge
PPA	Pavement Performance Analyzer
QAM	Quality Assurance Manager
SHRP	State Highway Research Program
SOGR	State of Good Repair
TAM	Transportation Asset Management
TAMP	Transportation Asset Management Plan
TIP	Transportation Improvement Plan
TPB	Transportation Planning Board
TPM	Transportation Performance Management
VMT	Vehicles Miles Traveled

Government of the District of Columbia

Department of Transportation

Office of the Director

October 18, 2022

Mr. J. Christopher Lawson
Division Administrator
District of Columbia Division
Federal Highway Administration
1200 New Jersey Avenue, SE
East Building, Room E61-312
Washington, DC 20590

RE: Request for Certification of Final Transportation Asset Management Plan (TAMP)

Dear Mr. Lawson:

This letter serves as a formal request to FHWA for an annual consistency determination, which is an evaluation whether the District Department of Transportation (DDOT) has developed and implemented a TAMP that is consistent with the requirements established by 23 U.S.C. 119 and 23 CFR part 515.

Attached here for your review are the most recent State DOT approved TAMP and supporting documents to demonstrate implementation of the TAMP as required by 23 CFR 515.13(b).

Should you have any questions, please contact Howard Ways, Chief, Operations Administration, at howard.ways@dc.gov or (202)535-2192.

Sincerely,

E. Lott

Everett Lott
Director

Intentionally left blank

Executive Summary

Chapter 1. Introduction

TAMP minimum requirements

- ✓ Listing of the pavement and bridge assets on the National Highway System in the State, including a description of the condition of those assets;
- ✓ Asset management objectives and measures;
- ✓ Performance gap identification;
- ✓ Lifecycle cost and risk management analysis;
- ✓ A financial plan; and
- ✓ Investment strategies.

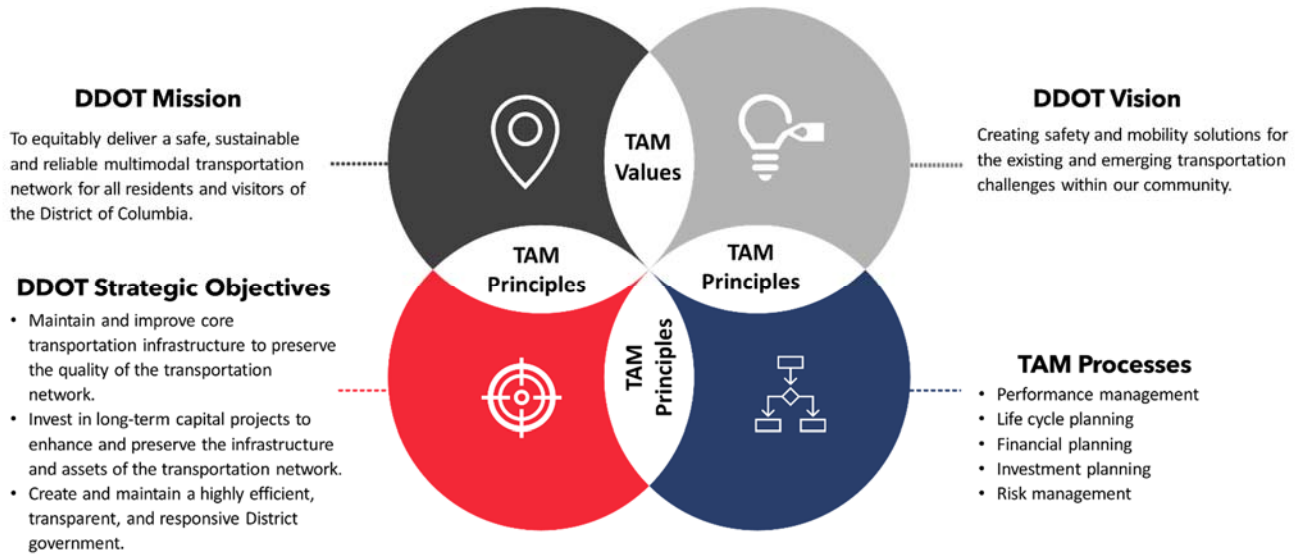
This 2022 **Transportation Asset Management Plan** (TAMP) provides updates to the Transportation Asset Management Plan certified by the Federal Highway Administration (FHWA) in August 2019. The TAMP is a *ten-year* strategic document that enables the District Department of Transportation (DDOT) to achieve asset management objectives while supporting agency-wide strategic goals.

This 2022 TAMP includes NHS pavements and bridges, DDOT-maintained non-NHS pavements (i.e., local roads and federal-aid roads), non-NHS bridges (including pedestrian bridges), tunnels, alleys, and sidewalks. While DDOT has attempted to develop a comprehensive TAMP including other assets, the analysis in this TAMP has been limited to assets which have sufficient data and information. As such, additional assets beyond the NHS pavement and bridges are not to be considered part of the TAMP recertification process.

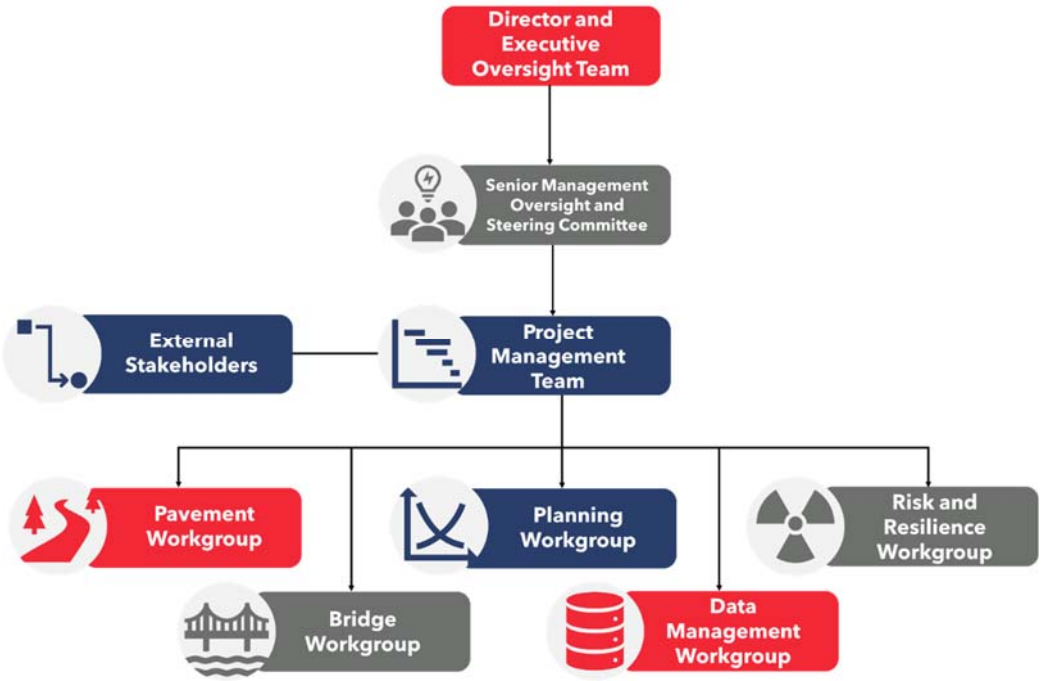
Chapter 2. TAM at DDOT

What is TAM?

"A strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based upon 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 (SOGR) over the lifecycle of the assets at minimum practicable cost."

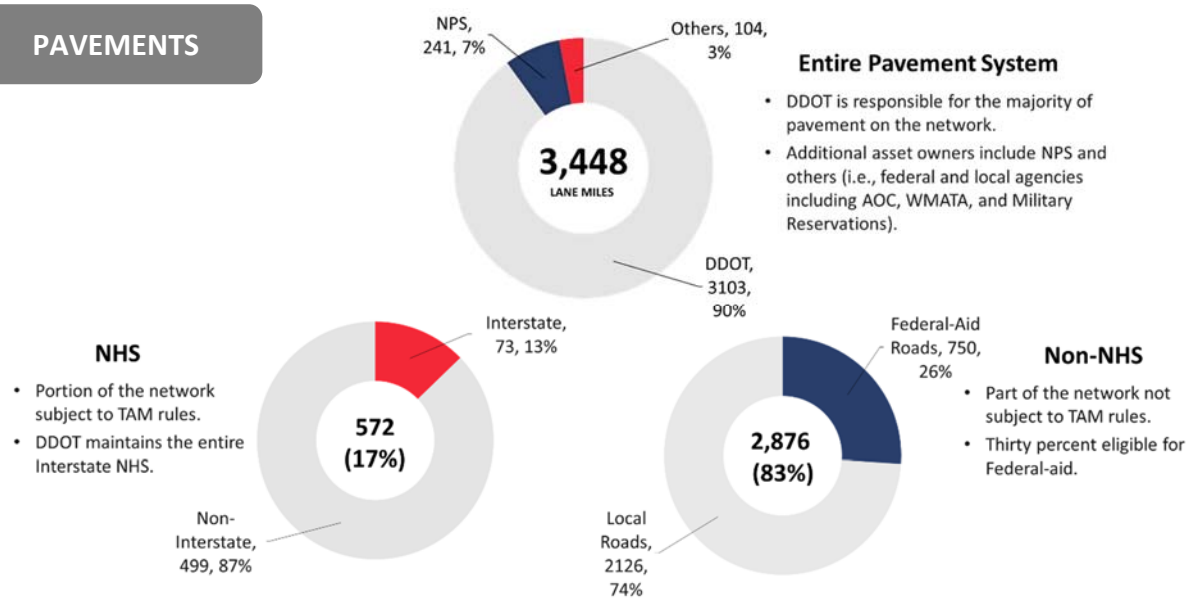


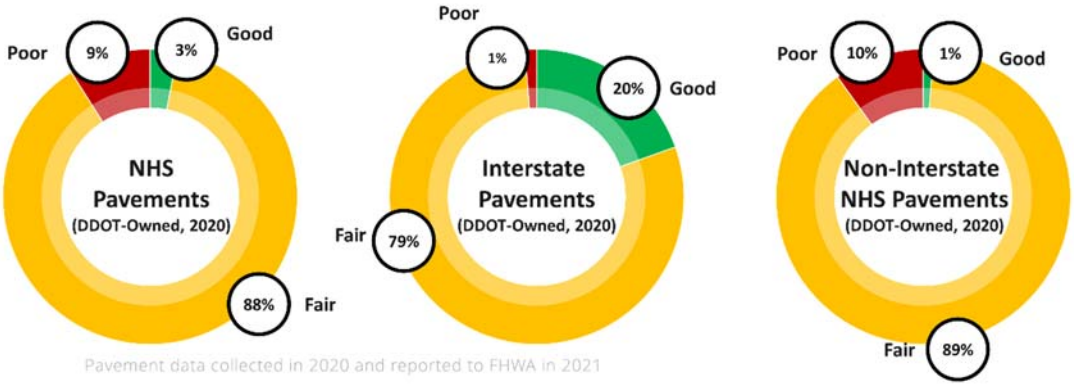
The **governance structure** reflects the flow of TAM information across the organization. DDOT regularly updates the governance plan to keep up with the changing roles and turnover of staff. Additionally, DDOT also involves and continuously communicates with key stakeholders of NHS assets such as the National Park Service (NPS) and the Architect of the Capitol (AOC) (pavement only), as well as the Metropolitan Washington Council of Governments (MWCOG).



Chapter 3. Asset Inventory and Conditions

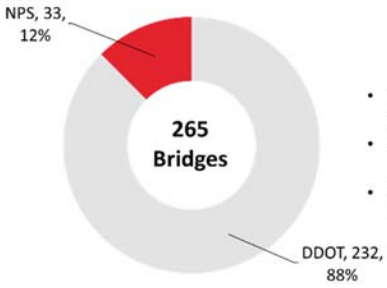
PAVEMENTS





Pavement data collected in 2020 and reported to FHWA in 2021

BRIDGES

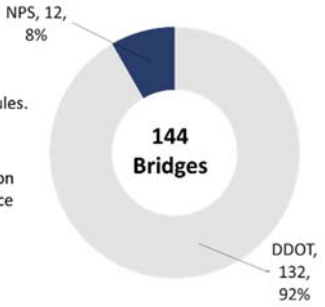


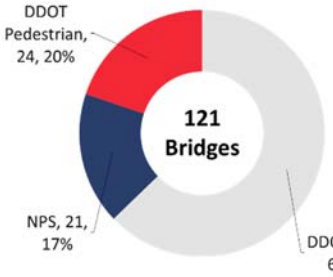
Entire Bridge System

- Total bridge deck area is 6.3 million square feet.
- DDOT maintains 5.9 million square feet.
- NPS maintains 500K square feet of deck surface area.

NHS Bridges

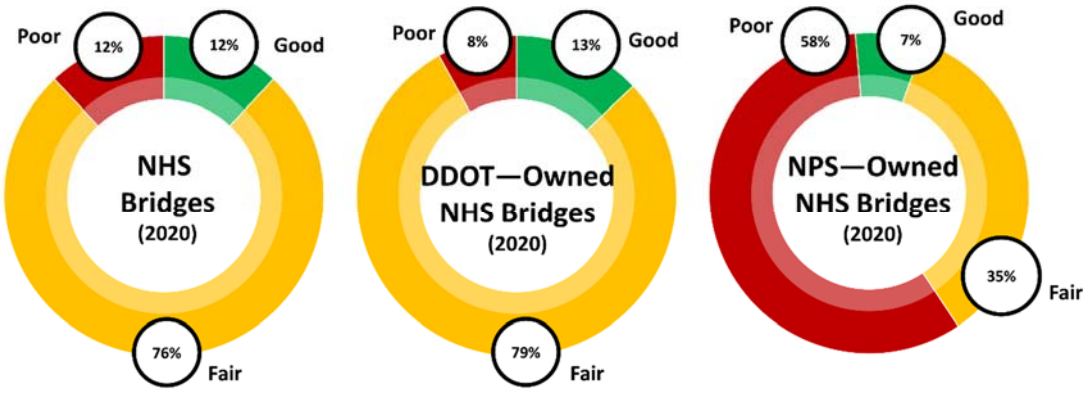
- Bridges subject to TAM rules.
- Deck area of 4.9 million square feet.
- DDOT maintains 4.5 million square feet of deck surface area.





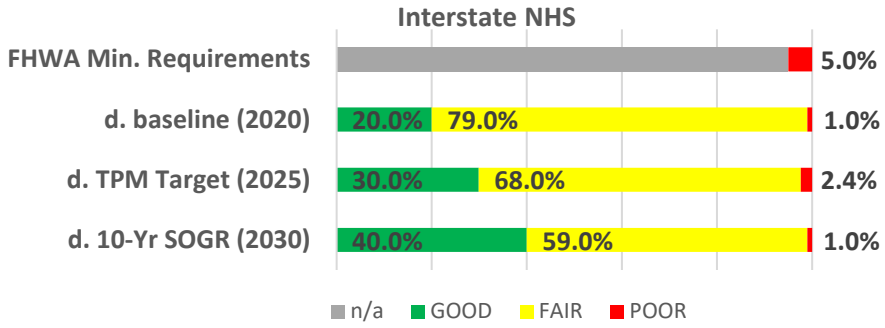
Non-NHS Bridges

- Bridges not subject to TAM rules.
- Includes 24 pedestrian bridges.
- Deck area of 1.4 million square feet.



Bridge data collected in 2020 and reported to FHWA in 2021

Chapter 4. Asset Performance Goals and Targets



Interstate NHS Pavements

2020 Condition
% Good = 20%
% Poor = 1%

2025 Target
% Good ≥ 30%
% Poor ≤ 2.4%

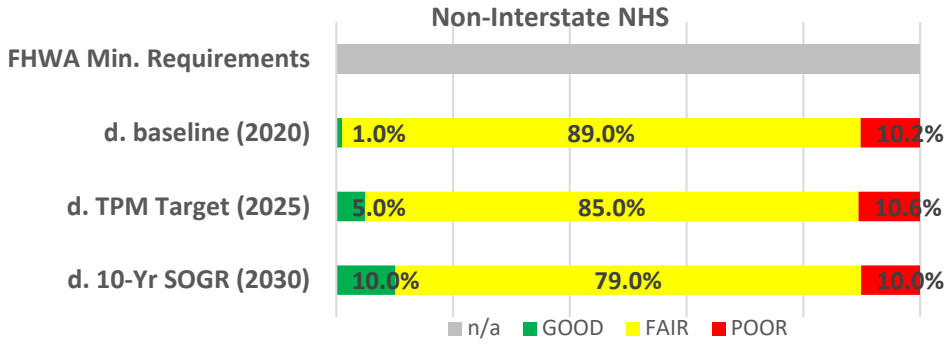
10-Year SOGR
% Good ≥ 39.5%
% Poor ≤ 1%

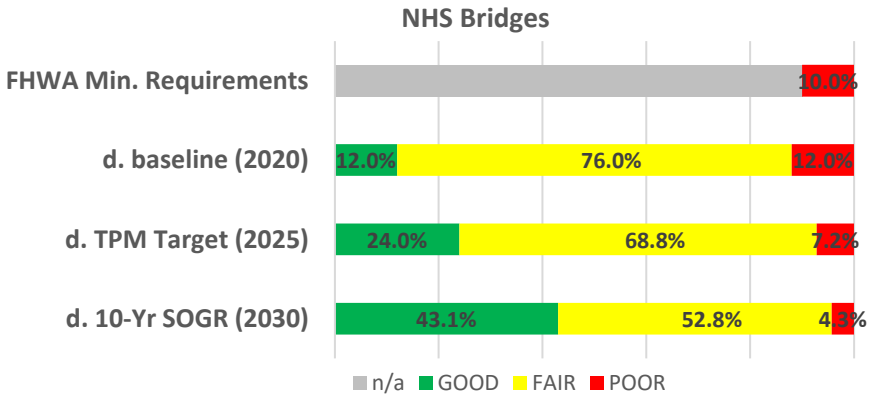
Non-Interstate NHS Pavements

2020 Condition
% Good = 1%
% Poor = 10%

2025 Target
% Good ≥ 5%
% Poor ≤ 10%

10-Year SOGR
% Good ≥ 9.5%
% Poor ≤ 10.6%





NHS Bridges

2020 Condition
% Good = 12%
% Poor = 12%

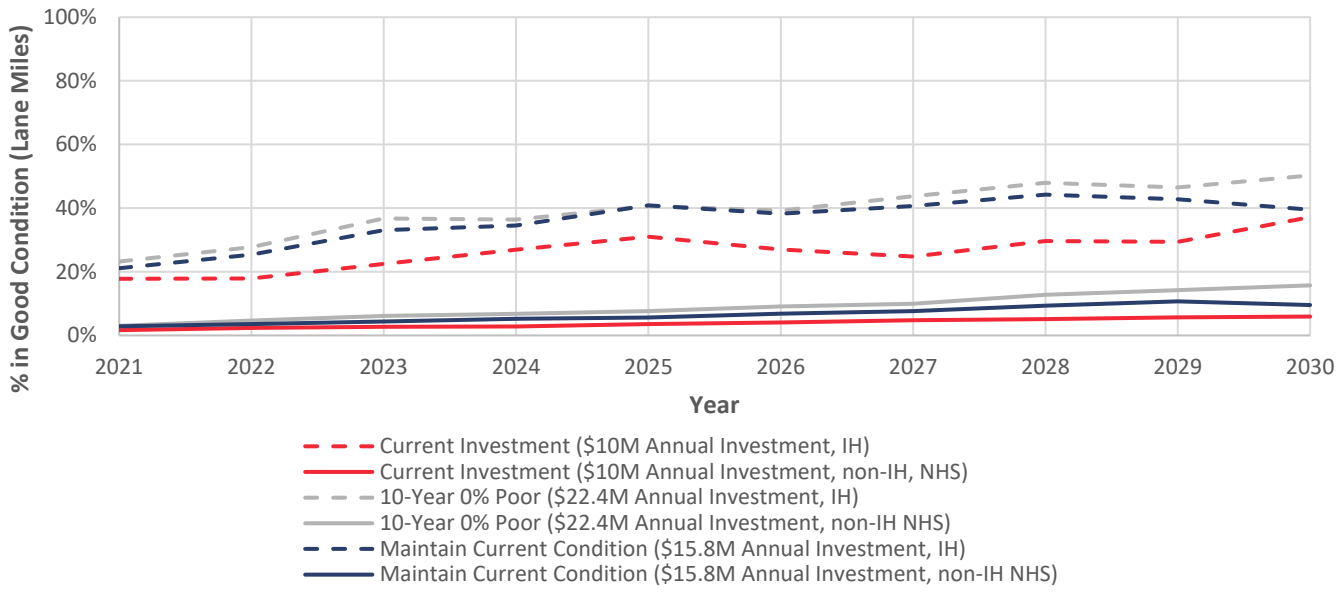
2025 Target
% Good ≥ 24%
% Poor ≤ 7.2%

10-Year SOGR
% Good ≥ 43.1%
% Poor ≤ 4.3%

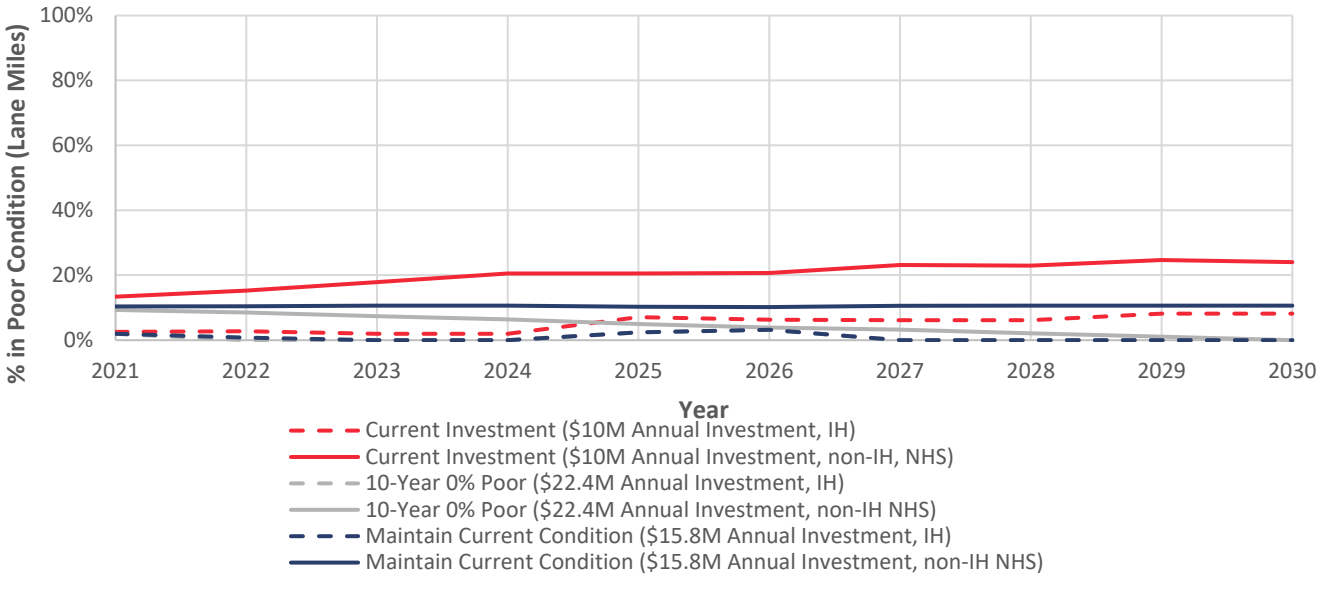
Chapter 5. Life Cycle Planning

Life Cycle Planning (LCP) is a concept of strategically selecting treatments to optimize the performance of the network while minimizing the cost. DDOT utilized three types of life cycle planning scenarios:

- **Maintain Current Conditions:** Assesses the level of investment necessary for DDOT to maintain the asset network at current conditions over the analysis period.
- **Achieve Specified Condition:** Determines the level of investment necessary for DDOT to meet a desired performance for the asset (i.e., 0% of the NHS in Poor condition by Year 10).
- **Specified Investment:** Evaluates the network performance given a specified budget.

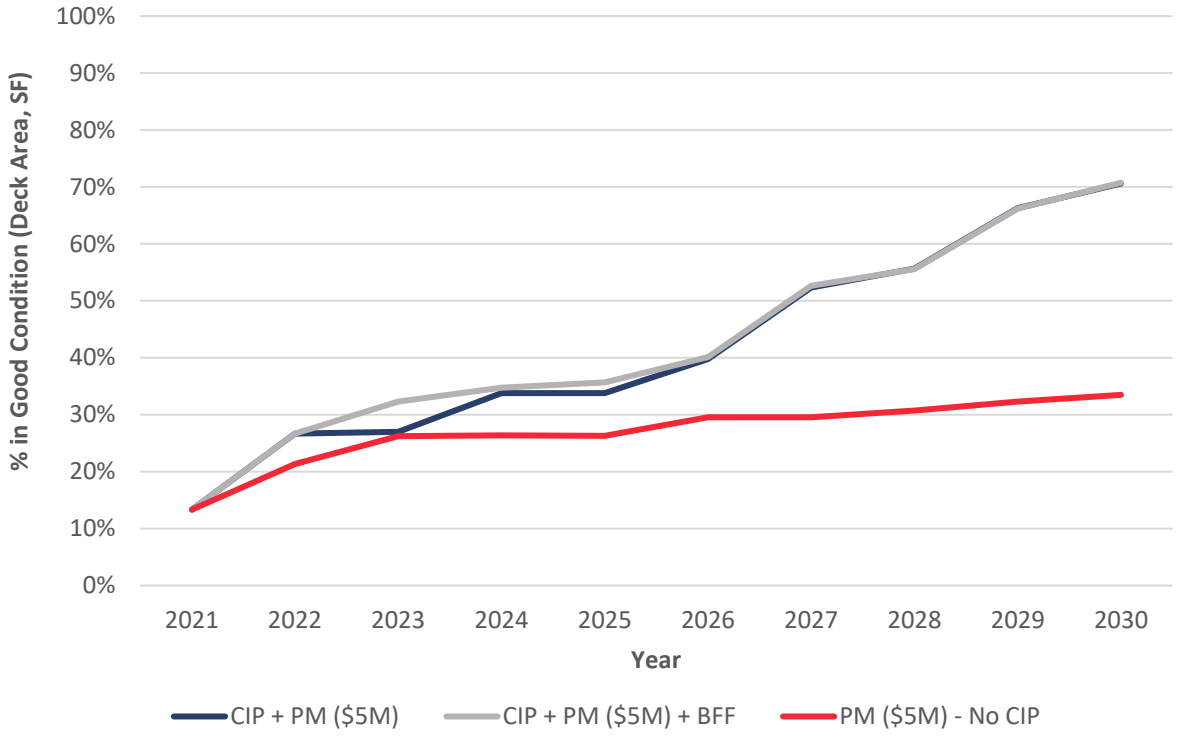


Percent of Pavements in Good Condition for LCP Scenarios

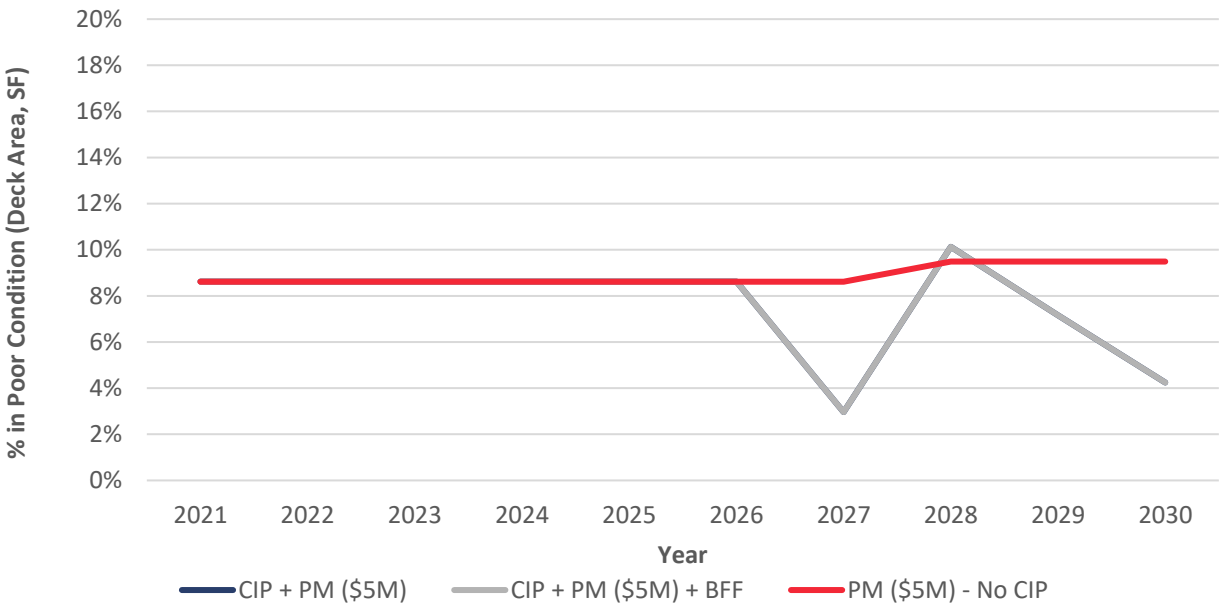


Percent of Pavements in Poor Condition for LCP Scenarios

DDOT's bridge LCP scenarios focused on assessing different funding levels including Capital Improvement Projects (CIP) funding only (CIP Only), $5 million for preventative maintenance (PM) ($5M), and other different combinations of these funding sources and funding available through the Bridge Formula program (BFF).



Percent of NHS Bridges in Good Condition for LCP Scenarios



Percent of NHS Bridges in Poor Condition for LCP Scenarios

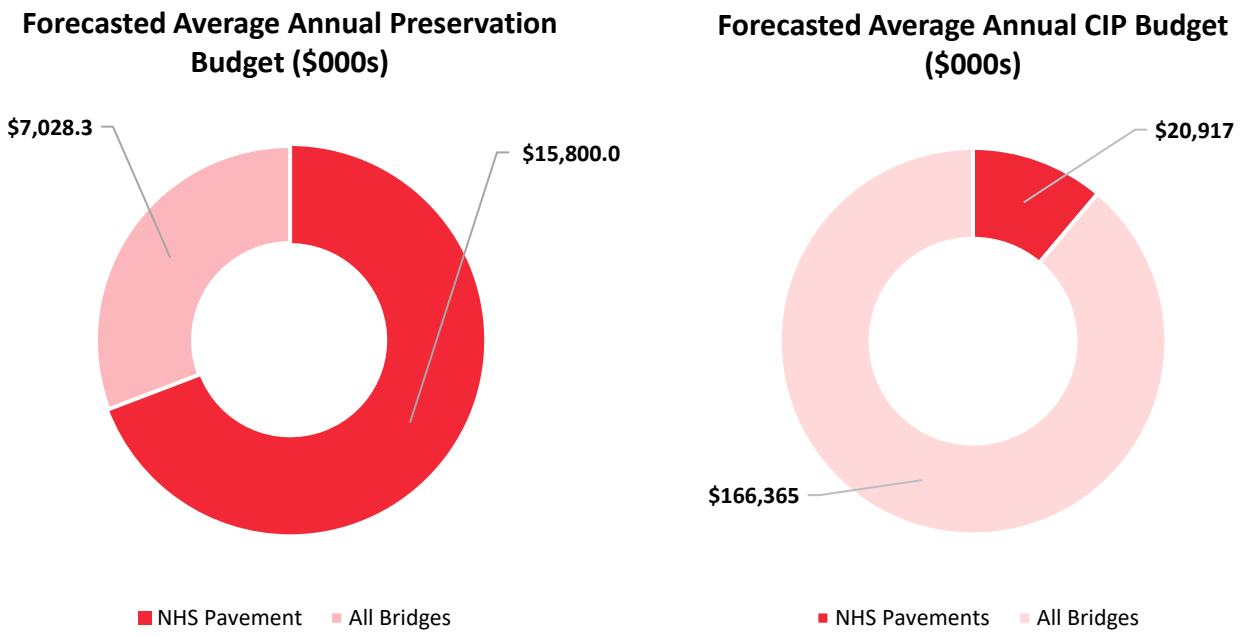
Chapter 6. Risk Management Analysis

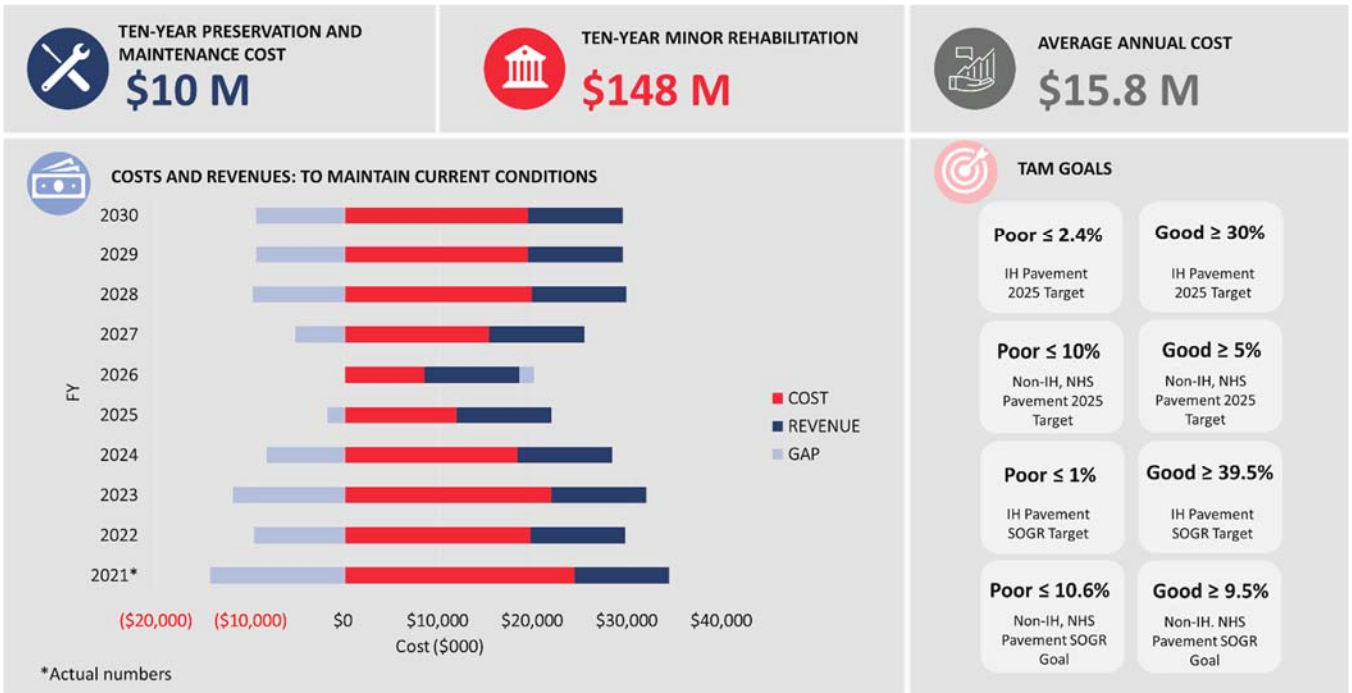
DDOT relies on best practices to analyze and respond to asset management risks. Specifically, the Agency has adopted a four-step risk management process that incorporates federal and international standards of risk management. The process focuses on identifying, analyzing, evaluating, mitigating, and monitoring risk. DDOT used the process to create a risk register that documents and tracks risks events, their likelihood of occurrence and consequences/impacts, the associated actions to alleviate their impact, and the owners of the risks. A summary of DDOT's top-five high priority risks is provided below.

Top-5 High Risks to DDOT Assets

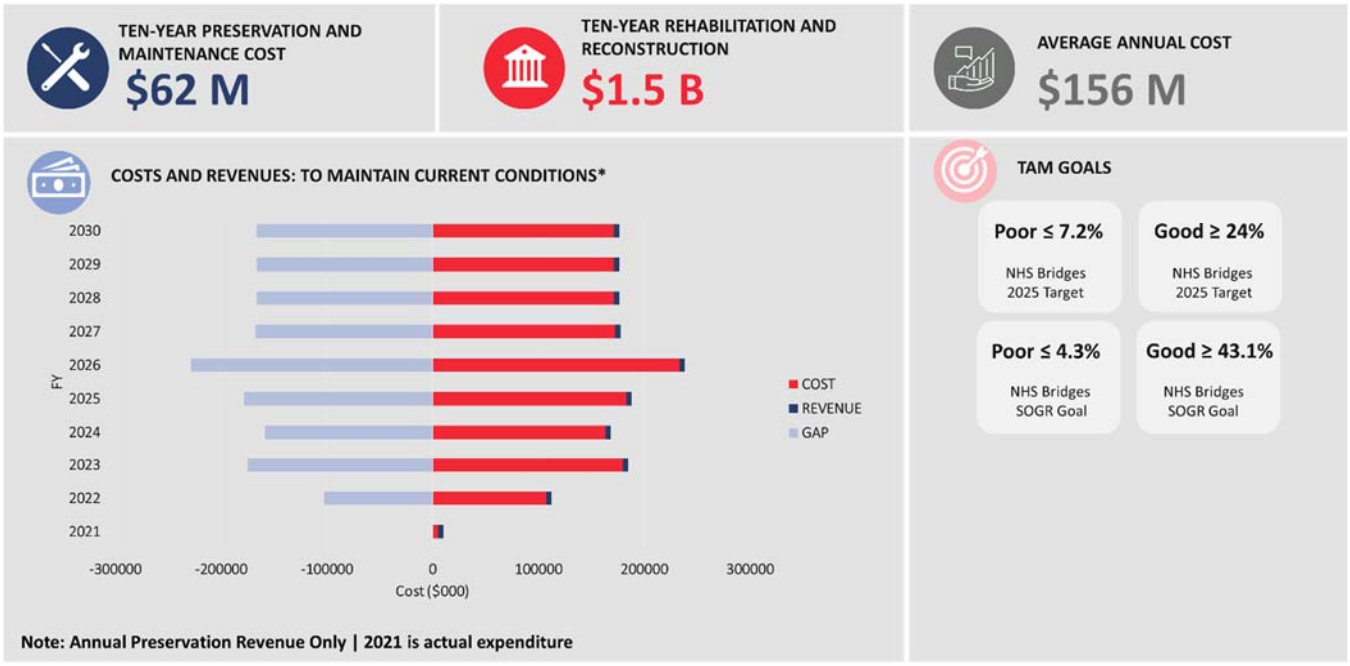
Risk Score	Risk Event	Potential Impact
20	Inability to procure qualified contractors in a reasonable amount of time and at a reasonable cost to support program delivery.	❖ Delays in project delivery. ❖ Unmet program and performance goals. ❖ Increased customer complaints. ❖ Negative impacts on the Department's reputation.
19	Local funding appropriation is impacted by diverse government policies and restrictions.	❖ Unmet department and program goals and performance targets. ❖ Unfunded local projects. ❖ Increased customer complaints.
18	Loss of performance or damage to assets due to the failure of utilities assets or buried pipes.	❖ Premature failure of transportation assets. ❖ Extended roadway closures. ❖ Increased cost due to emergency repairs. ❖ Delayed projects due to the diversion of funds for emergency repairs. ❖ Increased safety and mobility concerns.
18	Use of poor-quality materials and workmanship	❖ Increased construction defects. ❖ A decreased expected service life of assets. ❖ Increased deterioration rate. ❖ Increased cost due to premature failure.
18	Program delivery impacted by multimodal or corridor-related projects.	❖ Delayed projects due to the lack of funding. ❖ Unmet performance targets and goals. ❖ Inefficient use of limited resources.

Chapter 7. Financial Planning

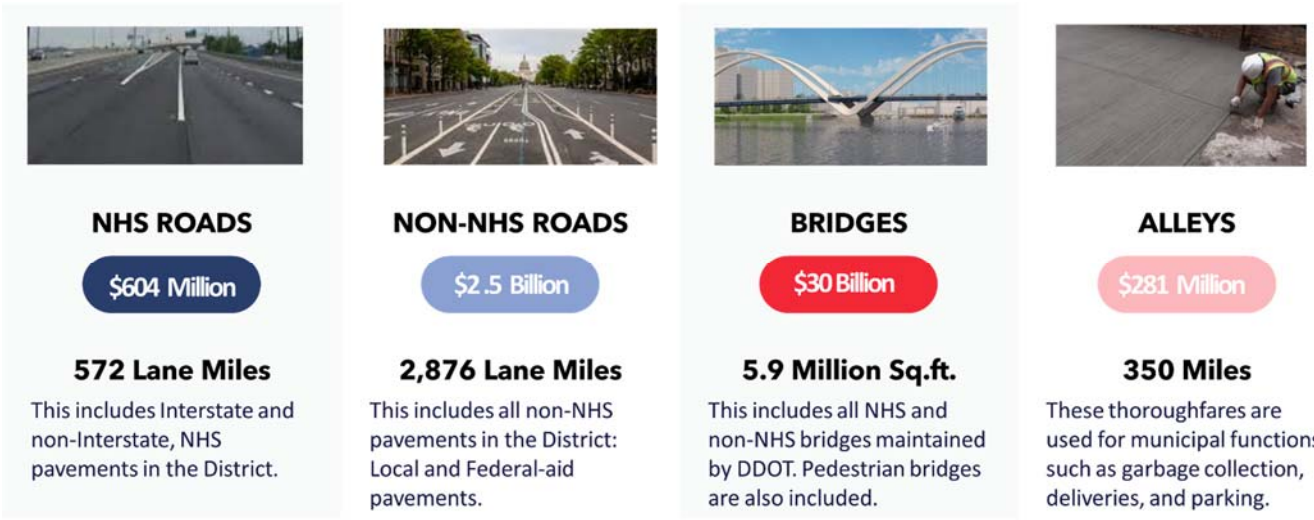




Summary of Financial Needs of DDOT NHS Pavements



Summary of Financial Needs of DDOT-Owned NHS Bridges



Asset Replacement Cost

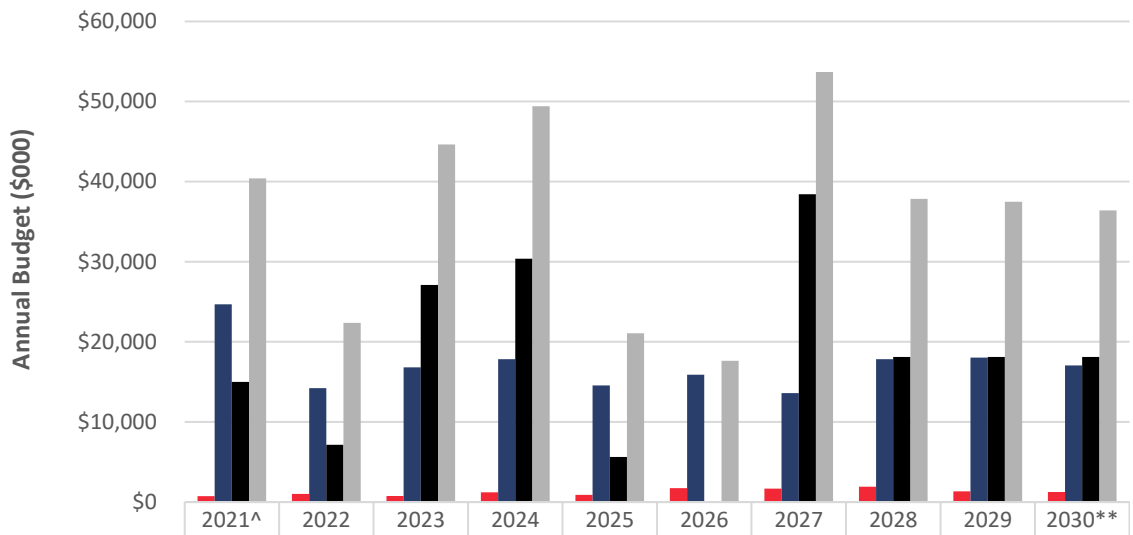
Chapter 8. Investment Strategies

Investment strategies are simply a set of tactics that enable a State to achieve performance targets while also minimizing costs and managing risks. The figures below show the performance gaps, funding needs, and performance of NHS pavements and bridges based on developed investment strategies.

Performance Gap Between Baseline Condition (2020) and 10-Yr DDOT's SOGR Target for NHS Pavements

Performance Gap Between 2030 Projected Performance and 10-Yr SOGR Target for NHS Pavements

Performance Gaps for DDOT's NHS Bridges

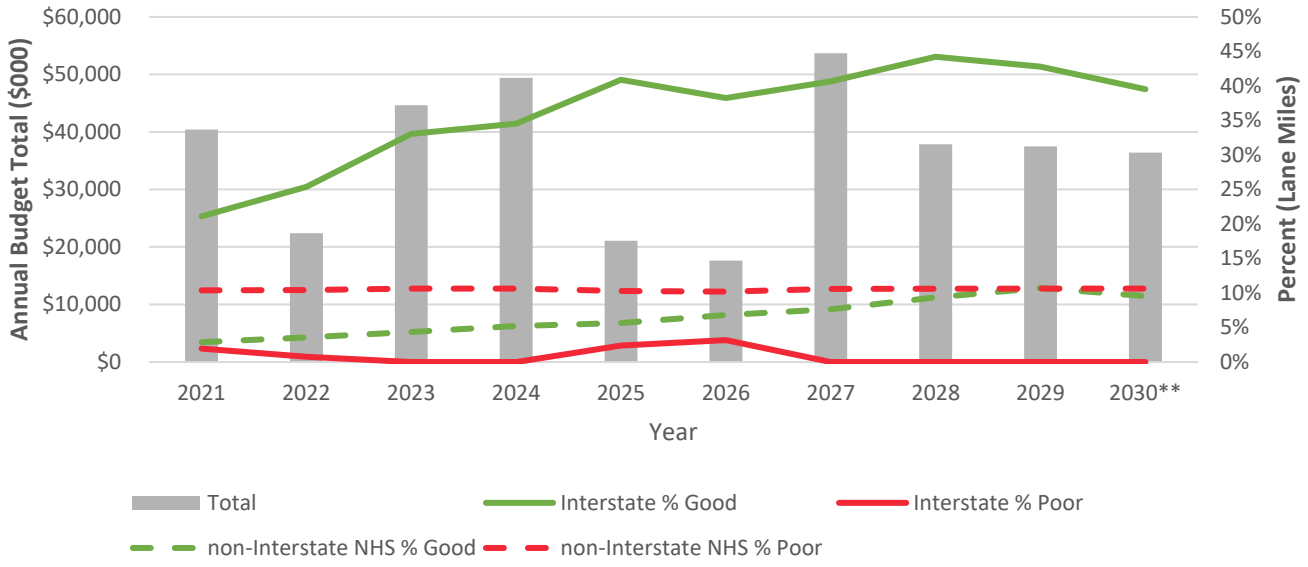


	2021^	2022	2023	2024	2025	2026	2027	2028	2029	2030**
Preservation	$731	$998	$748	$1,200	$883	$1,726	$1,670	$1,913	$1,330	$1,244
Minor Rehab	$24,672	$14,220	$16,800	$17,833	$14,555	$15,893	$13,594	$17,827	$18,035	$17,048
Major Rehab/Reconstruction (CIP)*	$15,000	$7,149	$27,086	$30,368	$5,631	$0	$38,417	$18,108	$18,108	$18,108
Total	$40,403	$22,367	$44,634	$49,401	$21,069	$17,618	$53,681	$37,848	$37,473	$36,400

Annual Investment Trend – NHS Pavement

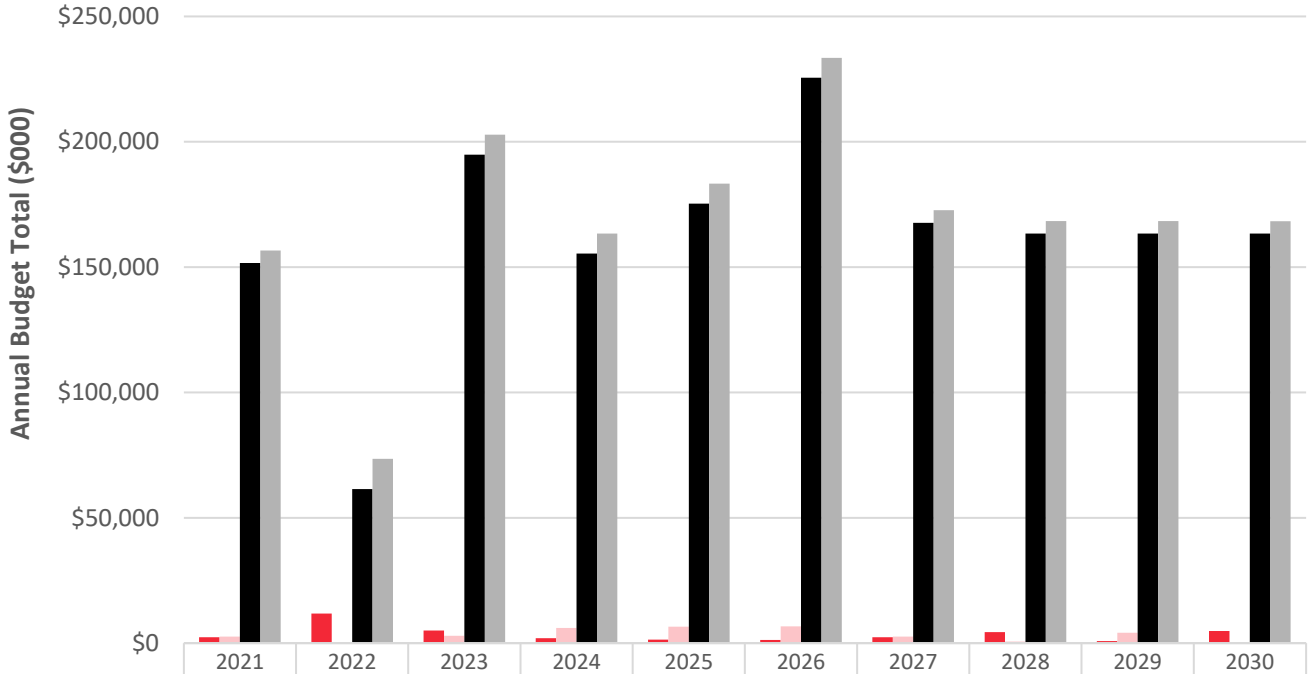
* While CIP funding is included in the above, the CIP projects that will be completed in the next five years will not significantly impact the performance of the NHS pavement network. Additionally, an average value was used to populate the CIP budget for 2028-2030 as the existing financial projections for CIP stop at FY 2027. ^Note: FY2021 data is actual. This was used because the asset baseline data available was 2020 data reported in 2021.

** 2030 Preservation and Minor Rehabilitation values are based on the average spending for each, respectively.



Projected Performance and Funding – NHS Pavements

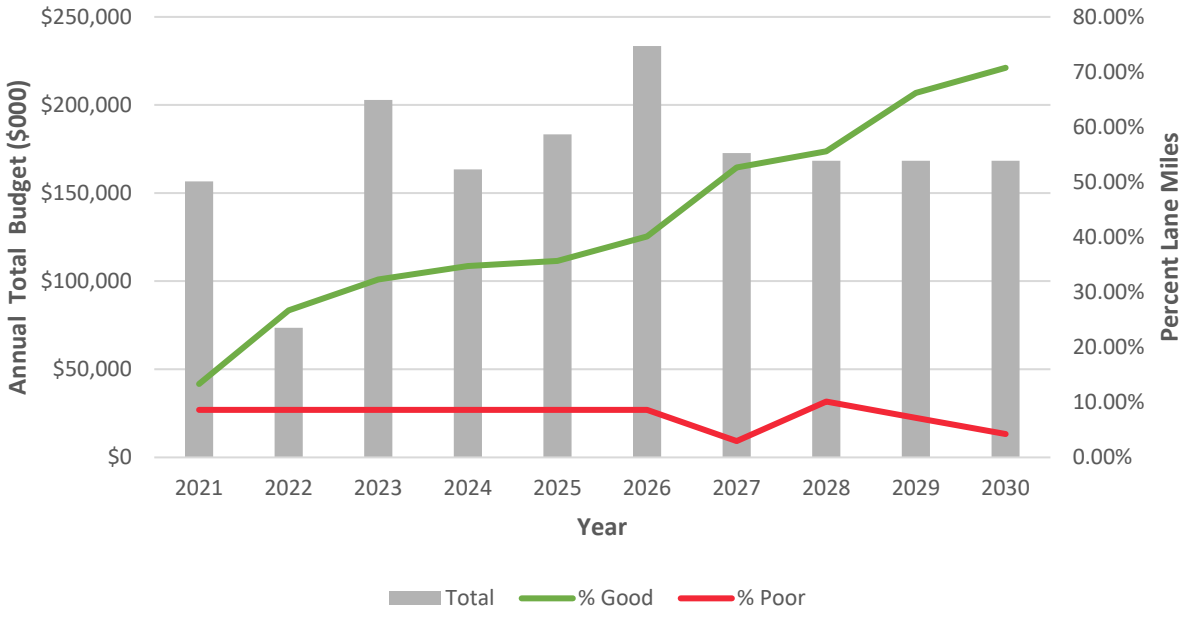
** 2030 Preservation and Minor Rehabilitation values are based on the average spending for each, respectively.



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Preservation (Repairs)	$2,362	$11,782	$5,039	$1,958	$1,396	$1,247	$2,370	$4,381	$803	$4,858
Preventative (Cyclical)	$2,638	$218	$2,936	$6,039	$6,585	$6,719	$2,620	$616	$4,155	$92
CIP*	$151,628	$61,488	$194,838	$155,388	$175,295	$225,512	$167,672	$163,365	$163,365	$163,365
Total	$156,628	$73,488	$202,813	$163,385	$183,276	$233,478	$172,662	$168,362	$168,324	$168,316

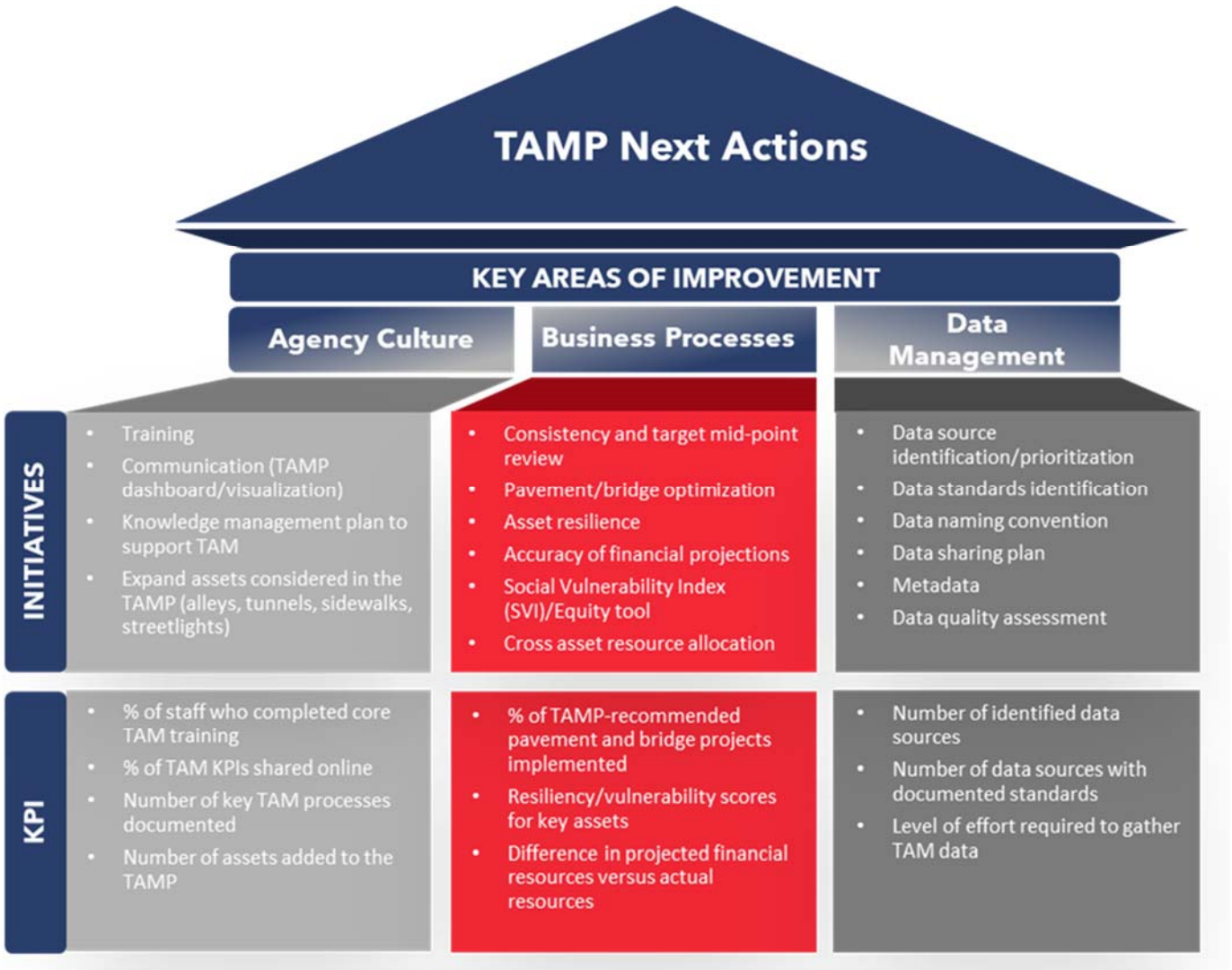
Annual Investment Trend – NHS Bridges

*An average value was used to populate the CIP budget for 2028-2030 as the existing financial projections for CIP stop at FY 2027.



Projected Performance and Funding – NHS Bridges (Scenario: CIP + PM ($5M) + BFF)

Chapter 9. Continuous Process Improvement



Chapter 1. Introduction

1.1. About This Plan

This 2022 Transportation Asset Management Plan (TAMP) provides updates to the Transportation Asset Management Plan certified by the Federal Highway Administration (FHWA) in August 2019. The TAMP is a ten-year strategic document that enables the District Department of Transportation (DDOT) to achieve asset management objectives while supporting agency-wide strategic goals. It is intended to be a continuously updated, living document detailing DDOT's asset inventory and condition, forecasted funding and performance, estimated value, the cost to maintain these assets, and actions to manage risks and build system resilience.

The Moving Ahead for Progress in the 21st Century Act (MAP-21) and the Fixing America's Surface Transportation Act (FAST) require State Departments of Transportation (State DOTs) to develop and implement a risk-based asset management plan following the FHWA TAMP requirements, **23 CFR § 515.9**. Under these requirements, DDOT must update and resubmit its risk-based TAMP for certification at least every four years, or whenever the TAMP is modified, to ensure the Department meets applicable federal requirements. One of the key updates in this TAMP is the consideration of extreme weather and resilience as part of the lifecycle cost and risk management analysis. This is due to the amendments of the TAMP requirements by the Bipartisan Infrastructure Law (BIL) which requires States to include extreme weather and resilience as part of the TAMP processes.

TAMP minimum requirements

- ✓ Listing of the pavement and bridge assets on the National Highway System in the State, including a description of the condition of those assets;
- ✓ Asset management objectives and measures;
- ✓ Performance gap identification;
- ✓ Lifecycle cost and risk management analysis;
- ✓ A financial plan; and
- ✓ Investment strategies.

List of Assets in TAMP

- ✓ NHS Bridges
- ✓ NHS Pavements
- ✓ Tunnels
- ✓ Pedestrian Bridges
- ✓ Local Pavements
- ✓ Alleys
- ✓ Sidewalks

Federal regulation also requires DDOT to report on all National Highway System[1] (NHS) pavements and bridges in its TAMP, irrespective of ownership. However, DDOT also maintains other critical transportation assets which require formal and systematic management. This 2022 TAMP includes NHS pavement and bridges, DDOT-maintained non-NHS pavements (i.e., local roads and federal-aid roads), non-NHS bridges (including pedestrian bridges), tunnels, alleys, and sidewalks. While DDOT has attempted to develop a comprehensive TAMP including other assets, the analysis in this TAMP has been limited to assets which have sufficient data and information. As such, additional assets beyond the NHS pavement and bridges are not to be considered part of the TAMP recertification process.

The remainder of this chapter describes the **progress in Transportation Asset Management (TAM)** DDOT has made, and the **organization of the TAMP**.

1.2. Progress in TAM

TAM is a way of doing business to equitably deliver a safe, sustainable, and reliable multimodal transportation network for all residents and visitors of the District of Columbia (DC). In 2017, DDOT conducted an assessment to better understand the maturity and gaps in the Department's existing TAM program. Based on the 2017 maturity assessment and gap analysis, DDOT developed two guiding documents for its program—the TAM Strategic Plan and the **2019 TAMP**. The two plans helped to identify a list of improvements in three critical areas—**Agency Culture, Business Processes, and Data and Technology**—to advance the TAM practice. These three areas of improvement support the six overarching improvement themes—**Organization and People, TAM Strategy and Planning, Asset Performance, Resource Allocation, Monitoring and Adjustment, and**

[1]The National Highway System includes the Interstate Highway System as well as other roads important to the nation's economy, defense, and mobility.

Information and Systems—identified in the American Association of Highway and Transportation Officials **(AASHTO) TAM Guide Framework**[2] and are used to facilitate an improved TAM practice.

Since the development of the TAM Strategic Plan and the publication of the 2019 TAMP, DDOT has made substantial progress in implementing these identified improvements. Figure 1-1 provides a synopsis of completed and ongoing activities significantly impacting this TAMP and the overall TAM program. The activities are grouped under the key areas defined previously, with more extensive descriptions provided in subsequent chapters.

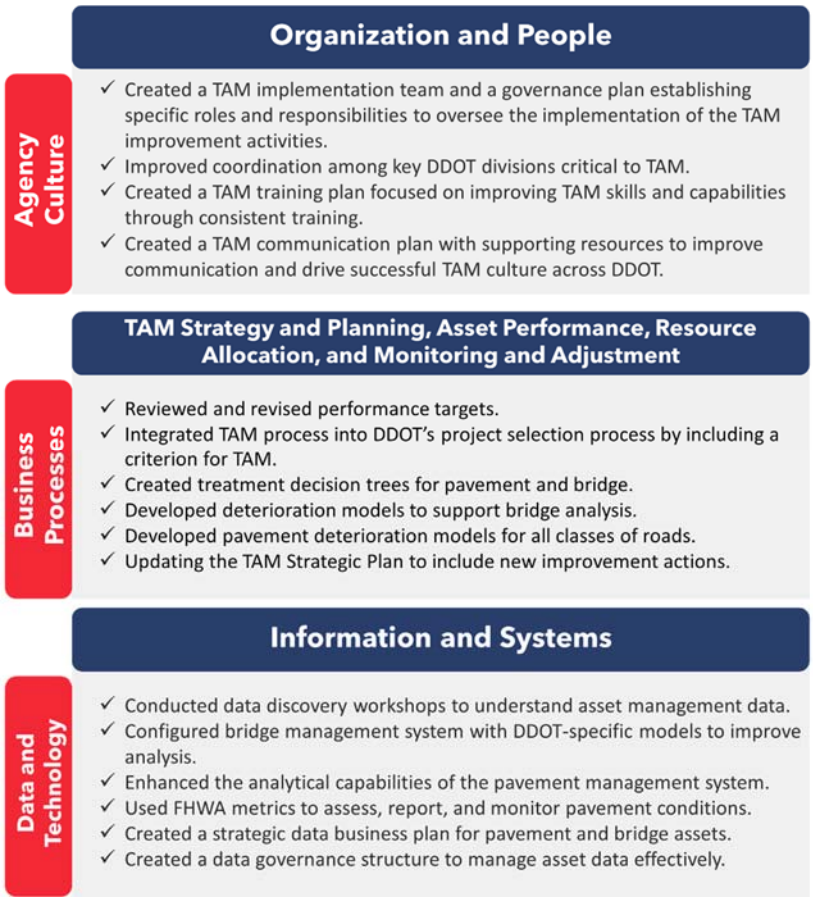


Figure 1-1. Completed and Ongoing TAM Improvements

Despite limited resources (in terms of people and funding), DDOT's progress in the implementation of improvement action items shows DDOT's commitment to TAM. As a result of these actions, the 2022 TAMP will focus on communicating these improvements and the value each has provided in allowing the Department to not only establish and achieve the TAMP performance targets, but also make significant progress in achieving the Mayor's systemwide goals and Agency-wide mission and objectives.

1.3. Organization of TAMP

The remainder of this plan provides an overview of the processes used to comply with the FHWA TAMP requirements. Table 1-1 summarizes the contents of each chapter—the degree to which the chapter addresses the major TAM requirements—and the improvements made since the 2019 TAMP.

[2] This guide provides an understanding of asset management techniques to advance asset management practices.

Table 1-1. TAMP Organization and Key Improvements

Chapter and FHWA Requirements		Main Improvements/Updates
2	**TAM at DDOT** Provides a detailed overview of asset management within the context of DDOT.	❖ Updated TAM strategies, objectives, and measures. ❖ Improved integration with planning processes. ❖ Updated governance structure. ❖ Developed training and communication plans.
3	**Asset Inventory and Condition** Presents the inventory and condition data for the entire NHS pavement and bridge assets and other assets included in the TAMP using systems with capabilities to forecast future conditions.	❖ Updated asset inventory and conditions. ❖ Used FHWA metrics to rate NHS pavement and bridges.
4	**Asset Performance Goals and Targets** Contains asset performance measures and gap analysis results.	❖ Used new bridge and pavement management systems with capabilities to forecast State and Federal measures. ❖ Updated pavement and bridge performance targets and State of Good Repair.
5	**Life Cycle Planning (LCP)** Contains the long-term financial needs over the service life of the assets and alternatives to improve resilience and minimize the long-term costs associated with operating and managing the assets.	❖ Updated management approaches for pavement and bridge LCP. ❖ Developed pavement and bridge deterioration models to support LCP strategies. ❖ Incorporated resilience in LCP.
6	**Risk Management** Contains all inherent risks and mitigation strategies to facilitate risk management and improve system resilience.	❖ Updated risk register to include agency-wide risks. ❖ Included a risk action plan with specific strategic, tactical, and operational level actions. ❖ Described how emergency planning documents inform investment planning. ❖ Considered DDOT's resiliency efforts.
7	**Financial Planning** Contains a 10-year financial plan for managing the conditions of all NHS pavement and bridge assets.	❖ Documented all DDOT revenue sources and how the revenue sources are allocated within DDOT. ❖ Documented performance-driven programming processes. ❖ Included information on revenue from external owners of the NHS.
8	**Investment Strategies** Provides information on investment strategies DDOT will use to optimize the performance of the pavement system.	❖ Used new pavement and bridge management systems to make investment recommendations. ❖ Used updated performance models to forecast gaps. ❖ Considered how whole life costs impact SOGR.
9	**Continuous Improvement** Contains areas DDOT will make continuous improvement to.	❖ Updated TAM improvement actions.

Intentionally left blank

Chapter 2. TAM at DDOT

2.1. Overview

TAM is defined by the federal government as "a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based upon 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 (SOGR) over the lifecycle of the assets at minimum practicable cost."[3] DDOT is committed to integrating TAM principles into its transportation planning processes to achieve and sustain a SOGR over the life cycle of transportation assets. DDOT defines SOGR as the state of achieving or exceeding the federal minimum performance requirements established for Interstate pavement and NHS bridges. More details about DDOT's SOGR and performance targets are provided in Chapter 4 Asset Performance Goals and Targets and Chapter 8 – Investment Strategies.

What is TAM?
"A strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based upon 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 (SOGR) over the lifecycle of the assets at minimum practicable cost."

The remainder of this chapter describes how the TAM program integrates and informs DDOT's strategic goals and planning processes/documents. Specifically, the chapter outlines the following:

TAM Principles and Objectives
This section describes the alignment between DDOT's TAM objectives, TAM principles, and the supporting activities DDOT is undertaking to achieve the objectives.

TAM Integration with Planning Processes
This section describes how DDOT's TAM/TAMP interacts with other DDOT planning documents.

DDOT's Strategic Approach
This section describes DDOT's vision, mission, and goals and how TAM processes support DDOT's strategic direction.

TAM/TAMP Governance
This section describes the governance processes, structures, and defined roles and responsibilities in place to implement TAM and develop and manage the TAMP. It also describes DDOT's coordination activities with external owners of the NHS.

2.2. Asset Management Principles and Objectives

The fundamental principles underlying DDOT's asset management program include making integrated, transparent, and accountable decisions, improving asset conditions, managing risks, and minimizing life cycle cost while providing a resilient transportation network. Through these values, DDOT achieves its TAM objectives and responds to the FHWA asset management plan requirements as described in Part 515 of 23 C.F.R.. DDOT has identified four main TAM objectives, which align with the TAM principles outlined in the AASHTO TAM guide. Table 2-1 summarizes DDOT TAM objectives, their alignment with TAM principles, and the actions DDOT takes to achieve each objective.

[3] Moving Ahead for Progress in the 21st Century Act, 23 U.S.C. § 101(a). (2012).

Table 2-1. DDOT TAM Objectives

DDOT TAM Objectives	Aligned TAM Principles	DDOT Activities
Modify culture and enhance capabilities to advance TAM across all divisions and levels of DDOT.	• Policy-driven • Continuously improved	• Developing and implementing TAM communication plan. • Developing and implementing TAM training plan. • Conducting a periodic self-assessment of the Agency's capabilities.
Enhance performance-based decision-making.	• Performance-based • Transparent • Information-driven/evidence-based	• Developing and updating pavement and bridge models. • Enhancing management systems analytical capabilities. • Updating asset inventory and forecasting asset performance.
Incorporate risk and resilience into investment planning.	• Policy-driven • Risk-based • Option-oriented	• Considering risk in resource allocation, prioritization, and project delivery. • Considering asset criticality in prioritizing investments.
Minimize the inventory of pavement lane miles and bridges in poor condition.	• Performance-based • Information-driven/evidence-based • Agency priority alignment	• Providing the long-term outlook of funding to eliminate assets in poor condition. • Connecting TAM measures with DDOT strategic goals.

2.3. DDOT's Strategic Approach

The TAM principles discussed guide the efforts of DDOT towards common goals. The values define what DDOT believes in and how TAM decisions will support the Agency's strategic direction. The three pillars of DDOT's strategic direction include the Department's vision, mission, and strategic objectives, which are integrated into the Agency's business processes through TAM. Three of the six strategic objectives are directly related to enhancing the conditions of physical assets and how DDOT can create a transparent approach in providing services. The other three strategic objectives relate to the performance of the transportation network. Figure 2-1 illustrates the coordination between DDOT's strategic direction (Agency mission, vision, and strategic objectives) and TAM processes.

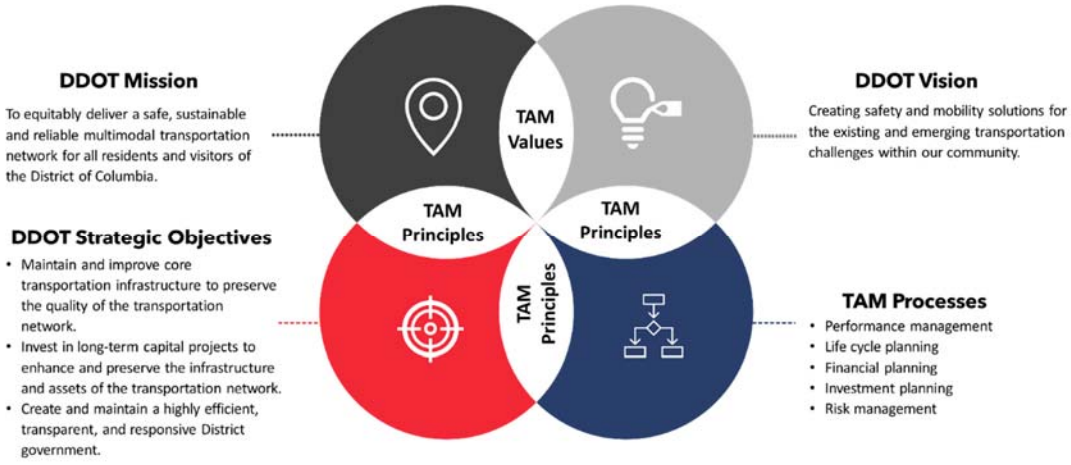


Figure 2-1. Alignment of TAM with DDOT Strategic Direction

The TAM processes also provide business and engineering guidance that steer decision-making and establish a standard for executing day-to-day functions. For example, through this TAMP, DDOT defines a coherent set of **TAM objectives** that fit together to support the achievement of the Agency's strategic objectives as well as reinforces the Agency's **equity statement** through project prioritization and delivery.

2.4. TAM Integration with Transportation Planning Processes

Traditionally, DDOT is involved in multiple comprehensive planning and programming processes that support strategic decision-making and business operations. The primary products of these planning processes include **MoveDC**, the long-range multimodal transportation plan for the District of Columbia, the DC Statewide Transportation Improvement Program (**DC STIP**), the region's 4-year Transportation Improvement Program (**TIP**), and the District's 6-year Capital Improvement Program (**CIP**).

TAM is used as a tool to inform and improve these planning and programming processes as well as support efforts to achieve and sustain a desired SOGR over the life cycle of the Agency's assets. In establishing performance targets for the District's NHS, the Department works with transportation agencies in the District. For example, DDOT coordinates with the National Capital Region Transportation Planning Board (TPB) and Metropolitan Washington Council of Governments (MWCOG) to ensure the region's transportation future is considered. DDOT will provide input and gather feedback to update the TAMP throughout the update of the TPB's long-range transportation plan, **Visualize 2045**. DDOT also works with the National Park Service (NPS) to understand how their programming and project delivery of NHS roads within the jurisdiction of the District of Columbia will impact the overall performance of the NHS. Additional information on how DDOT coordinates their activities during TAMP development is detailed in **Section 2.6 Stakeholder Engagement and TAMP Implementation**.

The asset management final rules, **23 CFR 515.19(h)**, require that DDOT integrates its asset management plan into the Department's transportation planning processes, such as the **DC STIP**. Figure 2-2 illustrates how the DDOT TAMP informs and is integrated into existing planning processes at the State, local, and network levels for different planning horizons.

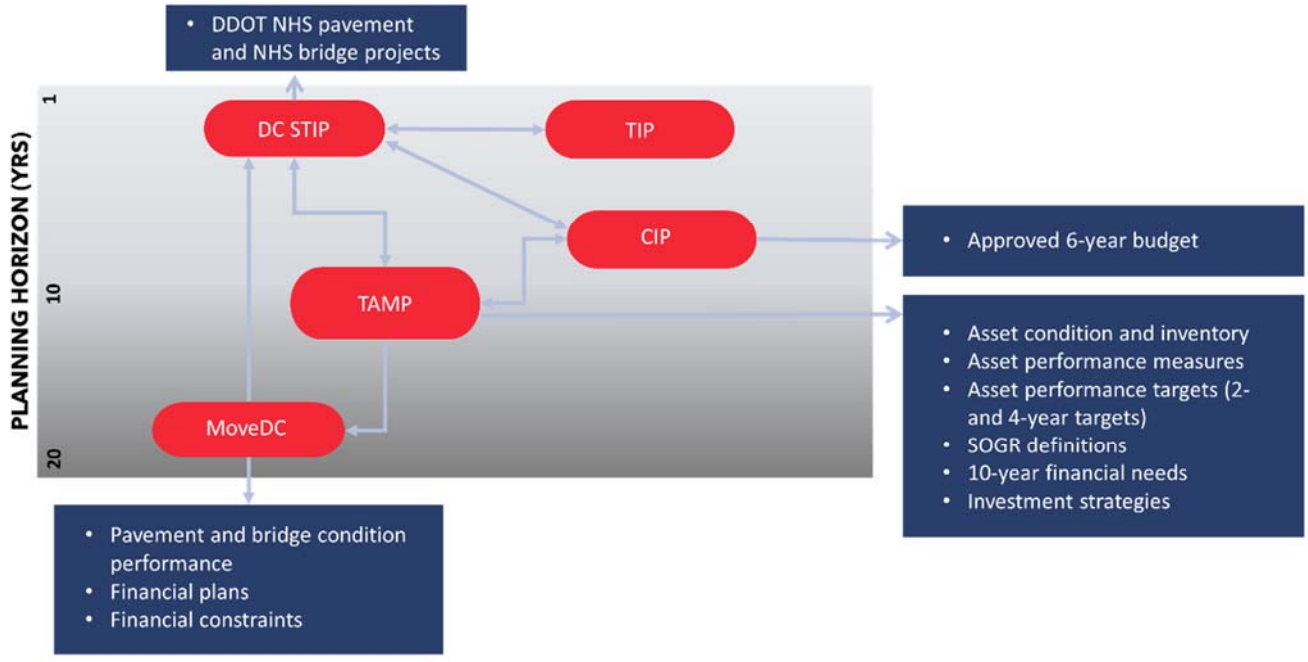


Figure 2-2. TAM Coordination with Planning and Programming Process

2.5. TAM Governance and TAMP Development

DDOT's organizational structure consists of four primary units—Project Delivery Administration, Operations Administration, Administrative Administration, and Performance Administration—essential to planning, programming, scoping, design, construction, maintenance, and operations of assets. Each administration has a unique role in ensuring the Department achieves TAM objectives. Asset management tasks are undertaken by staff from these different divisions and offices within DDOT, requiring coordination across the Agency. Therefore, representatives from key departments are vital to TAM governance.

DDOT's TAM program is a part of and led by champions within the Operations Administration. The team continues to implement TAM processes throughout the Department and manage the development, update, and implementation of the TAMP.

DDOT also relies on various working groups to coordinate TAM activities across the key divisions of the Department. The working groups are assigned specific roles and responsibilities, meeting on an ad-hoc basis, to provide input on the TAMP development and TAM implementation process. To formalize the coordination process, DDOT has developed a TAM Governance Plan, which outlines the goals of the governance team, the composition of each group, and the key roles and responsibilities of the governing bodies.

The governance structure reflects the flow of TAM information across the organization. DDOT regularly updates the governance plan to keep up with the changing roles and turnover of staff. The Senior Management Oversight and Steering

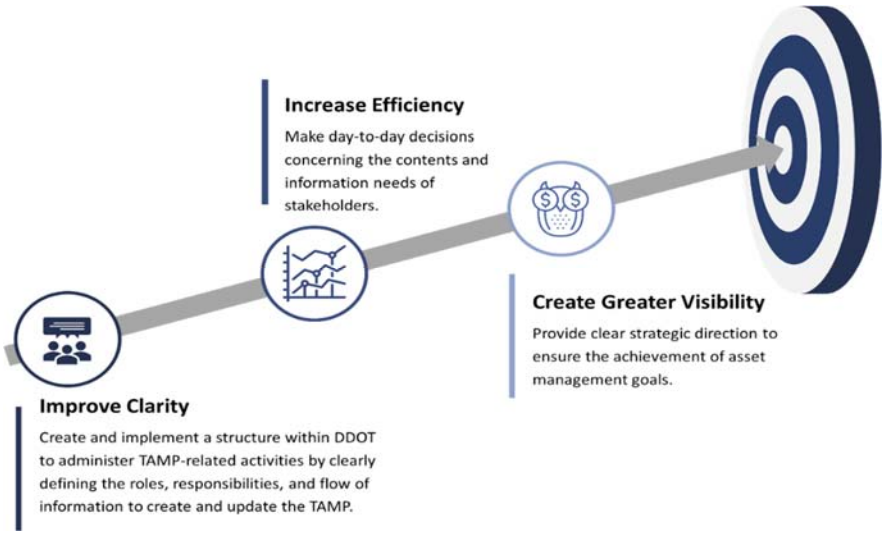


Figure 2-3. TAM/TAMP Governance Goals

Committee continues to provide guidance and support for the implementation of improvement actions identified through the development of the 2019 TAMP. The implementation progress DDOT had made since 2019 is outlined in **Section 1.2 Progress in TAM**.

The TAM governance team, as depicted in Figure 2-4, is functional rather than organizational and consists of the following key groups:

- Director and the Executive Oversight Team
- Senior Management Oversight and Steering Committee
- Project Management Team
- TAM Focus Area Workgroups (i.e., Pavement, Bridge, Planning, Data Management, Risk Management, and External Stakeholders)

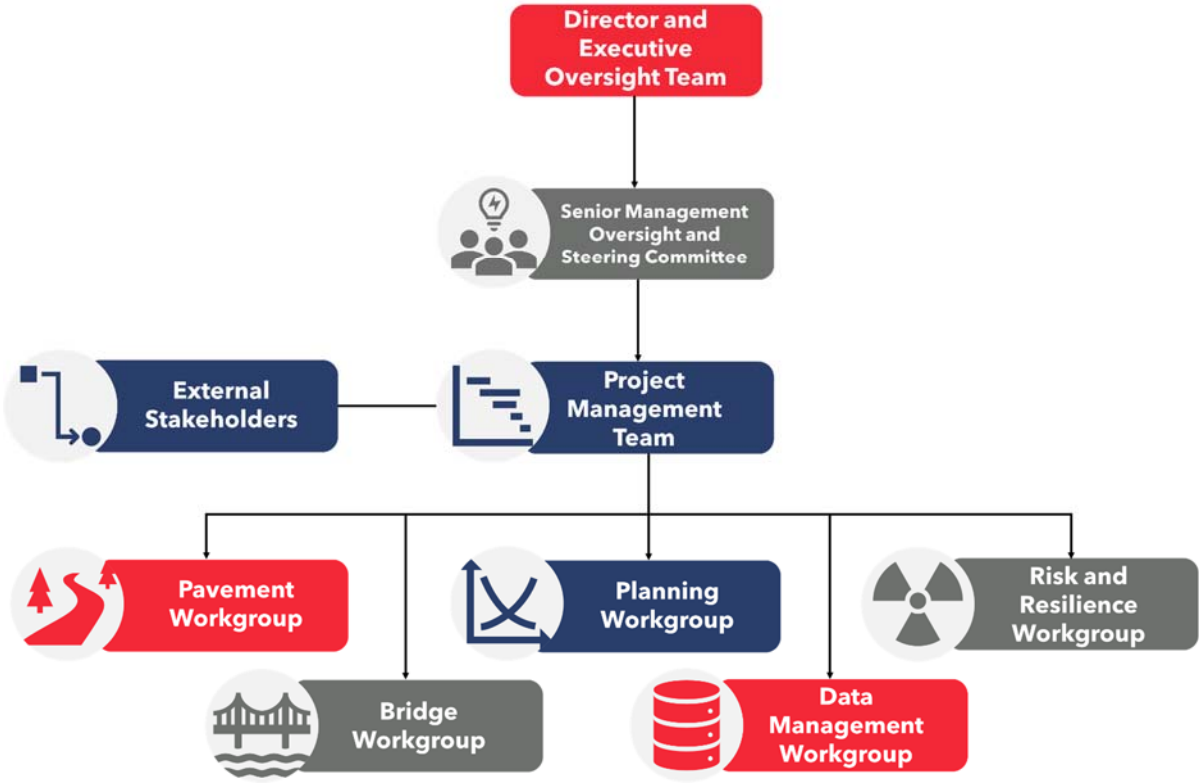


Figure 2-4. TAM/TAMP Governance Structure

The following sections describe the roles and responsibilities of each functional group. The membership includes Division Chiefs, key Associate Directors, and representatives from multiple divisions within the DDOT's current organizational structure.

Director and Executive Oversight Team

This team serves as the executive champions of TAM, providing strategic direction to the TAMP development process and making key decisions concerning the contents of the TAMP.

Senior Management Oversight and Steering Committee

This team acts as the advisory body to DDOT's TAM program, providing regular guidance to the Project Management Team on both direction and technical matters.

Project Management Team

This team ensures that the TAMP project deliverables are on schedule and the TAMP stays current. In addition, the team is responsible for the managing workgroup deliverables to produce an easy-to-follow TAMP product.

Asset Management Workgroups

At the more tactical level, the governance team consists of six asset management workgroups for the pavement, bridge, planning, risk and resilience, data management, and external stakeholders. These working groups focus on specific components or pieces of TAMP development and TAM implementation. A summary of the activities conducted by each workgroup is summarized in Figure 2-5.

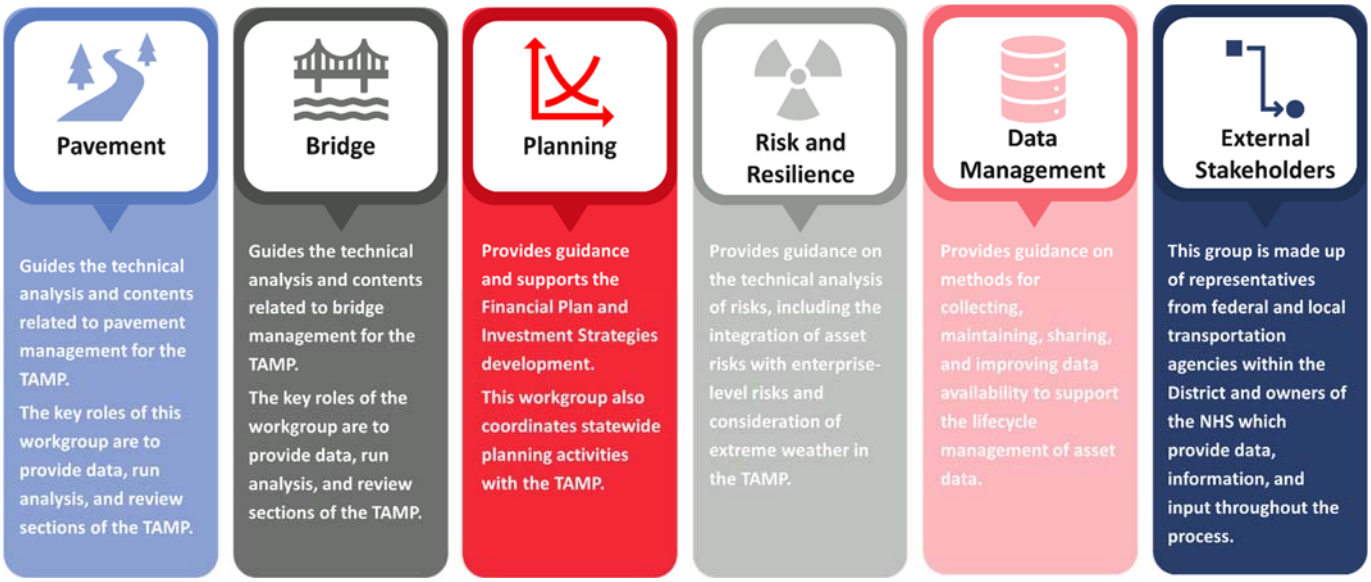


Figure 2-5. Asset Management Workgroup Roles

2.6. Stakeholder Engagement and TAMP Implementation

The TAM rule **23 CFR § 515.9(b)** requires that the TAMP include a summary of the NHS pavement and bridge assets, regardless of ownership. While DDOT owns and maintains most of the NHS pavements and bridges within the District, a small portion of these assets is owned and maintained by NPS and the Architect of the Capitol (AOC) (pavement only), both which are federal entities. In addition to asset owners of the NHS, other transportation and planning stakeholders are involved in the TAM process, including FHWA and the Metropolitan Washington Council of Governments (MWCOG). To achieve the performance targets and minimum requirements for the NHS assets, DDOT relies on coordination and information sharing on inventory and condition, performance target setting, and financial details between stakeholders.

DDOT involves these external stakeholders through meetings, workshops, and the TAMP review process. During the development of the 2022 TAMP, DDOT conducted several stakeholder engagement meetings to share and gather information for target setting. The first meeting was held on August 23, 2021 and included representatives from the Eastern Federal Lands Highway Division (EFLHD) and the DC Division from FHWA, NPS, and AOC. A follow-up meeting was held on October 27, 2021 to discuss the implication of the external stakeholders' asset performance on the overall performance of NHS asset conditions. To finalize the NHS bridge inventory and condition, DDOT held another call with EFLHD on February 17, 2022 to gather the most current NPS bridge inspection data for input into DDOT's bridge management system. DDOT will continue to engage the stakeholders on a yearly basis to gather and update information. In addition, DDOT will use the FHWA long-term bridge performance InfoBridge portal to update bridge conditions. Since DDOT gathers data on all NHS pavements, there will be meetings to reconcile conditions with the stakeholders.

Additionally, DDOT developed a non-binding, external stakeholder agreement to facilitate the coordination between DDOT, NPS, and AOC in 2018. This document was updated during the development of the 2022 TAMP to reflect changing roles and responsibilities. The agreement contains the goals and expected outcome of the coordination process, key contact people and their responsibilities in updating the TAMP, expected milestones, and the estimated level of effort required for each assigned activity. The matrix below shows the level of involvement of each external stakeholder in developing and implementing the DDOT TAMP.

	FHWA	NPS	AOC	MWCOG	DDOT
Establish TAMP development rules	R	I	I	I	R
Approve TAMP	R	I	I	I	R
Establish performance targets	I	I	I	C	R
Develop TAMP for NHS assets	A	C	C	C	R
Implement TAMP projects	I	R	R	C	R

R RESPONSIBLE A ASSIST C CONSULTED I INFORMED

Figure 2-6. External/Internal Stakeholders Responsibility Matrix

Intentionally left blank

Chapter 3. Asset Inventory and Conditions

3.1. Overview

In TAM, asset inventory and asset condition are critical in describing a system's state and making informed asset investment decisions over time. One of the primary activities of DDOT's TAM program is to maintain an asset inventory and report the condition of its primary assets (pavement and bridges on the NHS[4]), which are owned and managed by multiple agencies, including DDOT, NPS, EFLHD, and AOC. This multi-agency ownership requires DDOT to coordinate with these external agencies to gather data and information for the TAMP development. The coordination and collaboration efforts between DDOT and the external stakeholders are documented in **Section 2.6 Stakeholder Engagement and TAMP Implementation**. In addition to primary assets, DDOT has gone beyond federal requirement and begun to include additional assets beyond NHS pavement and bridges in this TAMP. Figure 3-1 shows the NHS extent and classification in the District.

The remainder of this chapter describes the inventory and conditions of the assets included in the TAMP. Specifically, the chapter outlines the following:

Pavement Assets
This section describes pavement assets owned by DDOT and other stakeholders on the network and shows historical condition trends.

Other Assets
This section describes other assets on the network included in the TAMP and shows historical condition trends. It also describes current efforts to include other assets beyond pavement and bridges in the TAMP.

Bridge Assets
This section describes bridge assets owned by DDOT and other stakeholders on the network and shows historical condition trends.

Demand for Transportation Infrastructure
This section describes the demand for transportation in the District, the impact on asset funding, risk, performance, etc., and how DDOT will use the TAMP to address the demand.

[4] The National Highway System (NHS) includes the Interstate Highway System as well as other roads important to the nation's economy, defense, and mobility.

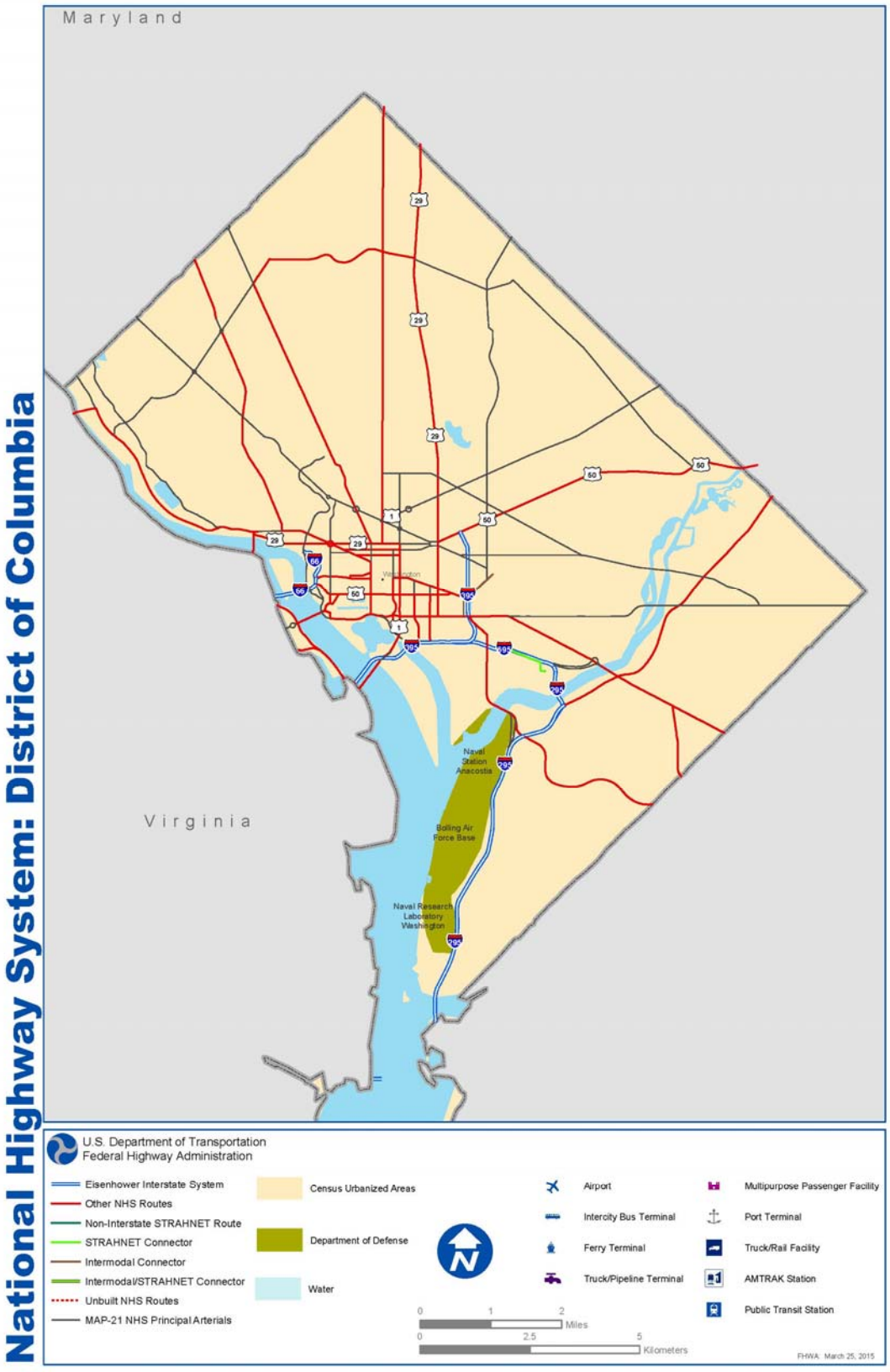


Figure 3-1. NHS Extent and Classification in the District of Columbia.

3.2. Pavement Assets

In this section, a summary of DDOT's pavement network is provided. Specifically, the section provides an overview of the District's pavement inventory and condition.

Pavement Inventory

The District's pavement network consists of about 3,448 lane miles of pavement[5]: 572 lane miles of NHS[6] (Interstate and non-Interstate) pavements, accounting for about 17 percent of the entire pavement network and subject to the federal regulation, and 2,876 lane miles of non-NHS (Federal-aid roads and local roads) pavements, representing 83 percent of the pavement network and not subject to the federal statute. Although the NHS is only 17 percent of the network, it carries approximately 50% of the vehicle miles traveled (VMT) each year in the District. DDOT maintains approximately 90 percent (i.e., 3,103 lane miles) of the District's pavement inventory, which includes 100 percent of the 73 lane miles Interstate pavement and approximately 90 percent (i.e., 442 lane miles) of the 499 lane miles of non-Interstate NHS. The remaining 10 percent of the NHS is maintained by NPS and other federal and local agencies. The pavement inventory has been mostly static over the years and is not expected to experience any significant growth for the duration of the TAMP. Figure 9 shows the breakdown of inventory by roadway class.

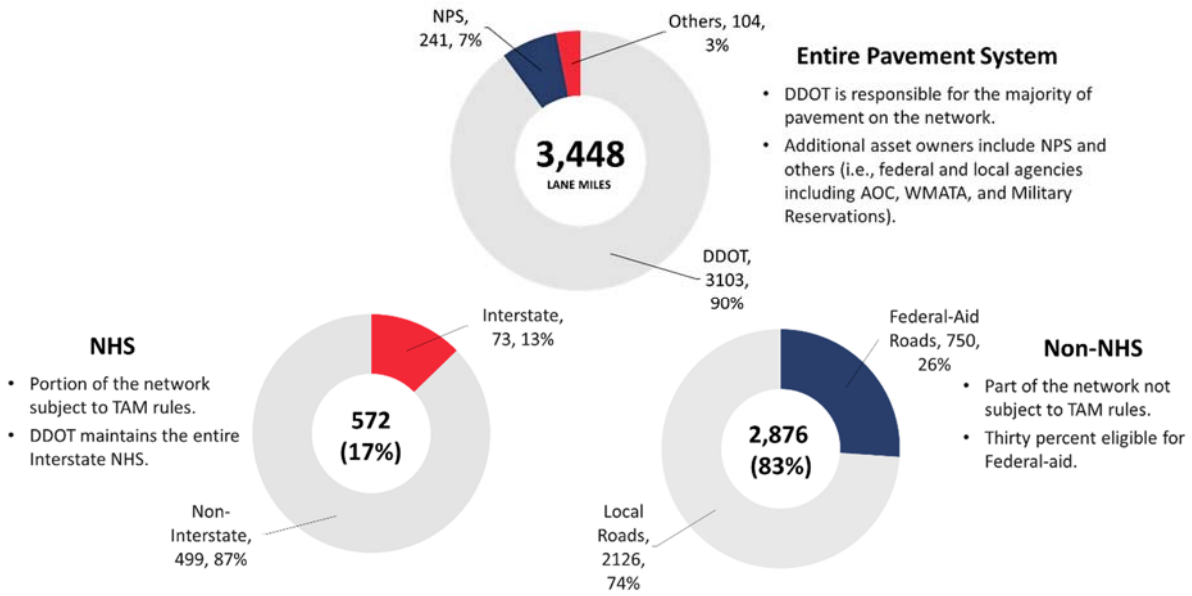


Figure 3-2. Pavement Inventory by Road Classification

As indicated in Figure 3-2, the non-NHS pavement forms a significant portion (i.e., 83 percent) of the entire pavement network, making it a critical asset for the District. These roadways are primarily maintained using local funding. As such, the Mayor has made it a goal to improve the condition of all local roads in "Poor" condition by 2024. Figure 3-3 shows the breakdown of maintenance responsibilities for the NHS and Non-NHS pavements.

[5] Table HM-60 - Highway Statistics 2020 - Policy | Federal Highway Administration (dot.gov)
[6] Table HM-43 - Highway Statistics 2020 - Policy | Federal Highway Administration (dot.gov)

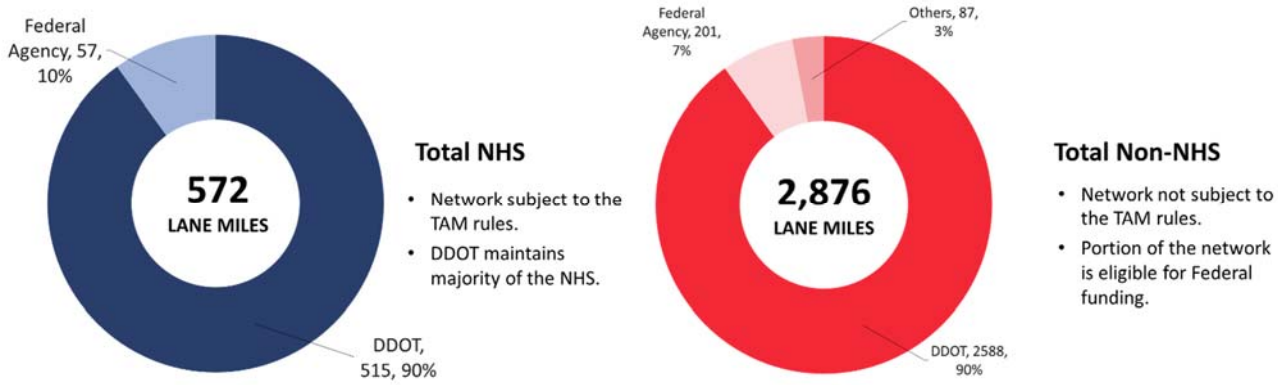


Figure 3-3. Pavement Maintenance Ownership

DDOT's pavement inventory is made up of three pavement surface types. Asphalt Concrete (AC) and Composite pavements make up over 95 percent of the inventory, with Portland Cement Concrete (PCC) pavements making up less than five percent.

Pavement Condition

DDOT collects pavement data to support condition-based management in accordance with the National Highway Performance Program (NHPP) (23 USC 119) and Federal rule 23 CFR Part 490 (Subpart C) reporting requirements. The annual pavement data collection enables the Department to develop deterioration models that evaluate and recommend timely interventions necessary to avoid costly maintenance and reconstruction activities. A description of processes, tools, and systems DDOT uses to gather and update pavement condition information is provided in **Chapter 5 Life Cycle Planning**.

Generally, DDOT uses the Pavement Condition Index (PCI) to assess pavement condition and to support decision-making. PCI uses metrics such as surface defects, surface deformations, and cracking percent to rate the pavement condition, resulting in a score of 0–100. Within DDOT, PCI is categorized into five categories based on the numeric PCI value, as depicted in Figure 3-4.

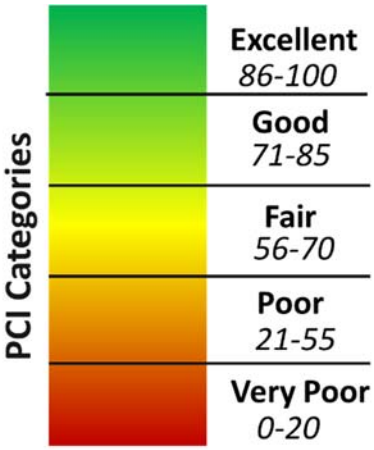


Figure 3-4. DDOT PCI categories

In this TAMP, DDOT calculated the pavement metrics following the federal requirements outlined in **23 CFR 490.311**. However, DDOT will continue to use PCI to drive pavement decisions, especially at the project-level, while reporting on the federal measures for NHS pavements. The federal metrics include International Roughness Index (IRI), rutting (for asphalt/composite pavements), cracking percent, and faulting (for concrete pavements). The figures below show the pavement conditions for the different road classifications included in the TAMP using the federal metrics for NHS and PCI for non-NHS.

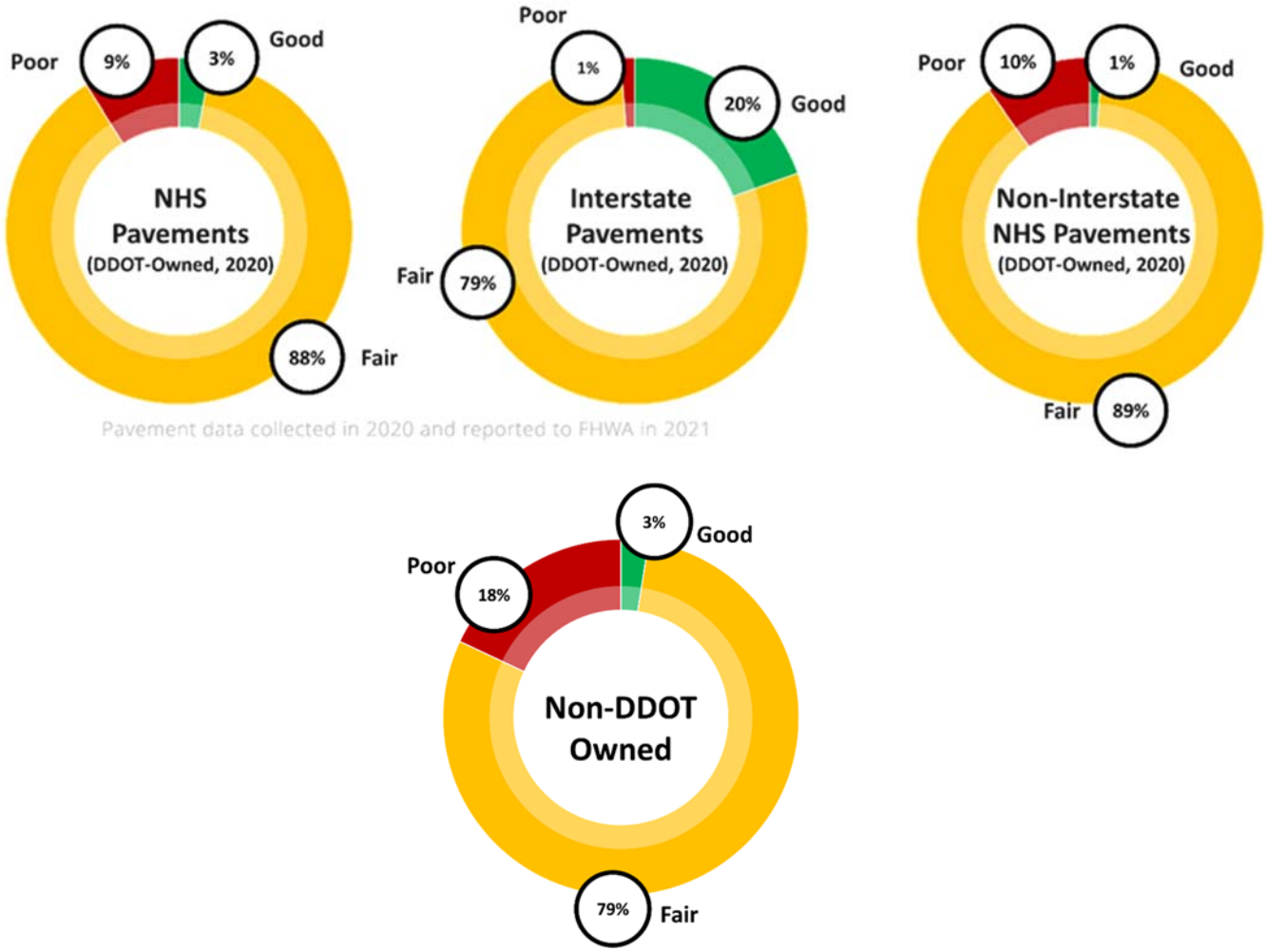


Figure 3-5. Overall Condition of NHS (DDOT Owned), Interstate Highway (IH, DDOT Owned), Non-Interstate Highway (Non-IH, DDOT Owned) NHS, and non-DDOT Owned NHS for 2020

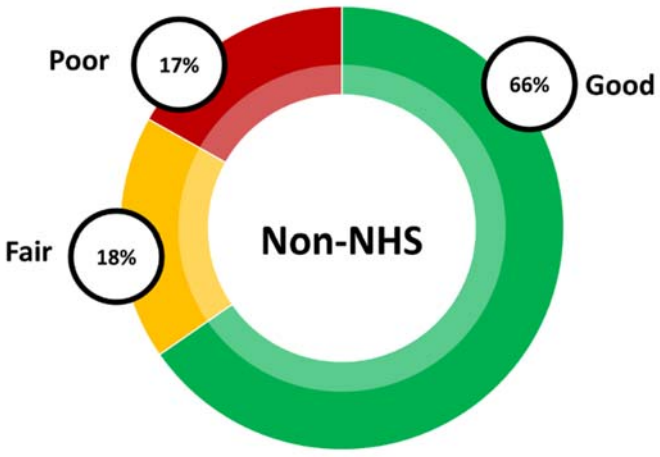


Figure 3-6. Non-NHS (Local and Federal-Aid) Condition (PCI) for 2020

3.3. Bridge Assets

In this section, a summary of DDOT's bridge network is provided. Specifically, the section provides an overview of the District's bridge inventory and condition.

Bridge Inventory

As of 2021, there were 265 bridges with a total deck area of 6.3 million square feet on the District highway system. The District's NHS bridge inventory has grown between 2012 and 2015, even though the inventory of DDOT-maintained bridges has remained steady over the past decade. The growth in the NHS bridge inventory since 2012 is a result of the reclassification of the NHS and DDOT's efforts to upgrade existing NHS bridges. In addition, DDOT expects the bridge deck area in the District's inventory to grow slightly in the next few years as major bridge projects are completed. One example is the replacement of the Frederick Douglass Memorial Bridge (depicted in Figure 3-7); the new bridge will have six traffic lanes and improved accommodations for pedestrians and bicycles, which will increase the bridge's deck area.

Figure 3-7. Frederick Douglass Memorial Bridge Improvements

The District's bridge inventory includes 144 NHS bridges and 121 non-NHS bridges. The NHS bridges are maintained by DDOT (132 bridges) and NPS (12 bridges). The remaining 121 non-NHS bridges include 24 pedestrian bridges with a total deck area of 93,000 square feet. NPS owns and maintains a smaller portion of District bridges but their inventory includes critical bridges such as the Arlington Memorial Bridge. The Arlington Memorial Bridge contributes about 200K of deck area to the total deck area of NHS bridges in the District. However, DDOT does not inspect or maintain this and other NPS bridges in the District, keeping limited information on non-DDOT bridges as part of the inventory.

The total NHS (including Interstate and non-Interstate) bridge deck area is approximately 4.9 million square feet, representing 78 percent per deck area of the entire bridge inventory. Figure 3-8 depicts the bridge inventory by classification and maintenance responsibility.

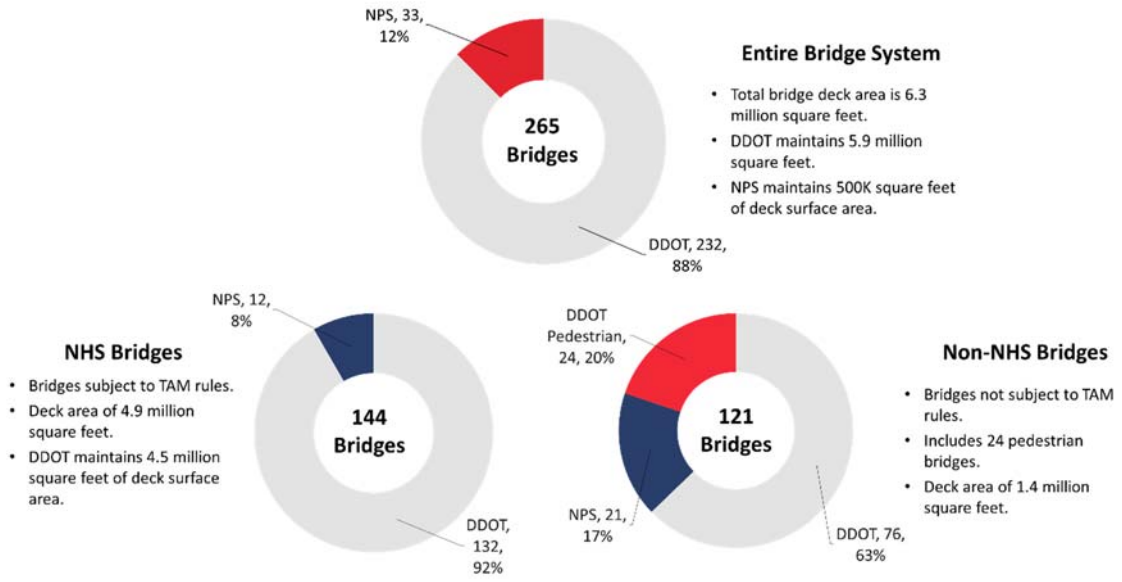


Figure 3-8. Bridge Inventory and Ownership

Bridge Condition

DDOT collects bridge condition information to support condition-based management. This information is essential to develop element-level and component-level deterioration models and evaluate timely interventions to avoid costly maintenance. Additional information on the tools and systems DDOT uses to gather and maintain bridge information is provided in **Chapter 5 – Life Cycle Planning**. In this TAMP, DDOT used the federal performance management measures to report bridge condition trends based on **23 CFR 490.407**. Additionally, the process DDOT used to determine Good and Poor conditions are described in **23 CFR 490.409**. Figure 3-9 shows the bridge condition for NHS bridges included in the TAMP. While the figure shows a high percentage of bridges in Poor condition for 2020, this number has and will continue to decrease as key bridge projects are completed and the new inspection data is used to update the bridge management system. For example, the completion of the Arlington Memorial Bridge rehabilitation project has significantly decreased the percent of bridges in Poor condition; based on the inspection and reporting data from 2022, only 8% are in Poor condition currently.

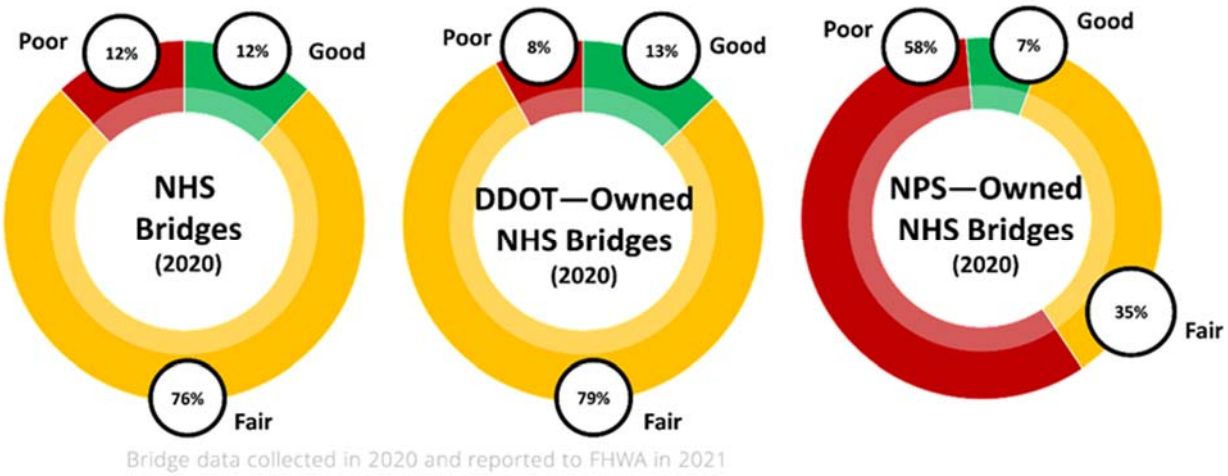


Figure 3-9. NHS Bridge Condition for 2020

3.4. Other Assets

In addition to the assets required in the TAMP, the federal rule 23 CFR 515.9(c) encourages, but does not require, State DOTs to include information on other NHS assets and on other public roads. Therefore, DDOT has included information on tunnels, pedestrian bridges, alleys, and sidewalks. However, it is important to note that the information provided on these additional assets is not intended to address the minimum requirements stated in 23 CFR 515.9(l) due to the lack of complete data. For this reason, DDOT will not consider these assets as part of the FHWA recertification process. The information included in this TAMP for these assets is consistent with the available data and resources. As the Agency's data management practices mature, the TAMP will be updated to reflect more complete information.

Tunnel Inventory and Condition

DDOT and NPS own and maintain 17 vehicular tunnels on the District's transportation network, which are subject to the federal requirements stipulated in 23 CFR 650 Subpart E. DDOT owns and maintains 15 of the 17 tunnels. The federal rules require tunnel owners, State governments, federal agencies, or tribal governments to establish a highway tunnel inspection program, maintain a tunnel inventory, and report to FHWA inspection results and critical findings, including structural or safety-related deficiencies that require immediate follow-up inspection or action. DDOT conducts routine and emergency tunnel inspections to evaluate performance. The Department spends about $4 to $5 million annually to preserve tunnel assets through a performance-based contract. As of 2022, all DDOT tunnels were rated to be in Good condition. When evaluating performance, DDOT divides tunnel elements into two major categories: structural, which is rated based on the results and evaluations of National Tunnel Inspection Standards (NTIS) element inspections, and functional systems, which includes all other tunnel elements inspected and evaluated on a quarterly basis. Each component is made up of different elements which are rated on a scale of one (Unsatisfactory) to five (Excellent). DDOT's performance objective is to have 80% of each component rated as four (Good) or above.

Tunnel Highlights

- ✓ 17 vehicular tunnels within the District
- ✓ 15 DDOT-maintained tunnels
- ✓ 2 NPS-maintained tunnels
- ✓ DDOT spends about $4 to $5 million annually on tunnel preservation
- ✓ 2020 conditions show all tunnels rated in Good condition

Alleys Inventory and Condition

DDOT maintains approximately 350 miles of 363 total miles of alleys within the District. This significant inventory of alleys receives frequent service requests for repair or upgrade. Through the Mayor's AlleyPalooza initiative, DDOT has repaired 1,000 alleys across the District since 2015, increasing the percentage of alleys rated as Excellent from 8% in 2015 to 67% in 2021. In Fiscal Year (FY) 2021 alone, the District repaved or fixed 152 alleys. Funding for alley maintenance and rehabilitation has increased over time in response to the Mayor's goal of all alleys being in a state of good or excellent repair by 2024. To meet this goal, DDOT determines appropriate maintenance activities based on a data-informed decision model and process. DDOT uses an alley's condition rating, outstanding 311 service request counts, the age of service requests, and other pertinent data to prioritize alley maintenance activities throughout the District. Additionally, engineering assessments also play a major role in the project selection process. Figure 3-10 shows baseline condition of alleys in the District from the last survey conducted in 2018.

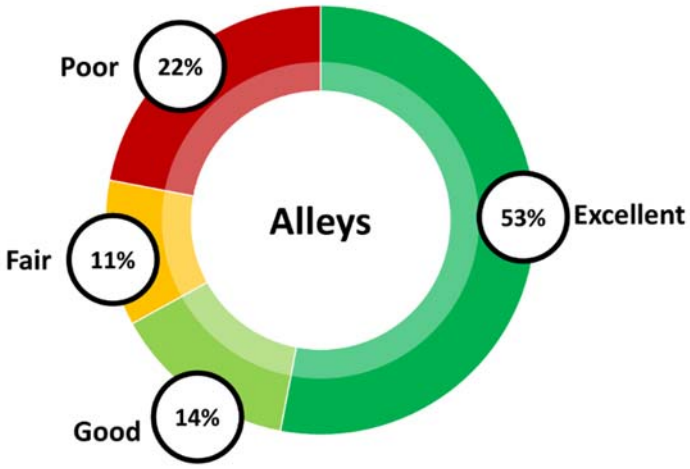


Figure 3-10. Alleys Condition in 2018 (Year of Last Survey)

Sidewalks Inventory and Condition

DDOT maintains approximately 1,407 of the 1,495 miles of sidewalks in the District. The goal of the Agency is to improve the condition of all sidewalks classified as being in "Poor" condition. To be more efficient with the Agency's limited resources, DDOT gathers condition data on sidewalks on an infrequent cycle as sidewalk deterioration is not as rapid as pavement and bridges, which require an annual data collection to monitor critical failures. Sidewalk data collected includes location information, pictures, length (extension), condition, and maintenance needs, among other attributes. Sidewalk project selection is based on both DDOT assessments and requests from citizens. In 2021, DDOT spent about $18 million of local capital funds on sidewalks, resurfacing or improving 33 miles of sidewalks. Figure 3-11 shows the baseline condition of sidewalks from the most recent survey conducted in 2015. The Agency plans to collect new condition data through a contract in 2023 so the Agency can more accurately report the condition of today's sidewalk network.

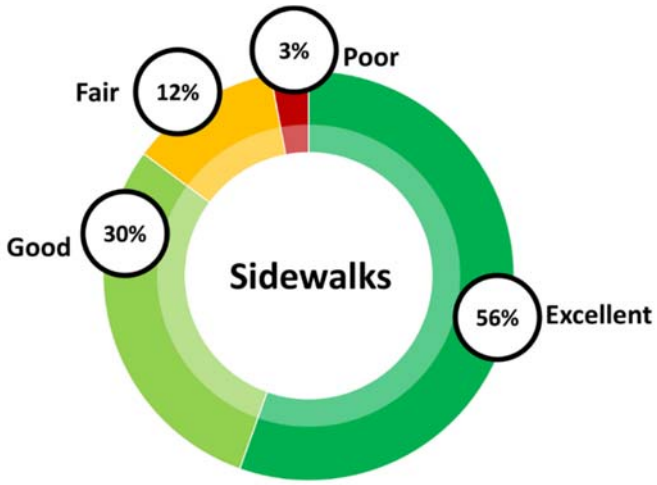
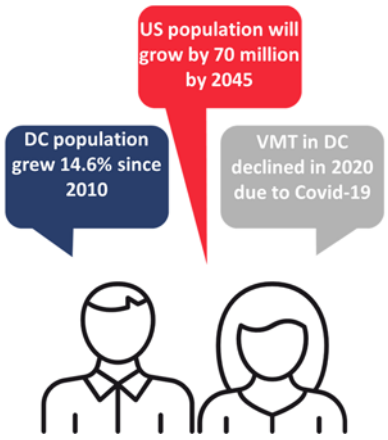


Figure 3-11. Sidewalk Condition for 2015 (Most Recent Survey)

3.5. Demand for Transportation Infrastructure

High-quality, equitable transportation infrastructure is necessary for the provision of accessible, efficient, affordable, and safe transport services to support economic, social, and recreational activities across the District. To do so, DDOT needs a better understanding of the demand for transportation across the District and the metropolitan area. One of the critical factors contributing to transportation demand is population growth. America's population is expected to grow by 70 million by 2045[7] and subsequently, travel demand is expected to grow with this population growth. The Federal Highway Administration estimates vehicle travel to increase at an average annual rate between 0.58 to 0.86 percent over the long-term[4], translating to a 19- to 29-percent increase in traffic on DDOT roadways by 2045. Since most population growth will be in metropolitan areas, increasing vehicle travel will excessively affect fast-growing metropolitan regions such as the National Capital Region.



After a continued decline since the 1950s, the District's population is projected to grow by double digits each decade for the next two decades. The Census data from 2020 shows the District's population growth nearly tripled compared to the previous decade. At a 14.6% increase since 2010, the District has the seventh-highest growth rate in the nation. This growth rate is expected to cause an increase in travel demand and therefore, an increase in the need for transportation infrastructure.

Figure 3-12 shows the trend of VMT in the District over the past decade[8]. In general, VMT has been consistent over the last decade; however, the District did report a sharp decline in VMT in 2020, likely because of the COVID-19 pandemic. Despite the temporary decrease in VMT reported across the nation (due to the COVID-19-related lockdowns), VMT is expected to grow post-pandemic, as businesses begin to slowly reopen and economic activities in the District recover. Improving economic conditions within the District will likely lead to increases in VMT, accelerating infrastructure deterioration, and deferred maintenance due to limited resources and rising costs of maintenance.

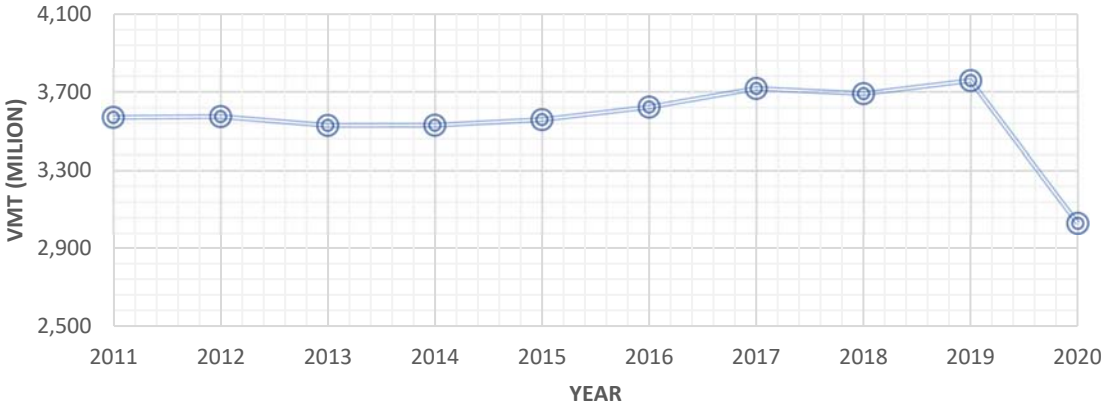


Figure 3-12. VMT Trend in the District of Columbia

[7] U.S. Department of Transportation. (2017). *Beyond Traffic 2045*. https://www.transportation.gov/sites/dot.gov/files/docs/BeyondTraffic_tagged_508_final.pdf

[8] Federal Highway Administration. (2021). *Highway Statistics Series*. https://www.fhwa.dot.gov/policyinformation/statistics/

DDOT will continue to plan effectively, engage other partners, and develop multi-pronged strategies that look beyond increasing roadway capacity for vehicular traffic to address transportation demand in the District. Among the many methods employed by the District to manage infrastructure demand is expanding the availability of transportation alternatives, including transit, biking, and walking. The Mayor has made it a priority to reduce the use of single-occupancy vehicles while promoting biking and other more sustainable modes of transportation. Considering this, DDOT plans to build 20 miles of new protected bike lanes by 2022, expanding the network of protected bike lanes to provide access to a safer bicycling experience and increased pedestrian and driver safety.

From the perspective of DDOT, these alternative solutions promote safety, reduce congestion, and improve access to multimodal transportation. Additionally, DDOT considers other key policy and management strategies to address transportation infrastructure demand. Specifically, DDOT relies on the following strategies to address demand:

- Ensure there is adequate revenue to address critical infrastructure needs.
- Manage users' expectations utilizing achievable performance targets, which will sometimes mean establishing declining performance targets.
- Use a performance-based approach to prioritize transportation investments.
- Improve coordination with the Office of Planning to prioritize investments that address demand through corridor enhancement and revitalization programs and projects.

It is important to note that this list does not constitute a prescriptive plan of action for the TAMP in addressing transportation demand; however, it reflects existing programs and plans DDOT undertakes to manage the transportation system holistically.

Intentionally left blank

Chapter 4. Asset Performance Goals and Targets

4.1. Overview

The purpose of the TAMP is to enable DDOT to prioritize investments that sustain a desired State of Good Repair and to achieve performance targets. SOGR, performance targets, and minimum condition requirements are critical elements of a comprehensive performance-based program. FHWA has established performance measures and minimum condition requirements for State DOTs to assess the condition of NHS pavements (Interstate and non-Interstate) and NHS bridges, and to predict and monitor the degree to which the transportation network achieves national goals and the State DOT's objectives for infrastructure condition.

Target

Target is defined as a quantifiable level of performance or condition, expressed as a value for the measure, to be achieved within a time period.

State of Good Repair

State of Good Repair is a condition in which the existing assets, both individually and as a system, are functioning as designed within their useful service life and sustained through regular maintenance, preservation, rehabilitation, and replacement programs.

Whole Life Cost and Target Setting

Whole life cost, also known as the "cradle-to-grave" cost, consists of initial, operational, maintenance, and salvage or deconstruction costs. The whole life cost represents the total cost of ownership. DDOT manages its pavement and bridge assets with these costs in mind while applying strategies with long-term benefits to achieve performance targets and minimize costs. DDOT's target-setting approach embodies essential aspects of whole life costs. Using existing tools and performance models, DDOT undertakes a variety of scenario analyses by employing different treatment types and analyzing their impact on the overall performance of the pavement and bridge networks, as documented in the Chapter 5 Life Cycle Planning and Chapter 8 Investment Strategies. Then, based on the outcome and associated costs, DDOT solicits stakeholder input and determines scenarios that meet programmatic needs and achieve acceptable performance, possibly extending the asset's expected service life.

By evaluating the costs of various scenarios, DDOT can explore trade-offs between cost, performance gaps, and the level of risk. As such, DDOT makes a significant effort to investigate as many scenarios as possible, including specific scenarios that are most likely to occur, and, in the process, identifies the most cost-effective strategies to close existing performance gaps. This comparative analysis enables DDOT to establish achievable performance targets for short- and medium-term goals while achieving long-term SOGR and minimizing assets' risks and whole life costs.

Reviewing and Reporting Targets

The effectiveness of the TAMP investment strategies is measured against the District's ability to meet established performance targets. DDOT consistently reviews and reports pavement and bridge performance targets through the National Highway Performance Program (NHPP). The Transportation Performance Management (TPM) timeline allowed DDOT to review and adjust their targets during the 2020 midpoint performance period (MPP) and the 2022 full performance period (FPP) when determining if significant progress was made towards achieving targets. The significant progress determination process allows DDOT to identify more effective strategies to achieve targets, identify emerging risks, adjust programmed projects, and refine modeling tools to reflect reality. Monitoring and evaluating performance are essential in TAM and performance-based, data-driven decision-making. TAM, TPM, and risk management provide an integrated approach for DDOT to minimize long-term costs, improve asset condition and system performance, and address high-priority risks.

The remainder of this chapter describes the performance measures (PM2—pavement and bridge) and performance targets DDOT uses in carrying out the NHPP. Specifically, the chapter outlines the following:

Pavement

This section describes DDOT pavement performance measures, defines SOGR and targets for pavements, and evaluates performance gaps.

Bridge

This section describes DDOT bridge performance measures, defines SOGR and targets for bridges, and evaluates performance gaps.

4.2. Pavement

DDOT uses a variety of metrics (FHWA-required and DDOT-specific) in assessing pavement condition and the overall network performance. The overall performance outcome of the network may vary slightly depending on the type of metrics used. For the NHS pavements, DDOT uses FHWA metrics and measures to follow the federal regulation. For all non-NHS (local and Federal-Aid) pavements, DDOT uses other indices to assess condition. The subsections that follow describe the measures and metrics used in assessing pavement condition within the TAMP.

Pavement Performance Measures

The federal rule **23 CFR 490.307** specifies four pavement performance measures for State DOTs to assess pavement conditions on the NHS. DDOT uses condition metrics and inventory data elements specified in the Highway Performance Management System (HPMS) Field Manual to calculate these pavement performance measures; **23 CFR 490.311** contains the procedure for calculating the pavement measures used in assessing NHS pavements. 0 summarizes the FHWA pavement performance metrics used to determine the condition of each section of asphalt pavement, jointed concrete pavement (JCP), and continuously reinforced concrete pavement (CRCP). The FHWA rating system combines these pavement metrics to determine the overall condition of the pavement section based on established **pavement condition thresholds**.

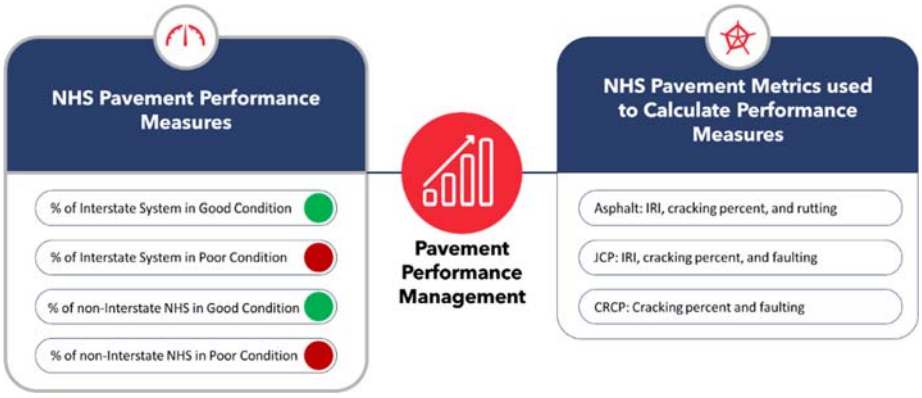


Figure 4-1. FHWA Pavement Performance Measures and Metrics

In addition to the FHWA pavement performance metrics, DDOT uses PCI in assessing and rating non-NHS pavements, which are not subject to the federal rules. The Department continues to use PCI to identify the need for preservation, maintenance, rehabilitation, or construction activities while responding to the federal measures. PCI uses metrics such as surface defects, surface deformations, and cracking percent to rate the pavement condition. Like the FHWA overall performance measure, PCI combines several condition metrics. However, PCI uses a mathematical formula and a weighting system to compute a composite value (between 0 and 100) for the condition of the pavement. The reported PCI helps inform the Agency's annual paving plan and support the PaveDC program. Figure 4-2 shows the metrics for computing PCI.

Pavement Performance Targets

Pavement performance target setting is an iterative process that requires condition data, existing and projected financial resources, and input from key stakeholders. Therefore, DDOT uses an integrated approach to set performance targets; the Agency conducts analyses using its pavement management system (Chapter 5 Life Cycle Planning), which utilizes both financial data (Chapter 7 Financial Planning) and DDOT investment strategies (Chapter 8 Investment Strategies), to define a SOGR and to establish pavement performance targets. Concurrently, DDOT coordinates with and engages key external stakeholders of the NHS to gather information and inform the target-setting process. Target setting is also informed by federal regulation. States are required to maintain Interstate pavements so that the percent of lane-miles in Poor condition does not exceed 5 percent. State DOTs not complying with this minimum requirement face penalties as described in 23 CFR 490.317(e).

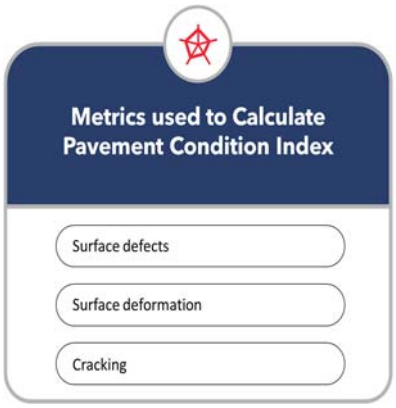
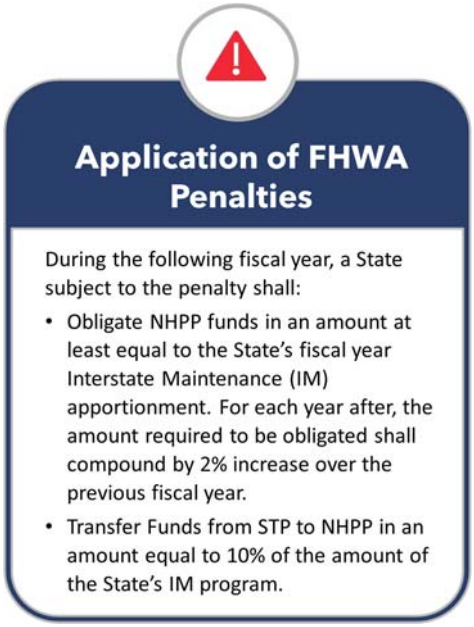


Figure 4-2. Metrics for Calculating PCI

23 CFR 490.315

DDOT is required to maintain Interstate pavements so that the percentage of lane-miles in Poor condition does not exceed 5.0 percent.

With these inputs and rulings in mind, DDOT initially set and reported its PM2 baseline performance targets for its NHS pavements in October 2018. These pavement targets were based on IRI for Interstate NHS and PCI for non-Interstate NHS, as the data requirements in 23 CFR 490.309 did not take effect until January 1, 2018 for Interstate pavements and January 1, 2020 for non-Interstate NHS. Each of these targets were reported and used for the analysis conducted in the previous TAMP.



During the 2020 MPP progress determination for the NHPP, FHWA found DDOT had not made significant progress towards achieving the performance targets for NHS pavements (excluding the Interstate, which was able to meet minimum requirements) and was required to submit a description of actions that would be taken to achieve these targets. As such, DDOT implemented several strategies to address the deficiency, including asking for additional resources to address pavements in Poor condition. DDOT continues to implement investment strategies, such as Preservation treatments (mainly crack sealing) to keep sections in Good condition and minor rehabilitation treatments (such as resurfacing) to improve sections that are in Poor condition.

Beginning in 2021, DDOT reported on the full extent of distress data for NHS roadways and therefore needs to reestablish Interstate and non-Interstate NHS targets using these metrics. Building on DDOT's experience in target setting and input received during the last progress determination, targets were set to be more pragmatic and aligned with the District's current allocated budget for NHS pavements. In doing so, DDOT reduces the impact of funding uncertainty and its effect on pavement performance. Figure 4-3 details the 2025 targets and the long-term (10-year) SOGR targets for Interstate and non-Interstate NHS pavements while Figure 4-4 visualizes these targets and the federal minimum requirements for NHS pavements.

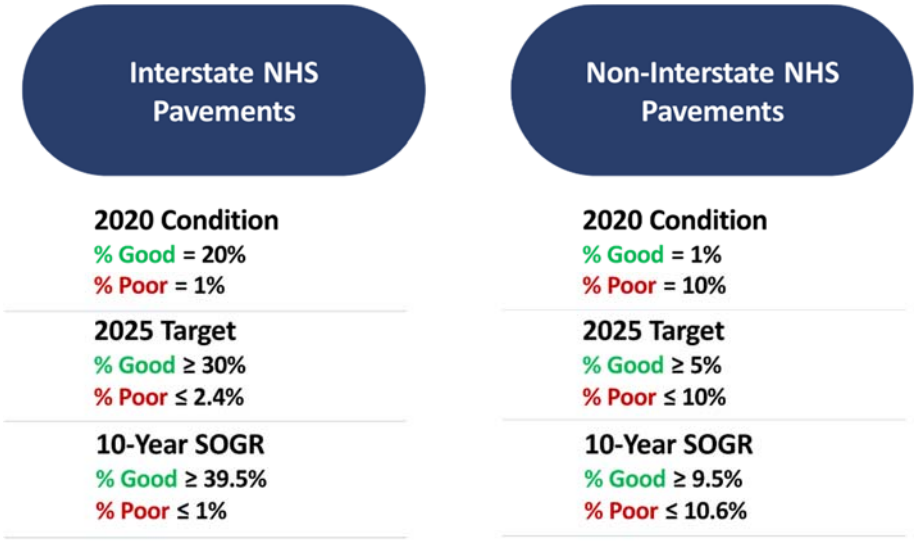


Figure 4-3. Pavement Performance Targets for DDOT's NHS

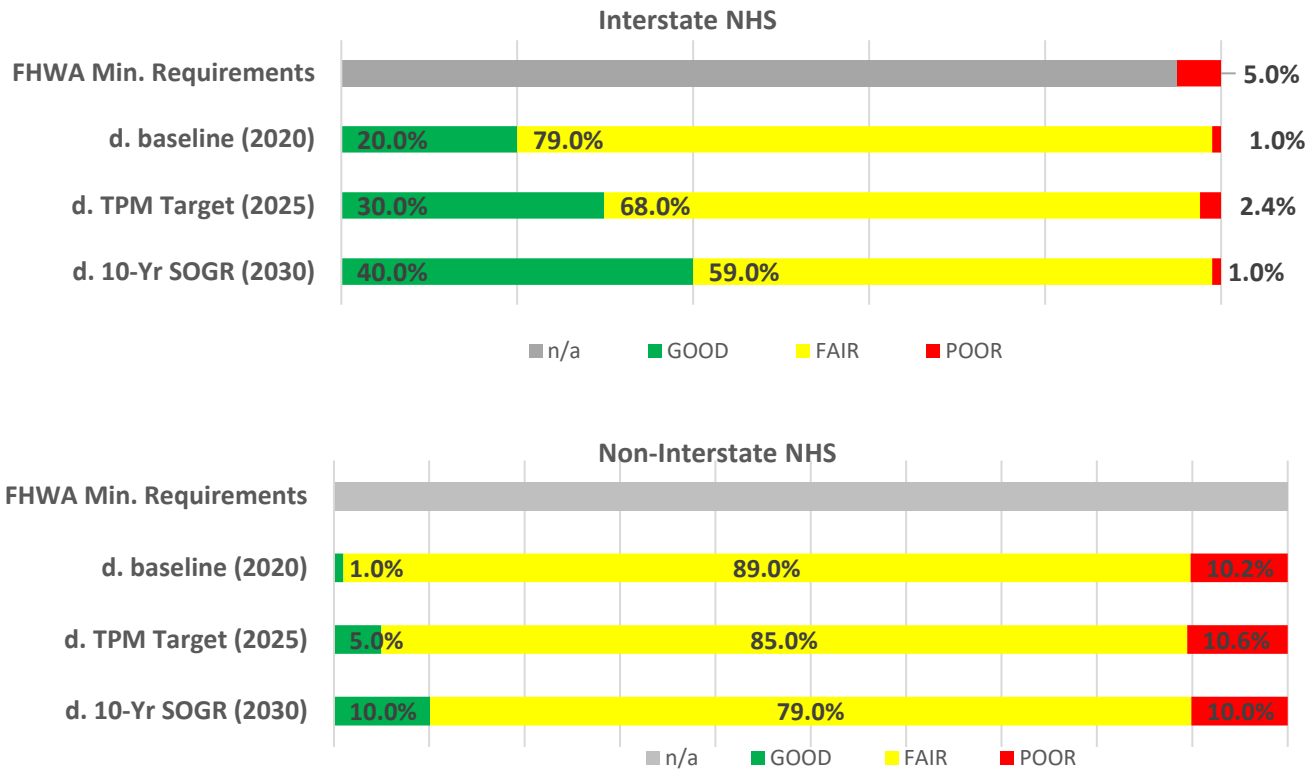


Figure 4-4. Summary of NHS Pavements Federal Requirements and Performance Goals

4.3. Bridges

DDOT uses FHWA-required metrics in assessing bridge condition. The subsections that follow describe the measures and metrics used in assessing bridge condition within the TAMP.

Bridge Performance Measures

Bridge condition can be assessed using three classifications: percent Good, Fair, and Poor. The federal rule **23 CFR 490.407** specifies two bridge performance measures (percent of NHS bridges classified as being in Good condition and Poor condition) for State DOTs to assess bridge condition on the NHS. DDOT uses the National Bridge Inventory (NBI) condition ratings for Deck, Superstructure, Substructure, and Culvert to classify bridge conditions. The bridge condition is assigned the lowest rating of these components. If the lowest rating of one of the NBI components is greater than or equal to 7, the bridge is classified as being in Good condition; if it is less than or equal to 4, the bridge is classified as being in Poor condition. **23 CFR 490.409** describes the procedure DDOT used to calculate the national performance management measures for assessing bridge condition and establishing targets. Figure 4-5 summarizes the FHWA bridge performance measures and NBI components used to determine the condition for each bridge.

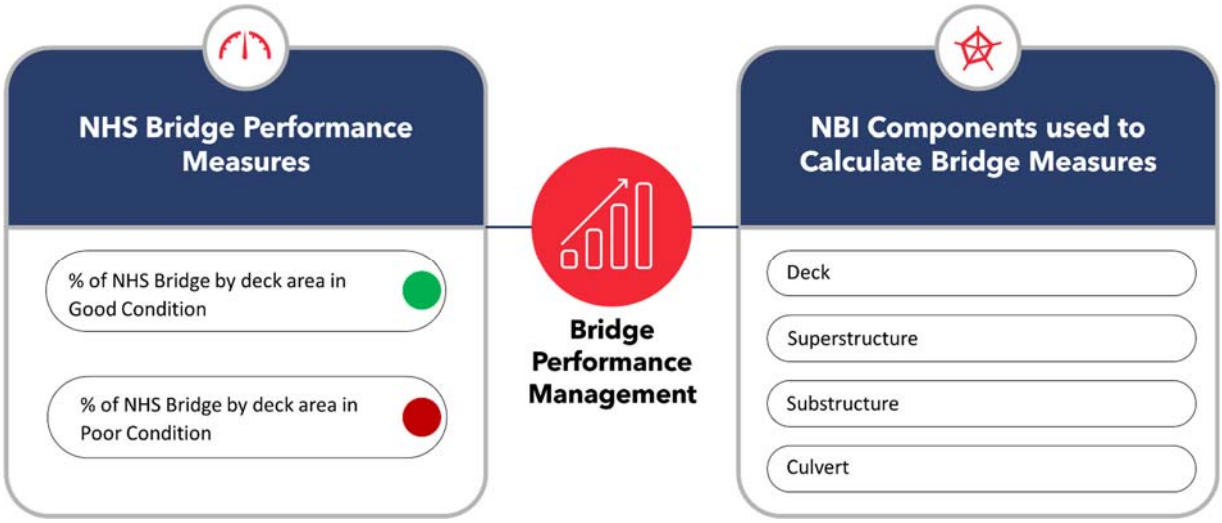


Figure 4-5. FHWA Bridge Performance Measures and NBI Components

Bridge Performance Goals

Like pavement performance target setting, DDOT conducted analyses based on the existing and projected financial resources to define a SOGR and to establish bridge performance targets. Throughout the TAMP development process, DDOT coordinated with and engaged key external stakeholders of NHS bridges to gather inventory, condition, and financial information to inform the process. Target setting included continuous engagement to evaluate, adjust, and finalize the targets. Additionally, federal regulation also informed this process. Federal rules require DOTs to maintain NHS bridges so that the percent of the deck area of bridges classified as being in Poor condition does not exceed 10.0 percent. DOTs not complying with this minimum requirement face penalties as described in **23 CFR 490.413**.

23 CFR 490.411

DDOT is required to maintain NHS bridges so that the percentage of the deck area of bridges classified as being in Poor Condition does not exceed 10.0 percent.

Using this information, DDOT set its bridge targets for the initial TAMP and subsequently, for PM2 reporting in 2018. The 2-year targets for the NHS system (2020) were 15.8% in Good condition and 8.8% in Poor condition. DDOT made significant progress in achieving the target for Good condition during the 2020 MPP progress determination for the NHPP, as DDOT reported approximately 12% of its NHS system being in Good condition. However, FHWA determined that the Agency had not made significant progress in achieving the target for percent of

Application of FHWA Penalties

During the following fiscal year, a State subject to the penalty shall:

- Set aside an amount equal to 50 percent of its FY 2009 Highway Bridge Program (HBP) apportionment for NHS bridges.
- The set-aside and obligation shall remain in effect for each subsequent fiscal year until less than 10 percent of the total deck area of bridges in the State on the NHS are in Poor condition.

NHS bridges in Poor condition; approximately 12% of its NHS bridges were in Poor condition. This was, in part, the result of the total surface area of NHS, NPS-owned bridges in Poor condition; the percentage of DDOT-owned bridges in Poor condition was 8.3% in 2020.

Since then, several bridge projects that were programmed, including 26 rehabilitation projects in the CIP, have been completed or are expected to be completed by 2022. Key projects that made a significant impact or will impact system performance include the rehabilitation of Theodore Roosevelt Bridge, East Capitol Street Bridge, and 14th Street Bridge (HOV), the replacement of Frederick Douglass Memorial Bridge, and the rehabilitation of the Arlington Memorial Bridge (NPS-owned). These improvements are expected to reduce the percent of NHS bridges classified as being in Poor condition and improve the percent of deck area in Good condition. In addition, DDOT has implemented preservation actions and performed routine maintenance such as bridge washing, deck sealing, scupper cleaning, and spot painting to slow down deterioration and hence preserve bridges in a SOGR.

Given the completion of these projects and the projected funding allocated to NHS bridges, DDOT has set its 2025 targets and 10-year SOGR targets, as detailed in Figure 4-6 and Figure 4-7. By 2025, DDOT aims to have greater than or equal to 26% of its system in Good condition and less than or equal to 8% in Poor condition. To achieve a SOGR, DDOT aims to have greater than or equal to 43.1% of its system in Good condition and less than or equal to 5% in Poor condition (NPS bridges included).

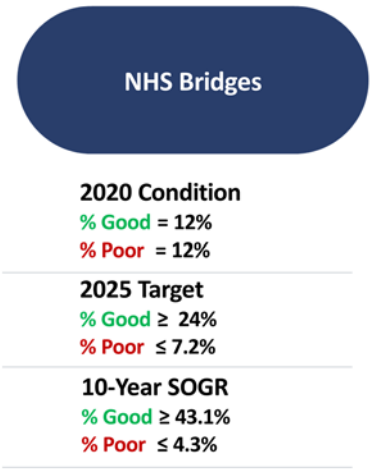


Figure 4-6. NHS Bridge Performance Targets

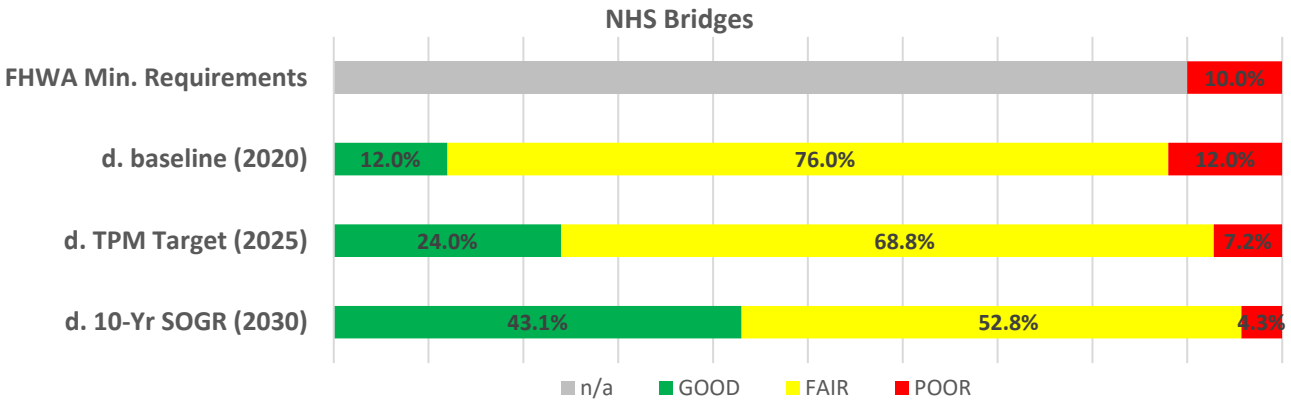


Figure 4-7. Summary of NHS Bridge Federal Requirements and Performance Goals

Chapter 5. Life Cycle Planning

5.1. Overview

When left untreated, an asset may deteriorate and reach the end of its useful life more quickly than if the asset had been treated and managed throughout its life. Therefore, DDOT focuses on managing its major assets by selecting the right treatment at the right time throughout the asset's useful life. The concept of strategically selecting the type and timing of treatments is known as **life cycle planning**. LCP provides DDOT with a framework for optimizing the performance of its network while minimizing the cost. The remainder of this chapter provides an overview of LCP within DDOT and is divided into the subsections summarized below.

Life Cycle Processes

This section describes the life cycle planning process and how DDOT utilizes life cycle planning to minimize cost while maximizing performance.

Pavement

This section describes the approach DDOT uses to conduct LCP for its pavement network, including the data, tools and modeling techniques, and work information used to support these analyses.

Bridge

This section describes the approach DDOT uses to conduct LCP for its bridge network, including the data, tools and modeling techniques, and work information used to support these analyses.

LCP Scenario Results

This section summarizes the results of LCP scenarios ran for DDOT's pavement and bridge networks. For each scenario, the cost of the scenario and the resulting network performance is reported.

5.2. Life Cycle Processes

Life cycle management is typically approached using one of three strategies—**worst-first, preservation-first,** or a **hybrid strategy**. The worst-first strategy prioritizes assets in worst condition before considering preservation. This strategy is typically more costly since it allows assets in Good condition to completely deteriorate before the asset is rehabilitated or reconstructed. The preservation-first strategy focuses on applying cost-effective treatments more frequently to preserve assets in Good conditions before considering assets in worse condition. The hybrid strategy is the most optimal approach, identifying a mix of preservation and capital improvement projects (CIP) to meet agency goals; DDOT manages pavement and bridge assets using the hybrid strategy. For example, DDOT has customized the AASHTOWare Bridge Management software to consider all its CIP projects while applying the preservation budget to bridges in Good and Fair condition when conducting the life cycle analysis.

Life cycle management has helped DDOT to consider asset performance from the asset's initial design and construction to the operation and maintenance of the asset once built. At the beginning of an asset's life, DDOT considers the traffic, environmental and climatic conditions, and safety of a project to select the appropriate materials, construction practices, and design standards to optimize the performance and resiliency of the asset in the long term. Once an asset is constructed, these same inputs are used to assess the best treatments and treatment timings. Life cycle planning is also an important consideration in resiliency; life cycle planning can be used to determine the appropriate design alternatives or treatments for repeatedly damaged or vulnerable assets. For example, in more recent years, DDOT has begun to install "**green infrastructure**" and "**green alleys**" to address issues with stormwater and flooding in areas with increased runoff. By collecting information on environmental risks prior to initial design, DDOT can select permeable pavers and other materials that reduce the stormwater and pollutants entering the sewer system; this enables the asset to be more resilient and more likely to last long-term. DDOT developed a Part 667 assessment support tool to collect this data (as discussed in **Chapter 6 Risk Management Analysis**) for its use in asset resiliency and life cycle planning. Figure 5-1 provides a summary of each phase of an asset's life and the key LCP inputs used to inform and drive decision-making at that phase.

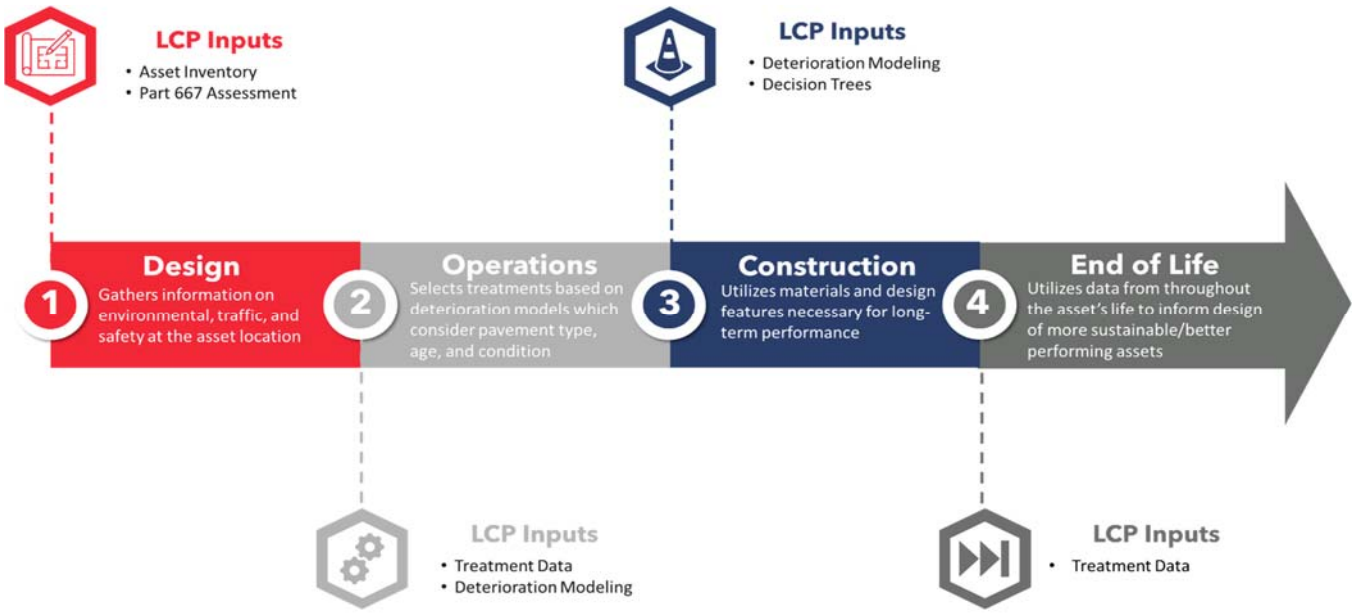


Figure 5-1. DDOT Implementation of LCP throughout Asset Life

LCP Scenario

As part of DDOT's LCP, the Agency uses scenario analysis to develop investment strategies that address uncertainties and risks and help make informed decisions in the short and long term. These scenarios are based on the hybrid LCP strategy described above and rely on structured assumptions and key information about the asset, including asset inventory information, treatment data (both treatment types and costs), deterioration models, and decision trees for treatment selection—as depicted in Figure 5-2.

Using the Agency's pavement and bridge management systems, DDOT develops different scenarios to estimate the impacts and cost incurred to implement each scenario and the performance of the network under each scenario. For the purposes of this TAMP, DDOT utilized three types of life cycle planning scenarios on its asset network. The scenarios, which are summarized in Table 5-1, include maintaining current conditions, achieving specified condition, and utilizing specified investment levels. The remaining subsections provide a summary of the key inputs used to develop each scenario for DDOT's primary assets—pavements and bridges.

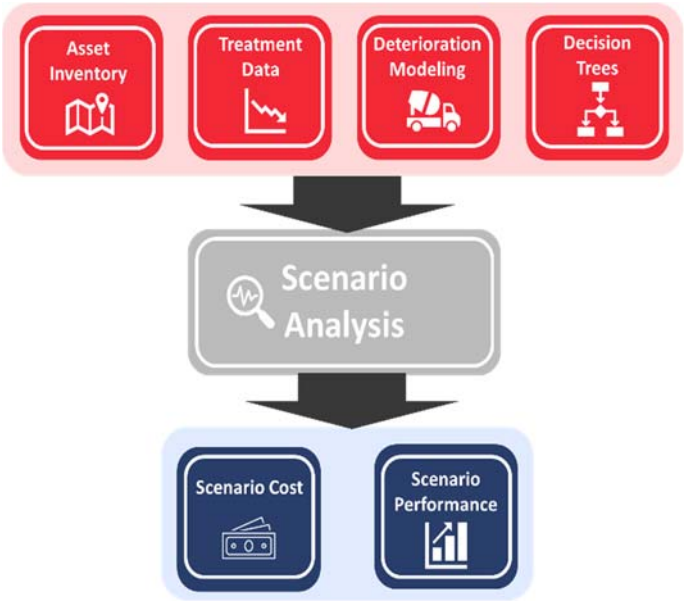


Figure 5-2. DDOT's LCP Process

Table 5-1. DDOT's LCP Scenarios

LCP Scenario	Description	Constraint Type
Maintain Current Conditions	Assesses the level of investment necessary for DDOT to maintain the asset network at current conditions over the analysis period.	Performance
Achieve Specified Condition	Determines the level of investment necessary for DDOT to meet a desired performance set for the asset (i.e., 0% Poor).	Performance
Specified Investment Level	Evaluates the network performance given a specified budget for each asset class.	Financial

5.3. Pavement

DDOT's methodology for conducting life cycle planning scenarios on its pavement network has matured since the development of the Agency's first TAMP. In this section, the primary inputs, analysis methods, and improvements implemented are described.

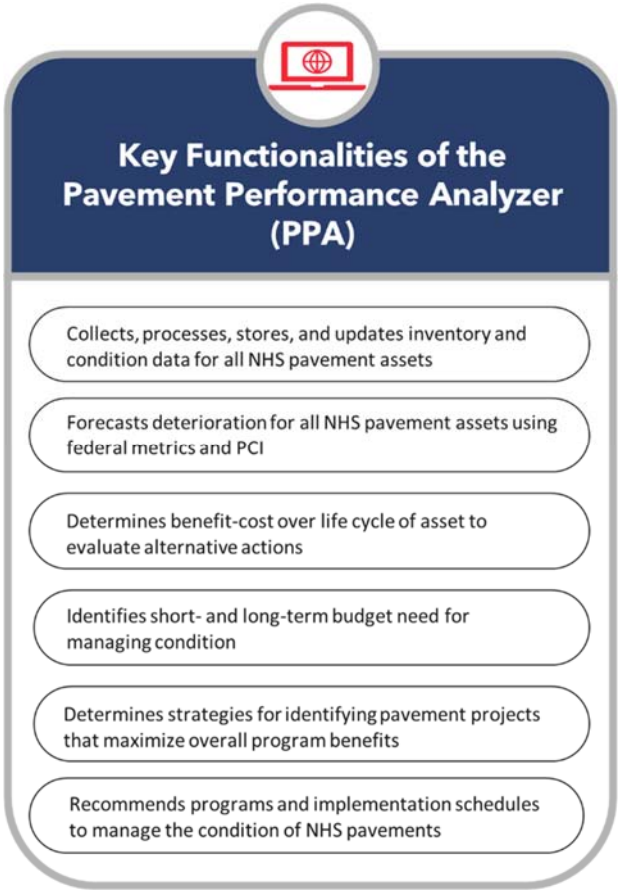
Asset Data Collection

As discussed in **Chapter 3 Asset Inventory and Conditions**, DDOT collects and updates pavement condition data throughout its network on an annual basis. The pavement condition survey, which is conducted using sensing vehicles and imaging technology, occurs on both federal and local roads, irrespective of the ownership and maintenance responsibility. For federally funded roadways, condition metrics collected include IRI, cracking percent, rutting, and faulting, while for non-federally funded roadways, PCI is estimated based on the number, type, and severity of surface distresses. Collected data is reviewed by pavement and field engineers who assess the quality and completeness of data. Federal data is stored and reported to the Federal Highway Administration's HPMS, while non-federal aid pavement data is stored in a separate database. The pavement condition data collection and quality control are based on the Agency's pavement Data Quality Management Plan (DQMP). The pavement DQMP documents the Agency's standards for collection equipment, calibration, and certification, certification of persons performing data collection, quality control measures before and during data collection, data sampling, error resolution, and data acceptance criteria. Once cleaned and quality controlled, all new condition data is merged to historical condition data DDOT has collected on its network. The merged data includes federally reported metrics, PCI information, and work history data from DDOT's project management system, ProTrack+.

Tools and Modeling Techniques

In response to 23 CFR 515.17 Minimum Standards for Management Systems, DDOT developed pavement performance models using over a decade of pavement condition data. The performance models, which are incorporated into a pavement management system and used to run the LCP scenarios, were developed for Interstate NHS, non-Interstate NHS, and non-NHS pavements for both federal metrics (IRI, cracking percent, rutting, and faulting) and local metrics (PCI). In addition to developing models for the behavior of pavements over time, consequence models were also developed for Interstate, non-Interstate NHS, and non-NHS roadways based on the most common treatments applied to DDOT pavements. The consequence models provide information on the change in performance following a specific treatment, based on the time at which it is applied to the pavement. As DDOT continues to collect condition and treatment data, these models will be further refined and updated to improve the overall reliability of the LCP analyses as data becomes available.

Both the data reported on the pavement network each year and the models developed are used as the primary inputs for DDOT's pavement management system, the *Pavement Performance Analyzer (PPA)*. PPA is an in-house PMS tool DDOT uses to estimate pavement needs based on specified goals or to assess and predict pavement performance under various funding scenarios. Using the PPA, DDOT can conduct each of the LCP scenarios on any subset of its pavement network. The results of the analysis are exported and used to inform short- and long-term investment decision-making.



Work Types, Treatments, and Cost

Additional inputs necessary for running LCP analyses include work type, treatment type, and cost information. To conduct the analysis carried out by the pavement management system, DDOT had to define work types, treatment types, and unit costs based on the classification of the roadway. In total, treatments are categorized as one of three primary work types (preservation, rehabilitation, or reconstruction) and four treatment types (crack sealing, microsurfacing, mill and resurface, and reconstruction), as depicted in Table 5-2. While DDOT also employs maintenance (e.g., deep patching) as a paving strategy, maintenance is considered an operational activity and therefore does not affect the DDOT's annual paving budget. The selection of the treatment type is dependent on a multitude of factors such as age and pavement condition which are captured and summarized in the PPA.

Table 5-2. Pavement Treatment Input Data

Road Type	Work Type	Treatment Type	Unit Cost ($/SY)	Typical Condition When Applied
NHS	**Preservation**	Crack Seal	4	◆ IRI: 0-95 in/mi ◆ Cracking %: 0-10% ◆ Rutting: 0-0.40 in ◆ Faulting: 0-0.08 in ◆ PCI: 70-95
		Microsurfacing	10	◆ IRI: 0-150 in/mi ◆ Cracking %: 0-10% ◆ Rutting: 0-0.40 in ◆ PCI: 65-85
	Rehabilitation	Mill & Resurface	50	◆ IRI: 90-500 in/mi ◆ Cracking %: 10-100% ◆ Rutting: 0.10-0.60 in ◆ Faulting: 0.15-0.25 in ◆ PCI: 30-70
	Reconstruction	Reconstruction	155	◆ IRI: 250 in/mi minimum ◆ Cracking %: 30-100% ◆ Rutting: 0.40-1.00 in ◆ Faulting: 0.25-1.00 in ◆ PCI: 0-40
Federal Aid non-NHS	**Preservation**	Crack Seal	4	◆ PCI: 70-95
		Microsurfacing	10	◆ PCI: 65-85
	Rehabilitation	Mill & Resurface	50	◆ PCI: 10-40
	Reconstruction	Reconstruction	155	◆ PCI: 0-40
Local	**Preservation**	Crack Seal	4	◆ PCI: 70-95
		Slurry Seal	5	◆ PCI: 65-85
	Rehabilitation	Mill & Resurface	50	◆ PCI: 10-55
	Reconstruction	Reconstruction	120	◆ PCI: 0-10

Summary of Pavement LCP Results

Using the inputs discussed in the subsections above, DDOT considered three LCP scenarios on its NHS pavement network. A summary of the analysis results is provided in Figure 5-3 and Figure 5-4 and discussed in the subsections below.

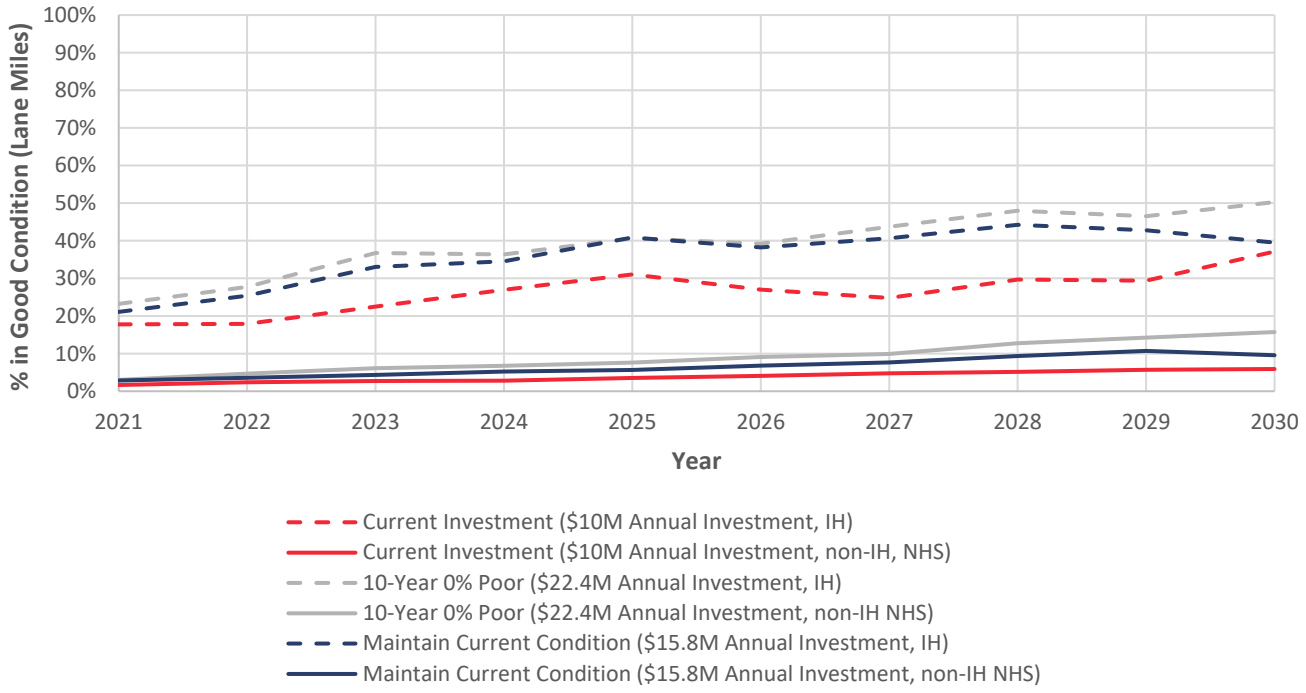


Figure 5-3. Percent of Pavements in Good Condition for LCP Scenarios

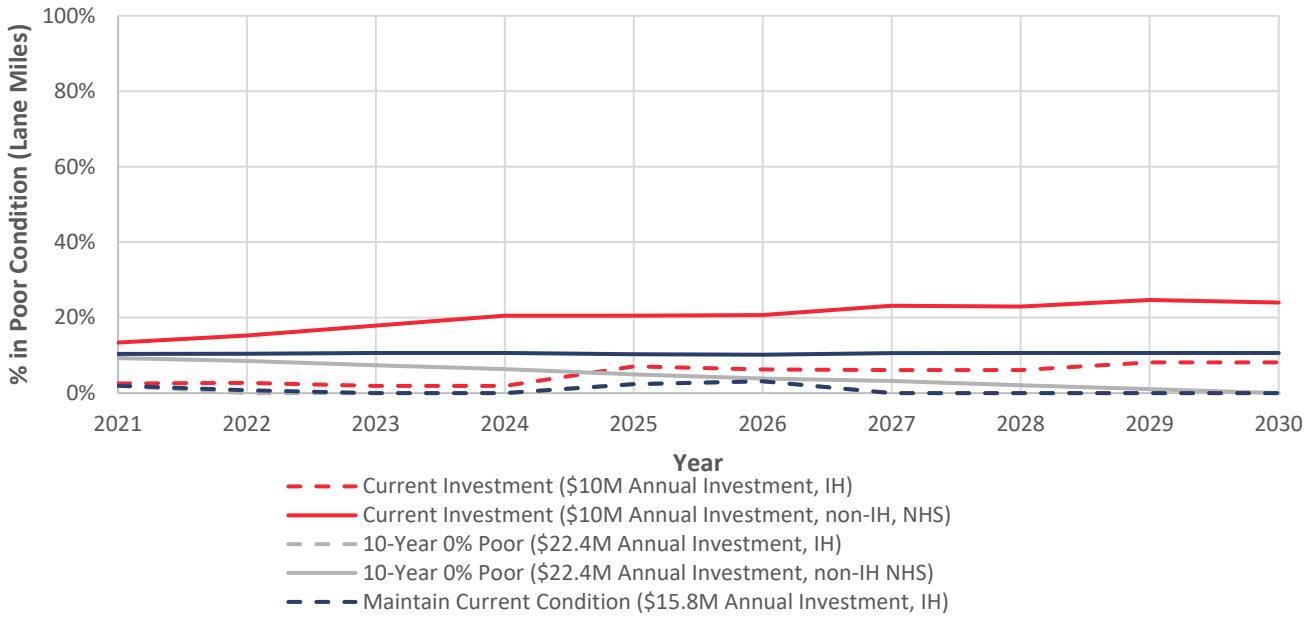


Figure 5-4. Percent of Pavements in Poor Condition for LCP Scenarios

Scenario 1: Maintain Current Conditions

The first scenario focused on "maintaining current conditions." In the case of NHS pavements, this meant maintaining the same percentage of pavements in Poor condition over a ten-year analysis period. Current conditions were defined as the overall condition of the NHS network (using federal metrics) based on data collected in 2020 (reported to FHWA in 2021); therefore, the scenario aimed to have less than 9.0% of the NHS network in Poor condition. Under this scenario, DDOT expects 39.5% and 9.5% percent of its pavements in Good condition and 0% and 10.6% percent in Poor condition for the Interstate and non-Interstate NHS, respectively. To meet these conditions, DDOT needs an estimated annual investment of $15.8 million for NHS pavements.

Scenario 2: Achieve 0% Poor over 10 Years (Achieve Specified Condition)

DDOT also looked at a scenario to determine the level of funding required to reach the goal of 0% pavements in Poor condition on the NHS network at the end of 10 years. The scenario, while unlikely to be implemented due to financial constraints and contracting capacity, is a useful scenario for understanding the maximum funding the Agency might need. Based on the analysis, if the Agency invests $22.4 million per year for the next 10 years, this scenario predicts that DDOT will meet the performance targets set with 0% of the NHS pavements in Poor condition at the end of 10 years.

Scenario 3: Current Investment (Specified Investment Level)

The third LCP scenario conducted was used to determine the performance of the NHS pavement network if DDOT continued with its current level of investment over the next ten years. The current investment level for NHS pavements, which is described in detail in **Chapter 7 Financial Planning**, is $10 million per year and excludes CIP projects (e.g., reconstruction work). Given this financial constraint, the scenario estimates that 37.1% of the Interstate pavements and 5.9% of the non-Interstate, NHS pavements would be in Good condition and 8.2% of the Interstate and 24% of the non-Interstate, NHS would be in Poor condition at the end of the 10-year analysis period.

5.4. Bridge

DDOT has also improved its bridge life cycle planning practices. In this section, the data collection, tools and modeling techniques, and work types and costs for the Agency's bridge LCP are summarized.

Asset Data Collection

DDOT collects data elements in the National Bridge Inventory (NBI) and element-level condition inspection data on a biannual basis for all DDOT-owned highway and pedestrian bridges. The inspection cycle becomes more frequent for bridges identified as having critical issues, such as bridges in Poor condition. NBI condition ratings (CRs) describe the general health conditions of each bridge component using an integer ranging from 0 to 9, where the higher the CR, the better the condition. CRs for decks (item 58), superstructures (item 59), and substructures (item 60) are recorded in the NBI as described in the *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges and the AASHTO Guide Manual for Bridge Element Inspection*. The overall condition of a bridge is equal to the lowest component CR. Poor bridges refer to bridges with any component (deck, superstructure, substructure, or culvert (item 61)) having a CR less than or equal to 4. The inspection reports and collected data are reviewed by the quality assurance manager (QAM) to ensure FHWA requirements are met.

The bridge inspection data is used as the primary input for DDOT's bridge management system, the AASHTOWare Bridge Management software (BrM). DDOT uses the BrM to manage bridge inventory and inspection data, forecast future needs, optimize bridge maintenance policies, and evaluate key performance measures. DDOT has customized BrM to address all the requirements in **23 CFR 515.17**. This includes developing network preservation policies, deterioration models, and using BrM to identify short- and long-term budget needs. In addition to BrM, DDOT also uses in-house tools for decision-making to analyze the BrM results, apply Agency constraints and policies (such as funding constraints and DDOT's way of doing business), and plan maintenance activities.

Tools and Modeling Techniques

DDOT uses AASHTOWare BrM for forecasting bridge performance and budget planning. In response to **23 CFR 515.17** Minimum Standards for Bridge Management System, DDOT developed State-specific parameters to replace the default

parameters provided in the BrM. This customization process ensured DDOT could develop more realistic bridge forecasting and needs analysis. To this end, DDOT developed deterioration models to be used for optimizations in the BrM. The models quantify the deterioration of the three main bridge components, *i.e.*, deck, superstructure, and substructure. DDOT also utilizes element-level deterioration models. To overcome limited data availability and to assure model reliability, elements with insufficient inspection records were grouped with the ones that have similar deterioration trends. Detail information on the modeling and BrM configuration process is documented in DDOT's BrM Configuration Report.. In addition to the deterioration models, DDOT defines repair schemes, maintenance and user costs, and repair benefit models in different funding scenarios. DDOT combines these parameters with decision trees and network and bridge preservation policies to develop work plans to achieve targets and goals.

Work Types, Treatments, and Cost

Deterioration models, action types, benefits, and cost information, as well as network and life cycle policies, are necessary to run LCP analyses. To conduct optimizations using the bridge management system, DDOT defined action types for each bridge component and assigned the benefits and unit costs associated with the actions at the component level, which was derived from element-level data in the BrM. Generally, treatments are categorized as one of five types—Preventive Maintenance Cyclical, Major Preventive Maintenance, Minor Rehabilitation, Major Rehabilitation, or Replacement—as depicted in Table 5-3. The associated benefits and unit costs were also defined at the element level. Each element has unique unit costs and depends on material types and condition states. The material types include steel, reinforced concrete, prestressed concrete, timber, masonry, and other materials. The selection of treatment types also depends on different factors such as the element- and component-level health conditions, available funding, Agency policies, and user cost (i.e., disruption to network activities). Unit costs were estimated using both historical contract data as well as data available through other State DOT plans.

Table 5-3. Bridge Treatment Input Data

Bridge Component	Action Type	Affected Elements	Range of Unit Cost
Deck	Preventive Cyclical	All deck elements	$1.5/SF deck area
	Major Preventive	All deck elements	$15-$52 (SF)
		Wearing surface (protective coating)	$35 (SF)
		Protective coating	$25 (SF)
	Minor Rehabilitation	Bridge railings	$16.5-$66(FT)
		All deck elements	$20-$77 (SF)
		All joints elements	$10-$100 (FT)
		Approach slab	$10-$26 (SF)
		Wearing surface (protective coating)	$35 (SF)
		Protective coating	$25 (SF)
	Major Rehabilitation	Bridge railings	$80-$125 (FT)
		All deck elements	$11-$147 (SF)
		All joints elements	$10-$1,250 (FT)
		Approach slab	$13-$50 (SF)
		Wearing surface (protective coating)	$35 (SF)
		Protective coating	$25 (SF)
	Replacement	Bridge railings	$80-$125 (FT)
		All deck elements	$42-$147 (SF)
		All joints elements	$10-$1,250 (FT)
		Approach slab	$50 (SF)
Superstructure	Preventive Cyclical	All super elements excl. cable	$1.5/SF deck area
		All super elements excl. cable	$200-$2,000 (FT)

Bridge Component	Action Type	Affected Elements	Range of Unit Cost
	Major Preventive	Bearings	$800 (EA)
		Steel protective coating	$30 (SF)
	Minor Rehabilitation	All super elements excl. cable	$296-$6,175 (FT)
		Bearings	$700-$1,000 (EA)
		Steel protective coating	$30 (SF)
		Wearing surface (protective coating)	$35 (SF)
	Major Rehabilitation	All super elements excl. cable	$370.5-$11,875 (FT)
		Bearings	$988-$6,000 (EA)
		Steel protective coating	$30 (SF)
		Wearing surface (protective coating)	$35 (SF)
	Replacement	All super elements excl. cable	$1,425-$11,875 (FT)
		All deck elements	$42-$147 (SF)
		Bearings	$3,000-$6,000 (EA)
Substructure	Preventive Cyclical	All sub elements	$1.5/SF deck area
	Major Preventive	Abutment	$1,000-$2,000 (FT)
		Pile	$2,000-$6,000 (EA)
		Pier cap	$2,000 (FT)
		Steel protective coating	$30 (SF)
	Minor Rehabilitation	Column	$2,912-10,920 (EA)
		Pier wall	$1,456-$3,640 (FT)
		Abutment	$1,456-$3,640 (FT)
		Pile	$2,912-$10,920 (EA)
		Pile cap	$582-$1,456 (FT)
		Pier cap	$582-$1,456 (FT)
		Steel protective coating	$30 (SF)
		Wearing surface (protective coating)	$35 (SF)
	Major Rehabilitation	Columns	$3,640-$21,000 (EA)
		Pier wall	$1,820-$7,000 (FT)
		Abutment	$1,820-$7,000 (FT)
		Pile	$3,640-$21,000 (EA)
		Pile cap	$728-$2,800 (FT)
		Pier cap	$728-$5,600 (FT)
		Steel protective coating	$30 (SF)
		Wearing surface (protective coating)	$35 (SF)
	Replacement	Columns	$14,000-$21,000 (EA)
		Pier wall	$7,000 (FT)
		Abutment	$7,000 (FT)
		Pile	$14,000-$21,000 (EA)
		Pile cap	$2,800 (FT)
		Pier cap	$2,800-$5,600 (F)

Summary of Bridge LCP Results

Using the inputs discussed in the subsections above, DDOT ran LCP scenarios for NHS bridges using BrM. A summary of the analysis results is provided in Figure 5-5 and Figure 5-6 and discussed in the subsections below.

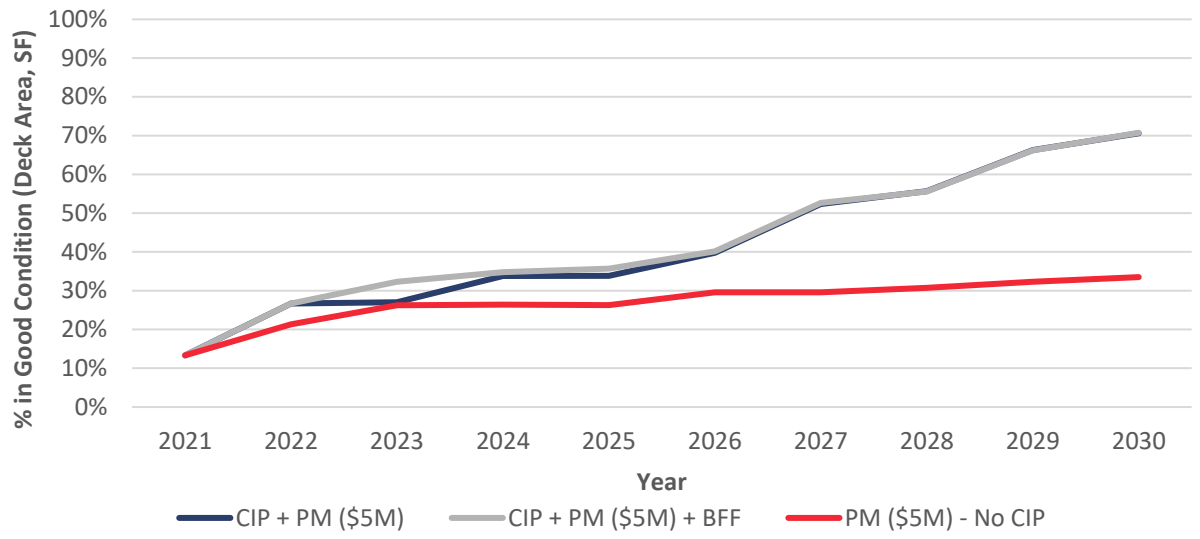


Figure 5-5. Percent of NHS Bridges in Good Condition for LCP Scenarios

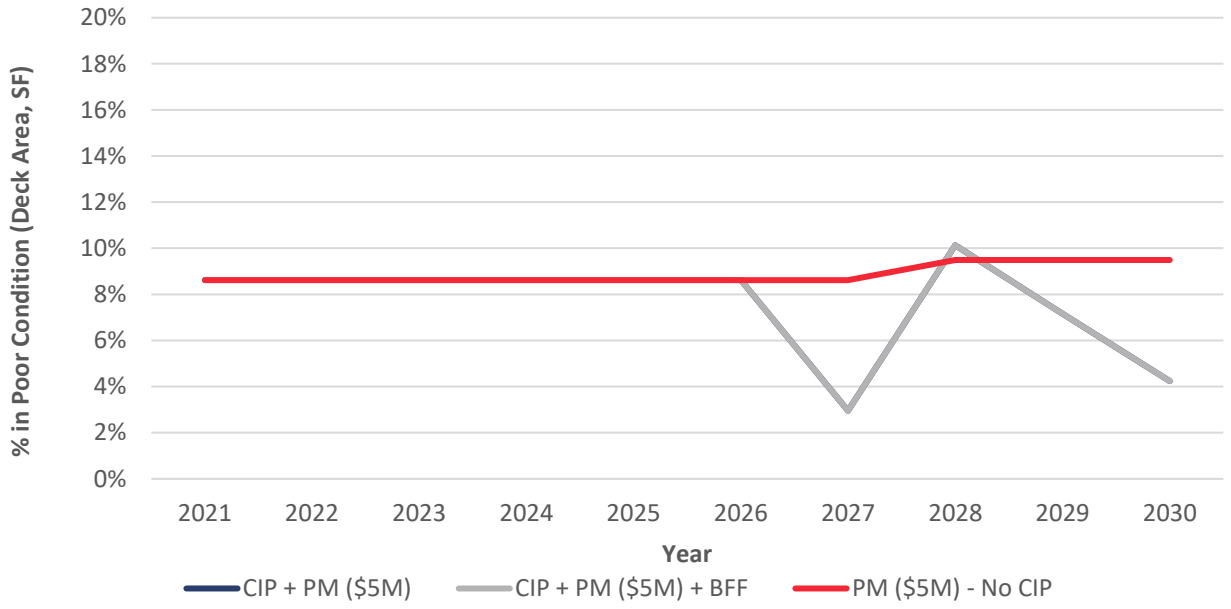


Figure 5-6. Percent of NHS Bridges in Poor Condition for LCP Scenarios

Scenario 1: Current Investment (Specified Investment Level)

DDOT considered the performance of the bridge network (NHS only, NPS excluded) under various funding constraints. As will be discussed in **Chapter 7 Financial Planning**, NHS bridges within the District are funded through both the Preservation and Maintenance Program and CIP. Through the Preservation and Maintenance Program, NHS bridges receive $5 million per year for Preventative Maintenance (PM) work, while through the CIP, the network receives funding to rehabilitate or replace specific bridges specified in the CIP. While preservation funding helps maintain the condition (or slow the deterioration) of bridges in Good and Fair condition, only rehabilitation and replacement (as is specified in the CIP) can improve the condition of a bridge in Poor condition. Given the available funding, the performance of the NHS bridge network (excluding NPS bridges) was analyzed for when CIP funding and $5 million for PM was available (CIP + PM ($5M)) and when only $5 million for PM was available (PM

($5M)- No CIP). The percentage of the NHS bridge network (based on deck area) in Good condition under these different investment levels ranged from 33.5% to 70.8% at the end of the ten-year analysis period, while the percentage of NHS bridges in Poor condition (based on deck area) ranged from 4.2% to 9.5%.

Scenario 2: Bridge Formula Funding (Specified Investment Level)

In addition to the $5 million annual preservation budget and CIP funding, DDOT plans to invest $12 million of the **federal Bridge Formula Program** (BFF) funds into bridge preservation, which will be evenly distributed between 2023 and 2026. Under this scenario, the percentage of the NHS bridge network (based on deck area) in Good condition will reach 70.8% at the end of the ten-year analysis period. The percentage of NHS bridges in Poor condition (based on deck area) will reach 4.2% when CIP funding is included.

Scenario 3: Preservation Only (No CIP investment)

This scenario was evaluated for informational purposes and to reinforce the importance of implementing CIP projects timely to decrease poor bridges. It also emphasizes the long-term benefits of consistent application of preservation treatments on good and fair bridges. Under this scenario, the percentage of the NHS bridge network (based on deck area) in Good condition stays flat and reaches 33.5% at the end of the ten-year analysis period. The percentage of NHS bridges in Poor condition (based on deck area) will increase to 9.0% compared to the other scenarios, which decrease the percentage of Poor bridges.

Intentionally left blank

Chapter 6. Risk Management Analysis

6.1. Overview

In addition to managing assets using a performance-based approach, federal regulation also mandates a risk-based asset management plan. Therefore, DDOT considers and manages its assets using both a performance and risk lens. The remainder of this chapter describes the risk-based asset management approach adopted by DDOT. Specifically, the chapter outlines the following:

Risk Basics

This section defines the fundamentals of risk management including key definitions, frameworks, processes, and integration with other processes.

Identified Risks

This section describes the risk register and highlights the top five identified risks of DDOT.

Risk Mitigation

This section provides a tactical plan for DDOT to address its high-priority risks.

Emergency Evaluation and Alternative Analysis

This section discusses the Part 667 process and results.

Resilience within DDOT

This section discusses how the Agency addresses resilience within asset management.

6.2. Risk Basics

The Federal Highway Administration defines a **risk** as "the positive or negative effects of uncertainty or variability upon agency objectives."[9] Within DDOT, risks include agency threats such as terrorism as well as asset-specific risks such as the effect of emergency events (flooding, extreme heat, etc.) and uncertainty pertaining to institutional resources (in terms of staff, funding, etc.) on pavements and bridges. While enterprise risks are monitored and managed through the Office of Risk Management, asset-specific risks for pavements and bridges are assessed and managed as part of TAM and TAMP development. The focus of this chapter is on asset management risks and how they fit in the broader enterprise risk management process.

> ***Risk*** — *"The positive or negative effects of uncertainty or variability upon agency objectives."*

Within DDOT, asset management risks are categorized into three groups—**Agency-level**, **Program-level**, and **Project-level**—based on the level of response necessary to address the risk. Agency-level risks are the most high-level and extensive risks, affecting all aspects of DDOT rather than TAM operations only, and require comprehensive management by Agency executives. Project-level risks are operational-level risks, affecting individual projects, and require targeted management strategies. Program-level risks are considered intermediary risks affecting more of the Agency than project-level risks but less than Agency-level risks. Table 6-1 provides a summary of the type, responsibility, and strategies for each of the risk management levels.

[9] Moving Ahead for Progress in the 21st Century Act. 23 CFR § 515.5. (2012).

Table 6-1. Risk Management Levels

	Agency-Level Risks	Program-Level Risks	Project-Level Risks
Type: The form of risk and extent of impact.	Multifunctional risks that impact the achievement of agency goals and objectives.	Impact program goals and are common to clusters of projects, programs, or entire business units.	Impact individual projects.
Responsibility: Group of people with the authority to deal with the risk effectively.	Agency Executives	Program Managers	Project Managers
Strategies: Examples of strategies used to address risk.	Risk is managed in a comprehensive manner for the success of the organization rather than a single unit or project.	Risk is managed by establishing program contingency funds and allocating resources to projects consistently to optimize the outcomes of programs.	Risk is managed using advanced analysis techniques, contingency planning, and consistent risk mitigation strategies specific to individual projects.

DDOT relies on best practices to analyze and respond to asset management risks. Specifically, the Agency has adopted a four-step risk management process that incorporates federal and international standards of risk management. The process, depicted in Figure 6-1, focuses on identifying, analyzing, evaluating, mitigating, and monitoring risk. DDOT used the process to create a risk register that documents and tracks risks events, their likelihood of occurrence and consequences/impacts, the associated actions to alleviate their impact, and the owners of the risks.

Figure 6-1. Risk Management Process

6.3. Identified Risks

As noted in the previous section, DDOT developed a risk register to document and mitigate risks to its transportation network. In updating the TAMP, DDOT reviewed its existing risk register and identified 27 risk events applicable to pavement and bridges. Each of the 27 risks were further categorized into three risk categories—high, medium, or low—based on their overall risk scores, or the product of their average likelihood and consequence. High risk events require more intensive or immediate action to minimize likelihood of occurrence or manage or mitigate consequences, medium risks require monitoring and management, and low risks require little to no action, but should be monitored over time. A summary of DDOT's top-five high priority risks is provided below, while the Agency's full risk register is provided in **Appendix A**.

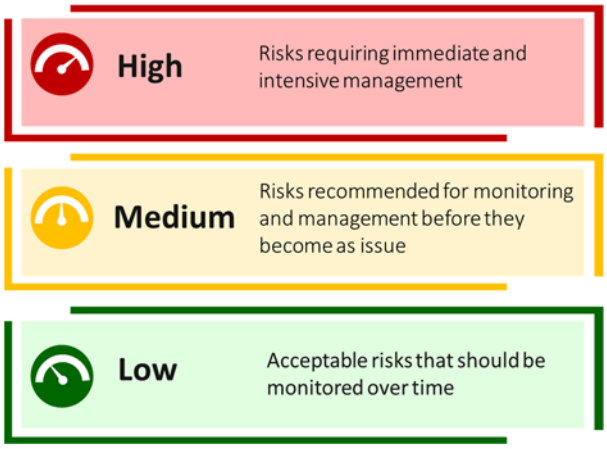


Table 6-2. Top-5 High Risk to DDOT Assets

Risk Score	Risk Event	Potential Impact
20	Inability to procure qualified contractors in a reasonable amount of time and at a reasonable cost to support program delivery.	❖ Delays in project delivery. ❖ Unmet program and performance goals. ❖ Increased customer complaints. ❖ Negative impacts on the Department's reputation.
19	Local funding appropriation is impacted by diverse government policies and restrictions.	❖ Unmet department and program goals and performance targets. ❖ Unfunded local projects. ❖ Increased customer complaints.
18	Loss of performance or damage to assets due to the failure of utilities assets or buried pipes.	❖ Premature failure of transportation assets. ❖ Extended roadway closures. ❖ Increased cost due to emergency repairs. ❖ Delayed projects due to the diversion of funds for emergency repairs. ❖ Increased safety and mobility concerns.
18	Use of poor-quality materials and workmanship	❖ Increased construction defects. ❖ A decreased expected service life of assets. ❖ Increased deterioration rate. ❖ Increased cost due to premature failure.
18	Program delivery impacted by multimodal or corridor-related projects.	❖ Delayed projects due to the lack of funding. ❖ Unmet performance targets and goals. ❖ Inefficient use of limited resources.

6.4. Risk Mitigation

Risk Tolerance — *"The type and amount of risk, on a broad level, that the agency is willing to accept in pursuit of program objectives."*

As part of managing risk, DDOT evaluates its risk tolerance to determine the appropriate response to manage each risk event. **Risk tolerance** or risk appetite is defined as "the type and amount of risk, on a broad level, that the agency is willing to accept in pursuit of program objectives."[10] DDOT defines its risk tolerance by assigning one of four mitigation strategies to manage each risk—terminate, treat, tolerate, or transfer—as described in Figure 6-2. DDOT's risk appetite extends to risks assigned to be tolerated or transferred, whereas risks assigned to be terminated or treated fall outside DDOT's risk tolerance. For risks that can be treated or tolerated, DDOT further categorizes the level of support or attention the Agency should give the risk event. For risk events that can be treated, DDOT identifies whether management of the risk is recommended, required, or required and intensive. Similarly for risk events that are tolerated, DDOT determines whether the risk is acceptable but requires monitoring, acceptable but requires regulation, requires close monitoring, or requires monitoring and management.

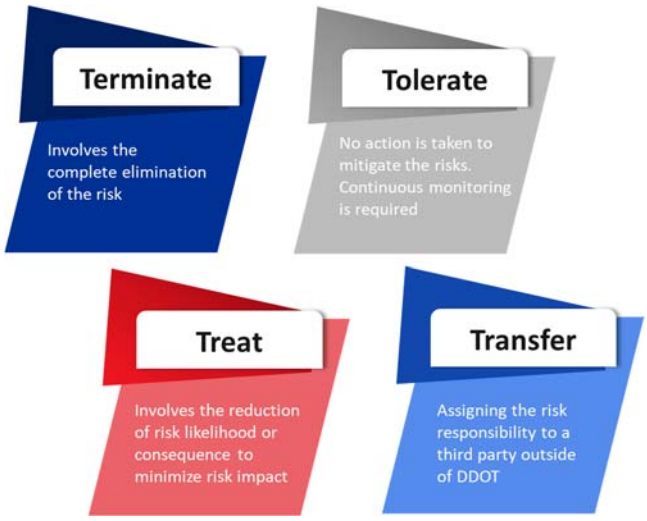


Figure 6-2. Risk Mitigation Strategies

In addition to assigning a mitigation strategy, DDOT also assigns a risk owner and mitigation actions for risk event in its risk register. Risk owners are expected to establish procedures which ensure risk management is being conducted, with a special focus on high priority risks. Since the development of the District's first TAMP and TAM risk register, the Agency has successfully implemented some of the mitigation strategies through their TAM implementation plan. For example, DDOT has developed a strategic data business plan, developed, or acquired new asset management systems, and improved its data-driven analysis over the last four years, which has reduced the risk associated with of "a lack of required data management systems and strategies." To further the progress made in risk mitigation, DDOT has begun the process of identifying more detailed and tactical steps to aid in the management of risk events. To start, DDOT has developed a summary of practical steps the Agency plans to take to manage its five highest priority risk events. An overview of the risk impacts, owners, mitigation response, strategic, tactical, and operational activities, and supporting tasks, as depicted in Figure 6-3, is provided in **Appendix B**.

[10] Federal Highway Administration. (2021). Handling Risk: FHWA's Integrated Approach. *FHWA-HRT-21-002*, 84 (4). https://www.fhwa.dot.gov/publications/publicroads/21winter/05.cfm

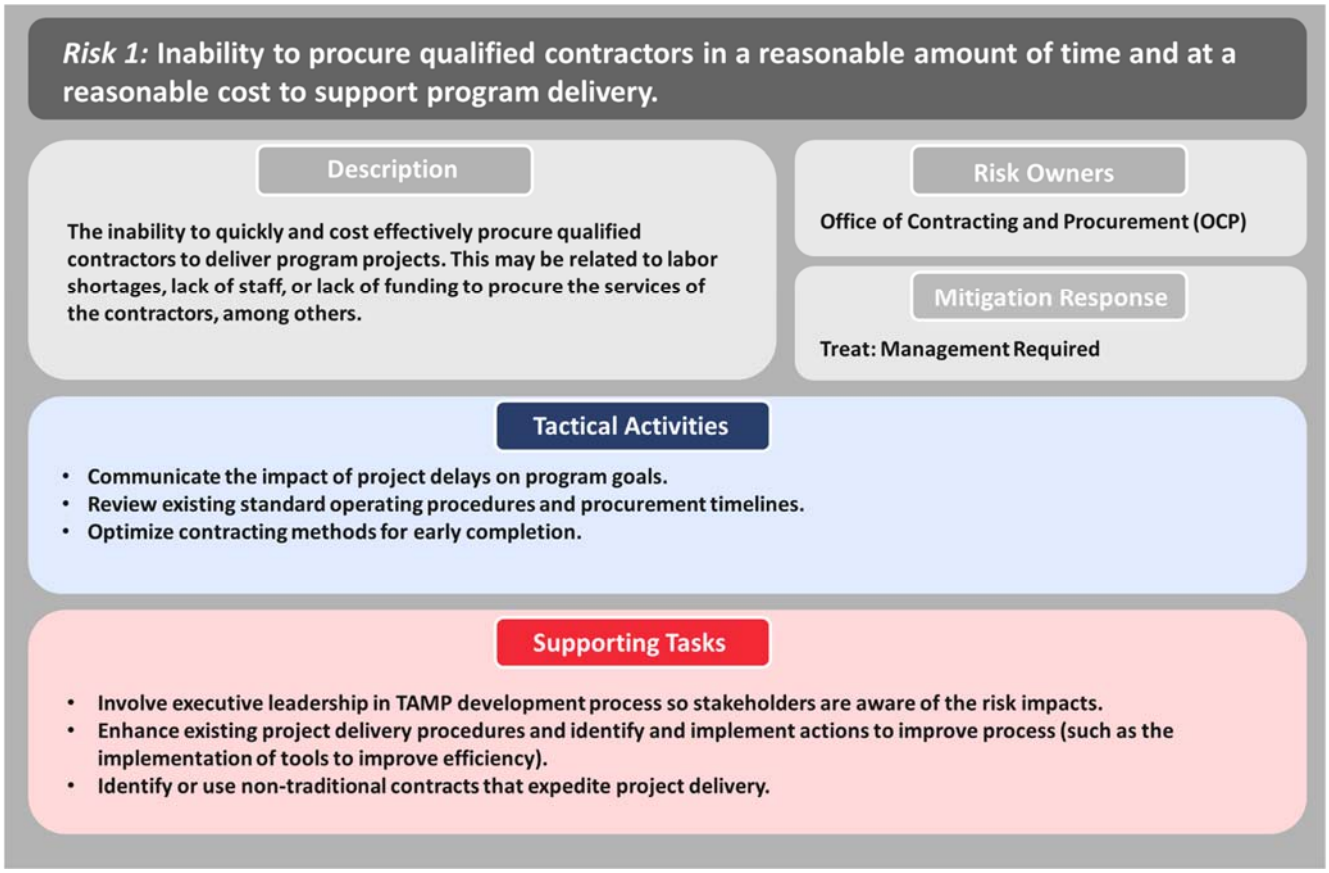


Figure 6-3. Example of Tactical Activities for Highest Identified Risk Event

DDOT also mitigates risk through TAM decision-making processes. In updating the TAMP, DDOT employed a risk-based approach to target setting, resource allocation, investment and performance analysis, financial planning, and alternative assessments. Figure 6-4 provides a summary of the ways in which risk management is implemented through these TAM processes.

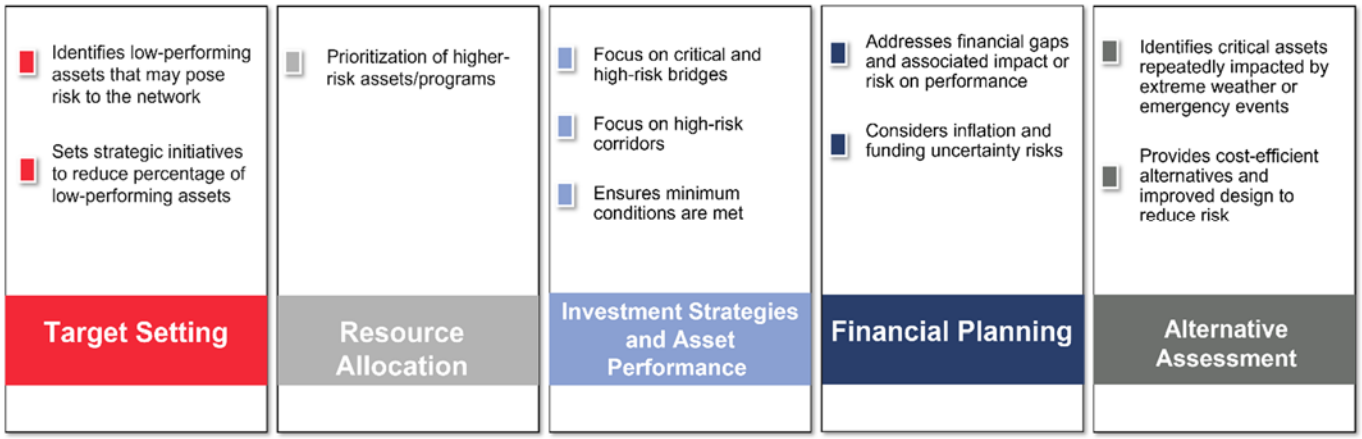


Figure 6-4. Risk Analysis within DDOT's TAMP Processes

6.5. Emergency Evaluation and Alternative Analysis

US 23 CFR 667.1—Periodic Evaluation of Facilities Repeatedly Requiring Repair and Reconstruction—requires States to identify assets that have been repaired or reconstructed multiple times due to emergency events that have occurred since 1997. The analysis, in addition to identifying vulnerable assets, provides DDOT with information to make more informed investment planning decisions; in cases where asset damage becomes a recurrent expenditure, DDOT can allocate funding each year to address these potential emergency events.

In response to the mandate, DDOT conducted an evaluation of its emergency event data for NHS roads, highways, and bridges and determined whether there were reasonable alternatives to assets that are repeatedly affected by emergency events. In addition to conducting an alternative analysis, DDOT also defined challenges in conducting the evaluation, especially in terms of data needs, and developed a path forward to conduct future assessments. The results, which were documented in a standalone technical memorandum, provided a framework for which DDOT would assess and conduct emergency event evaluation and alternative analysis, as depicted in Figure 6-5.

Figure 6-5. Emergency Evaluation and Alternative Analysis Framework

The evaluation conducted in 2018 and updated in 2022 indicated that no facilities required repeated emergency repairs. The analysis showed that DDOT had not conducted any permanent work on pavement or bridges in response to documented disasters since 1997. While no repair or replacement had been recorded in response to the identified emergency events, DDOT had conducted pre- and post-emergency actions that do not qualify as permanent work. Examples included post-event bridge surveys conducted in response to the 2011 earthquake in the Washington D.C. metropolitan area. However, DDOT did not record any specific repairs or reconstruction events in response to the event.

6.6. Resiliency within TAM

In addition to updating the analyses previously conducted on DDOT's primary assets, the 2021 Bipartisan Infrastructure Law (§ 11105) mandates that the Agency also consider extreme weather and resilience within the lifecycle cost and risk management analyses. DDOT takes an enterprise approach to resilience and resiliency planning. As discussed in the previous section, DDOT routinely assesses emergency or disaster declarations and their impact on the transportation network. In addition to this analysis, the District also considers extreme weather events where emergency declarations are not declared and has developed plans to prepare for the effects of these events. The following sections describe the types of events DDOT considers in its resiliency efforts and the plans and procedures the Agency has developed to respond to these events.

Extreme Weather Events

The District's transportation network is aging, and therefore faces infrastructural capacity issues (i.e., stormwater capacity), engineering and geographical problems (i.e., elevation and proximity to Potomac and Anacostia rivers combined with three buried waterways), and natural hazards (such as extreme weather events). As a result, the District is vulnerable to a wide variety of extreme weather events, including extreme rainfall and flooding, sea-level rise and storm surge, snow and ice storms, heatwaves, and derecho, and therefore requires a well-coordinated response to mitigate these threats. One major threat to the District's transportation system is flooding due to the Potomac and Anacostia Rivers, coastal storm surge, and interior/stormwater issues. As such, the District of Columbia (DC) Code 7-2301(3) classifies flooding as a public emergency

threatening the health, safety, or welfare of DC residents. However, due to the multi-agency ownership of transportation infrastructure, which includes both federal and local governments, flood response and recovery prove challenging within the District

Extreme weather events which pose the greatest threat to the District's transportation network:	• Rainfall and flooding • Sea-level rise and storm surge • Snow and ice storms • Heatwaves • Derecho

The District has experienced extreme weather events in the past and with increasing frequency. Recent extreme weather events in the District include the North American blizzard in February 2010, Hurricane Irene in 2011, Hurricane Sandy in 2012, and Hurricane Ida in 2021. In addition to these events, the intense tropical downpours in June 2006, which was equivalent to a 50-year storm, overwhelmed the City's transportation system, inundating the 9th and 12th Street tunnels under the National Mall and flooding two Metro Stations. Figure 6-6 shows how extreme weather has impacted the District's transportation system during similar events. This evidence warrants the need for the District to plan for the detrimental effects that extreme weather events can have on the District's transportation system. The following subsections describe the efforts DDOT has undertaken to address these events and develop a more resilient transportation system.

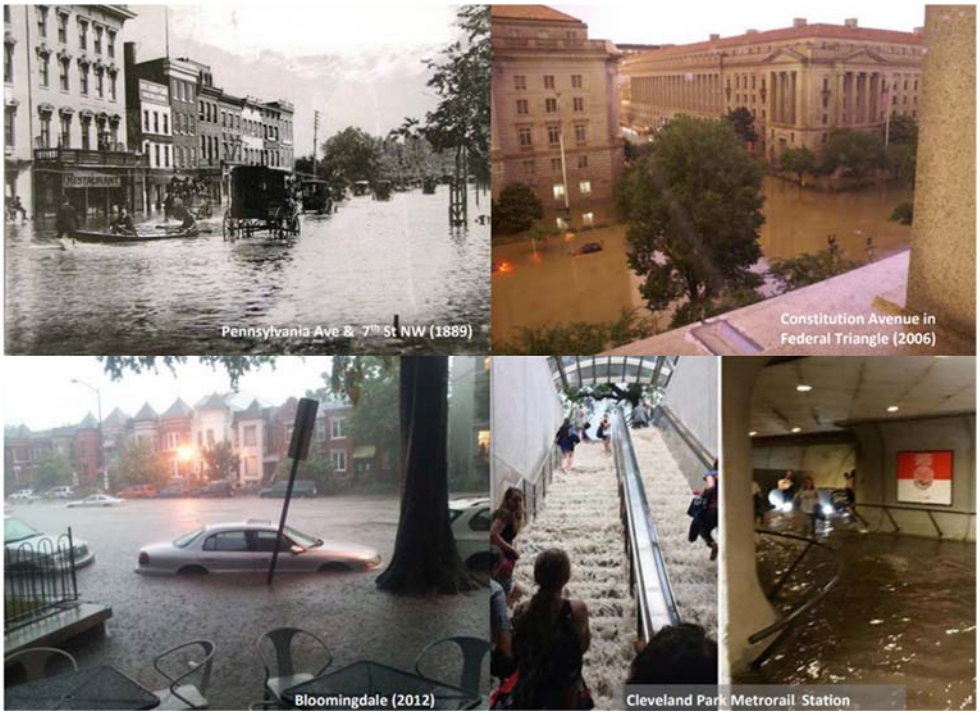


Figure 6-6. Examples of Flooding Events within the District

Climate Change Adaptation Plan

The Climate Change Adaptation Plan serves as the first step in responding to extreme weather and flooding events. The plan identifies strategies to ensure that the District's transportation system can withstand extreme weather conditions. Specifically, the plan contains DDOT's approach and strategies for assessing vulnerability and integrating vulnerability consideration into transportation asset management. The integration process includes, but is not limited to, evaluating transportation infrastructure designs to ensure they can survive future storm events. In creating the Climate Change Adaptation Plan, DDOT assessed the vulnerability of its critical assets to four climate stressors (i.e., temperature rise, precipitation, sea-level rise, and storms). This high-level, qualitative vulnerability assessment identified the potential impacts expected to affect each asset type and possible adaptation strategies (throughout the lifecycle of assets) to help minimize asset vulnerability to extreme weather events.

Flood Emergency Response Plan

To further promote resilience and make the District's infrastructure system resilient and more sustainable, the District of Columbia established a Flood Task Force (the DC Flood Task Force) to identify equitable ways to reduce the risk of flooding in the District. DDOT is a member of this District-wide task force to oversee the planning and implementation of strategies that improve transportation system resiliency. DDOT created a Flood Emergency Response Plan (FERP) through these efforts. The DDOT FERP serves as a high-level conceptual planning guide to help the District prepare for, respond to, and recover from a major flood event. It also discusses essential activities at each phase of the planning framework (ongoing or background activities, preparation, response, and recovery), and outlines roles and responsibilities of DDOT, other District governmental departments, and nongovernmental organizations within the District. In the FERP, DDOT and the United States Army Corps of Engineers identified ten vulnerable locations and assets within the District at high risk for disruption due to flooding and developed site-specific responses to minimize impact. The locations include Federal Triangle Area, Inlet of Broad Branch Road, Rhode Island Ave NE between 4th and 6th Street NE, Maine Ave East of 14th Street and Ramp from US Route 1, I-95 Ramp – Potomac Parkway Southbound, US Route 1 and 14th Street and D Street Southwest, Ohio Drive SW under Memorial Bridge, T.R. Bridge Ramp to Southbound Potomac Parkway, Rock Creek and Potomac Parkway below Virginia Ave, and 27th Street at Rock Creek and Potomac Parkway.

Integration of extreme weather and resilience in lifecycle cost and risk management

DDOT considers extreme weather and resilience as part of lifecycle cost and risk management by adopting a wide variety of strategies across the main stages of asset life cycle management (plan, acquire, use, and maintain).

Integration strategies include:

- Considering extreme weather events in asset planning and design stages.
- Evaluating design standards to accommodate future events.
- Defining project's targets for resilience in project planning and development process.
- Assessing and improving flood zone data and flood maps.
- Improving erosion control systems.
- Stabilizing stream banks.
- Evaluating vertical clearance for bridges on waterways.
- Evaluating bridge scouring risks.
- Improving pumping capacity of drainage systems in tunnels.
- Gathering asset data and assessing conditions frequently.

The FERP also outlines mitigation strategies and response plans to minimize the impact of flooding on system operation and system recovery. For high-risk locations, DDOT and its partners frequently inspect and improve levees to reinforce system resilience. In addition, DDOT works closely with its partners to make practical improvements to the transportation system to reduce flood risk and improve system resilience. For example, with guidance from the United States Army Corps of Engineers, and in collaboration with the National Park Service (NPS), the National Capitol Planning Commission, and the United States Commission of Fine Arts, the District of Columbia initiated a design of a more reliable removable post and panel closure structure to replace the 17th Street post and panel closure. DDOT managed the initial design process and provided $2.8 million for project design11. The structure was designed to provide protection against a greater than 100-year flood event. This $9.4 million levee improvement along the 17th Street helped to achieve one of the goals of Sustainable DC—the District Government's long-term sustainability plan—of making the District more resilient by reducing the risk of flooding to District residents, agencies, and businesses.

DDOT uses a multiprong approach to resilience planning—i.e., tackling the significant factors that contribute to flooding and implementing solutions that improve system resiliency. The Department is actively working with partner agencies to maintain and repair transportation assets in a State of Good Repair to better withstand the risks imposed by extreme weather events. Specifically, NPS ensures that the District's levee system is in good condition to hold back major Potomac River floods.

[11] https://www.adaptationclearinghouse.org/

Figure 6-7. New Flood Wall on the National Mall – 17th St NW

Minimizing Flood Impacts

DDOT continues to implement other mitigation actions to minimize the impact of future events such as drainage improvements and proper road contouring through major reconstruction work. Furthermore, DDOT ensures that new developments within a federally mapped flood hazard areas adhere to higher code requirements, minimizing flooding impacts. In addition to addressing resilience through the state of the physical infrastructure, DDOT is making changes in system operations. For example, DDOT is minimizing greenhouse gas emissions by adding electric buses to the District's Circulator fleet. Currently, 20% of the fleet consists of electric buses, with plans to increase this to 30% by 2023. In doing so, DDOT is reducing its carbon footprint, which may indirectly reduce the likelihood of extreme weather events such as flooding. These initiatives and other planned levee system and drainage control structures improvements will help minimize the risk extreme weather events pose and improve the resilience of the transportation network in the District.

Green Infrastructure and Stormwater Management

Green Infrastructure (GI) in DDOT	DDOT is installing GI as a part of construction projects and in retrofit projects to reduce stormwater runoff.

Another hazard that threatens the resilience of the District's transportation system is stormwater runoff, which occurs when precipitation from rain or snowmelt flows over a surface. The Agency continues to experience increased runoff throughout its transportation system and is therefore, implementing different approaches to reduce stormwater runoff. One such approach is through the installation of Green Infrastructure (GI) during new construction and retrofits. Green Infrastructure refers to assets that are designed and built using best practices for resilience and adheres to design and construction standards developed by DDOT in 2014. The standards address resilience at each stage of the project lifecycle, including technical drawings, specifications, design manual, plant list, and maintenance schedules to minimize flooding and improve resilience and sustainability within the District. GI enables the Agency to manage stormwater runoff by taking advantage of environmental processes such as infiltration and evapotranspiration to keep stormwater from overwhelming sewer systems and culverts. For example, the District's Green Alley Projects are designed to reduce the quantity of stormwater within the City's Right-of-Way. Through the Green Alley Projects, DDOT is replacing existing alleys with permeable surfaces such as pervious concrete, porous asphalt, or permeable pavers to allow water to pass through the surface into the soil below. DDOT has completed **over 30 Green Alleys** projects to date.

Intentionally left blank

Chapter 7. Financial Planning

7.1. Overview

For DDOT to allocate TAM funds effectively and efficiently, it is important to know the Agency's funding sources and uses, forecasted revenue, estimated future work within the asset network, and the impact on asset value in the long term. Several federal and local regulations require DDOT to prepare budgets and financial plans such as the **DC STIP** and **CIP** for capital and non-capital surface transportation projects. In addition to these rules, the TAMP regulation requires DDOT to prepare a 10-year (or longer) TAM financial plan documenting the sources of funds, estimated revenue, and predicted expenditures for NHS assets. The remainder of this chapter discusses the following:

Revenue Sources and Uses
This section describes DDOT funding sources (federal, local, and external sources), historical expenditure, projected revenue, and use of funds in all investment or program types.

Estimated Cost
This section describes the estimated cost to achieve different asset management goals, such as maintaining current conditions, achieving targets, and achieving a SOGR.

Asset Valuation
This section describes DDOT's asset valuation processes, results, and how DDOT uses asset value in making investment decisions.

7.2. Funding Sources and Uses

DDOT's transportation assets and TAM program are financed through two primary budgets—the operating and capital budgets. While DDOT's operating budget supports the Agency's day-to-day operations, the capital budget is used for maintaining, preserving, rehabilitating, and constructing infrastructure, such as bridges and roads within the District. Figure 7-1 shows the sources and uses of the Agency's operating and capital budgets. As described in the figure, the operating funds do not directly impact asset performance. Hence, the remainder of the financial plan will focus on the sources of and use of the capital budget, which directly impacts asset performance within the District.

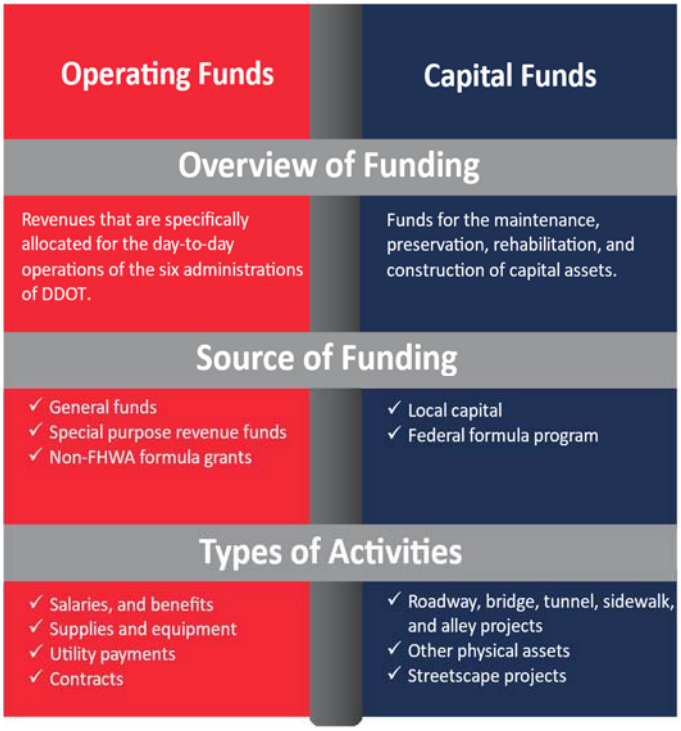


Figure 7-1. DDOT Revenue Sources and Uses

Funding Sources

DDOT's overall funding comes from varying internal and external sources including federal programming, local taxes, bonds, grants and PayGo (pay-as-you-go parking) revenue. Figure 7-2 shows the District's $2.1 billion[12] FY2022 budget by funding sources. The capital budget allocates $652 million or 30.8% to the Department of Transportation; $408 million is designated for the Local Transportation Fund, while $244 million is assigned to the Highway Trust Fund, which can be used on NHS assets. The FY 2022 – FY 2027 Capital

[12] https://dcgov.app.box.com/s/09xxasiudp45rhfsuwa3rl0gzx8zissq

Improvements Plan contains DDOT's 6-year approved capital budget for the Highway Trust Fund, as shown in Figure 7-3. DDOT's capital budget fluctuates greatly from year to year, with a significant drop in FY 2024. This fluctuation is likely tied to the specific projects selected and prioritized for programming each year; however, the decrease in funding during this period will ultimately affect the performance of the Agency's primary assets.

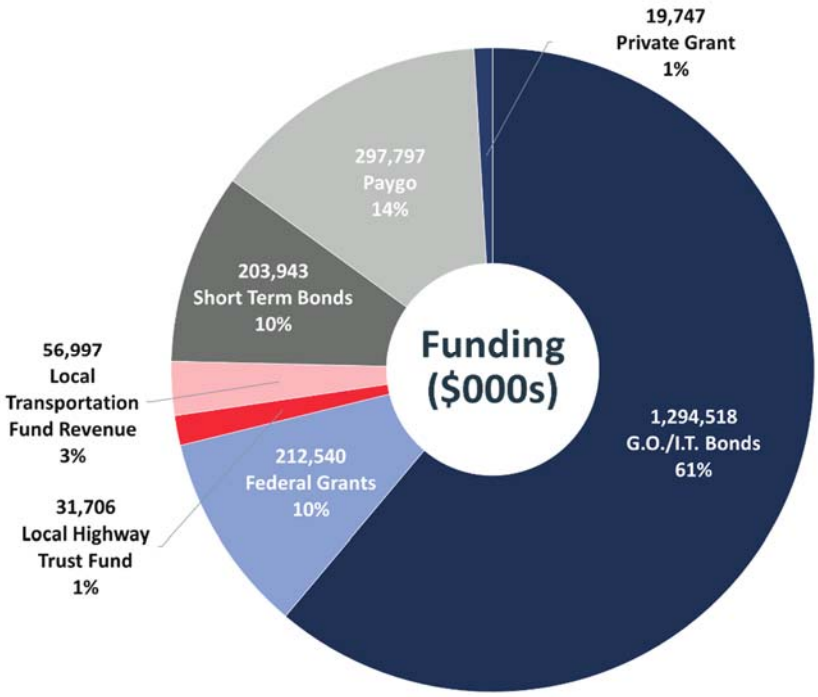


Figure 7-2. The District's FY2022 Capital Budget and Sources

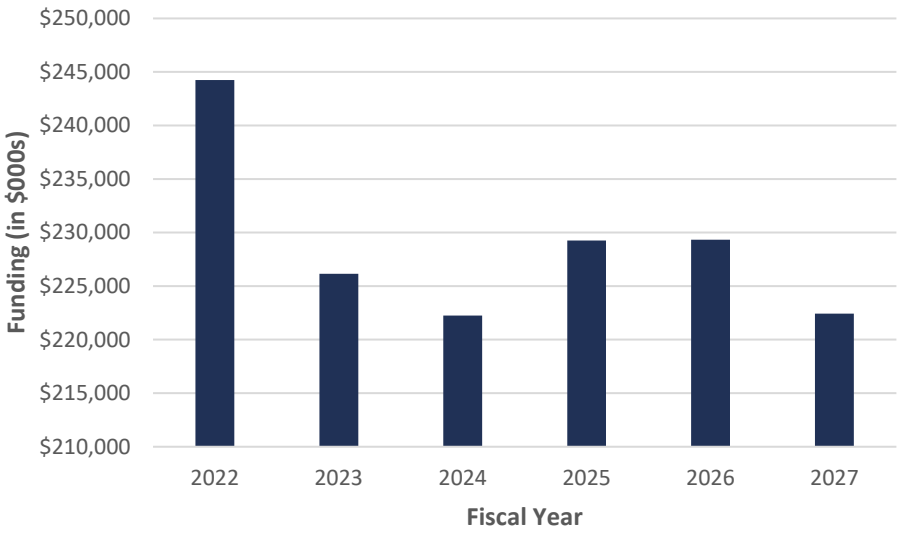


Figure 7-3. DDOT Budgeted Capital Funds

It is challenging to forecast revenue and funding due to external factors and uncertainty. One such example is the COVID-19 pandemic. This unprecedented pandemic has shown practitioners and decision-makers that relying on historical data to forecast expected funding will not be enough in the future. A refined forecasting approach that incorporates uncertainty will

provide a better understanding of how to deal with any significant decreases or increases in annual revenue. While DDOT's TIP and CIP provide information on expected funding and sources, these projections are only accurate if there is certainty that economic factors will remain the same. In **Chapter 6 Risk Management Analysis**, DDOT has identified specific actions in the risk register to enable the Agency address funding uncertainty.

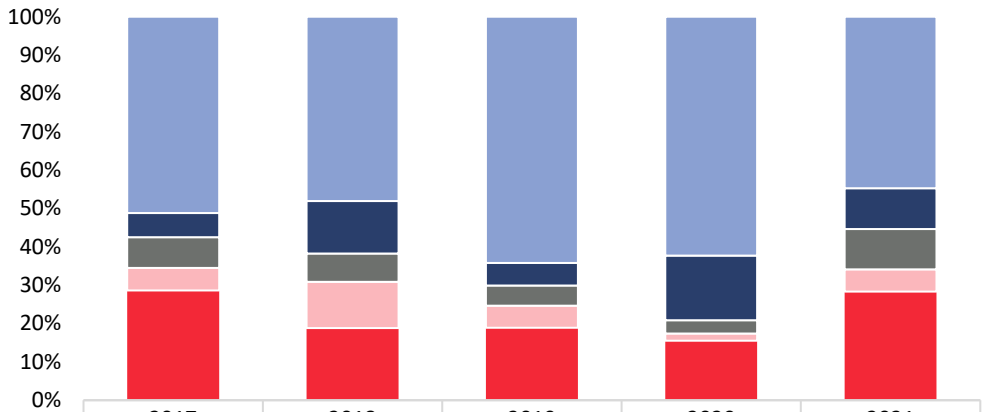
Use of Funds

DDOT's capital budget is used to improve the safety for pedestrians, cyclists, and drivers throughout the District; maintain and enhance the District's transportation infrastructure; and increase non-vehicular transportation modes to meet the mobility and economic development goals of the District. These objectives are achieved through asset Preservation and Maintenance and Capital Improvement Investments. DDOT also supports additional programs that have indirect effects on the performance of roadways, bridges, tunnel conditions, and network operation. Examples include education and safety programs to the improve operation of transportation systems, bicycle/pedestrian programs to improve mobility, streetscape space programs to improve modal choice and quality of public spaces, and planning/programming/fiscal/administrative programs to support planning studies. In developing investment plans for these programs, DDOT tries to consider how the level of investment in physical assets impacts the operations of the transportation network overall.

Preservation and Maintenance Program

DDOT utilizes a variety of work types on pavements, bridges, and tunnels to preserve asset condition and to extend each asset's useful life. These investments enable DDOT to make progress towards achieving performance targets, attaining a SOGR, and preserving the value of assets. For pavements, activities include maintenance (pothole filling), preservation (slurry seal, crack sealing, and microsurfacing), localized reconstruction, and surface rehabilitation. For bridges, activities include deck overlays, deck washing, deck seal, beam painting, and deck patching, among others. Figure 7-4 shows the 5-year historical investments in preservation and maintenance programs for the different asset classes while Figure 7-5 shows the forecasted average annual investments in pavements and bridges for the duration of the TAMP analysis period. Based on these projections, DDOT will invest approximately $10 million annually on preserving and maintaining NHS pavements and $5 million on bridges (including NHS bridges). However, DDOT is expected to receive or allocate additional funding for preservation of its NHS pavements and bridges within the next five to ten years. For pavements, DDOT has made a commitment to investment an additional $5.8 million a year on its NHS to meet its performance goals. For bridges, DDOT expects to receive $12 million in preservation funding through the **federal Bridge Formula Program**. Funding from this program will be evenly distributed on annual basis ($3 million per year) between 2023 and 2026 resulting in an average annual investment of $7 million between FY 2022 and FY 2027. These projected budgets will not be used for design costs, but instead will cover treatment/construction and construction management (CM)/overhead costs.

The preservation and maintenance funding allocated for these assets and used in the analyses conducted throughout the TAMP is a worst-case scenario. Typically, for pavements and bridges, additional funding is made available through the redistribution process that occurs each year. During this process, additional funds are freed up to be used on NHS assets. For example, in FY 2022, while DDOT only planned to allocate $10 million for its NHS pavements, an additional $26.45 million was made available through redistribution. While additional funding through redistribution is common, DDOT is only using already allocated funding to conduct LCP analyses on its NHS asset network. In doing, the Agency minimizes the risk to performance associated with funding uncertainty.



	2017	2018	2019	2020	2021
Local Pavements	$31,701	$33,234	$61,155	$81,911	$40,003
Federal Aid - Non-NHS Pavements	$3,899	$9,468	$5,592	$22,169	$9,523
Tunnels	$4,962	$5,103	$4,987	$4,564	$9,393
All Bridges	$3,648	$8,343	$5,490	$2,472	$5,181
NHS Pavement	$17,709	$12,993	$17,972	$20,347	$25,333

Figure 7-4. Five-Year Historical Investment in Asset Preservation and Maintenance Program ($000)

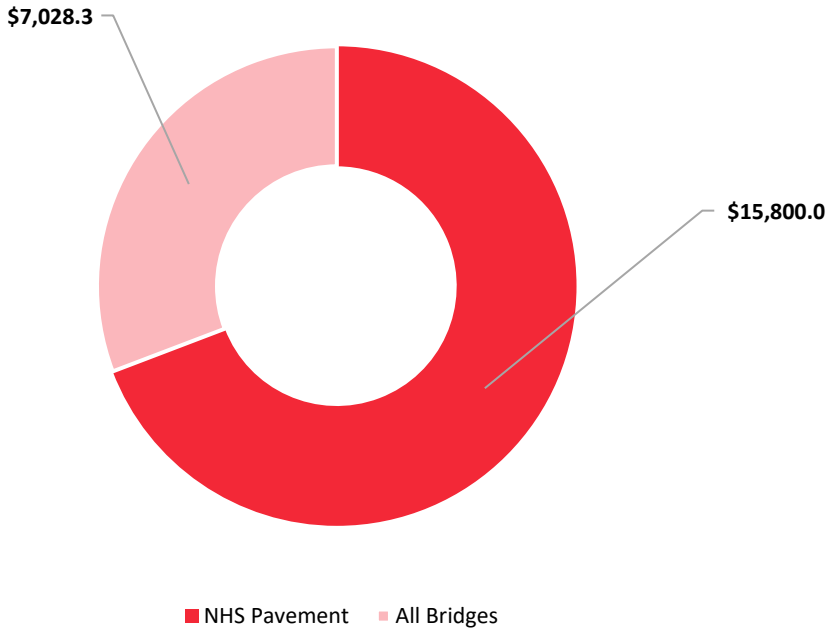


Figure 7-5. Forecasted Average Annual Investment in Asset Preservation ($000s) for NHS Pavements and Bridges

Figure 7-6 shows the forecasted average annual investment for preservation and maintenance of DDOT's additional assets for FY 2022-2027. These assets are not the focus of the TAMP, but the projected asset investment for each is included for future use as DDOT aims to integrate asset management practices into the existing planning practices for these assets.

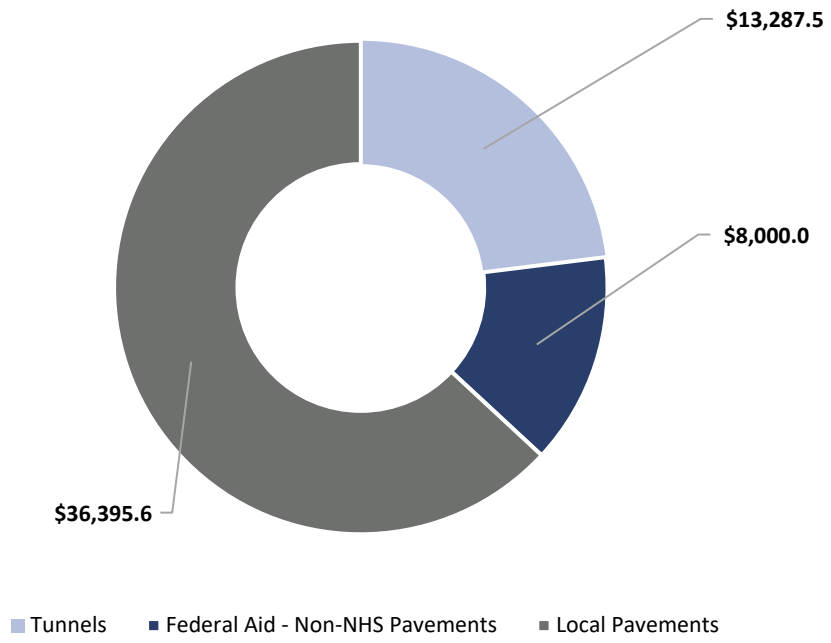


Figure 7-6. Forecasted Average Annual Investment in Asset Preservation and Maintenance ($000s): Federal Aid Non-NHS Pavements, Local Pavements, and Tunnels

Capital Improvement

DDOT undertakes several capital infrastructure projects a year to ensure the District's transportation network is properly maintained and continually improved. In addition to improving the physical condition of assets, these capital projects also revitalize the District and improve mobility of transportation corridors for cars, pedestrians, bicycles, and street cars. Capital improvement investments include mega/special multimodal projects (projects spanning more than one FY) such as the Frederick Douglass Memorial Bridge, 11th Street SE, and Key Bridge projects. These multimodal investments target highway and non-highway assets such as bicycle lanes and pedestrian facilities.

Capital projects can impact asset performance when major rehabilitation and reconstruction are included as part of the project scope, and therefore can help reduce or eliminate the number of assets in poor condition. Some capital projects also add new capacity and thus impact DDOT's inventory by increasing the number of pavement lane miles or the total square footage of a bridge deck. Changes in capacity due to capital projects are documented and used to update the asset inventory for future life cycle assessments.

Figure 7-7 and Figure 7-8 shows the forecasted average annual capital investments for DDOT assets between FY 2022 to 2027. DDOT is expected to invest approximately $126 million over a six-year period, or $21 million annually, to preserve and maintain NHS pavements. Similarly, approximately $998 million will be invested in bridges, averaging $166 million annually over the same period. While these investments are important for predicting the overall condition of both pavements and bridges in the long-term, there are no implementable (e.g., ready to be constructed) CIP projects within the next 5-year planning horizon that will directly impact the performance of the NHS pavement network. Therefore, all pavement analyses conducted for the purposes of this TAMP excluded CIP funding.

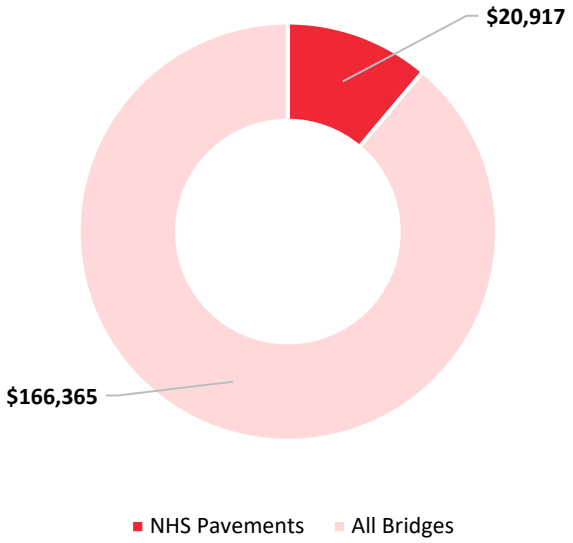


Figure 7-7. Forecasted Average Annual Capital Investment ($000s) for NHS Pavements and Bridges

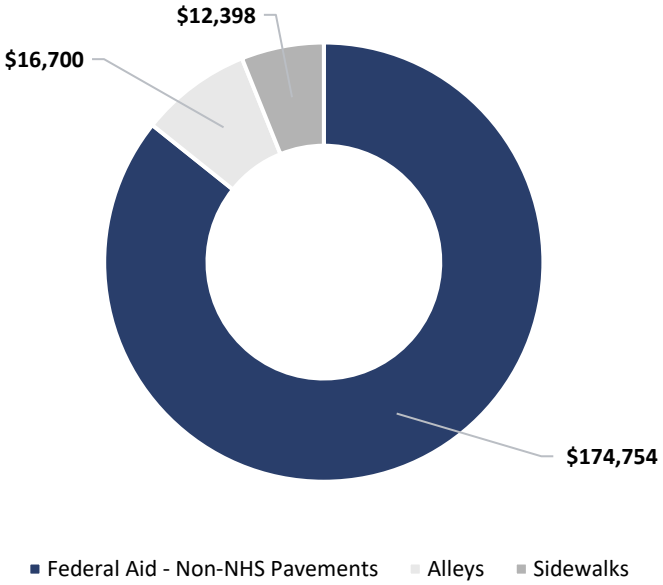


Figure 7-8. Forecasted Average Annual Capital Investment ($000s) for DDOT's Additional Assets

External Stakeholders Funding for NHS Assets

TAM rules require DDOT to coordinate with other agencies who own NHS assets to develop a 10-year financial plan. Therefore, DDOT works with external stakeholders to gather financial information on planned asset investments. This information includes NHS funding for NPS and AOC assets, which, while not owned by DDOT, can have a noticeable impact on system performance. NPS pavement and bridges are managed by the EFLHD. The EFLHD is not subject to the TAM requirements; however, other federal regulations, such as **Title 23 U.S.C 204**, require that the division prepares improvement plans for all Federal Lands projects as part of their transportation planning procedures. The EFLHD prepares a Transportation Improvement Plan (TIP), in cooperation with States and metropolitan planning organizations (MPOs), based on funding availability. Although

DDOT does not have control over these projects, coordination and discussion enables DDOT to recommend and support projects that will significantly impact the public and help to achieve NHS performance goals.

Currently, NPS has a forecasted annual budget of $36.5 million for the National Capital Region[13]. This investment is used for improvements for high priority roads and bridges, maintenance, and the construction of new facilities. Based on the available funding, NPS predicts that it will be able to maintain the current conditions of their highest priority roads and bridges over time. Therefore, the performance of NPS assets should not significantly impact the overall performance of the NHS system.

The TIP contains projects, including NHS bridge and pavement projects, that are delivered within the National Capital Region. Some of these projects have a significant impact on the performance of NHS pavements and bridges. Figure 7-9 shows the Arlington Memorial Bridge, which is approximately 200,000 square feet in deck area, during and after the rehabilitation project, in October 2018 and December 2020. This $227 million keystone project has helped to improve the overall condition of NHS bridges within the District. Other planned or ongoing NPS projects within the District include the rehabilitation of 17th Street, East and Westbound of Independence Ave and the Rock Creek Parkway. For many of these projects, NPS has engaged external stakeholders and focused on executing projects that will reduce the risk of flooding within the District and therefore, make the transportation network more resilient overall.

Figure 7-9. Example NPS Bridge Project: Arlington Memorial Bridge (photo credit: Federal Lands Highway)

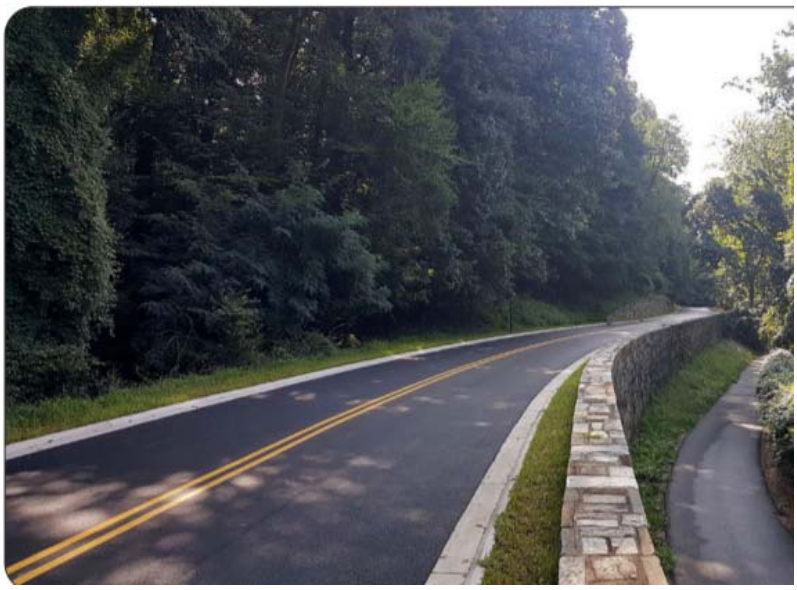


Figure 7-10. Example NPS Pavement Project: Rock Creek Parkway

There are several challenges in including the funding of external stakeholders within the TAMP. For example, funding for federal projects, such as the NPS, is often uncertain and does not go beyond the 6-year TIP planning horizon. Additionally, the TIP does not differentiate NHS projects from non-NHS projects, and therefore, additional assessment is necessary to identify NHS projects within the TIP and account for their impact on the NHS network. These compounding challenges limit DDOT in fully understanding the EFLHD forecasted funding available for NHS projects beyond the 6-year TIP duration[14]. DDOT will continue to work with NPS and EFLHD to gather reliable financial information to include in the TAMP.

[13] US Department of the Interior—National Capital Region of the National Park Service. (2018). *National Capital Region Long Range Transportation Plan*.
[14] FY2022-FY2025 Transportation Improvement Program. Federal Highway Administration, EFLHD.

7.3. Estimated Cost

In understanding the financial needs to achieve targets and make progress towards national performance goals, DDOT aims to better utilize available resources. Access to financial needs information enables DDOT to effectively address funding uncertainty and ensuing risks due to performance or funding gaps. DDOT will continue to analyze the financial needs to meet performance goals and plan to invest to maintain the value of its assets. The following sections present the estimated cost to meet DDOT performance goals.

Pavement

Figure 7-11 shows the results of the financial needs assessment for NHS pavements. This was developed using updated pavement deterioration models, decision trees, and an enhanced pavement management system implemented by DDOT. The pavement management system meets the requirements of the FHWA rules and has capability to forecast performance based on available funding.

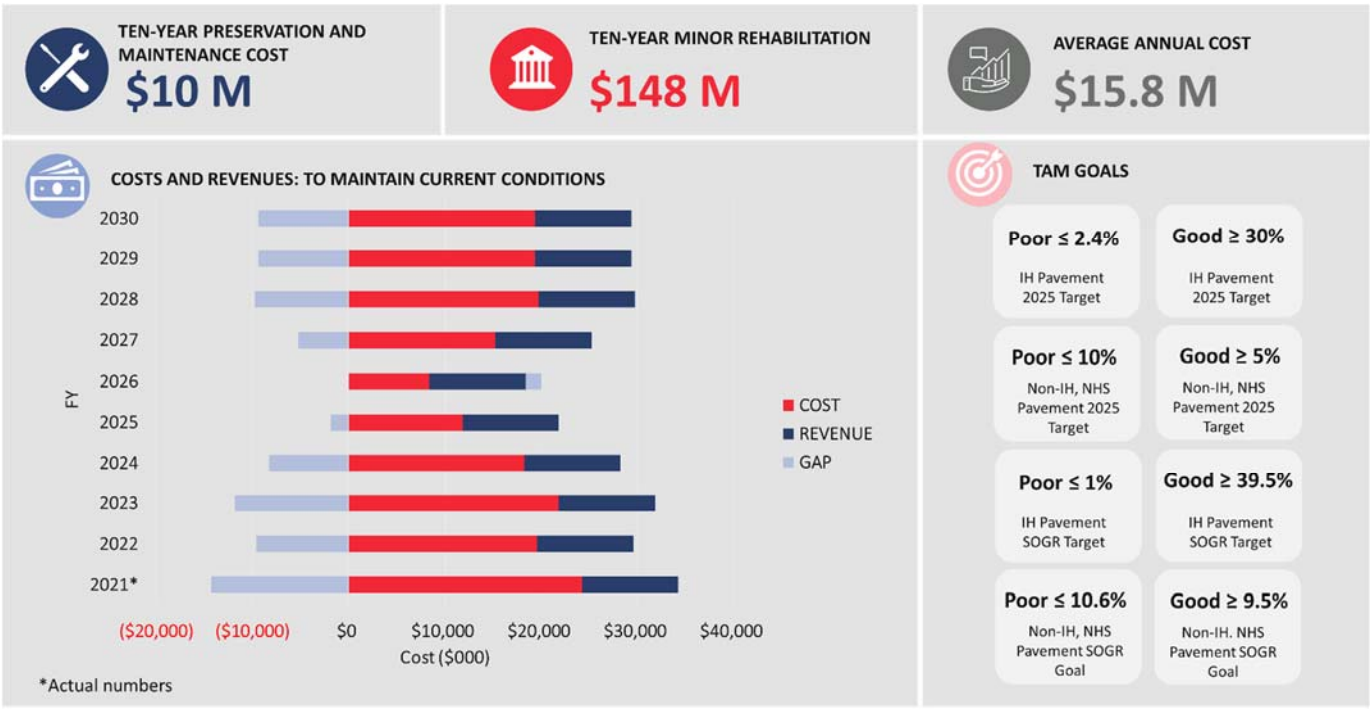


Figure 7-11. Summary of Financial Needs of DDOT NHS Pavements

Bridge

Figure 7-12 shows results of the financial needs assessment for NHS bridges. This was developed using updated bridge element deterioration models, updated decision trees, and an enhanced bridge management system. DDOT configured the AASHTO BrM with the Agency's specific deterioration and cost models, as well as treatment types to develop the following results. The AASHTO BrM meets the requirements of the FHWA rules and has the capability to forecast performance based on available funding.

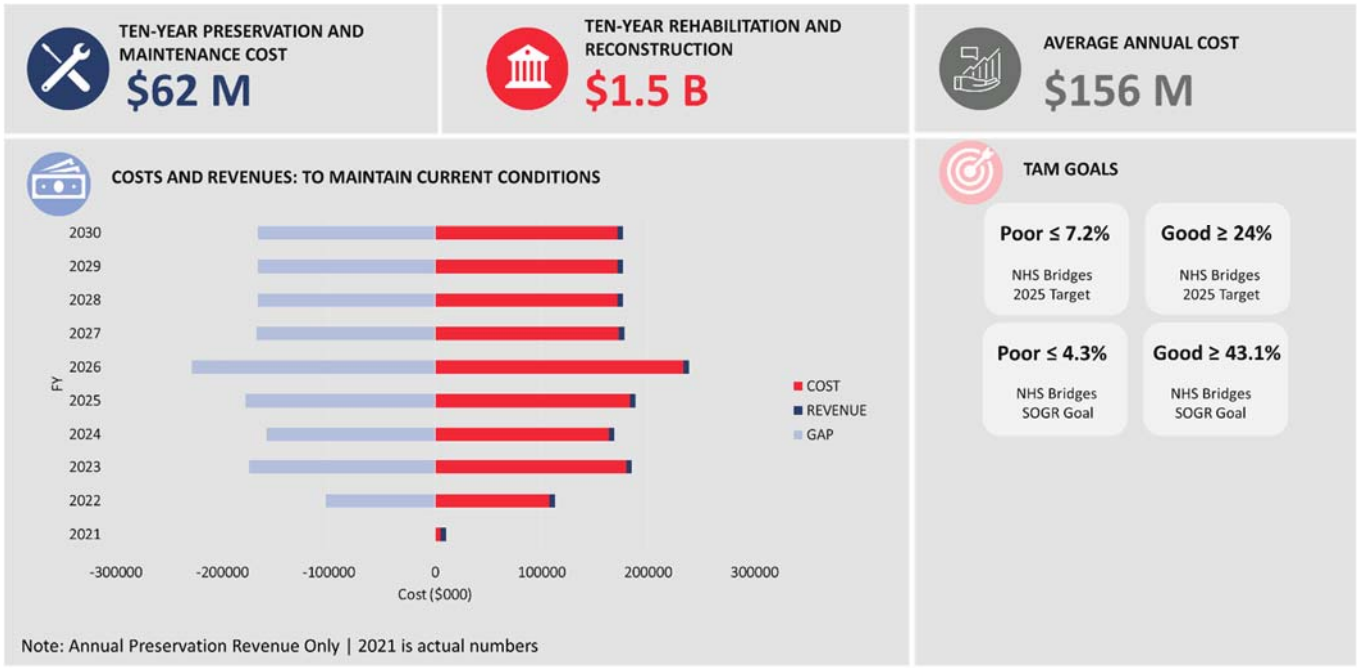


Figure 7-12. Summary of Financial Needs of DDOT-Owned NHS Bridges

7.4. Asset Valuation

There are several methods available to assign monetary value to transportation infrastructure. From the asset manager's perspective, it is critical to demonstrate to stakeholders that the asset's value is preserved by extending the asset life and slowing the rate of deterioration. In this case, the asset owner can relate the asset condition to value. For this TAMP, DDOT used the replacement cost approach to value its transportation assets. As the name implies, replacement cost refers to the monetary value needed to replace an asset. The approach estimates the cost to reconstruct an asset irrespective of its current condition, using a replacement unit cost. Although this approach enables DDOT to demonstrate to stakeholders that the Agency is responsible for a large portion of the District's capital, it does not account for depreciation, and therefore, usually yields a higher asset value than the actual asset value when existing condition is considered. Figure 7-13 provides a summary of the asset valuation for pavements, bridges, and alleys within the District.

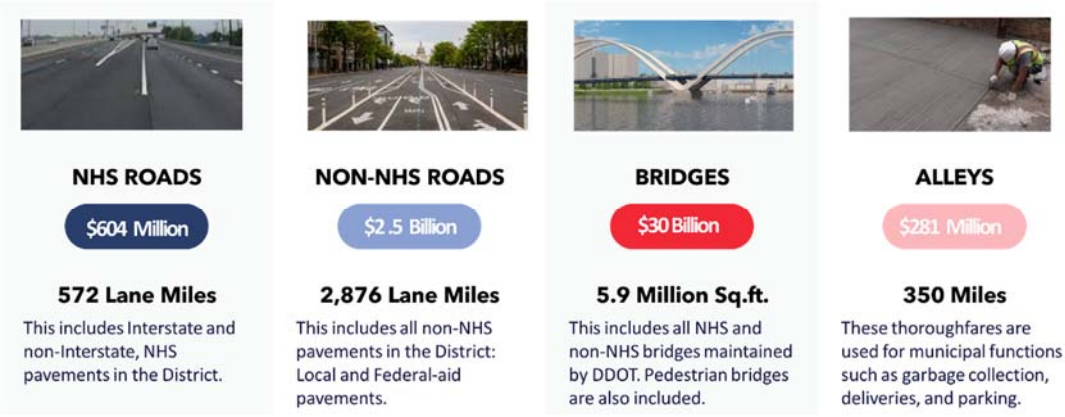


Figure 7-13. Asset Replacement Cost

Intentionally left blank

Chapter 8. Investment Strategies

8.1. Overview

Using the information presented in the previous chapters, DDOT makes decisions on how to best allocate asset management resources to achieve the Agency's performance goals, manage risk, minimize lifecycle cost, and optimize the expected life of assets in the Agency's network under given constraints. To do so, the District evaluates the gap between current investment levels and the levels of funding necessary to achieve performance goals at the minimum practicable cost.[15] **Investment strategies** are the result of analyses conducted for various funding scenarios. This chapter, as summarized below, discusses the process and results of developing DDOT's investment strategies.

Making Integrated Investment Decisions
This section describes how DDOT integrates performance, asset management principles, and risk management to make investment decisions.

Performance Gap Analysis
This section describes identified performance gaps between the projected performance of an asset and the performance target.

Investment Strategies
This section describes the investment strategies for each asset class to achieve DDOT performance goals and to address any performance gaps.

Asset Sustainability Reporting
This section describes DDOT's process for measuring asset sustainability and determining strategies to close existing performance and financial gaps.

8.2. Making Integrated Investment Decisions

The individual planning processes discussed throughout the TAMP are key inputs for investment decision-making. DDOT relies on performance management practices to set Agency goals, asset management principles such as life cycle planning to assess different network scenarios, and risk management to identify events that may impact the asset network. The integration and use of these planning processes for investment decision-making requires coordination and the promotion of transportation asset management throughout the Agency. To ensure an integrated approach to investment decision-making and TAM overall, DDOT has implemented some best practices for management integration, such as resource sharing and the promotion of common goals through a TAM-centered culture.[6] Specific processes that aided in the integration of performance, asset management principles, and risk management are summarized in Figure 8-1 and discussed in further detail below.

- **Business Process Mapping:** DDOT established a TAM governance structure that fosters coordination between different Divisions within the Agency. Through the TAM Workgroups (pavement, bridge, risk management, etc.), experts within DDOT provide input on the needs and the goals of the Agency's TAM program, through the lens of their areas of expertise. Coordination and communication have led to an integrated approach to performance management and risk management and resulted in changes to the resource allocation and project prioritization process.
- **Project Selection:** Project selection, for both pavement and bridges, is another example of how DDOT has taken an integrated approach to make investment decisions. While project selection is based on the outputs of DDOT's pavement and bridge management systems, as well as other external factors like Service Requests (including requests from 311 calls), safety, multimodal improvements and ADA accessibility, the process is informed by both risk and performance management. The performance of the asset network drives the project selection conducted by asset management systems (such as PPA and AASHTOWare BrM), while the level of risk associated with a project or asset helps further prioritize asset work. Therefore, both risk and performance inform what projects are selected and the investment levels necessary to complete the selected projects. The recommendations from the management systems are further reviewed through meetings with upper management, finance and resource allocation before they are

[15] FHWA, Developing TAMP Financial Plans, 2017

entered into the CIP and STIP. On an annually basis, the CIP is updated and any revisions in the projects are updated in the STIP.

- **Enterprise Risk Management:** While the risks discussed throughout this TAMP are focused on events that would likely impact pavements or bridges, some of the identified risks have implications to other business functions and Divisions within DDOT. Specifically, risk events tied to safety, politics, financial uncertainty, and data or information security are considered enterprise-wide threats. Therefore, the process of identifying these risks helps inform the Agency of key areas where risk responses are necessary. For example, the loss of expertise and institutional knowledge due to staff turnover and retirement was one identified risk within the risk register. While this event was identified as a key risk to transportation assets, the issue is Agency-wide and might be addressed through strategic efforts to train and retain staff.
- **Training and Communication Planning:** Since the 2019 TAMP, DDOT has developed both training and communication plans to promote a TAM-centered culture within the Agency. The training plan details TAM training areas, audience, and resources necessary to implement training, while the communication plan highlights the TAM topics and types of communication necessary. While these plans are just beginning to be implemented, DDOT intends to roll out the strategies from each plan across the Agency. In doing so, DDOT will create awareness and additional coordination that is valuable in investment decision-making.

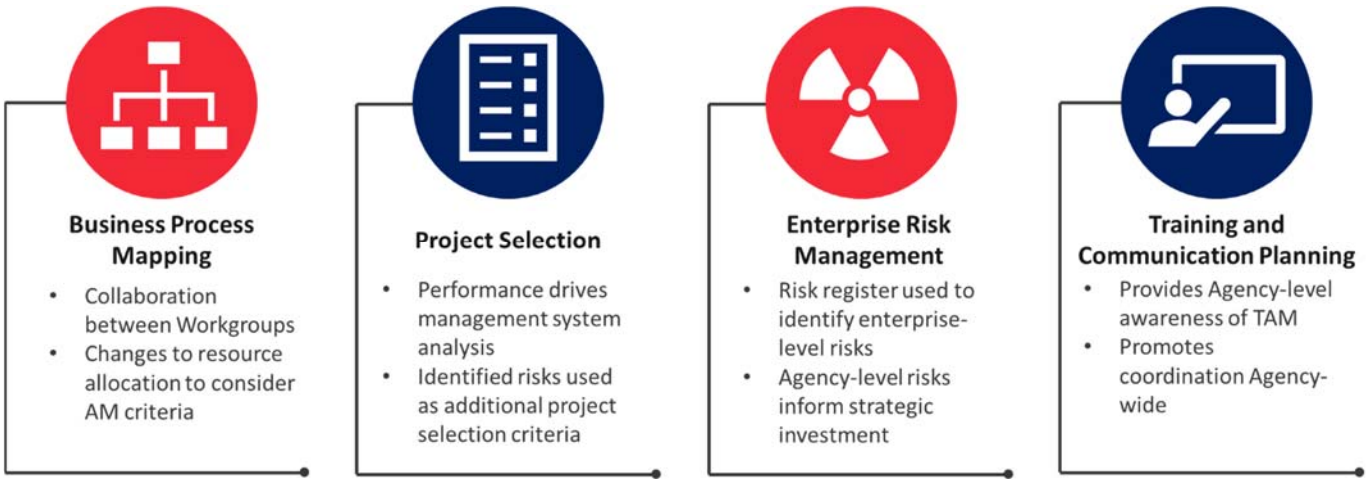


Figure 8-1. Key Integration Processes for Investment Decision-Making

8.3. Performance Gap Analysis

In **Chapter 4 Asset Performance Goals and Targets**, DDOT defined a set of performance goals for its pavement and bridges to reach by 2025 and 2030. These performance targets, which were informed by the current condition of the network and scenarios ran as a part of **Chapter 5 Life Cycle Planning**, were used to assess the annual needs and expected performance of DDOT's asset network. This section provides a comparison of the performance of the asset network given DDOT's current investment levels and the short-term and long-term performance goals for pavements and bridges, respectively.

Pavement Performance Gap Analysis

Figure 8-2 and Figure 8-3 show the outcome of the performance gap analyses for the Interstate and non-Interstate NHS pavements. The performance gap is defined as the percentage difference between the condition of the system—either the baseline condition (2020) or the projected condition in 10 years using the Maintain Current Conditions scenario—and the Agency's 10-year SOGR performance goal. A positive performance gap for the percent of the system in Good condition implies that the baseline/projected performance is worse than the Agency's set performance goal, and a negative gap implies the performance is better than the set performance goal. For the percentage of the system in Poor condition, a positive performance gap indicates the baseline/projected performance is worse than the set performance goal, while a negative performance gap indicates it is better.

As shown in the figures below, DDOT's NHS pavement system will improve from the 2020 baseline conditions and successfully meet its SOGR goals using the Maintain Current Conditions investment strategy. To do so, an average budget of $15.8 million per year is required for NHS pavements over the next 10 years. This is $5.8 million more than the current projected budget of $10 million per year (excluding CIP funding). DDOT has communicated this funding need internally and through the redistribution process, aims to allocate the additional funding necessary to achieve these goals.

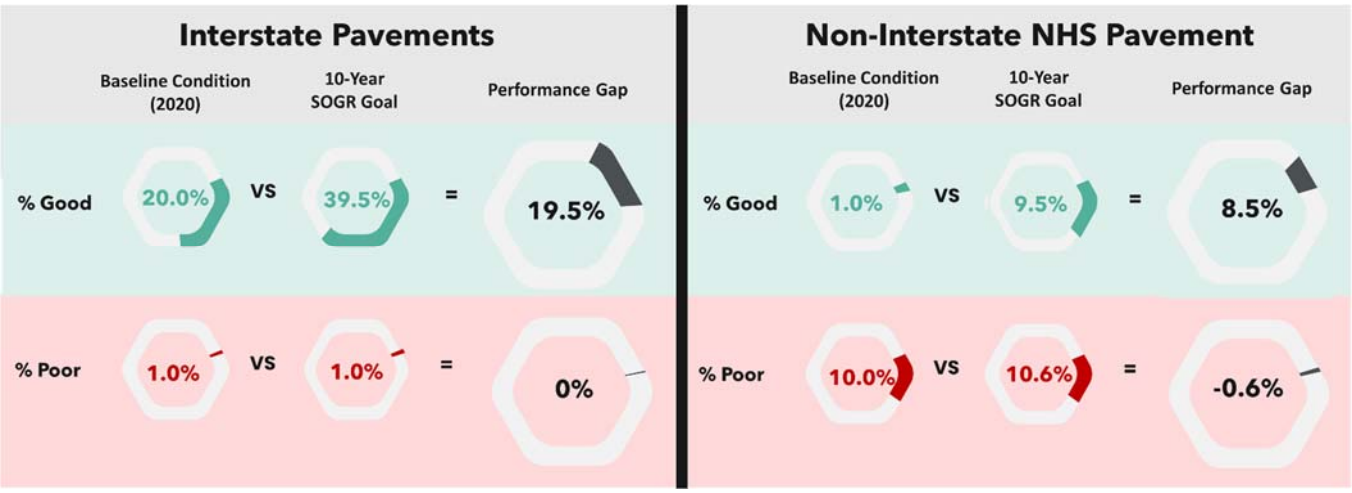


Figure 8-2. Performance Gap Between Baseline Condition (2020) and DDOT's SOGR Target for NHS Pavements

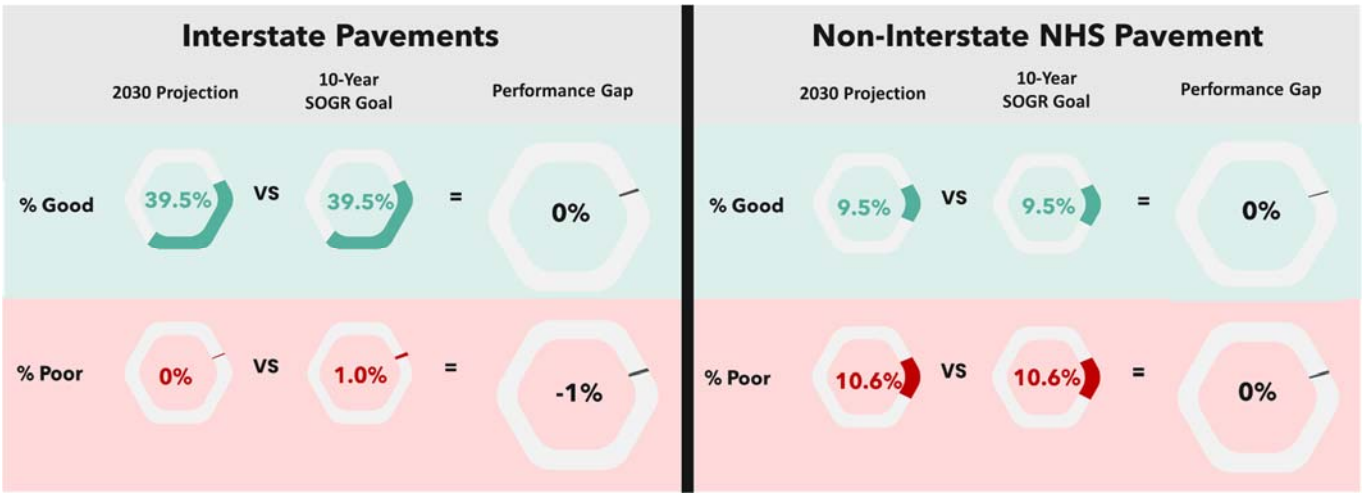


Figure 8-3. Performance Gap Between 2030 Projected Performance and SOGR Target for NHS Pavements

Bridge Performance Gap Analysis

Figure 8-4 and Figure 8-5 depict the outcome of the performance gap analysis for NHS bridges. The performance gap is defined as the percentage difference between the condition of the system—either the baseline condition (2020) or the projected condition in 10 years using the CIP + PM ($5M) + BFF scenario—and the Agency's SOGR performance goal. A positive performance gap for the percent of the system in Good condition implies that the baseline/projected performance is worse than the Agency's set performance goal, and a negative gap implies the performance is better than the set performance goal. For the percentage of the system in Poor condition, a positive performance gap indicates the baseline/projected performance is worse than the set performance goal, while a negative performance gap indicates it is better. As shown in the figures below, DDOT's NHS bridge system will improve from the 2020 baseline conditions and successfully meet its SOGR goals using the CIP + PM ($5M) + BFF investment strategy.

Figure 8-4. Performance Gap Between Baseline (2020) Performance and DDOT's SOGR Target for NHS Bridges

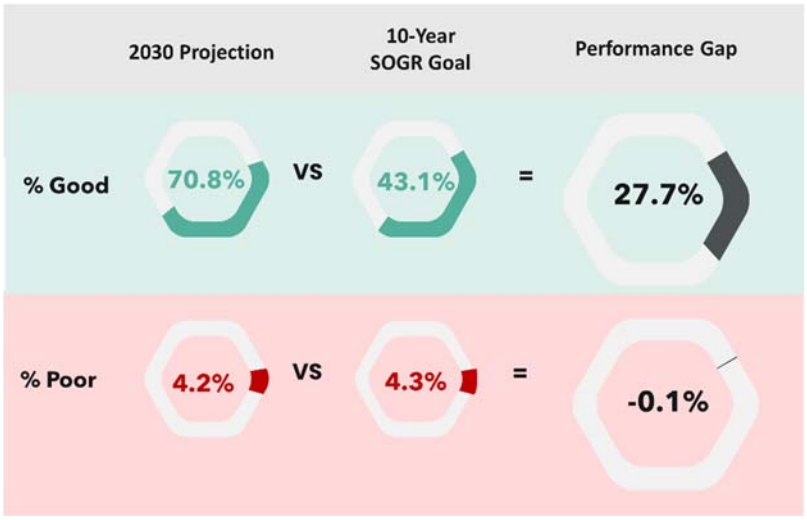


Figure 8-5. Performance Gap Between 2030 Projected Performance and SOGR Target for NHS Bridges

8.4. Investment Strategies

Based on the risk analysis, the financial planning, and performance gap analysis, DDOT has adopted a set of strategic principles to guide the development of investment strategies. Investment strategies are simply a set of tactics that enable a State to achieve performance targets while also minimizing costs and managing risks. The four strategic principles guiding DDOT's investment strategies include the following:

- **Use low-cost treatments (preservation) to help assets in "Good" condition stay in "Good" condition**: As discussed in Chapter 5 Life Cycle Planning, it is important to use a hybrid approach to treat assets. While the "worst-first" approach is important for reducing the percentage of assets in Poor condition, the "preservation-first" approach ensures that assets in Good condition are invested in so they can remain in Good condition for longer. This low-cost approach enables DDOT to avoid reliance on higher-cost rehabilitation and reconstruction treatments, as deferred treatments accelerate the deterioration of assets and increase lifecycle cost.

- **Maintain or reduce the number of bridges in Poor condition:** Until recently, DDOT's bridge inventory included a significant number of bridges in Poor condition. As a result, DDOT did not meet the required minimum performance targets for NHS bridges in 2020. Since then, DDOT has made a consistent effort to address the NHS bridges in Poor condition through continued investment, mainly through CIP. As a result, less than 10% of DDOT-owned bridges are currently in Poor condition. DDOT's goal is to ensure the number of bridges in Poor condition do not increase.
- **Halt the deterioration of large, critical bridges and pavements in the District:** DDOT's bridge inventory includes large bridges that contribute significantly to the total surface area of NHS bridges within the District. During the risk analysis process, these bridges were identified as a potential risk; due to the size of their deck area, these bridges can significantly increase the total deck area of bridges in Poor condition and hence impact DDOT's ability to meet federal regulations and established performance targets. To address this risk, DDOT uses this investment principle to identify high-risk bridges and target resources to halt the deterioration of critical bridge components through preservation and maintenance. DDOT uses this strategic principle to address pavement needs as well, ensuring resources are efficiently allocated, risks are efficiently managed, and cost is practicably minimized.
- **Improve asset conditions**: In addition to reducing the percentage of assets in Poor condition and maintaining assets in Good condition, DDOT also aims to improve the performance of its assets. This investment principle focuses on the actions that will improve current performance and enable DDOT to meet and exceed the national performance goals and established performance targets. Whereas the previous investment principles prioritize preservation, this approach will focus on capital investments in rehabilitation and reconstruction to help DDOT improve asset conditions and to meet expected demand and performance.

These guiding principles helped to inform the investment strategies developed for pavements and bridges. The subsections to follow describe the results of the investment strategies for each and the potential challenges in implementing these investment strategies.

Pavement Investment Strategies

To meet the performance targets set in **Chapter 4 Asset Performance Goals and Targets**, DDOT evaluated multiple life cycle planning scenarios to determine the minimal practicable cost to optimize pavement performance and meet these goals. As discussed in previous chapters, all the pavement analyses excluded funding for reconstruction because the CIP projects that are programmed within the next 5-year planning horizon will not have a significant impact on the performance of the NHS network. Based on these analyses and the guiding principles discussed in the previous section, an optimal investment strategy for the NHS network was developed.

Figure 8-6 provides the breakdown of investments by treatment type for Interstate and non-Interstate NHS pavements over the ten-year planning period covered by the investment strategy. Currently DDOT spends approximately 10% of the NHS maintenance funding on preservation. DDOT has piloted new (for DDOT) treatments like Microsurfacing for high volume roads for the NHS. This was completed through the State Highway Research Program (SHRP-2). DDOT plans to perform more preservation work and increase the level of investment for preservation work. Within the next ten years, DDOT expects to invest 54% and 4% of its annual budget on preservation for Interstate and non-Interstate NHS pavements, respectively. The remaining 46% and 96% of the Interstate and non-Interstate funding will be used on minor rehabilitation (such as mill and resurface). This increased investment in minor rehabilitation for non-Interstate NHS pavements is related to the current condition; there are more non-Interstate NHS pavements in Fair and Poor condition than Interstate pavements.

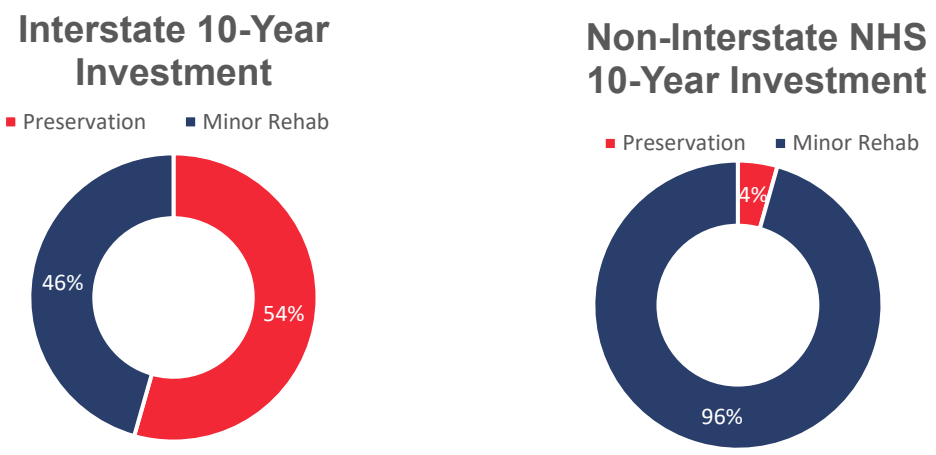
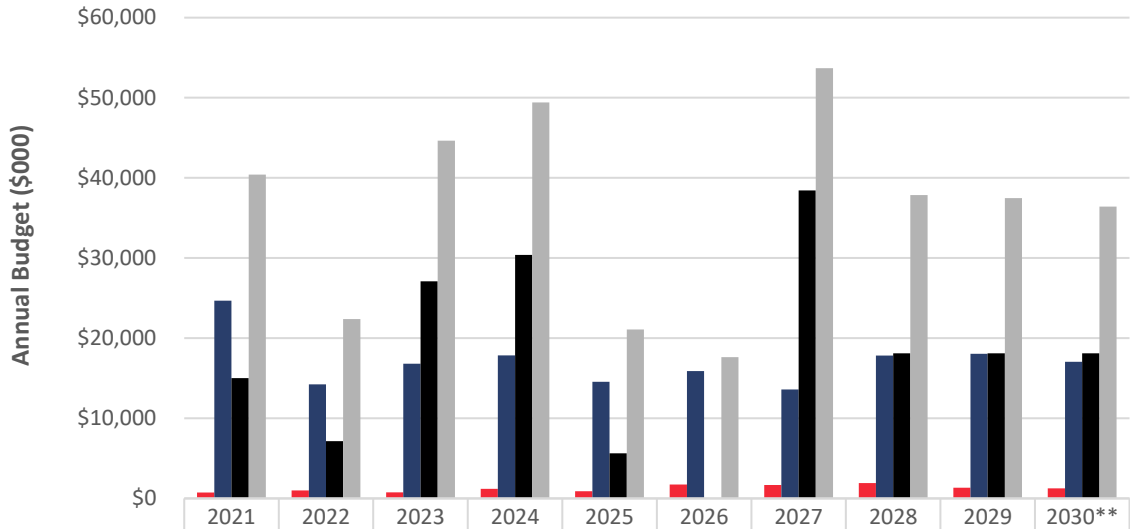


Figure 8-6. NHS Pavement 10-Year Investment Strategy

Figure 8-7 shows the annual breakdown of investments by treatment type between 2021 and 2030 using this pavement investment strategy. On average, a total of $15.8 million will be required annually for the suggested investment strategy.

Figure 8-8 show the annual expected performance for Interstate and non-Interstate NHS pavements given the total investment suggested for a given year. As indicated by the figures, the suggested investment strategy enables DDOT to meet its short-term and long-term performance goals for both Interstate and non-Interstate NHS pavements. However, as indicated previously, this investment strategy requires DDOT to invest an additional $5.8 million per year to meet these pavement targets.

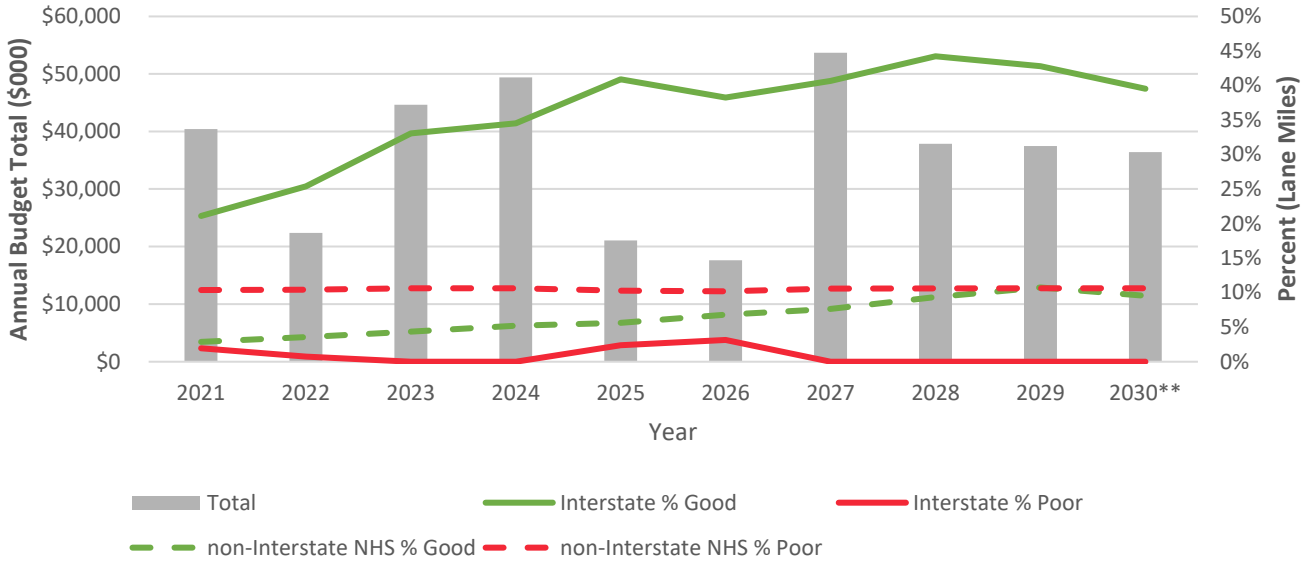


	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030**
Preservation	$731	$998	$748	$1,200	$883	$1,726	$1,670	$1,913	$1,330	$1,244
Minor Rehab	$24,672	$14,220	$16,800	$17,833	$14,555	$15,893	$13,594	$17,827	$18,035	$17,048
Major Rehab/Reconstruction (CIP)*	$15,000	$7,149	$27,086	$30,368	$5,631	$0	$38,417	$18,108	$18,108	$18,108
Total	$40,403	$22,367	$44,634	$49,401	$21,069	$17,618	$53,681	$37,848	$37,473	$36,400

* While CIP funding is included in the above, the CIP projects that will be completed in the next five years will not significantly impact the performance of the NHS pavement network. Additionally, an average value was used to populate the CIP budget for 2028–2030, as the existing financial projections for CIP stop at FY 2027.

** 2030 Preservation and Minor Rehabilitation values are based on the average spending for each, respectively.

Figure 8-7. Annual Investment Trend – NHS Pavement



** 2030 Preservation and Minor Rehabilitation values are based on the average spending for each, respectively.

Figure 8-8. Projected Performance and Funding – NHS Pavements

Bridge Investment Strategies

To meet the performance targets set for NHS bridges in **Chapter 4 Asset Performance Goals and Targets**, DDOT adopted an investment strategy based on the results of the CIP+PM($5M)+BFF LCP scenario. In this scenario, it is assumed that NHS bridges will receive the full CIP budget for NHS bridges, $5 million for preservation annually, and an additional $3 million annually for preservation between 2023 and 2026, inclusively, from the federal Bridge Formula program. Figure 8-9 provides the breakdown of investments by treatment type for NHS bridges over the ten-year planning period covered by the investment strategy. During this time, DDOT expects to invest 96% of its budget on CIP projects, 2% on Preservation (Repairs), and 2% on Preventative (Cyclical). As DDOT aims to continue to reduce the percentage of its NHS bridges in Poor condition, this investment strategy favors the prioritization of CIP projects.

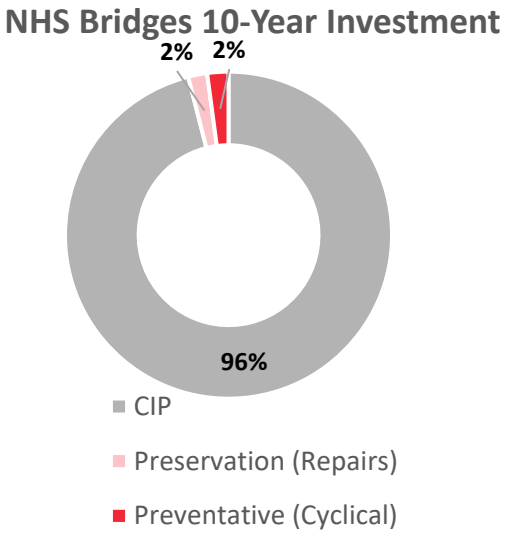
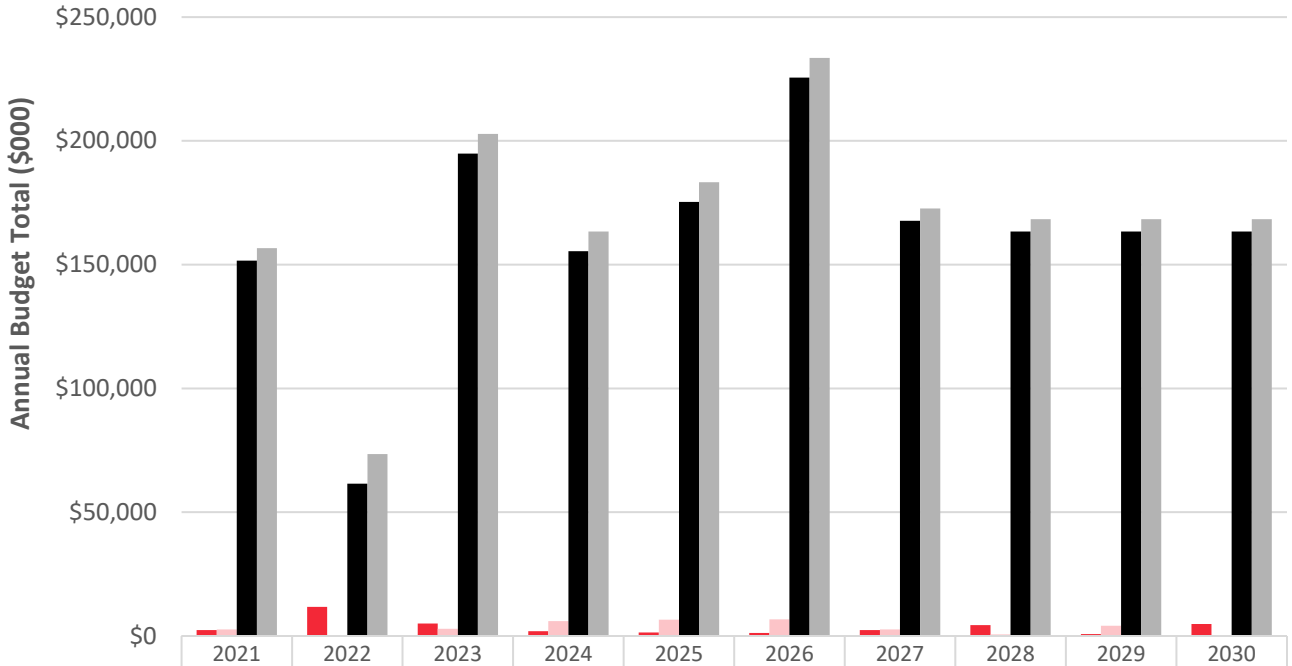


Figure 8-9. NHS Bridge 10-Year Investment Strategy

Figure 8-10 shows the annual breakdown of investments by treatment type between 2021 and 2030 using the NHS bridge investment strategy. On average, a total of $169 million, including CIP, is required annually for the suggested investment strategy. Figure 8-11 shows the annual expected performance for NHS bridges given the total investment suggested for a given year. As indicated by the figures, the suggested investment strategy enables DDOT to meet its short-term and long-term performance goals.



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Preservation (Repairs)	$2,362	$11,782	$5,039	$1,958	$1,396	$1,247	$2,370	$4,381	$803	$4,858
Preventative (Cyclical)	$2,638	$218	$2,936	$6,039	$6,585	$6,719	$2,620	$616	$4,155	$92
CIP*	$151,628	$61,488	$194,838	$155,388	$175,295	$225,512	$167,672	$163,365	$163,365	$163,365
Total	$156,628	$73,488	$202,813	$163,385	$183,276	$233,478	$172,662	$168,362	$168,324	$168,316

*An average value was used to populate the CIP budget for 2028–2030, as the existing financial projections for CIP stop at FY 2027.

Figure 8-10. Annual Investment Trend – NHS Bridges

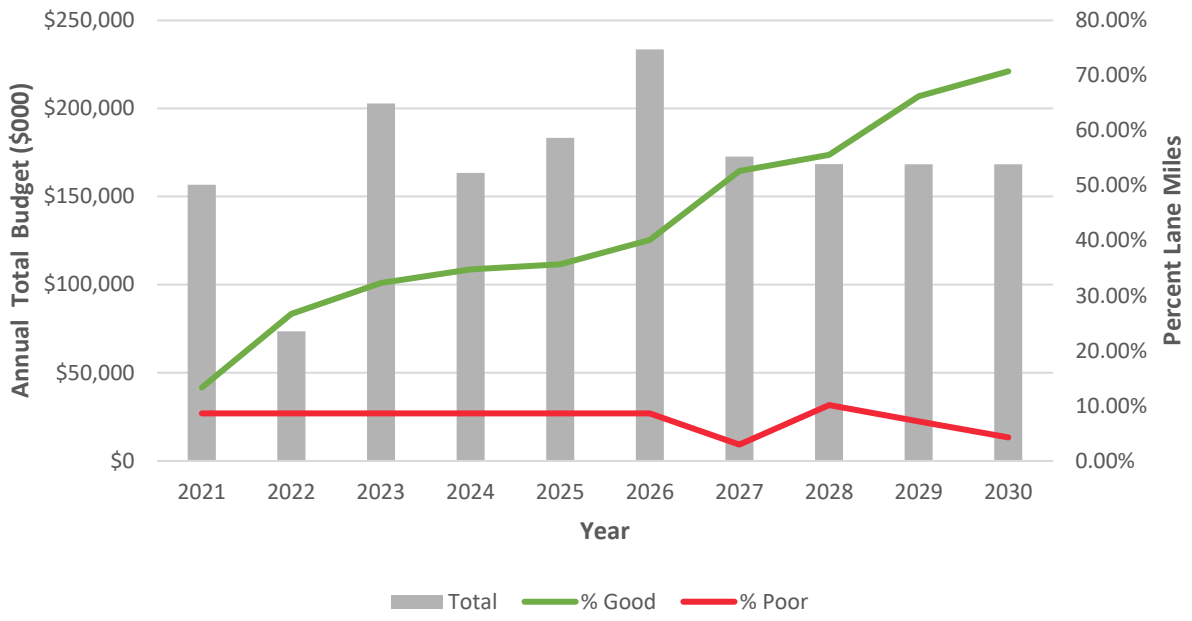


Figure 8-11. Projected Performance and Funding – NHS Bridges (Scenario: CIP + Preservation + BFF)

Challenges

While the Agency aims to implement the investment strategies described above, DDOT recognizes that the performance of NHS assets is affected by a myriad of factors DDOT cannot control. Specifically, uncertainty in funding and project delivery, lack of control over NPS assets, and the limitations of the existing pavement management and bridge management systems are three potential challenges DDOT may face when implementing the suggested investment strategies.

The first challenge is related to uncertainty in pavement and bridge funding over the next ten years. While DDOT is confident that a minimum of $10 million will be available for NHS pavements and $5 million for NHS bridges, any funding outside of this is subject to uncertainty and delay. In the case of NHS bridges, without the additional funding provided by the CIP or the BFF, the suggested investment strategy cannot be implemented. Therefore, it is unlikely DDOT would be able to meet its short-term and long-term performance goals. DDOT has accounted for some delay of CIP project completion within its bridge asset management system, where the completion of CIP projects, and therefore the improvement of the overall NHS system, is strategically shifted one or more fiscal years. For pavements, an additional $5.8 million for the NHS is crucial for the successful implementation of the investment strategy described. To address this, DDOT has communicated the financial need and potential penalty the Agency would face if the funding were not available to its Executives.

Another challenge that the Agency may face in successfully implementing the investment strategies described is related to NPS assets. While NPS assets on the NHS are currently in fairly good condition and therefore are not preventing DDOT from meeting federal minimum requirements, there could be a scenario, especially for NHS bridges, where the performance of these NPS assets contribute to a larger percentage of the system being in Poor condition. To mitigate the impact of such an event, DDOT has and will continue to communicate with and monitor the performance of NPS assets through stakeholder engagement. In doing so, DDOT can plan on adjusting its pavement and bridge investment levels to account for changes in NPS asset performance.

The final challenge in implementing or achieving the performance targets of the different investment strategies is related to the method in which the investment strategies were developed. While DDOT has made notable progress in developing and implementing asset management systems for both its pavements and bridges, these systems may not perfectly model real-world conditions. Therefore, it is possible that while the projected performance of the NHS system under the determined investment strategies shows the system meeting performance goals, real-world conditions result in worse performance than expected. This may be the result of the increased premature deterioration of assets due to many external factors like extreme weather, utility cuts, unforeseen subsurface defects and failures, or other events which DDOT cannot directly control. Instead,

DDOT will continue to monitor the actual performance of its assets versus the projected performance and adjust the pavement and bridge management systems accordingly.

8.5. Asset Sustainability Reporting

$$\text{Asset Sustainability Index} = \frac{\text{Asset Class Fiscal Year Budget}}{\text{Asset Class Fiscal Year Needs}}$$

Asset sustainability refers to an Agency's ability to manage the long-term performance of its physical assets. Because assets require investment to maintain an acceptable level of condition, asset sustainability is focused on the difference between the financial needs to maintain an asset and the investment the Agency makes available to maintain that asset. FHWA recommends the evaluation of asset sustainability using an Asset Sustainability Index (ASI)[16]. ASI is the ratio of the amount budgeted for an asset divided by the amount needed to adequately sustain the infrastructure at a targeted condition. An index of one or more indicates the asset investments meet the financial needs to maintain or improve performance while an index less than one indicates the Agency is underfunding and will need additional investment to close the performance gap. For DDOT, ASI is calculated for each asset class for each fiscal year, where the asset class need refers to the level of funding necessary for the Agency to meet its SOGR goals.

In cases where the ASI for pavement or bridges falls below one, DDOT will require additional investment to meet performance goals. In cases where the ASI of one asset is greater than one and the ASI of the other asset is less than one, DDOT will consider the diversion of funding from the asset with an ASI greater than one to the asset with an ASI less than one. In cases where both assets have an ASI less than one, DDOT will need to look to both internal and external sources to meet the necessary investment levels. Internally, sources may include funding for other assets outside of pavements and bridges or changes to the ways in which assets are treated to emphasize lower-cost but highly effective treatments such as preservation. Externally, the use of fees, taxes, or bonds imposed by the District may provide additional sources for investment.

Figure 8-12 provides a summary of the ASI for pavements over the next five years. For all years, the ASI of NHS pavements is less than 1, indicating that existing funding levels are insufficient and that additional funding is necessary for the network's performance to be sustained. For bridges, the ratio of the NHS bridge budget and the NHS bridge needs are equal for the next 10 years; the performance targets for NHS bridges were developed based on the availability of the CIP funding, BFF, and $5 million for preservation. Therefore, NHS bridges have an ASI of 1 for the next 5 years.

[16] FHWA, Asset Sustainability Index: Quick Guide. 2013

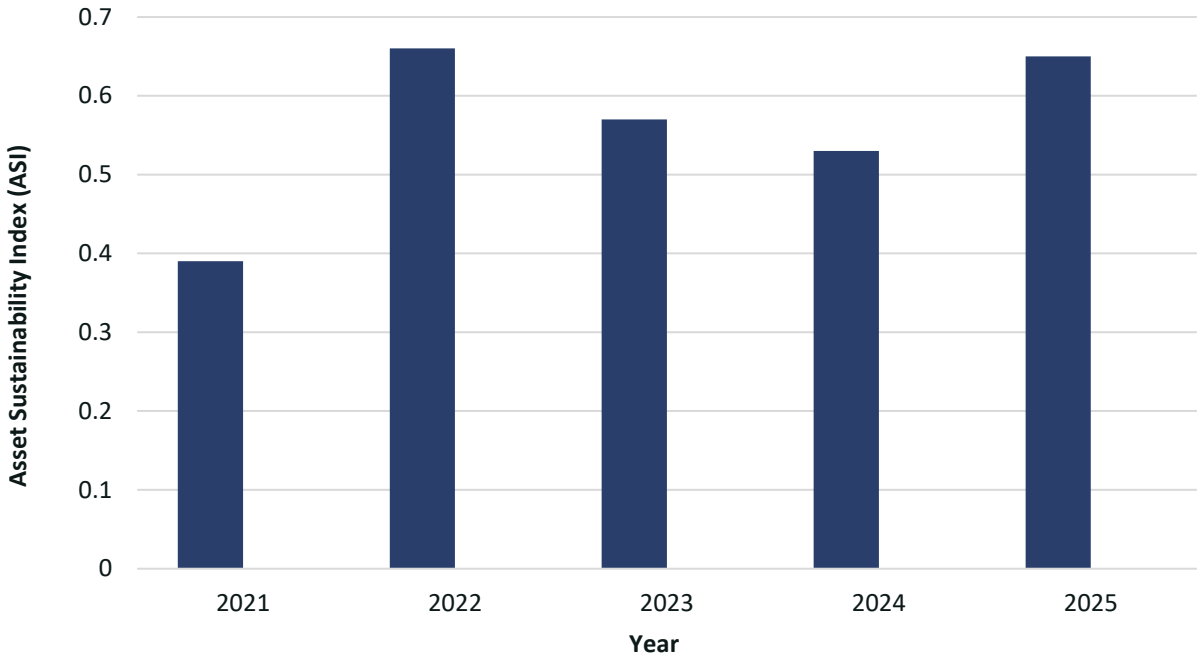


Figure 8-12. Asset Sustainability Index Over Time for Pavement

Intentionally left blank

Chapter 9. Continuous Process Improvement

9.1. Overview

Since the development of the 2019 TAMP, DDOT has made great strides in addressing gaps within the transportation asset management program. Of the forty-three action items proposed to strengthen and support DDOT's vision for TAM in DDOT's *TAM Strategic Plan*, thirty-six action items have been completed or are currently underway. While this progress signifies DDOT's TAM program is maturing, the Agency still strives to continually improve upon and strengthen the quality of information provided in the TAMP and the effectiveness of TAM processes. To help in this effort, DDOT promotes continuous process improvement; the Agency prioritizes improvements to TAM and monitors and reports on the progress made in implementing proposed improvements. This chapter provides a summary of the process DDOT uses to identify actions for TAM improvement, prioritize actions, and monitor and report these actions, as well as the barriers to improvement. A summary of each subsection is provided below.

Improvement Priorities

This section describes areas within TAM that DDOT aims to improve and strengthen for the next iteration of the TAMP.

Monitoring and Reporting

This section describes how DDOT will monitor and report implementation progress.

Barriers to Improvement

This section summarizes the main challenges DDOT faces in implementing TAM improvement activities.

9.2. Improvement Priorities

As part of the TAMP development process, FHWA encourages State DOTs to conduct periodic self-assessments of TAM capabilities. As such, DDOT has developed and is in the process of updating its *TAM Strategic Plan*. By updating the TAM Strategic Plan, DDOT conducts an evaluation of improvements made, as discussed in **Chapter 1 Introduction**, and gaps the District will address moving forward. In this subsection, a summary of the process used to assess areas of improvement within TAM and the resulting action items from this assessment are summarized.

Continuous Process Improvement in DDOT

Continuous process improvement is the ongoing assessment and enhancement of the way things are done within an organization. With respect to TAM, continuous process improvement refers to the iterative implementation, assessment, and revisions taken to improve TAM processes and ensure alignment with the mission, strategic goals, and objectives of asset management within the Agency. For example, as discussed in **Chapter 1 Introduction**, DDOT has made significant progress in improving its data management program for asset data. Over the past three years, DDOT has conducted data discovery workshops to better understand its asset data and developed a strategic data business plan in response to the workshop findings. However, DDOT will not stop there; improvement of its data management program for asset data requires continual implementation and assessment to make sure the products, plans, and processes developed are meeting DDOT's needs. Other examples of areas in which DDOT implements continuous process improvement include communication of TAM materials, pavement and bridge decision trees, and asset deterioration modeling.

DDOT utilizes continuous process improvement to close existing gaps identified throughout the development of the TAMP and within the *TAM Strategic Plan*. Key improvement actions identified through this process correspond to one of three asset management enablers—policies, procedures, structures, and tools that provide additional motivation for improvement—and at least one of the six overarching improvement areas described in **Chapter 1 Introduction**. Within DDOT, key asset management enablers include Agency culture, business processes, and data and technology, as summarized in Figure 9-1.

Figure 9-1. Asset Management Enablers and Improvement Areas within DDOT

Improvement Areas and Action Items

Through the assessment conducted as part of the development of this TAMP and the Agency's updated *TAM Strategic Plan,* action items/initiatives were identified for the improvement of DDOT's TAM program. One example is the need for continuous improvement of engineering and construction applications. DDOT continues to explore various construction methods and treatments that will help improve the performance of the assets. In addition to the pilot Microsurfacing study, DDOT has implemented treatments like saw cut and seal on new asphalt surface because the treatment was found to reduce joint reflective cracking on composite pavement.

Additional action items identified through this process were categorized into one of the three improvement or asset management enabler categories. To make each initiative easier to measure, a Key Performance Indicator (KPI) was identified for most action items. Details of how each action item is prioritized and specific subtasks for each are currently being developed as a part of the *TAM Strategic Plan* update. DDOT will use these action items to drive progress within TAM and regularly update and monitor the status of their completion. Figure 9-2 provides a summary of the some of the key initiatives and improvements that DDOT has identified to strengthen its TAM program.

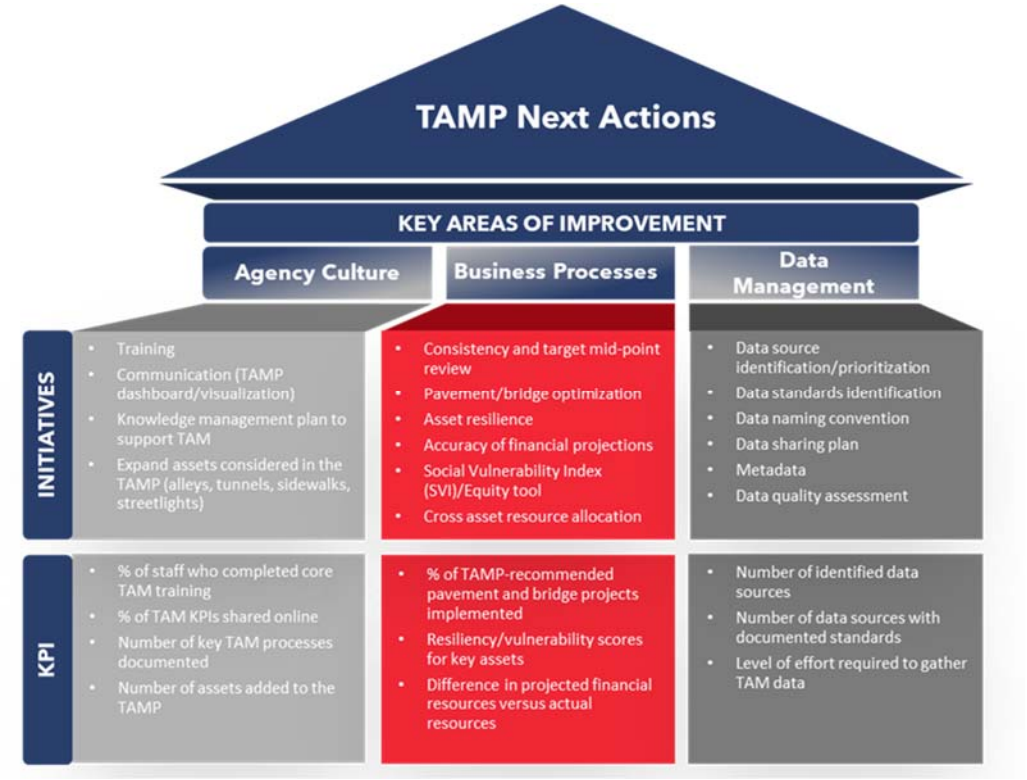


Figure 9-2. DDOT TAM Strategic Initiatives

9.3. Monitoring and Reporting

To facilitate implementation, DDOT will actively monitor and report on the progress made in completing each action item and identify implementation issues. The Agency plans to develop a dashboard to update the status of the action items in real-time and to assign champions to lead each action item. The dashboard will provide information on the steps taken to improve TAM processes throughout the year and will be supplemented with frequent review by the TAM Project Management Team. More detailed subtasks will be documented within the Agency's *TAM Strategic Plan* update. As the needs and resources available to DDOT change, the action items will be updated to accommodate changing conditions.

9.4. Barriers to Improvement

As discussed, DDOT has made and will continue to make significant improvements within its TAM program. However, the Agency's overall progress is limited by challenges familiar to many DOTs. The following highlights the main hurdles hindering the advancement of TAM and the implementation of the TAM processes within DDOT.

- **Resource Allocation** – Like many DOTs, DDOT must balance its scarce resources with the many needs of the Agency. This challenge tends to impact TAM investments as funding is allocated to other investment priorities, which often are not consistent with the investment strategies detailed in the TAMP. This funding uncertainty can prevent DDOT from meeting the criteria of a TAMP consistency review and hinder the Agency's ability to meet asset performance targets and FHWA minimum condition requirements for its primary assets. Besides funding, DDOT also deals with other resource issues such as workforce capacity to support TAM initiatives.

- **Project Delivery** – The timely delivery of projects significantly impacts DDOT's ability to adhere to TAMP investment strategies and meet established performance targets and Agency goals. The main drivers of a delay in project delivery include funding uncertainty or availability, as described above, and the lack of capacity to undertake projects. The District has a unique challenge to balance utility work, safety, mobility, and delay with ongoing projects. Due to the interconnectedness of DDOT's transportation network, the Agency can only take on a limited number of capital or maintenance projects at one time. Some programmed projects are delayed, allowing for coordination with other planned utility work. These challenges have caused DDOT to delay critical projects that contribute to asset performance and targets significantly.

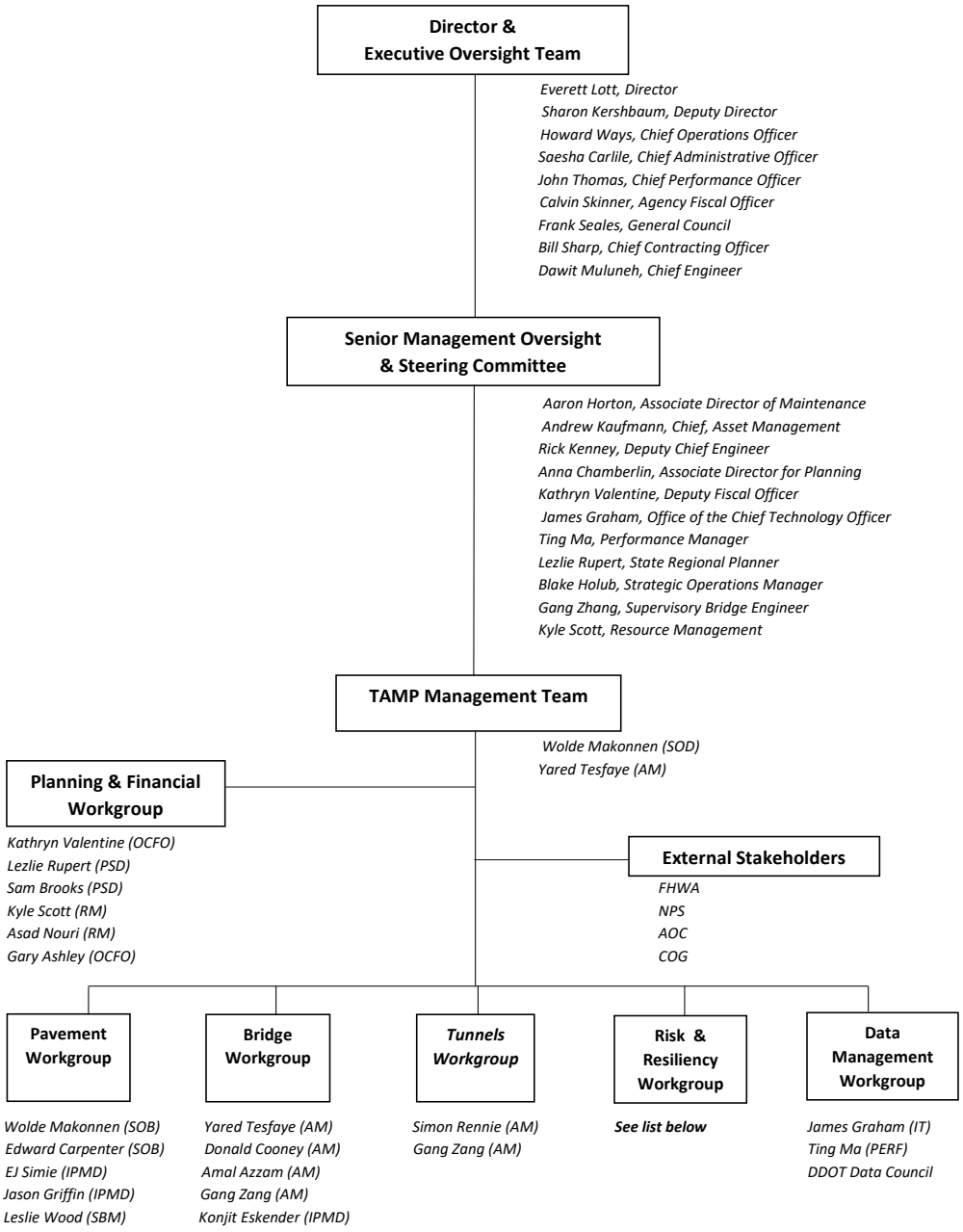
- **Data Availability** – Data is the cornerstone of TAM analysis. The ability of DDOT to expand TAM to assets outside of NHS pavements and bridges depends on the availability of accessible and high-quality data. Although DDOT has made significant progress in developing a complete database for bridge and pavement analysis, there still exist areas, such as bridge cost data, that can benefit from improvement. As a result, DDOT plans to integrate TAM information by acquiring an Enterprise Asset Management System (EAMS) that meets the Department's needs. DDOT started this process by conducting a data discovery workshop in the summer of 2020, which resulted in a model EAMS architecture.

- **TAM Integration** – TAM does not happen in a vacuum, so it is DDOT's long-term goal to fully integrate TAM with other planning processes and strategic documents in the Agency. Achieving and sustaining an agency-wide TAM program will require DDOT to demonstrate how TAM promotes the goals of these planning processes and strategic documents. For example, DDOT made progress in including TAM criteria in its Transportation Improvement Plan (TIP) call for projects process. This improvement allows DDOT to track pavement expenditure by work type in the financial reporting system. In the long term, DDOT plans to achieve comprehensive integration by implementing the TAM communication and training plans to create awareness, disseminate TAM benefits, and train the workforce to use TAM principles that inform other strategic and business activities.

In identifying these challenges to implementation, DDOT aims to monitor each over time. As discussed in **Chapter 6 Risk Management Analysis**, DDOT has developed specific actions to help alleviate and bring awareness to these challenges or risks and will continue to work to mitigate these issues in the pursuit of a more mature and robust TAM program.

ACKNOWLEDGEMENTS

This document was developed through the various contributions of DDOT's internal team and external stakeholders. Specifically, the TAMP was developed through the valuable contributions of the TAMP Project Management Team, the TAM Implementation Team (see below), DDOT's external stakeholders including the Federal Highway Administration, National Park Service, the Metropolitan Washington Council of Governments, and the Architect of the Capitol, and the DDOT's consultants on the TAMP, Wood Environment and Infrastructure Solutions (E&IS).



AM:	Asset Management Division	SOD:	Strategic Operations Division	RM:	Resource Management
IPMD:	Infrastructure Project Management Division	OCFO:	Office of the Chief Financial Officer	PERF:	Performance Management
SRPD:	State and Regional Planning Division	OCP:	Office of Contracting & Procurement	NPS:	National Park Service
TOSD:	Traffic Operations & Safety Division	SBM:	Street & Bridge Maintenance Division	AOC:	Architect of The Capitol
SSD:	Safety and Security Division	COG:	Council of Governments		

RISK WORKGROUP

Tesfaye, Yared - AM
Horton, Aaron - AM
Azzam, Amal - AM
Tackoor, David - IPMD
Platek, Margaret - OCP
Cooney, Donald - AM
Carpenter, Edward - SOD
Simie, Ej - IPMD
Griffin, Jason - IPMD
Valentine, Kathryn - OCFO
Eskender, Konjit - IPMD
JonesBest, Natalie - SSD
Henderson, Sandra - OGC
Rennie, Simon - AM
Kaufmann, Andrew - AM
Zhang, Gang - AM
Holub, Blake - SOD
Achebe, Eloka - AM
Scott, Kyle - RM
Rupert, Lezlie - SRPD
Wood, Leslie - SBM
Kim, Huntae - IPMD
Dorriz, Zahra - IPMD
Shakeri, Ali – IPMD
Makonnen, Wolde – SOD

APPENDIX A. RISK REGISTER

Risk Event/Activity	Risk Potential Impact	Likelihood	Consequence				Risk Score	Mitigation Strategy	Mitigation Actions	Risk Owners
			Mobility	*Safety*	*Asset Damage*	*Finance*				
Inability to procure qualified contractors in a reasonable amount of time and at a reasonable cost to support program delivery.	• Delays in project delivery. • Unmet program and performance goals. • Increased customer complaints. • Negative impacts on the Department's reputation.	5	4	4	4	4	20	Treat: Management Required	• Communicate the impact of project delays on program goals. • Review existing standard operating procedures and procurement timelines. • Optimize contracting methods for early completion.	Office of Contracting and Procurement (OCP)
Local funding appropriation is impacted by objectives and goals of changing leadership.	• Unmet department and program goals and performance targets. • Unfunded local projects. • Increased customer complaints.	5	3	4	4	4	19	Treat: Management Recommended	• Secure buy-in from the executive leadership team. • Pursue processes, tools, or policies that institutionalize asset management.	Asset Management
Loss of performance or damage to assets due to the failure of utilities assets or buried pipes.	• Premature failure of transportation assets. • Extended roadway closures. • Increased cost due to emergency repairs. • Delayed projects due to the diversion of funds for emergency repairs. • Increased safety and mobility concerns.	5	3	4	4	3	18	Tolerate: Close monitoring Required	• Establish a working understanding with utility agencies. • Require performance-based repairs from utility agencies. • Improve repair and performance enforcements.	Asset Management

Risk Event/Activity	Risk Potential Impact	Likelihood	Consequence				Risk Score	Mitigation Strategy	Mitigation Actions	Risk Owners
			Mobility	*Safety*	*Asset Damage*	*Finance*				
Use of poor-quality materials and workmanship.	• Increased construction defects. • A decreased expected service life of assets. • Increased deterioration rate. • Increased cost due to premature failure.	5	3	3	4	4	18	Treat: Management Required	• Enhance project inspections to comply with industry standards and project specifications. • Implement and enforce strict quality control processes in contract documents.	Project Delivery
Program delivery impacted by multimodal or corridor-related projects.	• Delayed projects due to the lack of funding. • Unmet performance targets and goals. • Inefficient use of limited resources.	5	3	3	4	4	18	Treat: Management Required	• Communicate the impact of project delays on program goals to stakeholders. • Secure buy-in from the executive leadership team. • Coordinate with other departments to consider asset performance during project selection.	Asset Management
Effect of extreme weather (flooding, heat, etc.) on assets.	• Premature failure of transportation assets. • Increased cost due to emergency repairs. • Delayed projects due to the diversion of funds for emergency repairs. • Increased safety and mobility concerns.	4	4	4	4	4	16	Treat: Management Required	• Continue to monitor the impact of extreme weather events as part of the Part 667 analysis. • Coordinate with the stormwater department and other external stakeholders on extreme weather mitigation strategies.	Asset Management

Risk Event/Activity	Risk Potential Impact	Likelihood	Consequence				Risk Score	Mitigation Strategy	Mitigation Actions	Risk Owners
			Mobility	*Safety*	*Asset Damage*	*Finance*				
Lack of motivation for agency-wide asset management at DDOT.	• Reduced efficiency in operation. • Inefficient uses of limited resources. • Lack of consistency in information and business process. • Decreased information sharing.	4	3	3	4	4	14	Treat: Management Required	• Develop an asset management strategy. • Develop resources and tools (communication and training) to facilitate buy-in at all levels. • Develop a framework to prioritize other assets into the TAM program. • Start with already visible programs such as sidewalks and alleys.	Office of the Director/Asset Management/ Division Heads
Inability to attract workforce with required experience and expertise.	• Increased delays in program delivery. • Overstretched workforce. • Increased cost due to increased dependency on external resources.	4	3	4	4	3	14	Treat: Management Required	• Improve outreach programs to target all levels of the school system to expose students to the opportunities that exist and the required education and skills. • Expand job advertisement to an external audience. • Expand internal training to enable cross-training and effective transfer of internal staff.	Human Resources/ Division Heads

Risk Event/Activity	Risk Potential Impact	Likelihood	Consequence				Risk Score	Mitigation Strategy	Mitigation Actions	Risk Owners
			Mobility	*Safety*	*Asset Damage*	*Finance*				
Inefficient use of project management tools to support program delivery.	• Increased costly failed projects. • Unmet project and program goals. • Unmet performance goals. • Unmet customer expectation.	4	3	3	4	4	14	Treat: Management Required	• Enforce or enhance existing project management strategies. • Establish formal training to introduce staff to current tools and techniques. • Develop a complete inventory of current tools and their capabilities.	Human Resources/IT/Training Department
Effect of truck weight on asset performance.	• Increased asset rate of deterioration. • Increased cost due to frequent restoration work.	4	4	4	3	3	14	Treat: Management Recommended	• Monitor asset deterioration and analyze the impact of truck weight on decline. • Reduce overweight trucks on critical roads and bridges. • Develop adaptive design guidelines.	Asset Group Owners
Lack of funding due too poor prediction of funding	• Deferred maintenance will lead to increased replacement cost. • Unmet performance goals. • Unmet customer expectations.	4	3	3	4	4	14	Treat: Management Recommended	• Enhance and implement analytical tools to support asset management and needs assessment. • Use innovative analysis techniques. • Communicate the impact of deferred maintenance on future cost and performance.	Asset Management

Risk Event/Activity	Risk Potential Impact	Likelihood	Consequence				Risk Score	Mitigation Strategy	Mitigation Actions	Risk Owners
			Mobility	*Safety*	*Asset Damage*	*Finance*				
Effects of inflation on funding capital and maintenance projects.	• A decreased purchasing power of available funds. • Increased cost in funding projects. • Delayed projects due to the lack of funding. • Unmet performance goals.	4	3	3	3	4	13	Treat: Management Recommended	• Maintain consistent and effective escalation rate to use in all financial projections. • Identify other sources of funds for future use.	Finance
Lack of required data management systems and strategies to support performance-based program delivery.	• Decreased objectivity in decision making. • Inefficient use of available resources. • Lack of consistent data on assets. • Increased unexpected asset failure.	4	3	3	4	3	13	Treat: Management Required	• Develop an agency-wide strategy for data and information flow. • Conduct asset management tools assessment and identify needs and improvements for system capabilities. • Develop a long-term implementation plan to improve asset management system functionalities and capabilities.	IT/Asset Group Owners
Unexpected variations in project cost (i.e., labor or material shortages).	• Increased change order request. • Delayed projects. • Increased agency costs. • Reduced trust in agency capability.	4	2	3	4	4	13	Treat: Management Required	• Use practical tools to support better scope development.	Project Delivery

Risk Event/Activity	Risk Potential Impact	Likelihood	Consequence				Risk Score	Mitigation Strategy	Mitigation Actions	Risk Owners
			Mobility	*Safety*	*Asset Damage*	*Finance*				
Federal and local funding are significantly reduced across the board for transportation.	• Increased asset deterioration. • Unmet programs goals. • Loss of flexibility in using federal funds.	3	4	4	4	4	12	Tolerate: Risk may be acceptable, but requires monitoring	• Consider alternative funding sources to meet asset needs. • Pursue processes, tools, or policies that institutionalize asset management and the funding of primary assets.	Asset Management
Maintenance and preservation projects are deferred due to prioritization of other strategic initiatives (such as capacity/expansion projects).	• Delayed projects due to the lack of funding. • Unmet performance targets and goals. • Inefficient use of limited resources. • Deferred maintenance will lead to increased replacement cost. • Unmet performance goals. • Unmet customer expectations.	3	4	4	4	4	12	Tolerate: Risk acceptable, requires regulation	• Communicate the impact of maintenance and preservation on program goals to stakeholders. • Secure buy-in from the executive leadership team. • Coordinate with other departments to consider maintenance and preservation during project selection.	Asset Management
Loss of expertise and institutional knowledge due to staff turnover and retirement.	• Overstretched workforce. • Increased hiring cost. • Loss of consistency in business processes and smooth operation.	4	3	3	3	3	12	Treat: Management Required	• Develop and implement an effective knowledge management strategy to capture essential knowledge and critical skills of retiring generation. • Develop and implement effective employee retention strategies to maintain a steady workforce.	Human Resources

Risk Event/Activity	Risk Potential Impact	Likelihood	Consequence				Risk Score	Mitigation Strategy	Mitigation Actions	Risk Owners
			Mobility	*Safety*	*Asset Damage*	*Finance*				
Unanticipated increases in project scope impact project delivery.	• Increased change order request. • Delayed projects. • Increased agency costs. • Reduced trust in agency capability.	4	3	3	3	3	12	Treat: Management Required	• Use practical tools to support better scope development.	Project Delivery
Effect of economic development on asset performance.	• Increased usage of assets increases asset deterioration. • Increased cost to maintain and preserve asset performance.	4	3	3	3	3	12	Treat: Management Recommended	• Conduct studies and research to track and project the impact of economic development on asset performance and demand. • Communicate information with decision makers. Align feature designs with study findings.	Asset Management
Cybersecurity threat on systems.	• Loss of pavement and bridge data to support TAM. • Declining agency's reputation.	3	4	4	3	4	11	Treat: Management Recommended	• Develop an agency-wide strategy for cybersecurity of asset data. • Develop a long-term implementation plan to improve security of asset management data.	IT/Asset Group Owners

Risk Event/Activity	Risk Potential Impact	Likelihood	Consequence				Risk Score	Mitigation Strategy	Mitigation Actions	Risk Owners
			Mobility	*Safety*	*Asset Damage*	*Finance*				
Effect of a pandemic event.	• Delayed projects due to the lack of resources. • Unmet performance targets and goals. • Deferred maintenance/ preservation will lead to increased replacement cost.	3	4	4	3	3	11	Treat: Management Recommended	• Conduct studies and research to track and project the impact of pandemic events on asset performance and demand. • Communicate information with decision makers.	Asset Management
Lack of coordination between Departments/assets within DDOT.	• Inefficient use of available resources. • Lack of consistent data on assets.	3	3	3	3	3	9	Treat: Management Recommended	• Conduct regular coordination meetings to ensure asset groups are aligned/not duplicating work. • Implement an enterprise asset management system.	Asset Management /Asset Group Owners
Unfunded federal mandates impact the ability to deliver programs efficiently.	• Increased asset deterioration. • Unmet programs goals. • Loss of flexibility in using federal funds.	2	4	4	4	4	8	Tolerate: Risk may be acceptable, but requires monitoring	• Monitor funding trends. • Adopt effective resource allocation tools and techniques to balance limited resources with performance. • Explore other project delivery methods.	Asset Management

Risk Event/Activity	Risk Potential Impact	Likelihood	Consequence				Risk Score	Mitigation Strategy	Mitigation Actions	Risk Owners
			Mobility	*Safety*	*Asset Damage*	*Finance*				
Loss of performance or damage to assets due to retaining wall failure or slope failure.	• Increased emergency repair costs. • Unmet performance goals. • Increased mobility and safety concerns.	3	2	2	3	3	8	Treat: Management Recommended	• Develop a framework to implement other assets into the TAM program. • Communicate the impact of wall failure to stakeholders. • Identify critical walls and monitor performance.	Asset Management
Inability to meet performance goals due to the drop in performance of large, critical bridges.	• Loss of flexibility in using federal funds. • Unmet federal minimum requirements. • Increased deterioration in bridges causing safety concerns.	2	4	4	4	4	8	Treat: Management Recommended	• Implement a bridge management system capable of analyzing bridge performance and budget. • Prioritize bridge preservation and investments based on performance, criticality, and risk.	Bridge Group
Loss of performance or damage to assets due to hazardous material spills.	• Increased emergency costs. • Increased safety concerns.	2	3	4	4	3	7	Treat: Management Recommended	• Increase visible signs in high-risk locations. • Provide effective barriers at high-risk locations.	Asset Group Owners

Risk Event/Activity	Risk Potential Impact	Likelihood	Consequence				Risk Score	Mitigation Strategy	Mitigation Actions	Risk Owners
			Mobility	*Safety*	*Asset Damage*	*Finance*				
Loss of performance or damage to assets due to the failure of other ancillary assets.	• Deferred maintenance and preservation due to transfer of funds to address the unexpected failure of ancillary assets. • Unmet performance goals. • Increased mobility and safety concerns.	3	2	2	2	3	7	Treat: Management Recommended	• Develop resources and tools (communication and training) to facilitate holistic asset management and buy-in from all levels of the Department. • Develop a framework to prioritize other assets into the TAM program. • Start with already visible programs such as sidewalks and alleys.	Asset Management

APPENDIX B. HIGH-RISK TACTICAL PLAN

Risk 2: Local funding appropriation is impacted by objectives and goals of changing leadership.

Description

Change in local funding appropriation due to a change in leadership. For example, the local funding appropriation might prioritize improving the geometrics of roads and bridges with high crash rates. This will impact the types of projects that are let and therefore, effect the performance of DDOT's primary assets.

Risk Owners

Asset Management

Mitigation Response

Treat: Management Required

Tactical Activities

- Secure buy-in from the executive leadership team.
- Pursue processes, tools, or policies that institutionalize asset management.

Supporting Tasks

- Communicate the benefits of asset management to executive leadership using compelling data-driven analysis and training.
- Involve executive leadership in TAMP development process so stakeholders are aware of the risk impacts.

Risk 3: Loss of performance or damage to assets due to the failure of utilities assets or buried pipes.

Description

Assets are damaged or lose performance as utility cuts are necessary to address utility failures or buried pipes. While the management of utilities is important, utility cuts and utility failure have a notable impact on asset deterioration/performance.

Risk Owners

Asset Management

Mitigation Response

Tolerate: Close monitoring required

Tactical Activities

- Establish a working understanding with utility agencies.
- Require performance-based repairs from utility agencies.
- Improve repair and performance enforcement.

Supporting Tasks

- Establish policies to coordinate street cut/ repairs to reduce work on recently treated assets.
- Assist in the development of a plan or policy for performance-based repairs.
- Incorporate repair and performance policies into contracts.

Risk 4: Use of poor-quality materials and workmanship.

Description

Poor-quality materials and/or construction practices are used to construct or repair assets. This could result in accelerated asset deterioration and lead to an overall degradation of network performance.

Risk Owners

Project Delivery

Mitigation Response

Treat: Management Required

Tactical Activities

- Enhance project inspections to comply with industry standards and project specifications.
- Implement and enforce strict quality control processes in contract documents.

Supporting Tasks

- Develop a guide for project inspections based on a literature review of industry standards.
- Consider past performance and quality of previous work when selecting contractors.
- Conduct contract auditing and reporting for asset-related projects.

Risk 5: Program delivery impacted by multimodal or corridor-related projects.

Description

Program delivery is focused on multimodal or corridor-related projects. While these projects can lead to a more resilient network and lessen structural damage to the network, the prioritization of these projects may lead to less funds for treating primary assets and maintaining the system in a SOGR.

Risk Owners

Asset Management

Mitigation Response

Treat: Management Required

Tactical Activities

- Communicate the impact of project delays on program goals to stakeholders.
- Secure buy-in from the executive leadership team.
- Coordinate with other departments to consider asset performance during project selection.

Supporting Tasks

- Continue to utilize a project selection/prioritization tool that considers asset management as a selection factor.
- Work collaboratively with all divisions and offices to improve project planning, design, and delivery.
- Involve executive leadership in TAMP development process so stakeholders are aware of the risk impacts.

For additional information, please contact the DDOT Asset Management Division.

Intentionally left blank

District Department of Transportation