MARYLAND DEPARTMENT OF TRANSPORTATION

TACTICAL ASSET MANAGEMENT PLAN

December 2025

MESSAGE FROM THE ACTING TRANSPORTATION SECRETARY

Utilizing tactical asset management strategies to optimize the lifecycle performance of our assets and drive sound transportation investment decisions with a long-term perspective

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The Maryland Department of Transportation (MDOT) maintains a complex and interconnected system of assets that support the public and the statewide economy. Through the asset management program, we strive to deliver safe, resilient, and reliable infrastructure that operates efficiently and delivers on our community needs and priorities.

This Asset Management Plan (AMP) summarizes our ongoing asset management journey, provides a guidepost for ongoing advancement, and allows our modals to tell the story of their assets, demonstrate progress, and highlight impacts. MDOT's program success is achieved through the ongoing efforts of dedicated employees that place an everyday focus on maintaining, preserving, and enhancing our critical transportation systems. Established asset management policies and standards allow MDOT to objectively evaluate investment decisions through a risk-based lens with an emphasis on collaborative multi-modal planning and prioritization.

The AMP has been developed through the ongoing efforts of the Asset Management Steering Committee, with active representation and participation from each of our six modals. Embedded throughout the AMP is an emphasis on ensuring adequate funding and resources. These focused investments allow MDOT to deliver proactive maintenance and preservation programs that sustain condition and performance, result in long-term cost efficiencies, and effectively manage risk.

The case studies embedded in this document highlight specific programs, initiatives, and projects that are enhancing our asset knowledge, improving decision making, communicating needs and priorities, and empowering staff to deliver innovative solutions.

The AMP builds upon our 2025-2030 Strategic Asset Management Plan (SAMP) and will allow MDOT to continue to advance the state of practice and strengthen our standing as a leading public infrastructure agency recognized for our innovation and efficiency.

TABLE OF CONTENTS

01.

INTRODUCTION

Asset management is about understanding critical infrastructure portfolio needs and making data-driven decisions that optimize lifecycle investments and align with long-term strategic priorities. This Asset Management Plan (AMP) provides tactical details on MDOT's implementation strategies in support of the recently published Strategic Asset Management Plan (SAMP).

This document provides an overview and update on our key program milestones and impacts, and presents information important to both public stakeholders and internal MDOT teams. The AMP summarizes the frameworks, guidelines, and strategies that drive the asset management program and communicates program progress and achievements. The AMP was developed in collaboration with key modal representatives and aligns with overarching strategies and objectives defined in the 2025 SAMP. A consistent and integrated approach to asset management enables MDOT to operate its integrated transportation systems and networks to best meet the needs of Maryland residents and businesses. Each section of the AMP provides details on the program components and strategies for modals to use as they develop and implement initiatives and improvements aligned with MDOT's mission to continue to advance the state of asset management practice. The individual AMP sections are briefly described below.

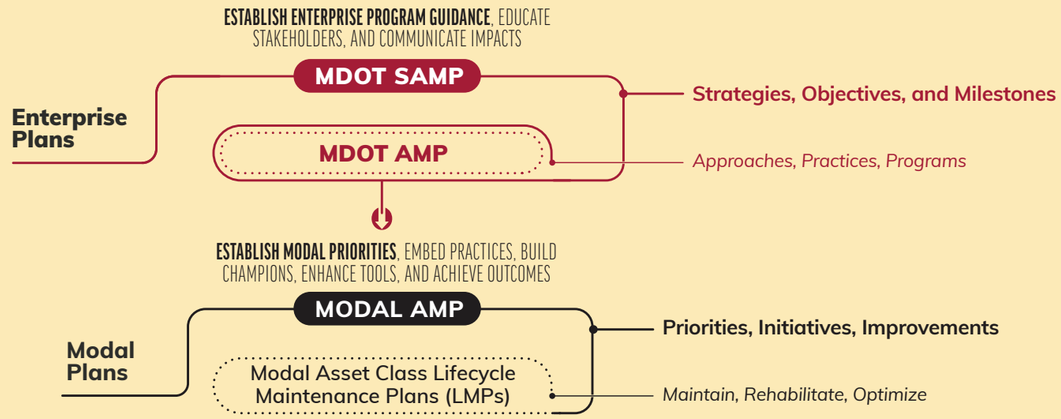
- **Asset Portfolio and Inventory** – provides an overview of MDOT's existing critical infrastructure and scope and highlights the importance of maintaining accurate information on what the organization owns, its age, and condition to support optimized decisions.
- **Performance Management and Reporting** – highlights how MDOT is measuring and managing the performance of its critical assets to ensure it complies with regulatory requirements and empowers staff to identity issues and deliver reliable systems and service.
- **Condition, Criticality, Risk, and Lifecycle Planning** – advances MDOT's understanding of asset risk and enables proactive, prioritized, and long-term forecasting for state of good repair (SGR) needs.
- **Information Systems and Data Management** – summarizes how asset data is structured, validated, and managed and the critical information systems that support analysis and planning.
- **Investment Planning and Prioritization** – presents MDOT's approach to identifying, evaluating, prioritizing, and programming SGR needs through a financial forecast and business case for required investments.
- **Human Capital (Structure, Resources, and Training)** – demonstrates the important role that resources, training, and development play in the asset management program along with information sharing and knowledge management.
- **Continuous Improvement, Collaboration, and Culture Change** – defines the practices and strategies required to create champions and owners and continually evaluate, refine, and improve the asset management program and ensure it is delivering results and impacts.
- **Program Implementation** – codifies key initiatives, tasks, and activities across the modes that will keep the program moving forward in coming years.

PURPOSE OF THE TACTICAL ASSET MANAGEMENT PLAN

This AMP is a companion document to the 2025 SAMP and further supports the overarching strategies and principles including MDOT's policy, goals and objectives. It provides additional details on the priorities established and improvement plans underway across modals. The AMP documents and formalizes key programs and methodologies and highlights our achievements in consistency, collaboration, and alignment between modals and asset classes. Embedded throughout the document are case studies and examples highlighting progress, practices, and milestones. **Figure 1.1** shows the relationship between asset management planning documents at the enterprise level and how those filter down into individual modal plans.

Guidance and case studies provide real world details and examples for modal leadership to enhance their processes, tools, and systems and manage critical assets in accordance with broader MDOT policies. The intent is to provide foundational information for modals to build a consistent structure that aligns with their diverse asset class needs, drivers, and strategies.

FIGURE 1.1 | **RELATIONSHIP BETWEEN ENTERPRISE PLANS AND MODAL PLANS**



PARTICIPATION, OWNERSHIP, AND GOVERNANCE

The AMP was developed with guidance from the Asset Management Steering Committee and significant input from representatives across modals, including Asset Management Coordinators, Improvement Work Teams, Asset Class Work Teams, and Subject Matter Experts (SMEs), and it will be used as a guide for future modal AMP updates. Participants who were engaged in this effort will serve as ongoing program advocates and champions. This document will serve as an ongoing reference to support program implementation; it will be reviewed periodically and formally updated in parallel with future SAMPs on a five-year cycle.

GOALS, OBJECTIVES, AND PRIORITIES

Each modal has embraced the seven goals established through the SAMP and has established priority initiatives to incorporate these goals into ongoing program improvements.

MDOT AM GOALS	EXAMPLE MODAL INITIATIVES/ACHIEVEMENTS
1. **Enhance Asset Knowledge and Understanding** *through data quality assurance and governance*	↗ Completed utility asset class management programs including water, sanitary sewer, and electrical that raised overall GIS data quality from Level D to Level B (MPA). ↗ Performed ongoing data quality reviews to educate asset owners (Light Rail, Metro, Bus, MARC) on the importance of data accuracy. (MTA). ↗ Completed an asset readiness assessment in 2024 to identify asset data sources and maturity to inform priority and level of effort for incorporation of these assets into VUEworks EAMS (SHA).
2. **Understand the Lifecycle Performance and Condition of our Assets** *including cross-modal interdependence*	↗ Development of comprehensive AMPs Stormwater and Geotech asset classes and LMPs for Fleet, Facilities, Linear Safety Devices and Bicycle/Pedestrian (SHA). ↗ LMPs fully developed for pavements and bridges with ongoing formal inspection of mainline pavement, parking lots, access roads, and ramps on a three-year cycle (MDTA). ↗ Completion of the facilities assessment by our A&E contractor provided a lifecycle analysis for both facilities and pavement assets (MVA).
3. **Prioritize and Plan for System Preservation Needs** *incorporating system, corridor, and neighborhood impacts*	↗ Conducting facility condition index (FCI) inspections of buildings that will provide building replacement cost estimates and repair costs for deficient systems (MPA). ↗ Developing a new process for project selection and initiation which uses asset data to assist in prioritization (MTA). ↗ Multi-factor project prioritization system that evaluates size/scope, purpose, type, risk, and financing (MAA).
4. **Educate, Train, and Embed Asset Management Across the Organization** *to support staff development and enhance institutional knowledge*	↗ Organized the engineering design project managers by asset class to ensure each has a deep functional understanding (MPA). ↗ Facilitated asset management awareness workshops that present goals, program definition, system components, and provide ongoing progress updates (MTA). ↗ Development of asset management workshops, videos, and training for new and existing hires and implementation of a formal steering committee and AM-Bassadors (MDTA). ↗ Used annual SGR reporting to bring together asset owners, improve practices, and drive initiatives (SHA). ↗ Created an environmental management system (EMS) team to review and update processes and procedures for environmental management that are incorporated with the asset management program (MVA).
5. **Enhance and Integrate Information Systems and Data** *and embrace advanced technologies and innovation*	↗ Ongoing spatial integration between GIS and Maximo EAM to support linear assets (MDTA). ↗ Transition to ArcGIS Field Maps for facility assessments, which allows the inspectors to use floor plans, generate exact asset locations, and capture information and photos (MTA). ↗ Custom applications to manage asset inspections (Roof and FAA Part 139) with GIS and Maximo EAM integration (MAA).
6. **Apply Risk-Based and Data Driven Decision Making** *including lifecycle analysis and maintenance and staff optimization*	↗ Structures has developed the Bridge Asset Management Program (BAMP) which aggregates bridge information and condition data to help aid in preservation planning and decision making (MDTA). ↗ Completed a pilot phase of the project prioritization framework including an outfall inventory risk model development (SHA). ↗ Utility management programs have given support for data-driven and long-term (10-15 year) capital investment programs to replace high risk assets (MPA). ↗ In the process of implementing risk and criticality scoring into Maximo EAM to automate analysis (MAA).
7. **Communicate Funding Needs and Priorities to Stakeholders** *to tell the story of our assets and secure long-term financial commitments needed*	↗ Coordination with state and MPOs on annual performance targets and long-term SGR financial needs as part of the TAMP update (MTA). ↗ Development of capital funding needs dashboards utilized during strategy and planning with long-term (25 year) projections and project status (MDTA). ↗ Hold annual district tours with asset offices, district staff, and leadership to identify needs, review, and prioritize capital projects (SHA).

Each modal focus reflects the unique drivers inherent to its infrastructure, business models, and challenges while remaining aligned with MDOT's broader strategies and objectives. Both SHA and MTA need to comply with comprehensive federal reporting requirements and focus on federally funded asset classes, while MPA, MAA, MVA, and MDTA are driven by customer and/or competitive demands to maintain high levels of service and asset functionality. All modals are required to comply with more focused sets of environmental, safety, and other regulatory requirements for specific asset classes.

CASE STUDY 1

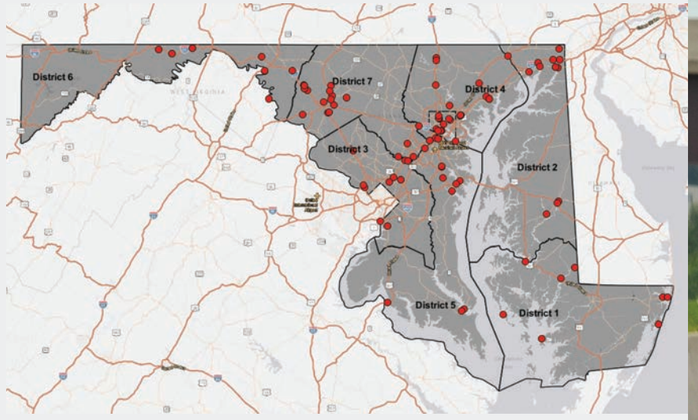
USING ASSET MANAGEMENT TO SECURE GRANT FUNDING (MDTA)

I-895 CORRIDOR REHABILITATION

Through its asset management program, MDTA identified multiple critical needs along the I-895 corridor between the K-Truss Bridge and the Baltimore Harbor Thruway Tunnel, including original 1958 pavement; aging bridges over Frankfurst Avenue, Childs Street, and the Shell Road flyover ramp; an obsolete toll plaza no longer needed; and a low-clearance Frankfurst Avenue bridge (14'-1") that experienced frequent strikes. By bundling these related deficiencies into a single comprehensive rehabilitation project, MDTA demonstrated a cost-effective, risk-based approach that prioritized safety, reliability, and modernization—ultimately securing an $80 million federal grant to extend asset service life, reduce hazards, and improve corridor operations.

CASE STUDY 2

USING ASSET MANAGEMENT TO SECURE GRANT FUNDING (SHA)



CLIMATE RISK AND RESILIENCY ANALYSIS (CR2A) PROJECT

SHA has partnered with the MDOT Office of the Environment on a statewide planning study to identify climate change risk factors and establish a weighting/priority framework that prioritizes resilience strategies for MDOT transportation modes. One of the outcomes of this project will be a GIS-based planning tool to identify risk characterization statewide and allow for project-level analysis and reporting. PROTECT formula funds will be used for a significant portion of this important project.

02.

ASSET PORTFOLIO AND INVENTORY

MDOT manages a diverse and complex portfolio of infrastructure assets as an integrated transportation system that supports Statewide goals and priorities. The agency is committed to advancing its collective knowledge and understanding and optimizing cross-modal decisions and outcomes.

MDOT PORTFOLIO

Modals have been focused on improving asset data to understand what MDOT owns and enhancing their knowledge of baseline attributes, including make, manufacturer, model, and material type along with important asset management attributes including age, condition, and replacement cost. MDOT is focused on seven of its most critical assets: pavement, structures, facilities, tunnels, rail, fleet, and major information technology (IT) systems. In future AMPs, an additional two asset classes are likely to be added to the list—stormwater (drainage) and utility (power and water) assets. Understanding the detailed needs of these seven asset classes for annual SGR planning is an integral part of MDOT's asset management program. Understanding asset profile, condition, criticality, and projected investment needs and backlog is a significant input into the annual Consolidated Transportation Program (CTP) and funding allocations. The characteristics of each of these asset classes can vary significantly between modes and structures. Structures for SHA are bridges and culverts, noise barriers, retaining walls, and sign structures, whereas structures for MPA are primarily shipping berths. Likewise, pavement for SHA is primarily roadway pavement, whereas MAA has runways and taxiways, and other modals primarily have customer and employee parking and storage lots. Across the seven critical asset classes, there are multiple considerations for operational needs, maintenance strategies, and relative importance within the broader transportation network.

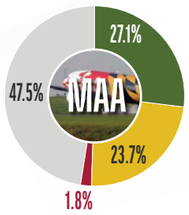
In some cases, MDOT may also have a small proportion of assets that are jointly owned by MDOT but maintained by others, or maintained by MDOT but owned by other entities. An example would be rail assets that are used by MTA for MARC service but may be owned and/or maintained by freight rail companies and/or Amtrak. The information below provides an overview of some of the key characteristics of MDOT's diverse modal portfolio.

Recent efforts have been focused on making asset inventory and condition information readily available in a timely manner with a high degree of accuracy and validity. Ongoing improvements have greatly enhanced the planning and prioritization process across MDOT. MDOT also deploys mobile technologies along with bar codes, QR codes, and radio frequency identification (RFID) to identify and track work performed on its assets to understand their functionality, performance, and operating conditions. **This enhanced understanding of the portfolio allows MDOT to focus on the most critical needs and better align its lifecycle strategies across modes as appropriate.**

MARYLAND DEPARTMENT OF TRANSPORTATION

State of Good Repair (SGR): Good Fair Poor Unrated

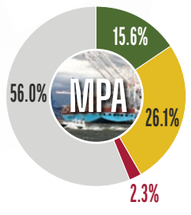
Total 6-year Investment Needs: Funded Unfunded



17% OF $3.4B FUNDED

$3.4B

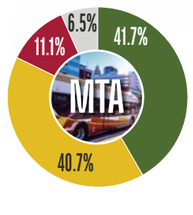
$21.2B TOTAL MDOT SGR NEEDS



36% OF $549M FUNDED

$549M

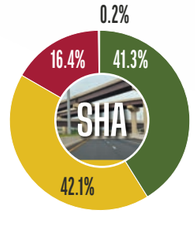
$21.2B TOTAL MDOT SGR NEEDS



76% OF $3.6B FUNDED

$3.6B

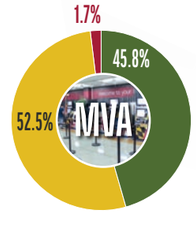
$21.2B TOTAL MDOT SGR NEEDS



50% OF $6.4B FUNDED

$6.4B

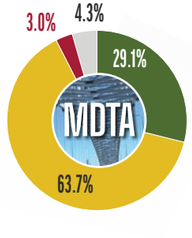
$21.2B TOTAL MDOT SGR NEEDS



76% OF $9.7M FUNDED

$97M

$21.2B TOTAL MDOT SGR NEEDS



89% OF $7.2B FUNDED

$7.2B

$21.2B TOTAL MDOT SGR NEEDS

KEY FOCUS AREAS AND CHALLENGES

- Most critical asset classes include pavement, facilities, and fleet
- Updated airfield pavement model is driving capital planning programs for a risk-driven replacement program aligned with funding availability
- Formal facility assessment programs are inspecting 25% of assets each year to prioritize and address the most critical deficiencies

- Most critical asset classes include structures (berths and piers), facilities, and utilities
- Established waterfront facilities inspections are ensuring all assets are assessed in-depth on a 5-6 year rolling basis and building facilities receive a formal Facility Condition Index (FCI) score
- Established areawide facilities contracts to address needs identified through FCI inspections
- Significant focus on utility assets (water, sewer, and power) including GIS data enhancements and funding for system preservation

- Most critical asset classes include fleet, facilities, and rail
- Have made steady progress in addressing SGR backlog over the past several years including in-progress rolling stock procurement
- Facility assessment programs have highlighted ongoing operations, maintenance, and customer needs that are being addressed through the long-range master plan

- Most critical asset classes include pavement and structures
- Preservation programs and overall condition of pavement and bridge structure assets have been consistent but risk losing ground due to funding gaps
- Have more significant funding gaps and SGR needs for ancillary assets including stormwater and lighting

- Most critical asset classes include fleet, facilities, and pavement
- Aging facilities portfolio has major system upgrade needs (roofs, plumbing, and HVAC) with only limited funding to address most critical backlog and smaller projects
- Pavement condition assessment programs have identified long-term needs, and funding is only sufficient to keep backlog stable and address smaller projects

- Most critical asset classes include pavement, bridge structures, and tunnels
- Pavement management program is addressing highest priority needs including 1-95 ramps and MD200 (ICC) pavement
- Tunnel preservation programs have focused on replacement and upgrades to ventilation systems and assets
- Important bridge investment programs are ongoing including Bay Bridge rehabilitation and are developing LMPs for other bridge(s)

INVENTORY STRATEGIES

MDOT has historically applied a strong focus on improving asset inventory and attribute information and data are now updated annually (at a minimum) through MDOT's enterprise Geographic Information System (GIS) portal. The portal provides a consolidated view of key information, including asset location, age, and condition. Modals also manage other key attributes including make, manufacturer, model, and replacement cost within their existing enterprise asset management (EAM) platforms for day-to-day management of lifecycle maintenance. Over the past five years, MDOT has significantly improved its understanding of the assets it has; assets that are under design and construction are quickly added to the portfolio for management and analysis.

Modals are also collaborating to develop common data standards to create more uniform information across the enterprise through common data governance procedures, including asset hierarchies, classes and types, naming conventions, and key attribute fields (e.g., condition score scales and asset install dates). Asset accuracy and timeliness is also improving, and there is ongoing focus on reducing the burden of data collection through mobile tools and automated data capture. As summarized below, Maximo EAM and ESRI GIS are the most prevalent systems used across MDOT to manage critical asset classes, with several specialty tools used for analysis, planning, and preservation modeling of pavement, structure, and tunnel asset classes. In many cases document management software including SharePoint and ProjectWise are used to manage inspection reports and other asset management related documents.

MAJOR ASSET CLASSES AND SYSTEMS OF RECORD

	ESRI GIS	IBM MAXIMO EAM	BENTLEY ASSETWISE INSPECTIONS	OTHER SYSTEMS (INCLUDING ASSET MODELING)*
Pavement	SHA MPA MVA MDTA MTA MAA	MVA		SHA MAA
Structures	MPA MVA MAA		SHA MTA	MDTA
Facilities	SHA MPA MVA MDTA MAA	MPA MVA MDTA MTA MAA		SHA
Rail	MPA	MTA		
Tunnels				MDTA
Fleet	SHA MPA MVA MDTA MTA MAA			MPA MDTA
Major IT Systems	MPA	MAA		MDTA

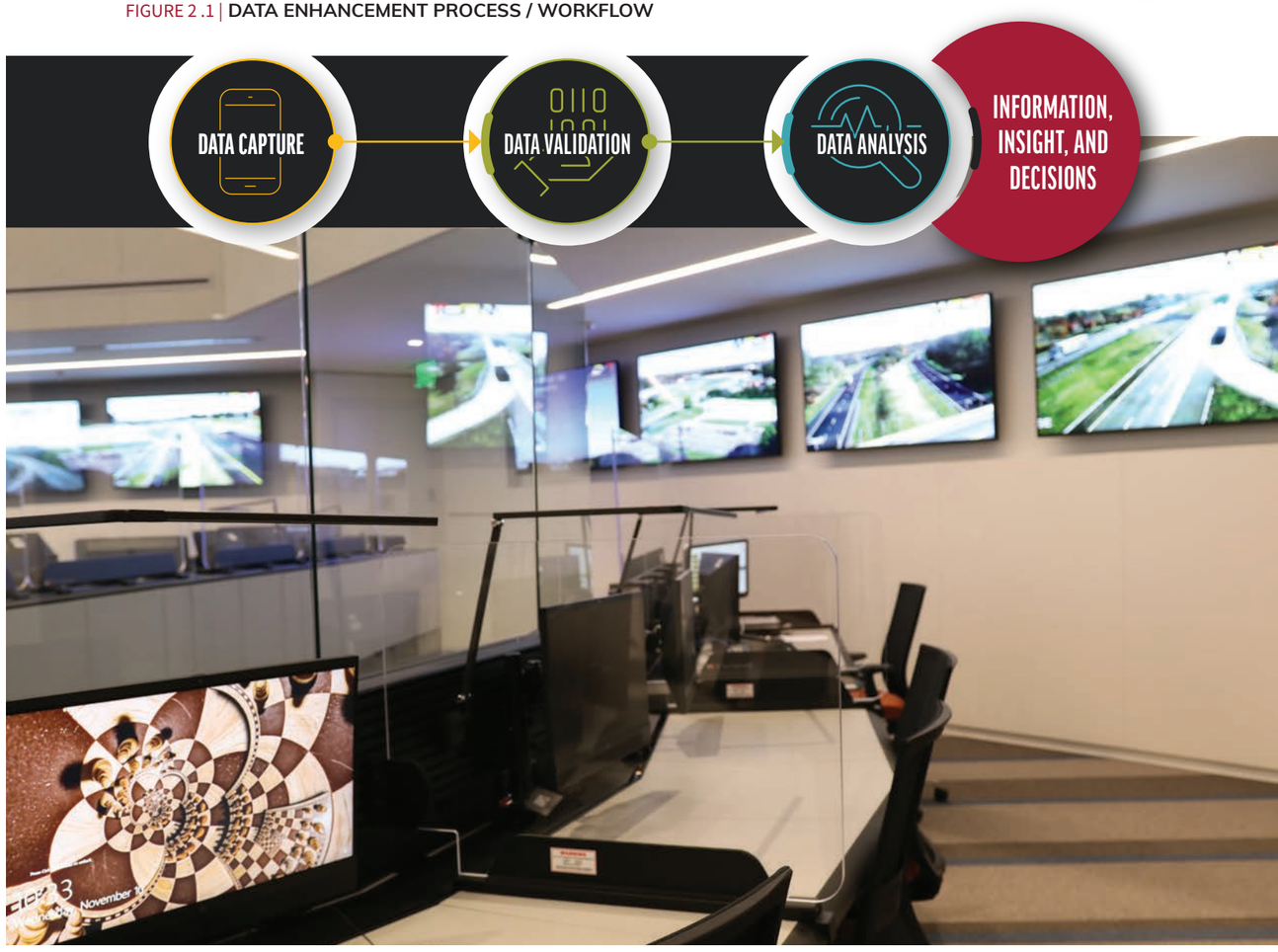
* Other significant systems include RoadCare, Paver, ASIR, and VUEWorks

SHA MPA MVA MDTA MTA MAA

EVOLVING FROM DATA TO INFORMATION

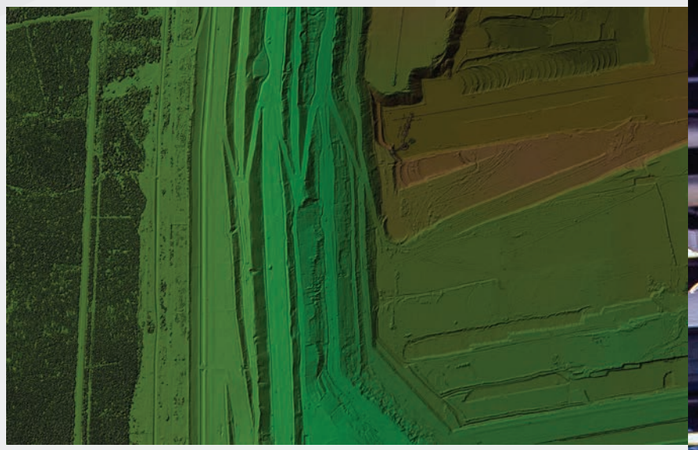
For inventory data to be useful for asset management, they must be complete with a high degree of accuracy, integrity, and consistency. When MDOT has a high degree of confidence in data, it can most effectively use these data for decision-making and can build strong business cases for infrastructure needs, priorities, and business decisions. By sharing this information across modals, MDOT can (1) enhance funding allocation and the planning process, (2) ensure that investments are specifically targeting the areas of greatest need and return, and (3) can demonstrate the impacts and benefits on the wider transportation system. MDOT's technology and asset class working team continue efforts to better document and standardize work processes that enhance the data-to-information work flow between and within modals as well as between inspectors, data analysts, asset coordinators, and capital planners. A simplified version of the workflow is shown in **Figure 2.1**. The technology work team is developing a comprehensive Data Governance Document that will help drive this effort forward.

FIGURE 2 .1 | **DATA ENHANCEMENT PROCESS / WORKFLOW**



CASE STUDY 3

USING AI TO ENHANCE ASSET INVENTORY (SHA)



MOBILE LiDAR INVENTORY

A mobile LiDAR inventory is being developed under the Enterprise Asset Data Collection (EADC) program. It will introduce new asset management procedures by utilizing AI technology to collect and extract multiple asset datasets at one time, optimizing both cost and time. AI technology will also improve safety by eliminating field work along the dangerous highway ROW. The technology uses mobile 3D scanning devices to collect asset data that will undergo a QA review by Asset Management Office staff and deliver greatly improved inventory data used for asset management analysis as well as future design and planning.

CASE STUDY 4

INTEGRATED DIGITAL WORKFLOWS (MTA)

FACILITY ASSESSMENT DATA COLLECTION PROCESS IMPROVEMENTS

Implementing a digital, GIS-enabled workflow using Esri's ArcGIS Field Maps for this project is allowing inspectors to collect location, condition data, and pictures for individual assets or facility components all in one location. This allows compliance with FTA requirements while also collecting an expanded database of asset management related information for decision-making, including maintenance strategy and funding projections. The project employed the use of LiDAR to scan larger, multi-room facilities and create CADD and 3D floorplans, which can be used to review the data while not physically at the facility.

03.

PERFORMANCE MANAGEMENT AND REPORTING

A robust performance management framework creates a clear mandate that includes critical asset performance metrics and targets and real-time data visibility for management and investment decisions. Dashboards are used to promote a responsive organization that proactively addresses needs and challenges.

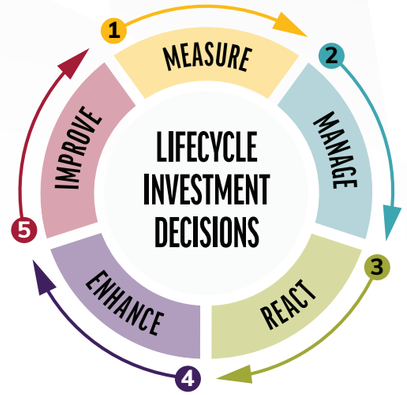
Performance management is an important element of MDOT's culture, and asset management programs help modals to apply data to decision-making and prioritize investments in alignment with overall asset management objectives. Good data allow asset managers to focus investment dollars on projects and programs that best preserve system functionality and deliver reliability and service-level impacts and/or mitigate critical system risks.

As core asset data improve, information can be presented and shared more frequently via automated dashboards that can present a real-time view of asset performance. Each modal is building a robust performance management culture and applying key metrics to demonstrate asset management progress.

By building a culture of data-driven decision-making, MDOT can present a strong business case for investment in proactive maintenance programs and justify an enhanced focus on SGR. In addition, formalizing condition, reliability, and service-level goals at the asset class level has allowed modals to develop and deliver lifecycle strategies that optimize long-term performance and help quantify the benefits of longer-term capital and maintenance investments. This process is shown in **Figure 3.1**.

A strong asset management program includes both strategic and operational metrics, while performance dashboards promote visibility and transparency with key stakeholders. Dashboards and data visualization are being used more frequently to track the progress and impact of key programs across MDOT.

FIGURE 3.1 | **PERFORMANCE MANAGEMENT PROCESS APPLIED TO ASSET LIFECYCLE DECISIONS**



MEASURING AND MONITORING PERFORMANCE

MDOT's current focus on performance management includes foundational metrics around asset condition, maintenance compliance, and asset reliability. As EAM use improves, MDOT will also track data quality and work order closeout and costing. A key measurement of asset management program outcomes is the annual SGR trends developed as part of the CTP, with an established goal of maintaining or improving overall SGR annually.

To report on these baseline metrics requires a second level of analysis and planning, and many of the critical assets apply more advanced data analysis, models, and analytic tools to determine future system preservation needs and priorities. These models and tools rely on multiple factors, including age, condition, treatment interventions, decay curves, and failure analysis. Additionally, these advanced models can be readily applied to some of the more mature asset classes, including pavement and bridge structures, where industry-accepted decay curves and optimal maintenance interventions are well known and can be incorporated into mathematical and financial models. For other asset classes such as sign structures, facility systems, and fleet, asset useful lives are well established and can be evaluated against existing age, condition, and historical reliability to accurately predict a reasonable range or trigger point where optimal lifecycle renewal or replacement is required.

Measuring and monitoring performance in alignment with regulatory requirements is also critical: SHA, MTA, and MAA have specific federal regulatory reporting requirements with defined data update intervals that are often aligned to federal funding eligibility. Federal Transit Administration (FTA) and Federal Highway Administration (FHA) have comprehensive asset management reporting requirements for key federally funded asset classes including pavement (highway) and bridge structures as well as track, facilities, and rolling stock. The Federal Aviation Administration (FAA) also focuses heavily on pavement (runway/taxiway) condition assessment and more recently on terminal facility assets. MDOT is using its enterprise-wide program to move beyond baseline compliance and expand the scope and impact of asset management across each modal, while remaining aligned with industry standards and regulatory requirements when appropriate.

OVERVIEW OF CRITICAL ASSETS PERFORMANCE

MDOT's ongoing focus is to improve reporting across all critical assets including newly added stormwater and utilities. While condition data and SGR needs and backlog are the primary metrics, modals are incorporating additional metrics as the asset management program matures. Some of these metrics are aligned with other MDOT goals and objectives, including climate resiliency. The seven critical asset classes all have specifically defined numerical condition scales that allow MDOT to evaluate Good, Fair, and Poor (G/F/P) condition data in a consistent way. The table on page 17 highlights many of the metrics currently in place, emerging metrics, and plans for future enhancements.

ASSET CLASS	METRICS	TRENDS / IMPACTS
Pavement	↗ Percent of assets in SGR ↗ Asset condition (Good/Fair/Poor) ↗ SGR annual needs and backlog	↗ Pavement condition (percent in fair to good condition) has been steady to improving (MDTA). ↗ Overall portfolio condition has increased from 2.8 to 3.2 from 2023-25 (MVA). ↗ Pavement condition has remained steady with a focus on customer needs and priorities (MPA).
Structures	↗ Percent of assets in SGR ↗ Asset condition (Good/Fair/Poor) ↗ SGR annual needs and backlog **Emerging/Future** ↗ Backlog of high-priority defects and resolution time	↗ Significant recent berth and pier preservation projects and SGR investments driven by condition inspections (MPA). ↗ Poor condition components are addressed on a regular basis based on inspection reports (MTA).
Facilities	↗ Percent of assets in SGR ↗ Asset condition (Good/Fair/Poor) ↗ SGR annual needs and backlog **Emerging/Future** ↗ System reliability or uptime/ downtime ↗ PM/inspection schedule compliance	↗ Major station and facility rehabilitations scheduled with long-range master plan and majority of other facilities are above a 3.0 condition (fair) score (MTA). ↗ Overall portfolio condition has increased from 3.2 to 3.4 from 2023-25 (MVA). ↗ Assessments performed on a formal four-year cycle with a real-time dashboard to track progress (MAA).
Fleet	↗ Percent of assets in SGR ↗ Asset condition (Good/Fair/Poor) ↗ SGR annual needs and backlog **Emerging/Future** ↗ MTBF/MTTR (Revenue Vehicles) ↗ PM/inspection schedule compliance	↗ Annual fleet inspections and condition assessments are being completed on-time (MDTA). ↗ Review of fleet replacement needs due to technical obsolescence and lack of parts availability (MPA).
Information Technology	↗ Percent of major systems in SGR (up to date and functional) ↗ Asset condition (Good/Fair/Poor) ↗ SGR annual needs and backlog	↗ Significant focus on system replacement and upgrades and condition ratings have remained high (MVA). ↗ Identifying software obsolescence and upgrade needs in addition to hardware (MPA).
Tunnels	↗ Percent of assets in SGR ↗ Asset condition (Good/Fair/Poor) ↗ SGR annual needs and backlog	↗ Regular inspections are conducted with scope that includes ongoing cleaning and maintenance (MTA).
Rail	↗ Percent of assets in SGR ↗ Asset condition (Good/Fair/Poor) ↗ SGR annual needs and backlog **Emerging/Future** ↗ Speed restrictions in place	↗ Recently started biannual track condition assessment to better gauge overall health of system put into place (MTA).

FUTURE REPORTING

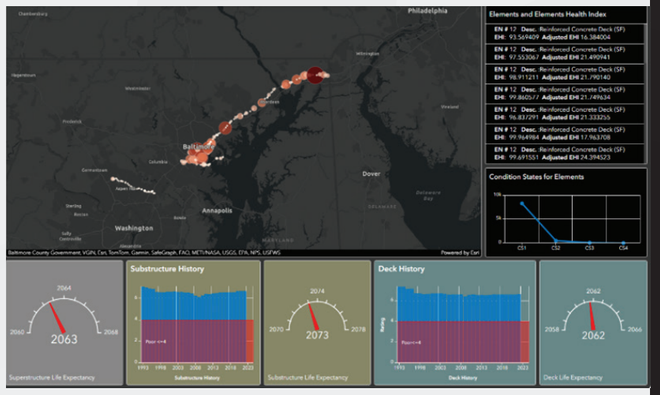
SHA and MTA must deliver federal transportation asset management plans (TAMPs) every four years. MDOT has aligned its own internal requirements to a similar schedule, although the scope of requirements may vary. For instance, FHWA only requires reporting for bridge and pavement assets within the National Highway System (NHS), which is a much smaller subset of the statewide critical assets within MDOT's much larger roadway network.

MDOT TSO is focusing on making all data much more visible across the organization and requiring key condition and SGR needs data to be updated annually (at a minimum) in alignment with the CTP process. This information is also being shared across modals via internal GIS dashboards, and modal work teams have ongoing collaboration to align data structures and governance to improve consistency. The benefits of cross-sharing of information are significant; cross-sharing helps MDOT to more effectively allocate funding agency-wide to the areas of greatest need and impact. Transparent reporting and collaborative planning also help to promote a culture of communication across modals and promote systemwide outcomes. A dedicated MDOT team is actively working on improving data governance to facilitate common processes and procedures and the potential for automated data updates and seamless information sharing.

CASE STUDY 5

ITS DEVICES PERFORMANCE SUMMARY DASHBOARD (MDTA)

DEVELOPING DASHBOARDS TO SUPPORT OPERATIONS

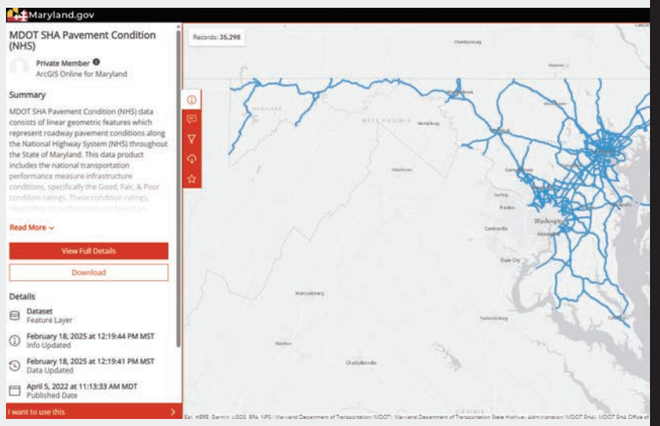


The dashboard tracks assets such as CCTV cameras, dynamic message signs (DMS), roadway and tunnel lighting, ATR/RTMS detectors, license plate readers, and related communication/security infrastructure. Tracking these assets through the dashboard provides centralized visibility into asset health, allowing real-time monitoring of outages and availability and supports performance trend analysis of and streamlined reporting. This enables proactive maintenance planning, faster outage response, improved system reliability, and data-driven decision-making for long-term planning and investment.

CASE STUDY 6

REPORTING DASHBOARDS THAT ENHANCE DATA VISIBILITY (SHA)

DASHBOARDS TO SUPPORT FEDERAL AND INTERNAL OPERATIONS REPORTING

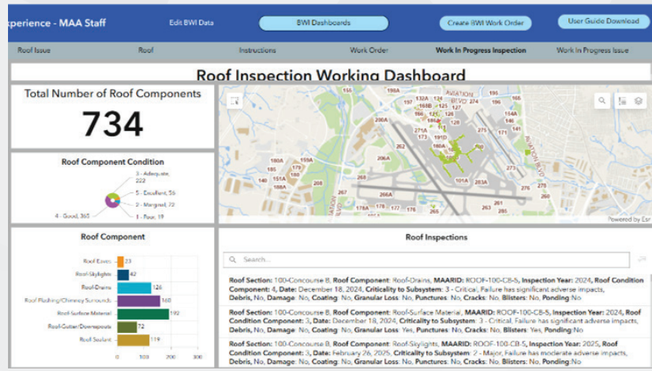


The NHS pavement and bridge dashboard (in development) is being used to manage data for federal TAMP reporting and better monitor trends and investments over time. The data will be available for sharing with other partners including the City of Baltimore and National Park Service that also manage statewide NHS assets. Internal dashboards have also been developed to track and report detailed maintenance activities and costs including guardrail replacement, line striping, vegetation mowing, and other key programs. These dashboards help to track program completion and compliance with level of service goals.

CASE STUDY 7

REPORTING DASHBOARDS TO SUPPORT MAINTENANCE AND INSPECTIONS (MAA)

DASHBOARDS TO SUPPORT ASSET CLASS LIFECYCLE MAINTENANCE



Multiple real-time dashboards have been developed using ESRI ArcGIS software to track ongoing inspection programs for roofs, fleet, and facilities. These allow staff to review, track, and analyze data in real time and understand program progress. Dashboards can track outstanding and completed work orders and summarize condition, criticality, and risk scores by system, subsystem, and component. The dashboards can consolidate and display information from both GIS and Maximo EAM and are available to asset management, maintenance, and engineering staff. These dashboards help to track program progress and compliance with annual goals.

04.

CONDITION, CRITICALITY, RISK, AND LIFECYCLE PLANNING

Optimizing lifecycle strategies supports MDOT's continued transition from reactive to proactive maintenance. Data are used to deliver triple bottom line outcomes (social, financial, and environmental) and improve asset and system reliability while focusing investments on the highest risks.

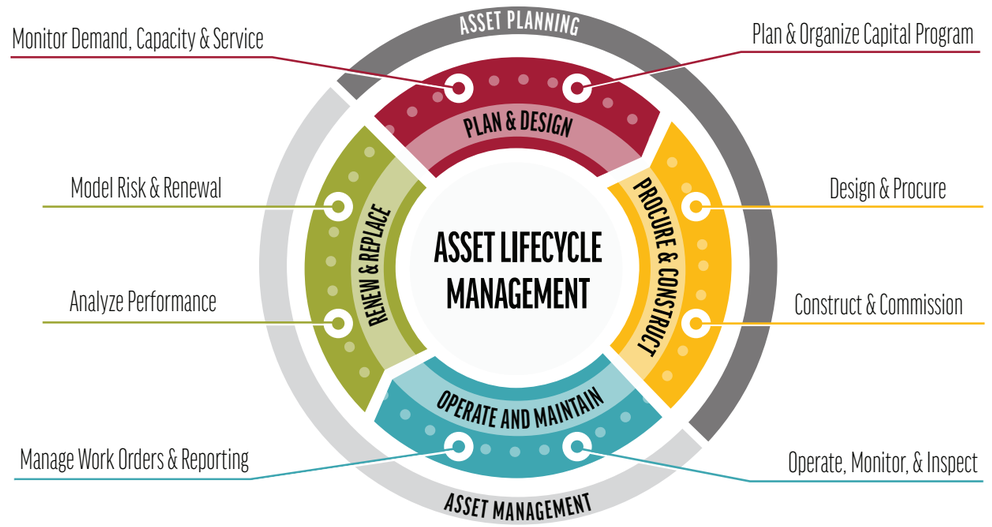
MDOT uses condition, criticality, and risk scores to prioritize SGR needs and support lifecycle planning, and significant advancements have been made in the collection of timely condition data and the application of criticality and risk methodologies to prioritize needs. These advancements include the use of mobile workforce tools to capture condition data during routine inspections and development of targeted condition assessments using advanced evaluation technologies.

There has been a specific focus and steady progress on lifecycle planning for critical assets over the past several years, including additional funding for programmatic inspections and preventive programs that better identify capital and maintenance needs, improve reliability, and reduce risks.

MDOT continues to strengthen its approach toward risk-based decision-making and apply asset management concepts and tools at each phase of the asset lifecycle. Starting with critical asset classes, MDOT modals apply a range of analytics from basic age and condition-based approaches to more advanced modeling tools to develop a program of preventive and corrective maintenance treatments. These approaches optimize cost, sustain the useful life of assets, and allow staff to perform cost-effective interventions to maintain or extend life. The asset management program incorporates important strategies at each phase of the asset lifecycle as **Figure 4.1** demonstrates.

MODAL	RECENT CONDITION PROGRAM ENHANCEMENTS	ASSET CLASSES INCLUDED (CRITICAL AND NON CRITICAL)
SHA	Enhanced field condition assessment program for stormwater outfalls in coordination with Illicit Discharge Detection and Elimination (IDDE) program	Stormwater
MAA	Enhanced programmatic roof and baggage handling system condition assessment programs and initiation of assessment programs for underground storage tanks, fire hydrants, and generators	Facilities
MPA	Water and sewer data collection and condition assessment programs have improved survey accuracy and provided condition scores	Utilities
MTA	Enhancements to rail condition assessment approach, methodology, and scoring	Rail
MVA	Contractor-performed facility assessments now include stormwater assets	Stormwater
MDTA	Established consistent pavement assessment of all highway ramps to create a confident preservation program in coordination with SHA	Pavement

FIGURE 4.1 | **ASSET LIFECYCLE MANAGEMENT PHASES AND KEY ACTIVITIES**



During **planning and design**, consistent standards are applied to help select materials and technologies that align with best practice, are readily maintainable, and will perform reliably throughout their expected operational life. Initial lifecycle planning, including significant periodic or mid-life overhauls, also occurs during this phase. During **procurement and construction**, assets are inspected, and engineers and construction managers provide critical attribute data to allow assets to be effectively tracked and managed as soon as they are commissioned.

Operations and maintenance is the core of asset management activities and includes tracking of inspections, condition assessment, and preventive maintenance to ensure reliability and drive intervention decisions; while **renewal and replacement** strategies are used to extend the life of an asset through rehabilitation treatments until an asset is no longer cost effective to maintain and is removed or replaced.

Risk management is also essential to lifecycle planning and strategy, with an emphasis on prioritization of funding in a fiscally constrained environment. Modals are advancing their approach to asset-class level criticality and risk to prioritize funding. They are also identifying, monitoring, and mitigating enterprise risks related to wider economic, climate, human capital, and other systemic risks in addition to risk-based prioritization of SGR needs.

RATING ASSET CONDITION

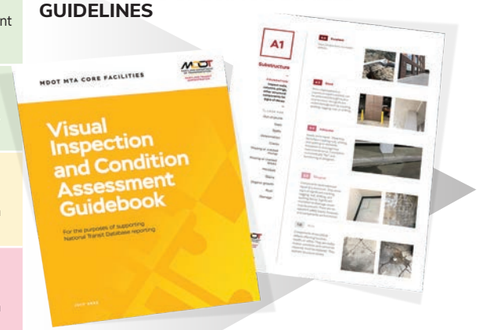
For critical asset classes, cross-modal working teams have developed consistent approaches to define "what is an asset"—these definitions include asset hierarchies and parent/child relationships critical for accurate inventory and tracking of condition assessment. As applicable, modals are using industry standard approaches such as FHWA 1-9 bridge condition ratings or Pavement Condition Index (PCI) for airfield pavement. For most other asset classes, an industry standard 1-5 condition rating is applied that provides MDOT with a uniform approach to compare and prioritize asset needs and translate scoring methodologies into a Good/Fair/Poor standard for SGR reporting. These frameworks are fully documented in formal methodology and guideline documents as represented in **Figure 4.2**.

FIGURE 4.2 | **SAMPLE ASSET CONDITION ASSESSMENT FRAMEWORKS AND GUIDELINES**

ENTERPRISE GUIDELINES:

Score	Grade	Description
5	**Excellent** New or Like new with no visible defects	New or Excellent Condition
4	**Good** Minor defects; Minor signs of wear and/or corrosion and some slight defects and/or visible deterioration, but with no expected functional or level of service impact	Minor Defects Only
3	**Adequate** Moderate deterioration; Moderate signs of war and/or corrosion and some moderate defects and/or visible deterioration, with moderate corrective/capital maintenance needs and minimal functional or level of service impact	Moderate Deterioration
2	**Marginal** Significant Deterioration; Major signs of wear and/or corrosion and major defects and/or visible deterioration, with major corrective/capital maintenance needs and moderate functional or level of service impact	Significant Deterioration
1	**Poor** Critical defects, significant signs of wear and/or corrosion and critical defects and/or visible deterioration, with major impairment of asset functionality and level of service provided; substantial asset overhaul required.	Virtually Unserviceable

ASSET CLASS SPECIFIC DETAILED GUIDELINES



Facilities (By Type/System)

Scores 5 and 4 are considered "Good", Score 3 is considered "Fair", and Scores 2 and 1 are "Poor".

As condition assessment techniques mature, modals are incorporating physical and functional assessments. Physical condition assessments include both basic visual inspections as well as more advanced monitoring and testing. In some cases, these assessments use advanced technologies such as drones, light detection and ranging (LiDAR), and artificial intelligence (AI) to make the process more efficient and cost effective.

Functional condition assessments incorporate consideration beyond age and deterioration and consider whether an asset is meeting requirements for safety, regulatory, capacity, obsolescence, resource, and resiliency needs. These assessments ensure that assets and systems that are undersized, use obsolete or unsupported technology, or use extensive amounts of resources (water and energy) are also identified for potential SGR replacement.

Most importantly, MDOT has a consistent process to annually update and refine condition scores for internal tracking and reporting. The steps in this process are detailed below.

1. **Review asset hierarchy and data structures** – and generate a list of assets that require annual condition assessments including ongoing efforts with preventive maintenance and inspection programs. Most modals assess asset condition on a rolling basis (on a one-to-five-year cycle) that considers asset age, prior condition, and/or criticality, and/or they are completing ongoing assessments based on route or geography.
2. **Perform condition assessment and scoring** – with experienced and trained staff using formal assessment guides and manuals to ensure consistency and using advanced assessment techniques as applicable (testing, analysis, monitoring). Mobile workforce tools are being used to improve productivity and data availability.
3. **Review and analyze scores** – and update SGR needs and backlog for ongoing maintenance and capital planning. Information is shared throughout MDOT via GIS and other enterprise tools. Condition assessment programs are reviewed and enhanced on an ongoing basis to keep up with technology and planning needs.
4. **Report, evaluate, and refine** – including updating dashboards, examining annual trends, and identifying enhancements to ongoing processes.

Baseline condition reporting is a critical foundation for MDOT's asset management program reporting, allowing MDOT to establish and monitor SGR targets, including percentage of assets in SGR and track long-term trends. Defining SGR thresholds between asset classes is flexible enough to allow for the application of specific regulatory requirements along with consideration for asset type, function, and criticality. In most cases, SGR is defined between 2.5 and 3.0 and above on a 1–5 scale. Condition scores are translated into Good/Fair/Poor (G/F/P) and color-coded as Green/Yellow/Red to ensure a common interpretation and visualization across diverse modals and asset classes.

For each asset class, there is additional detailed guidance on condition scoring approaches, methodologies, and guidance for assessors to ensure consistency and understanding of the scoring process and provide a reference manual for training and further understanding. These manuals also typically include defined roles and responsibilities; process steps; and guidance for data capture, analysis, quality assurance, and updates to enterprise systems. Inspection cycles are also fully defined with baseline thresholds such as a four-year cycle or specific triggers that may require more frequent assessments based on asset criticality, design, maintenance history, or other appropriate characteristics. Asset teams

(e.g., fleet, facilities, and structures) developed detailed condition frameworks, and the frameworks provide appropriate guidance for composite scoring, including visual condition, testing, operational factors, and maintenance history. In the case of fleet, scores are based on visual assessments, run-time, and mileage specific to individual asset classes or types (e.g., passenger vehicles, dump trucks, and construction equipment).

ASSESSING AND MANAGING RISK

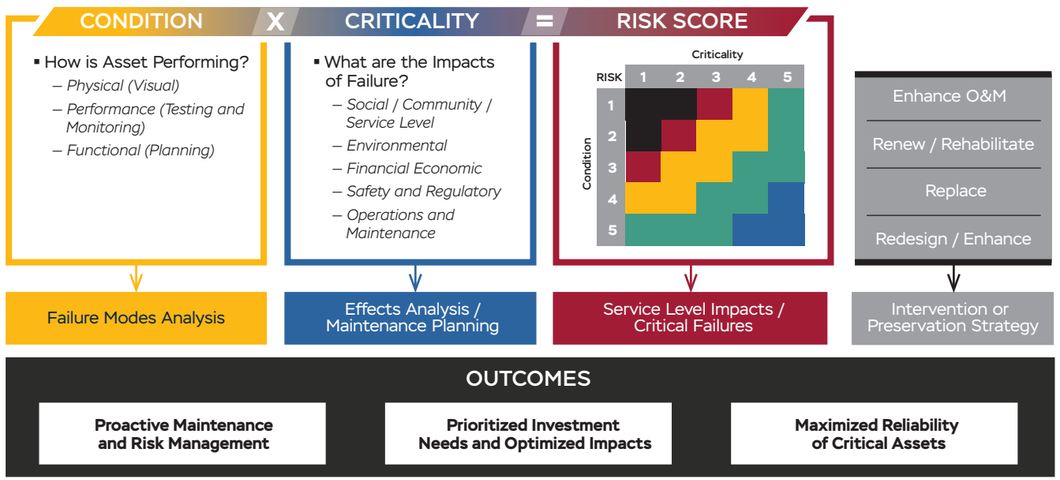
Understanding the criticality and risk of assets is an important element in driving objective prioritization of asset needs. In addition, identifying the most critical assets from a service level, safety, and resiliency perspective allows MDOT to assign appropriate inspection and maintenance strategies and target available funding to areas of greatest impact and benefit. Having a full picture of asset conditions and their criticality within the larger transportation system helps MDOT balance needs across the asset portfolio, manage risks, and ensure cost-effective service to the public.

The MDOT enterprise risk framework (Condition x Criticality = Risk, as depicted in **Figure 4.3)** allows modals to objectively identify, assess, analyze, monitor, and mitigate risks across a diverse platform of asset classes and systems.

The asset management program proactively evaluates asset and system-level risks as part of MDOT's larger risk management framework that also considers enterprise risks such as climate, resiliency, economic conditions, and workforce. Risk management involves routine efforts to maintain and update a risk matrix that allows MDOT to identify, monitor, and/or mitigate all types of risks to the agency, programs, and assets to protect the value of investments.

Effective management of risks is critical to achieving MDOT's overall infrastructure goals and targeting appropriate resources toward the highest risks across the agency. Risk-based planning allows asset management teams to acknowledge, identify, assess, and prioritize risks that may impact performance.

FIGURE 4.3 | **ENTERPRISE RISK FRAMEWORK**



Three main categories of risks are relevant to MDOT's asset management program, SGR planning, and wider CTP planning efforts:

- **Enterprise risks** include more systematic corporate, financial, and organizational risks—and can encompass diverse domains such as: climate change, regulations, operational, resiliency, security, health, and economic trends.
- **Program or project risks** apply most specifically to the capital and maintenance project portfolio and can include materials costs, construction and permitting uncertainties, and contractor and resource capabilities.
- **Asset and asset management risks** can be identified through asset condition and criticality assessment and addressed through appropriate intervention strategies. These risks include asset deterioration, material performance, rehabilitation techniques, failure modes, and data analysis accuracy.

Risk evaluations are now being widely used during annual CTP funding to ensure that the most critical projects are brought forward and funded during periods of financial constraints. Critical SGR needs and backlog are also being considered as part of broader funding discussions between modals and asset classes. Modals are incorporating resilience planning into SGR prioritization to address the most critical vulnerabilities and consider projects in high-risk areas for cost-effective options to strengthen or harden new or rehabilitated infrastructure to reduce future risk. Lastly, the known highest risk assets or critical points of failure are evaluated for potential additional monitoring or mitigation to reduce the potential impacts of asset decay or failure. This may include additional proactive inspection and maintenance or installation of additional redundancy.

DEVELOPING LIFECYCLE MANAGEMENT PLANS

MDOT has placed significant recent emphasis on developing Lifecycle Management Plans (LMPs) for critical asset classes, starting with structure and pavement assets. In future years, LMPs will be developed for the remaining asset classes per the 2025 policy updates.

LMPs are part of wider efforts to formalize approaches to commissioning, inspection, preventive maintenance, mid-life overhauls/renewals, replacement, and eventual decommissioning/disposal. LMPs help MDOT standardize best practices and approaches across locations and teams. LMPs have been instrumental in supporting the business case for more proactive investment including inspection and preventive programs that are extending asset life, improving reliability, and reducing cost in the long run. They have also highlighted the need for better data collection and management to support enhanced investment planning and modeling.

MODAL	LIFECYCLE PLANNING INNOVATIONS	PHASES IMPACTED
SHA	Development of LMPs for stormwater and geotechnical assets as part of federal TAMP efforts and ongoing LMP development for lighting assets	Operate and maintain Renew and replace
MAA	Use of mobile tools to record asset condition and defects in the field and enable better tracking of follow-up actions and established BIM and COBie standards for new construction	Plan and design Operate and maintain
MPA	Water and sewer CIP was developed as part of the terminal management program FCI inspections are being completed to inform major building preservation and replacement	Plan and design Procure and construct Operate and maintain Renew and replace
MTA	Developing formal LMPs for bus and light rail modes	Operate and maintain Renew and replace
MVA	Plan to use recent stormwater assessment program to create a formal LMP	Operate and maintain Renew and replace
MDTA	Performing a gap assessment for 3 critical assets (Fleet, ITS, and Tunnels) in order to better formalize LMPs and SGR needs for those asset classes	Plan and design Procure and construct Operate and maintain Renew and replace

OPTIMIZING PROCUREMENT BUSINESS PROCESSES TO SUPPORT ASSET PLANNING

MDOT is actively improving procurement processes to better support programs embedded with LMPs by standardizing maintenance contract scopes and developing timely and effective procurement plans. Procurement enhancements are a critical part of the work team's effort in 2025 and beyond and will help ensure that MDOT has the resources to continue to move from reactive to proactive strategies. Initial targets include the most frequently used and consistent maintenance programs across modals, including pavement rehabilitation, structural inspections, and routine facility systems maintenance.

This collaborative work team effort supports MDOT's overall focus on enhanced communication, adoption of best practices, and sharing of resources. MDOT also anticipates significant improvements in day-to-day work tracking and contractor performance and quality.

ADVANCED ASSET MODELING FOR RISK-BASED OPTIMIZATION (MAXIMIZING ASSET VALUE DELIVERY TO MDOT)

As part of lifecycle planning efforts, MDOT also employs more advanced asset modeling tools that can predict and prioritize renewal and replacement needs and optimize interventions based on asset age and condition. These tools are mostly employed for mature asset classes where significant historical data exist and industry has developed advanced analysis tools to model the most appropriate interventions and treatments. Currently, these models and software tools are most widely used for bridge and pavement assets, but they are being more widely adopted for other asset classes, including utilities (water, wastewater, and stormwater networks). For other asset classes, MDOT relies on age, condition, historical failure data, and maintenance costs to model and prioritize future SGR needs. In the future, MDOT would like to move to even more advanced risk models where criticality can be incorporated into models and perform multi-asset class prioritization of needs based on systems, corridors, and/or networks.

CASE STUDY 8

RISK-BASED PLANNING (MPA)

WATER SYSTEM RENEWAL PROGRAM

Dundalk Marine Terminal (DMT) water system renewal plan was developed in response to an increasing frequency of watermain breaks. The project updated the water system GIS inventory including development of a formal risk score for each main segment based on asset-specific criteria (including age, material, diameter, and break history). These data generated a prioritized capital renewal program to replace all high-risk watermain assets over 15-year period.

CASE STUDY 9

ASSET LIFECYCLE MODELING APPROACH (MDTA)

GIS PLATFORM FOR BRIDGE ASSET MANAGEMENT PRESERVATION MODELING

Currently piloting the migration of a Microsoft Excel-based bridge asset management tool into a more robust enterprise GIS-based platform. This innovative approach uses Python scripting to analyze deterioration histories of key bridge components (deck, superstructure, substructure, and culvert) to predict future deterioration timelines. The platform then calculates element and bridge health indices, enabling the prioritization of bridge maintenance and rehabilitation projects. While still in progress (not yet deployed in production), this pilot demonstrates promising potential for enhancing data accuracy and asset management decision-making. The platform will enable MDTA to better prioritize maintenance and rehabilitation activities that will support optimized resource allocation, asset life extension, and improved infrastructure safety and reliability.

05.

INFORMATION SYSTEMS AND DATA MANAGEMENT

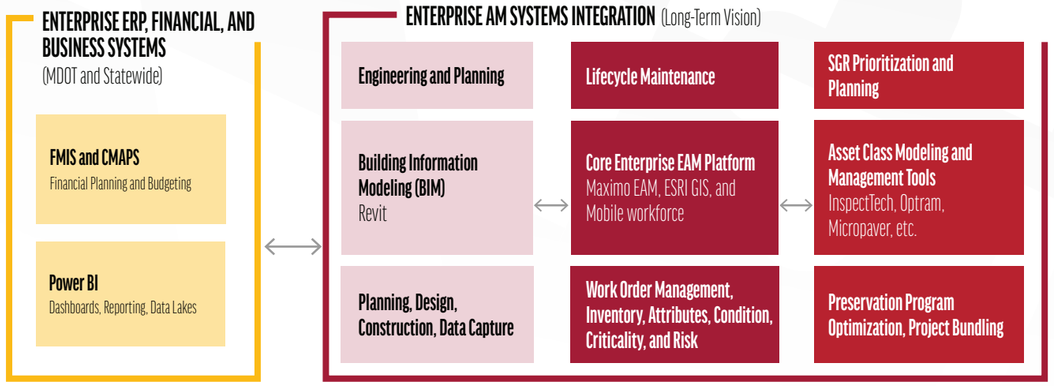
Configuring robust technology systems with accurate data ensures these systems are actively used by staff and provide a single system(s) of truth that is readily accessible across the organization. These systems provide timely and accurate dashboards that inform maintenance strategy, capital investment, and tracking and reporting of key metrics.

SYSTEM CONFIGURATION AND INTEGRATION

Well-developed and integrated information systems are critical to supporting MDOT's goal of data-driven decision-making and enabling lifecycle management and reporting supported by robust information within common core systems as depicted in **Figure 5.1**, including:

- **Enterprise Asset Management (EAM)** to act as the system of record for many asset classes and support work order management for all preventive and corrective work whether performed by internal staff or contractors. EAM also includes **mobile workforce tools** to empower staff in the field and simplify completion of work orders through handheld devices and interfaces. *While several modals currently use different EAM software vendors, much of MDOT is moving toward and encouraging standardization with Maximo EAM.*
- **Geographic Information System (GIS)** to support spatial/linear assets such as roadway and runway pavement and utilities where geospatial location and segmentation is critical. *GIS and EAM systems must be fully integrated to support asset management.*

FIGURE 5.1 | ENTERPRISE INFORMATION SYSTEMS AND FUNCTIONS



- **Asset Class Modeling** tools are used across several modals and asset classes, including pavement, rail/track, and bridge structures. These systems function with specialized modeling capabilities to determine optimized preservation treatments and programs based on asset characteristics and available funding constraints. *These systems will remain critical to program implementation and can be better integrated with EAM/GIS to ensure a single system of record for asset inventory and key attributes.*
- **Building Information Modeling (BIM)** tools are becoming standard in the industry during the delivery of new capital projects. When fully implemented with common data standards, BIM can support rapid commissioning and operation of new infrastructure with an automated download of information into EAM systems (inventory, hierarchy, attributes, maintenance programs) after commissioning.
- **Financial and Reporting** systems generally support MDOT and, in some cases, the state of Maryland and serve core business functions. While less critical for day-to-day asset management, these systems are important for financial and project planning and can be better integrated with the EAM platform over time. *Enterprise dashboard tools can also be used to pull key information from existing systems to develop uniform dashboards for key metrics and reporting.*

DATA GOVERNANCE AND INFORMATION LIFECYCLE

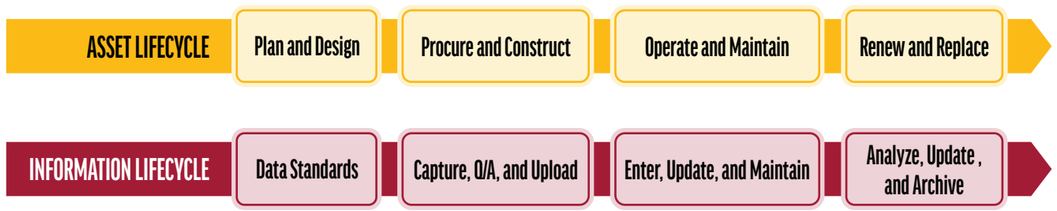
MDOT is actively working to standardize core systems and create an integrated platform that enhances the asset management program and supports maintenance program efficiency. The Technology Working Group is developing a formal **Data Governance Document** to define asset data hierarchies and attribute standards. The working group will establish formal guidelines and procedures when producing, collecting, updating, and sharing critical asset data, as well as methods to ensure appropriate scope, quality, and timeliness. Consistent, reliable, and available datasets will improve MDOT planning efforts and reporting activities by making it easier to convert complex data into information that is ready to use and easy to understand.

MDOT's overarching objectives will support additional consistency of information architecture and data structures across all modals by:

- **Balancing the efficiencies of centralized asset management systems and support while maintaining flexibility** for modals to address their unique business drivers, regulatory requirements, and infrastructure portfolio characteristics.
- **Enabling responsive and efficient technical support and knowledge transfer** to and across modals for critical applications including ESRI GIS (DOIT) and IBM Maximo (TSO).
- **Establishing common principles, best practices, and Standard Operating Procedures** that support effective data management and lead to improved data scope, accuracy, quality, and availability.
- **Enhancing data reliability and accessibility** through clear system controls to deliver information that can be readily analyzed and used for business decisions.

The ongoing data governance and system enhancement work across modals supports the alignment of the asset lifecycle with the information lifecycle as visualized in **Figure 5.2**. During the **planning and design phase**, comprehensive data standards can be provided to design engineers to structure and transfer information during the early phases of a project with ongoing collaboration during design reviews and submittal approvals. During the procure and construct phase, program managers and contractors confirm that information is updated, detailed as-built changes are reflected, and final submittals are formatted for easy upload into EAM systems so that new projects are ready for commissioning and operations and maintenance (O&M). During the operate and maintain phase, data management standard operating procedures and work order workflows validate that work is properly recorded against an asset or system for lifecycle planning. Accurate data ensure that ongoing analysis can be performed to support renew and replace decisions and that cost/benefit and reliability analysis can be performed to determine optimal interventions and/or replacement decisions. Robust data management practices also ensure that renewal activities are properly recorded and information from decommissioned assets is properly archived for historical purposes.

FIGURE 5.2 | **ALIGNMENT OF ASSET AND INFORMATION LIFECYCLE**

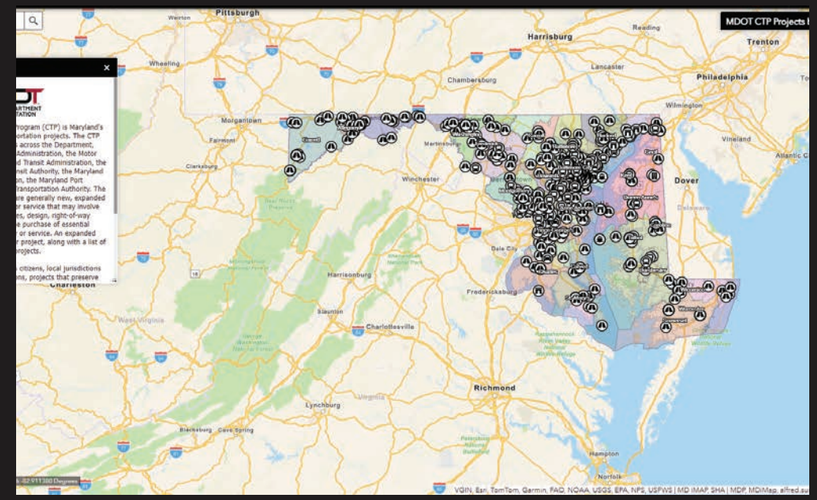


CASE STUDY 10

DATA CAPTURE DURING PROJECT COMMISSIONING (MDTA)

GIS DATA SUBMITTAL STANDARD

MDTA developed and implemented GIS data submittal standards for contractors to ensure the accuracy and completeness of asset data deliverables. Initial standards were based on Excel and GIS templates that have been refined into a more streamlined, GIS-based format. Standards are accompanied by clear contractor guidance for consistent submission of newly commissioned asset data directly into the GIS system, reducing labor effort and improving turnaround time. This shift supports alignment with EAM needs from the outset of project delivery and allows for quicker asset commissioning and transition to Engineering and O&M staff.



06.

STATE OF GOOD REPAIR INVESTMENT PLANNING AND PRIORITIZATION

Informed planning supports enhanced long-term financial forecasts and a transparent process to validate and justify needs to stakeholders through a strong business case. A robust business case and prioritization approach ensures funding is applied appropriately so that critical assets are proactively maintained in SGR.

Annual SGR planning is a fundamental element of the asset management program and is driven by structured risk-based approaches that prioritize the most critical asset, project, and program needs. When funding is constrained, this process allows MDOT to advocate for preservation investments that have the most direct impact on the performance and reliability of the transportation system and align with broader strategic goals.

The 2025 SGR analysis identifies a six-year funding need of approximately $21.2B to achieve and maintain the seven critical assets in SGR. Of this $13.2B or 62% is currently funded through existing sources. Approximately 39% of the 2025-2030 CTP has been allocated to SGR to help address this backlog. The lifecycle and risk strategies presented in Section 4 of this document are designed to help MDOT allocate its available funds to the areas of most significant need and impact. The data collected through the asset management program support a strong business case, validated through a formal justification process that incorporates cost/benefit analysis and triple bottom line (community, financial, and environmental impacts) outcomes. In addition, staff are using improved data to evaluate initial capital as well as long-term O&M costs to provide a more complete picture of funding needs before and after assets and projects are commissioned.

An important element of MDOT's SGR analysis is the ability to forecast future condition through asset modeling tools that can evaluate various intervention options against available funding and target performance. These models are widely used for pavement and structure (bridge) assets and will be more widely applied to other asset classes in the future.

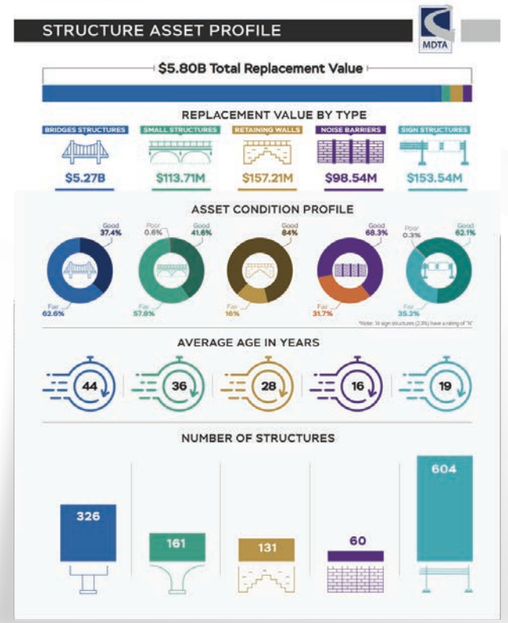
ASSET LIFECYCLE MANAGEMENT (MAINTENANCE) PLANNING

MDOT will continue to prioritize the development of asset LMPs that summarize and document inspection, preventive maintenance, and preservation programs. These programs are developed and justified through demonstrated benefits using appropriate supporting analytical tools and methodologies. LMPs are critical to building a strong business case for fully funded inspection and preventive maintenance programs that cost-effectively preserve or extend asset life. LMPs also highlight the impact that these programs have on sustaining the reliability and quality of MDOT's transportation systems. With pending updates to Policy 605, LMPs will be required for all critical asset classes over time, building on the pavement and structures LMPs that were developed in 2022. **Figure 6.1** shows an example asset profile from a recent LMP.

PROGRAM FUNDING AND CAPITAL PLANNING PROCESS

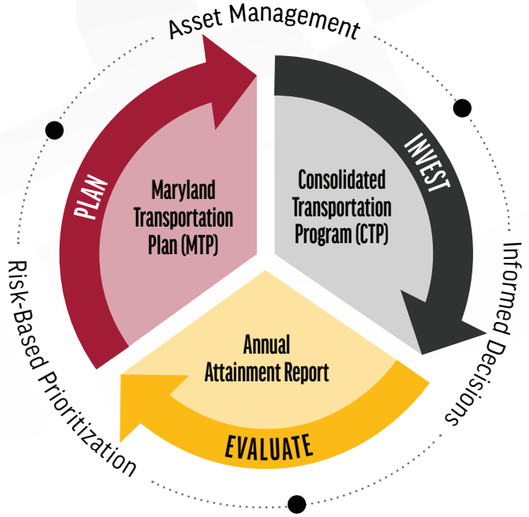
MDOT's capital and maintenance programs are funded through a variety of sources including annual federal allocations, the state transportation trust fund, and discretionary grants. A strong asset management program helps MDOT remain in compliance with federal funding requirements (specifically for highway, transit, and aviation assets) and is a critical element of many federal grant opportunities, demonstrating that the agency is a strong steward of its assets and investment dollars.

FIGURE 6.1 | **EXAMPLE ASSET PROFILE FROM LMP**



The asset management program has become an integral component of the annual CTP process and supports an enhanced emphasis on SGR. The program data and visibility have strengthened the recognition among MDOT's stakeholders about the need to prioritize lifecycle maintenance needs and funding for systems and assets that are already in service. This recognition has allowed MDOT to create a more appropriate balance between growth, expansion, and preservation. Asset management plays a critical role at each stage of the planning process (see **Figure 6.2**). During the planning stage, asset management provides information to help understand the overall needs of the system as an input into MDOT's wider transportation goals. During the invest stage, risk-based SGR needs are a direct input into the CTP program and funding prioritization. During the evaluate stage, MDOT uses metrics and dashboards to continually evaluate the success of the SGR programs and investments and re-prioritize as needed in subsequent plans.

FIGURE 6.2 | **MDOT PLANNING PROCESS (MODIFIED FROM CTP FACTSHEET)**



PLAN

Understand needs and balance priorities across critical asset classes, build business case justification, and strengthen staff and technical skills to deliver on strategic goals

INVEST

Prioritize needs through risk-based approaches, develop and fund long-term maintenance and SGR, and manage program implementation and outcomes

EVALUATE

Measure asset and system performance through dashboards, promote data driven decisions, monitor progress, and refine strategies to meet LOS goals

CASE STUDY 11

ENHANCED SGR NEEDS FORECASTING (SHA)

ANNUAL ASSET CLASS PLANNING PROCESS

Over the last several years, SHA has refined the annual SGR needs planning process to include both the seven critical MDOT asset classes as well as eight additional asset classes to provide a full picture across the entire portfolio. The planning process includes a formal presentation to executive leadership from each asset class owner and the AMO team to present SGR projections, preservation program justification, and ongoing asset management related improvements.

07.

HUMAN CAPITAL (STRUCTURE, RESOURCES, AND TRAINING)

Resource planning and organizational enhancements provide the resources, tools, and capabilities to support asset management strategic goals. Modals are focused on strengthening knowledge management and staff capabilities through training, mentorship, and career development as a key part of the asset management program.

Empowering and supporting MDOT's workforce is key to asset management program success, and the principle of embedding asset management across the organization and supporting staff development is one of the SAMP's seven goals. The program has established a successful governance structure that formalizes cross-modal collaboration through committees and working groups and provides overarching support and facilitation. This structure empowers teams to deliver on MDOT- and modal-specific priorities while establishing common approaches, methodologies, tools, and practices. The human capital work team is one of four work groups (see governance structure in **Figure 7.1**) that is actively engaged in addressing current challenges related to recruiting, hiring, staffing, and retention of key asset management resources.

The human capital work team will continue to develop recommendations for a focused structure that includes key roles and responsibilities required to deliver on SAMP objectives, with the intent of promoting critical resources for each modal and a consistent baseline structure. Asset management will partner with MDOT Human Resources to develop new or revised classification(s) to align with recruiting and staffing needs across MDOT. This consistent structure is likely to include a hybrid approach of new positions for critical and foundational (leadership) roles as well as embedding asset management responsibilities into existing positions as appropriate (see **Figure 7.2**, Proposed Structure).

FIGURE 7.1 | **ASSET MANAGEMENT PROGRAM GOVERNANCE STRUCTURE**

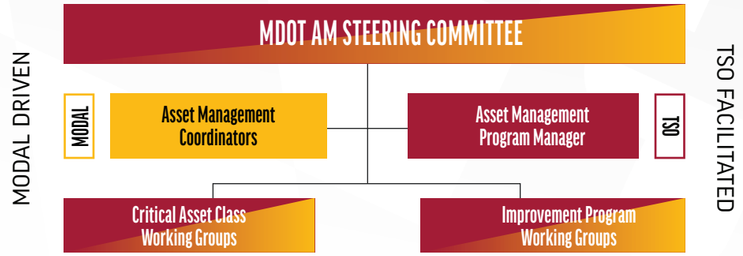
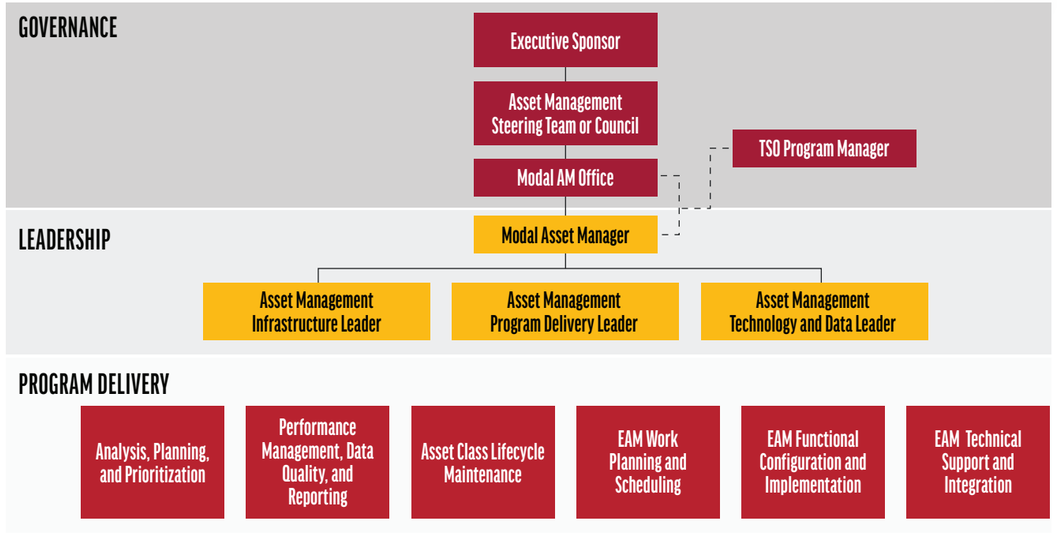


FIGURE 7.2 | **PROPOSED STANDARDIZED ASSET MANAGEMENT STRUCTURE WITH KEY GOVERNANCE, LEADERSHIP, AND DELIVERY ROLES**



Successful long-term recruitment and retention will also require adequate budget for asset management training to help staff develop appropriate knowledge and skillsets and stay connected to industry trends and emerging practice. Training is especially critical for internal or external recruitment where qualified staff may bring industry and infrastructure expertise but require additional focus and knowledge on asset management-specific skills and principles within the transportation sector. Support for training and development will deliver long-term benefits to culture, belonging, and employee engagement. Investment in training and skills development also demonstrates MDOT's commitment to innovation and highlights the importance of incorporating emerging asset management technology and best practices that will help the program to continually evolve.

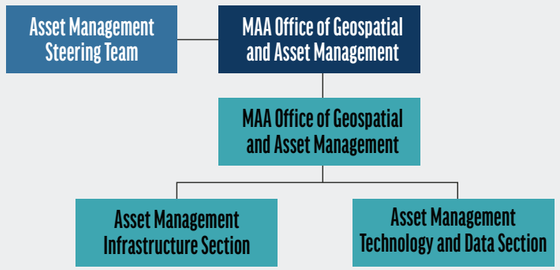
The work team has also focused on developing **critical success factors** to track and monitor in support of long-term success.

SUCCESS FACTOR	KEY SUPPORT ACTIVITIES/ACTIONS
Approval for internal asset management PINs at each modal, starting with initial key positions	↗ Annual approvals for additional PINs that are actively used to fill key positions (likely to be phased in over several years).
Effective recruiting and high retention rates for key asset management roles	↗ Sustained effort to recruit and retain key asset management staff across MDOT modals. Focus on retention of existing staff currently in related roles.
Focus on enhanced use of EAM system and expanding implementation across asset classes	↗ Create a stronger business case for impact of key EAM professionals and SMEs through better and more consistent EAM software deployment.
Adequate budget for training and development	↗ Secure appropriate annual funding for training, development, and certification to help ensure new positions, roles, and responsibilities have a strong foundation for success.

CASE STUDY 12

ENHANCING THE ASSET MANAGEMENT ORGANIZATION (MAA)

STRUCTURE, ROLES, AND RESPONSIBILITIES TO DELIVER AN EFFECTIVE PROGRAM



MAA is in the process of establishing the new Office of Geospatial and Asset Management (OGAM) that will formalize recent program enhancements and investments. The structure places a specific emphasis on capturing benefits from advanced use of technology and data for decision-making and includes roles for data governance, software performance and integration, ownership and support, and technical support and administration. Efforts to roll out the new structure will also include staff workshops and training and monthly coordination and advisory meetings to ensure that the drivers and benefits are well understood and embraced by staff.

08.

CONTINUOUS IMPROVEMENT, COLLABORATION, AND CULTURE CHANGE

MDOT promotes a culture that embraces performance improvement and program flexibility. Ongoing program management and support encourages a continuous review of progress, assessment of impacts, and appropriate refinements made along the way.

Asset management is a long-term commitment for MDOT, and a culture-focused approach helps the organization proactively tackle challenges and roadblocks along the way, including external forces, funding constraints, resource scarcity, and resistance to change. Consistent executive-level support, dedicated champions, and program flexibility are critical to tackling these challenges while promoting steady progress and demonstrated impact. The embedded work teams and asset class teams have already broken down barriers and created a collaborative culture and commitment to success that will guide MDOT through these challenges and keep the program improving and evolving (see **Figure 8.1**). These culture-focused program principles have been embraced through ongoing change management and communication efforts, including **Asset Management Ambassadors (TAM/Bassadors)** in place at MTA and MDTA to foster more frequent communication and initiatives such as work sessions, town halls, and informational videos. MDOT continues to emphasize the importance of participation, review, feedback, and refinement with new and updated initiatives to refresh the program and create a culture of collective ownership, accountability, innovation, and creativity.

FIGURE 8.1 | **CONTINUOUS IMPROVEMENT CYCLE**

Collaborative cross-modal work teams will remain an essential part of the program with ongoing efforts focused on improving data and information for decision-making, strengthening the core asset management workforce, and streamlining lifecycle program delivery.

Modal-driven efforts are also essential to the program and include the development of modal AMPs and LMPs and ongoing efforts to improve data and work management through EAM enhancements. Modals continue to communicate, promote, and champion their efforts and engage and involve the workforce at all levels to embrace asset management as "the way MDOT does business." MDOT leadership will continue to monitor progress and solicit feedback and input from staff to keep the program fresh, innovative, and relevant. Additional modal activities focused on outreach, culture, and improvement are highlighted below.

STRATEGY	MODAL SCOPE	KEY ACTIVITIES/ACTIONS
Asset Management educational and outreach videos and/or workshops	SHA, MTA, MDTA, MAA	↗ Intranet videos from key leaders promoting asset management and its impact on staff and stakeholders along with program updates and priorities. Internal stakeholder outreach workshops and/or forums.
External staff training and certifications	MTA	↗ Intranet page highlighting staff success stories and promoting trainings and certifications to encourage others and expand knowledge.
Environmental Management System (EMS) alignment	MVA	↗ Education and training (external) to align EMS and asset management initiatives and outcomes.
Asset management ambassador programs	MTA, MDTA, MAA	↗ Appointment of key staff to communicate and promote asset management and act as modal or asset class champion and first line of connection.

09.

PROGRAM IMPLEMENTATION

Implementation will translate the tactical needs outlined in this AMP into a roadmap, focused on priority initiatives, for ongoing improvement at MDOT over the next several years. MDOT will continue to enhance organizational alignment, deliver clear benefits, and establish long-term support and collaboration across modals.

ENSURING CONTINUED PROGRESS AND IMPACTS

Asset management is becoming further embedded and incorporated into annual business and financial planning processes. It is reinforced as a strategic priority throughout MDOT's family of planning documents, including the MDOT Playbook (2050 Maryland Transportation Plan), CTP, Annual Attainment Report, and the Transportation Resilience Improvement Plan. At the modal level, asset management is a critical element of strategic business plans that include SHA's 2023 Asset Management Program Strategic Business Plan and MDTA's Asset Management Strategy.

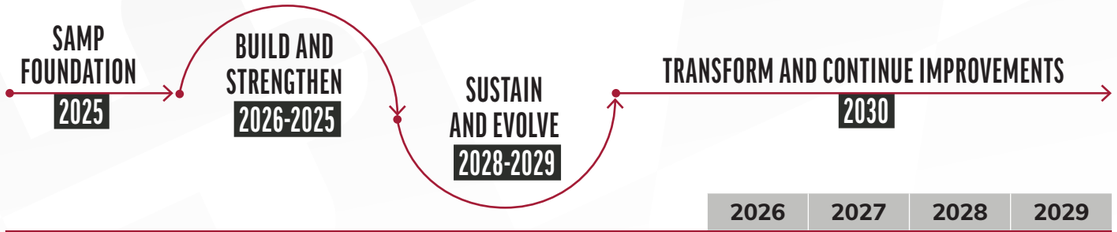
The human capital, procurement, and technology work teams have continued to make significant progress throughout 2025 (see **Figure 9.1**). Asset class work teams are also being refreshed: two new critical asset classes were added in 2025. The technology work team has finalized an initial Data Governance Document that will guide improvements to data scope, quality, and consistency and help MDOT to better leverage existing systems and software. The human capital work team has developed MDOT-wide guidelines for organizational structure, roles, and responsibilities to promote baseline consistency across modals and support workforce development and knowledge management. Each modal is also progressing with individual efforts to improve their program, engage the workforce, and ensure ongoing progress.

The asset management program is critical to MDOT's overall focus on improving SGR and reliability and continued efforts supporting resiliency and infrastructure "hardening" along with longer term investments in electrification.

PLANNING AND PROGRAM MANAGEMENT

MDOT continues to execute on the priority initiatives identified in the 2025 SAMP. With recent enhancements to Policy 605, modals will be adding additional critical asset classes to the program and focus on modal AMP and LMP development throughout 2026-27. As defined in the SAMP, the **Build and Strengthen Phase (2026-27)** will focus on further embedding changes and improvements throughout the modal workforce with significant impacts, ownership, and outcomes, and the **Sustain and Evolve Phase (2028-29)** will be characterized by continued refinement and evolution through annual program reviews, benefits tracking, and a transformational culture of asset management innovation and excellence. Efforts will continue past 2030 and will be driven by an updated five-year SAMP. Ongoing cross-modal collaboration will continue, with each modal focusing on detailed implementation efforts aligned with the broader MDOT vision. The overall program schedule is shown in **Figure 9.1**. Modal initiatives are summarized in **Figure 9.2**.

FIGURE 9.1 | **PROGRAM IMPLEMENTATION AND EVOLUTION**



	2026	2027	2028	2029
Ongoing Asset Management Program Initiatives to Support Data Driven Decision Making				
T1: Develop, Publish, and Communicate MDOT-Wide SAMP and AMP	*COMPLETED in 2025*			
T2: Modal AMPs and LMPs				
T3: Maximo EAM Enhancements, Integration and Usability Improvements				
T4: Annual Asset Inventory, Condition, and SGR Reporting and Needs Analysis				
T5: Annual Capital Planning (CTP) Planning, Allocation, and Prioritization				
T6: Asset Management Communications, Awareness, Outreach, and Training				
Human Capital: Long-Term Asset Management Staffing and Resource Strategies				
T1: Document Current Organizational Models and Develop Recommendations	*COMPLETED in 2025*			
T2: Develop Standard Asset Management Classification Series (In-Process)				
T3: Develop Baseline Staffing Recommendations				
T4: Develop MDOT Strategy for Securing PINs and Staffing Commitments				
Technology: Implement, Enhance, Configure, and Integrate Useable EAM Systems				
T1: Establish Data Governance				
T2: Data Management, Analysis, and Reporting				
T3: Document Current Systems, Architecture, Integration				
T4: Develop Model for Operational Support Needs (With Human Capital Team)				
Procurement: Increase Flexibility, Reduce Effort, and Improve Outcomes for Common Procurement Needs				
T1: Identify Current (and Recent) Procurement Vessels				
T2: Create Reference Library of Asset Management-related RFP Scopes				
T3: Develop Cross-Modal RFP Committee				
T4: Develop Guidance on Lifecycle Maint. Contracts and Incorporation of KPIs				
Incorporate Additional Critical Asset Classes				
T1: Finalize Enhancements to Policy 605	*COMPLETED in 2025*			
T2: Develop Guidelines for Additional Asset Class: Stormwater				
T3: Develop Guidelines for Additional Asset Class: Utilities				

FIGURE 9.2 | **MODAL INITIATIVES**

MODAL	ADDITIONAL PRIORITY INITIATIVES	2025	2026	2027	2028	2029	2030
MDOT MARYLAND DEPARTMENT OF TRANSPORTATION – MARYLAND AVIATION ADMINISTRATION	Staff recruitment and onboarding for key positions within enhanced organization						
	Asset inventory and tagging initiative for Maximo EAM						
MDTA	Maximo EAM enhancement project						
	Maturity assessment, gap assessment, and improvement program for critical assets						
MDOT MARYLAND DEPARTMENT OF TRANSPORTATION – MARYLAND PORT ADMINISTRATION	Waterfront structures risk-based assessment, preservation, and replacement program						
	Utilities risk-based assessment, preservation, and replacement program						
MDOT MARYLAND DEPARTMENT OF TRANSPORTATION – MARYLAND TRANSIT ADMINISTRATION	Inventory data collection and data quality reviews						
	Inspection report reviews and SGR analysis						
MDOT MARYLAND DEPARTMENT OF TRANSPORTATION – MOTOR VEHICLE ADMINISTRATION	Updating the modal AMP and incorporating new asset classes						
	Adding updated SGR data from the facility assessment initiative						
MDOT MARYLAND DEPARTMENT OF TRANSPORTATION – STATE HIGHWAY ADMINISTRATION	Implementation of Enterprise Asset Management (EAM) system and related data enhancements						
	AMO Standard Operating Procedures (SOP) manual						

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