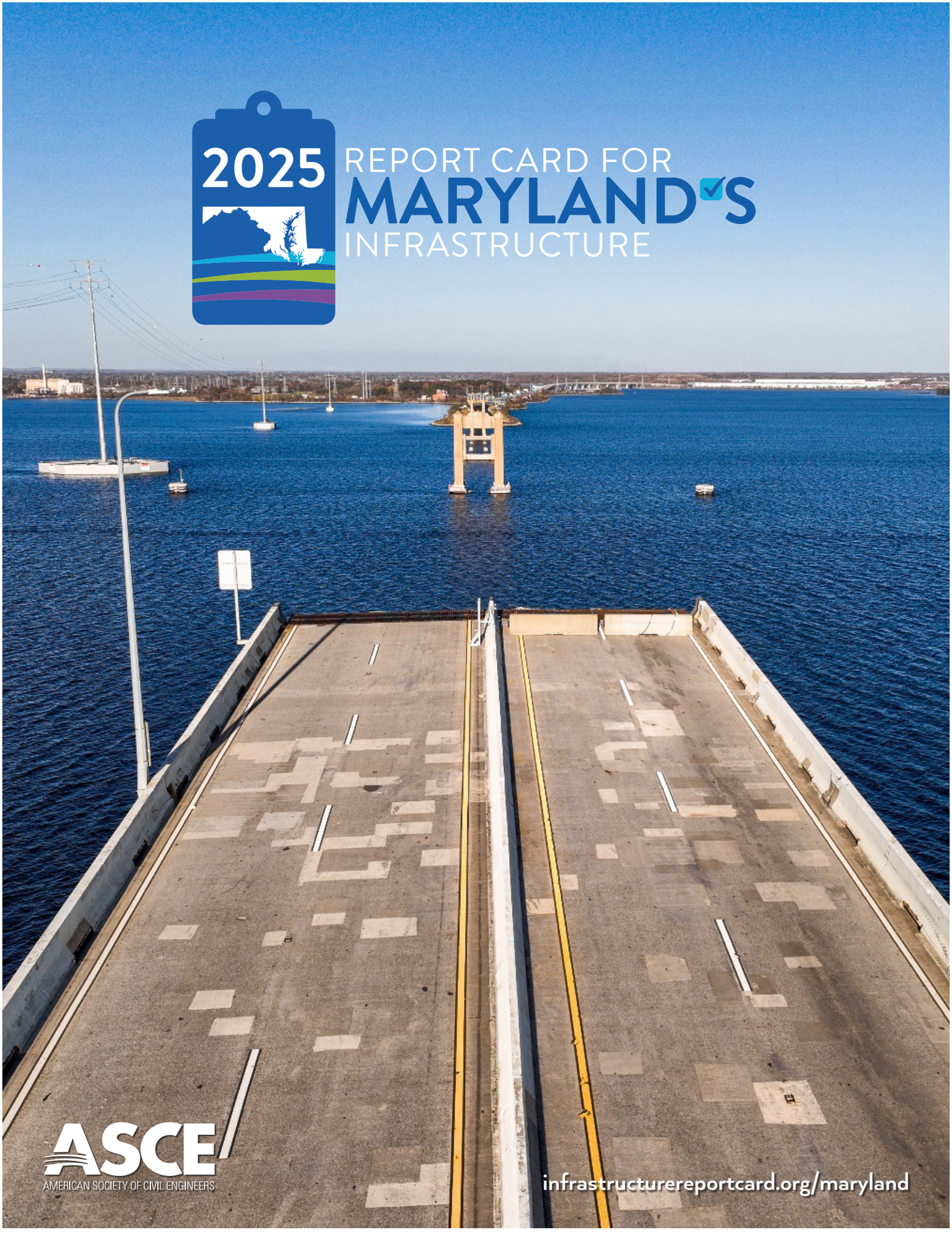
2025
REPORT CARD FOR
MARYLAND'S
INFRASTRUCTURE
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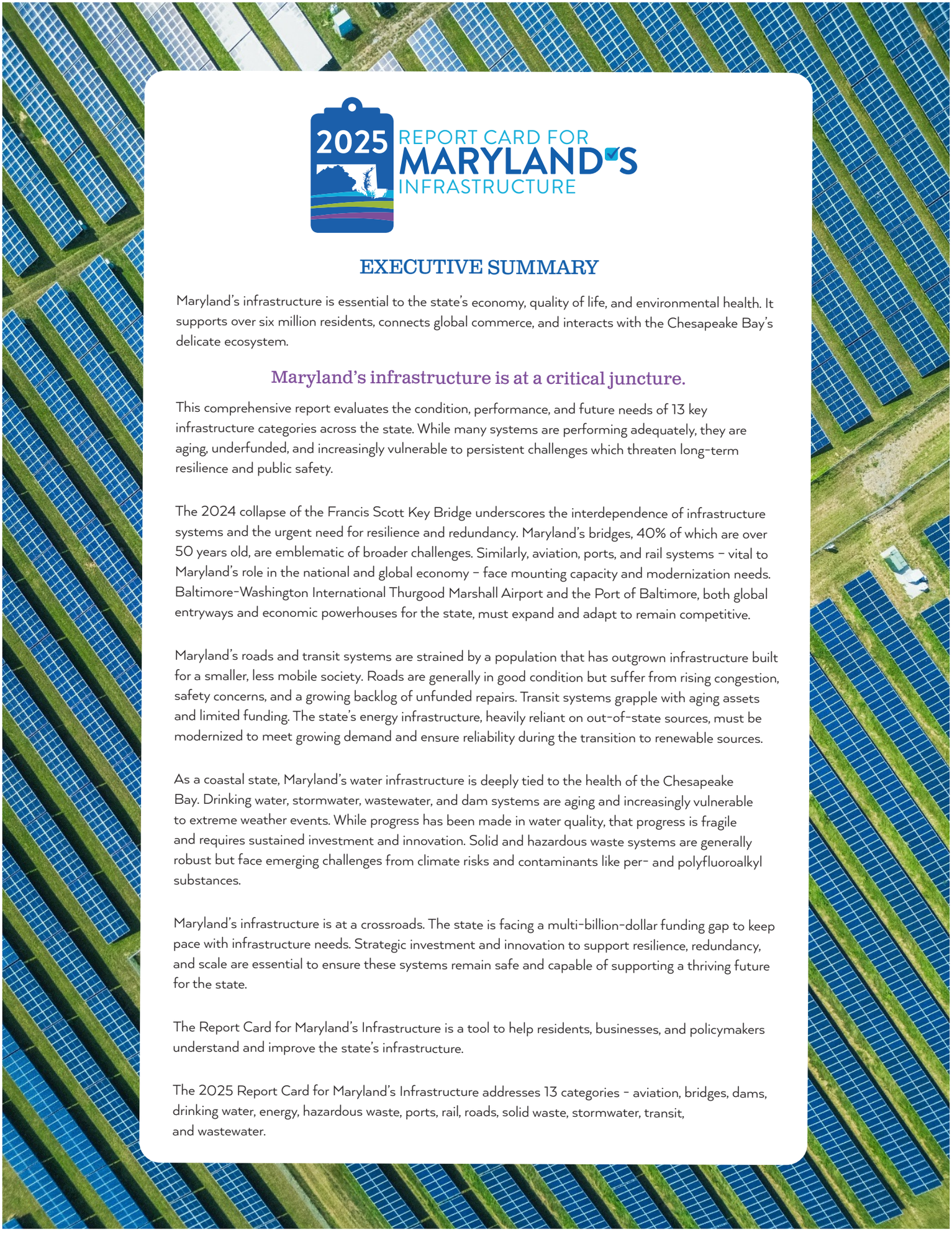

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

EXECUTIVE SUMMARY

Maryland's infrastructure is essential to the state's economy, quality of life, and environmental health. It supports over six million residents, connects global commerce, and interacts with the Chesapeake Bay's delicate ecosystem.

Maryland's infrastructure is at a critical juncture.

This comprehensive report evaluates the condition, performance, and future needs of 13 key infrastructure categories across the state. While many systems are performing adequately, they are aging, underfunded, and increasingly vulnerable to persistent challenges which threaten long-term resilience and public safety.

The 2024 collapse of the Francis Scott Key Bridge underscores the interdependence of infrastructure systems and the urgent need for resilience and redundancy. Maryland's bridges, 40% of which are over 50 years old, are emblematic of broader challenges. Similarly, aviation, ports, and rail systems – vital to Maryland's role in the national and global economy – face mounting capacity and modernization needs. Baltimore-Washington International Thurgood Marshall Airport and the Port of Baltimore, both global entryways and economic powerhouses for the state, must expand and adapt to remain competitive.

Maryland's roads and transit systems are strained by a population that has outgrown infrastructure built for a smaller, less mobile society. Roads are generally in good condition but suffer from rising congestion, safety concerns, and a growing backlog of unfunded repairs. Transit systems grapple with aging assets and limited funding. The state's energy infrastructure, heavily reliant on out-of-state sources, must be modernized to meet growing demand and ensure reliability during the transition to renewable sources.

As a coastal state, Maryland's water infrastructure is deeply tied to the health of the Chesapeake Bay. Drinking water, stormwater, wastewater, and dam systems are aging and increasingly vulnerable to extreme weather events. While progress has been made in water quality, that progress is fragile and requires sustained investment and innovation. Solid and hazardous waste systems are generally robust but face emerging challenges from climate risks and contaminants like per- and polyfluoroalkyl substances.

Maryland's infrastructure is at a crossroads. The state is facing a multi-billion-dollar funding gap to keep pace with infrastructure needs. Strategic investment and innovation to support resilience, redundancy, and scale are essential to ensure these systems remain safe and capable of supporting a thriving future for the state.

The Report Card for Maryland's Infrastructure is a tool to help residents, businesses, and policymakers understand and improve the state's infrastructure.

The 2025 Report Card for Maryland's Infrastructure addresses 13 categories - aviation, bridges, dams, drinking water, energy, hazardous waste, ports, rail, roads, solid waste, stormwater, transit, and wastewater.

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

Aviation	C+
Bridges	B-
Dams	C
Drinking Water	C
Energy	D+
Hazardous Waste	C+
Ports	B
Rail	B-
Roads	C-
Solid Waste	B
Stormwater	C+
Transit	D+
Wastewater	C+
Overall G.P.A.	C

Report Contents

About the Grades

The 2025 Report Card for Maryland's Infrastructure was researched and written by a committee of civil engineers from across Maryland who volunteered their time to collect and analyze publicly available data, prepare and review findings, and present conclusions. Infrastructure categories were evaluated on several criteria – condition, capacity, operation and maintenance, public safety, resilience, innovation, funding, and future needs.

The committee worked with ASCE staff and ASCE's Committee on America's Infrastructure to provide this assessment of Maryland's infrastructure. With a commitment to serve and protect the public, the committee compiled the Report Card as a public, voluntary service to residents and policymakers to inform them about Maryland's infrastructure needs.

Each category of infrastructure is graded based on the following eight criteria: capacity, condition, operation and maintenance, funding, future need, public safety, resilience, and innovation. ASCE defines the grades as follow:

A	B	C	D	F
Exceptional, Fit for the Future	Good, Adequate for Now	Mediocre, Requires Attention	Poor, At Risk	Failing/ Critical, Unfit for Purpose

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

The 2025 Report Card for Maryland's Infrastructure covers 13 categories – aviation, bridges, dams, drinking water, energy, hazardous waste, ports, rail, roads, solid waste, stormwater, transit, and wastewater.

Key Recommendations to Improve Infrastructure Grades

Across all sectors, several overarching strategies emerge as essential to improving Maryland's infrastructure:

- **Establish Sustainable Funding Mechanisms:** Transitioning from fuel taxes to more sustainable models, such as vehicle miles traveled, expanding user fees, and leveraging federal partnerships and programs are critical to closing funding gaps across aviation, roads, transit, and water systems and ensuring long-term financial viability.
- **Prioritize Resilience and Redundancy:** The Francis Scott Key Bridge collapse demonstrated how one failure can ripple across systems. Maryland must invest in backup capacity, resilient design, and disaster preparedness across all sectors – especially bridges, ports, energy, and water infrastructure.
- **Modernize Aging Systems and Promote Innovation and Technology Adoption for a Growing Population:** Roads, transit, and energy and waste systems must be upgraded to meet the demands of a larger, more mobile, and increasingly electrified population. This includes reducing congestion, improving transit reliability, expanding electric grid capacity, and scaling treatment, recycling, and reuse programs. Smart technologies, predictive maintenance tools, and emerging treatment methods should be incentivized to improve efficiency and safety.
- **Protect the Chesapeake Bay through Integrated Water Management:** Investments in stormwater, wastewater, and drinking water systems must be coordinated to reduce pollution and enhance resilience to extreme weather. Asset management, climate risk assessments, and green infrastructure should be prioritized.
- **Strengthen Workforce and Public Engagement:** Emphasizing workforce pipelines, such as expanding apprenticeship programs, improving public education on dam safety and recycling, and enhancing emergency response coordination will build capacity and public trust.
- **Enhance Coordination and Delivery:** Streamlining project delivery, consolidating utilities, and adopting alternative procurement methods will reduce costs and improve timelines, especially in transit and rail sectors.

By implementing these recommendations, Maryland can not only raise its infrastructure grades, but also ensure economic vitality, environmental health, and public well-being.

About ASCE MARYLAND

The Maryland Section of ASCE was founded in 1914 and currently has more than 2,000 members. ASCE is the nation's oldest and largest engineering society. Its membership comprises civil engineers at all career stages and in all sectors and disciplines. Civil engineers plan, design, construct, and operate society's economic and social engine – the built environment – while protecting and restoring the natural environment. ASCE, by advancing technical excellence, advocating lifelong learning, and developing leadership, enables its members, partners, and the public to improve our infrastructure and build a better quality of life.

Get involved

The 2025 Report Card for Maryland's Infrastructure addresses 13 categories and gives the state an overall GPA of C. There are recommendations for overcoming the challenges Maryland's infrastructure faces; following them will help raise Maryland's infrastructure grades.

By learning more about the conditions of the infrastructure you use every day, you can help raise the grade.

Get the full story behind this Report Card at infrastructurereportcard.org/maryland/.

Ask your elected leaders what they are doing to make sure your infrastructure is reliable for the future. Use your zip code to find your list of elected officials at infrastructurereportcard.org/take-action/.

AVIATION

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: C+

2020 Maryland: B- 2025 National: D+

Executive Summary

Maryland's aviation system plays a vital role in the state's economy, supporting business travel, tourism, and freight movement. The state's 33 public-use airports, including Baltimore-Washington International Thurgood Marshall (BWI Marshall), serve both commercial and general aviation needs. BWI Marshall alone accounts for 99% of Maryland's enplanements and generates over $11 billion in annual economic impact. Continued investment in airport infrastructure is essential to maintain safety, reliability, and capacity as passenger demand grows. While runways and facilities are generally in good condition, aging infrastructure and funding constraints pose significant challenges. Statewide, an additional $8 billion will be needed over the next 20 years for safety, capacity, and modernization projects. Although federal programs such as the Airport Improvement Program and the Infrastructure Investment and Jobs Act provide crucial support, Maryland's airports will require sustained and diversified funding sources to remain competitive, efficient, and resilient.

Introduction

Aviation contributes significantly to Maryland's economy. Airport infrastructure, comprising cargo facilities, passenger terminals, runways, parking garages, and more, supports business and tourism. In 2023, the total economic impact to Maryland from Baltimore-Washington International Thurgood Marshall Airport (BWI Marshall) was $11.3 billion. Additionally, there were 16,162 jobs directly generated due to aviation activity in the state, resulting in $4.2 billion in personal income and consumption expenditures. State and local governments received $342.9 million in tax revenues. Continuing to invest in airport infrastructure and support sound aviation policy is an important step in building a competitive economic future for Maryland.

Statewide, general aviation contributed $1.5 billion to Maryland's economy in 2024. State and local governments received $168.6 million in tax revenues. There were 5,319 jobs directly generated due to general aviation activity in Maryland with another 4,906 jobs indirectly created.

Capacity

There are 145 airports in Maryland. Of those, 33 are open to the public and three offer commercial air service – BWI Marshall (BWI), Hagerstown (HGR), and Salisbury (SBY). The 33 public use airports include the Pier 7 Heliport (4MD) and the Havre de Grace Seaplane Base (M06). There are 18 National Plan of Integrated Airport Systems (NPIAS) airports.

According to the most recent data available from the Maryland Department of Transportation (MDOT), BWI Marshall served over 27 million passengers in 2024. This was an overall decrease of 5.9% from the previous year. Ninety-nine percent of the enplanements in Maryland occurred at BWI Marshall. According to Airports Council International – North America, in 2024, BWI Marshall was ranked the 24th largest airport in the United States based on passenger traffic, 40th busiest airport based on airplane movements, and 28th busiest based on cargo tonnage landed at U.S. airports. Capacity at BWI Marshall is sufficient for now, however continued growth will necessitate planning and growth management to ensure effective operations. Asserted in the 2025-2029 NPIAS report to Congress, BWI Marshall will not suffer from a lack of operational capacity if planned improvements are implemented.

Condition

Given the essential nature of airport pavement surfaces, assessing their condition provides one prominent indicator of airport infrastructure condition. The Airport Safety Data Program is based on FAA Order 5010, which outlines the methods for collecting and disseminating operation and safety information about airports. On behalf of the Federal Aviation Administration (FAA), state transportation agencies conduct inspections of public airports annually and private airports every three to five years. The inspections produce a pavement condition index (PCI) which is a rating system that indicates the surface condition of airport runway pavement. PCI values range from 0 to 100 with associated ratings of pavement conditions from failed to excellent, respectively. According to the FAA 5010 inspection records, of the 37 paved public runways in Maryland, two runways are in excellent condition, 24 are in good condition, and ten runways are in fair condition. One public runway is in poor condition. This is a small decrease in overall condition from the previous report card in 2020 where six runways were in excellent condition, 22 were in good condition, and 11 were in fair condition.

Pavement deteriorates with time and use. Airfield pavement surfaces require regular maintenance and repair to maintain their operability. Without ongoing attention, pavement conditions could deteriorate quickly to fair, poor, and failed categories.

At BWI Marshall, many pavement reconstruction projects have been executed over the past several years. These projects replaced asphalt pavement on several taxiways and aprons with Portland cement concrete pavement, which handles modern aircraft wheel loads more efficiently than the asphalt pavement.

All five terminals (A through E) at BWI Marshall have undergone some level of renovation in the past 15 years. Renovations include the recently completed, award-winning project to rehabilitate many of the restrooms in the terminals behind security. Further expansions and renovations are expected to be completed over the next five years including a $480 million expansion to the Concourse A-B terminal, reconfiguration of passenger flow in the customs and border protection area, a Concourse C-D connector, and a new Air Traffic Control Tower.

The landside infrastructure such as roads, bridges and parking structures has been maintained in a serviceable condition. The infrastructure is aging and requires dedicated maintenance funding.

Operation and Maintenance

BWI Marshall and Martin State Airport (MTN) are owned by MDOT, while the remaining Maryland public use airports are owned and operated by local governments such as cities or counties. These entities oversee the daily operation and maintenance of their respective facilities and provide planning and management of facility construction projects.

MDOT Maryland Aviation Administration's (MAA's) Office of Regional Aviation Assistance (ORAA) inspects all public-use airports annually. It issues licenses to all eligible public-use, private-use, and commercial-use airports. The private-use, non-commercial use airports are only registered. Concurrent with the inspections, ORAA conducts Airport Safety Data inspections on behalf of the federal government to collect data published in federal documents and other public periodicals. ORAA provides land surveys for proposed new facilities, takes traffic counts, and evaluates obstructions to public-use airports. It assists local governments with preserving and improving existing airports and helps plan new facilities to meet needs for future capacity.

2025 Grade: C+

AVIATION

The MAA's FY2026 operating budget totals $253.3 million, with 96.5% dedicated to BWI operations, 3.2% to MTN, and 0.2% to statewide support, reflecting modest personnel growth and restored service contracts after prior cuts. According to the 2023 Maryland Aviation System Plan (MASP), system airports perform strongly in meeting key operational facility objectives, with high compliance in areas such as paved aircraft parking (96%), rotating beacons (94%), taxiway systems (94%), approach capability (88%), and lighted wind cones (91%). However, several critical planning and infrastructure objectives remain unmet. The most significant deficiencies include the lack of updated or existing airport Master Plans – only 17% of airports have one in place – as well as gaps in airport property fencing (56%), adequate runway length (62%), runway end identifier lights (62%), and updated airport layout plans (62%). The MASP introduces updated recommended intervals for Master Plan reviews – every five years for air carrier airports and every ten years for general aviation airports – to serve as check-in points rather than strict requirements. Airports are encouraged to coordinate with MAA and the FAA when planning updates are warranted or before applying for grant funding. Additionally, airports should regularly assess facility needs and ensure projects appear on FAA-approved Airport Layout Plans to maintain eligibility for federal funding.

Funding

Maryland's six-year Aviation Capital Program is supported by a diverse mix of funding sources, including approximately 29.5% from federal grants, 38.3% from the state's Transportation Trust Fund, and 32.2% from other sources such as revenue bonds (48%), Passenger Facility Charges (39%), and Customer Facility Charges (13%). This balanced funding structure enables ongoing investment in airport modernization, safety, and capacity improvements across the state system.

Commercial airports in Maryland utilize the FAA's Passenger Facility Charge (PFC) program. The PFC program allows commercial airports to fund FAA-approved projects that enhance safety, security, and/or capacity, reduce noise, or increase air carrier competition. These funds are vital to helping commercial airports meet future needs. The current PFC cap was instituted in 2000 and was not indexed for inflation or growth. PFCs are capped at $4.50 per flight segment with a maximum of two PFCs charged on a one-way trip or four PFCs on a round trip, for a maximum of $18 total. The cap limits an airport's ability to fund projects that are needed for future expansion, safety, capacity, and innovation. As a result, funding shortfalls result in deferred maintenance and push rehabilitation projects to later dates when they will be more expensive.

Other sources of airport revenue come from leasing commercial retail space inside and outside of terminals, parking fees, and renting space to airlines. These sources supplement PFCs, as PFC funding cannot be used for revenue-producing projects such as parking garages or terminal areas leased by specific air carriers. In addition to PFC funding and airport revenue, Maryland provides some funding for airport projects. According to the latest 2025-2029 Consolidated Transportation Program budget, total funding is $1.05 billion. Maryland's ORAA manages the grants-in-aid program for public-use airports in the state. For the public-use airports eligible for federal grants, these are awarded by the FAA under the Airport Improvement Program. Traditionally, for NPIAS general aviation airports, FAA provides 90% of the total cost of the project and the local government/owner contributes 10% to cover the remaining cost. The program typically provides half of the airport owner's share of the project. For the public-use airports not eligible for federal grants, MAA assists in capital development through the Maryland Aid to Private Airports program with 90% funding of the local government/owner's expected contribution. During FY2021-FY2025, Maryland received $64.2 million through the Airport Terminals Program and $125.8 million through the Airport Infrastructure Grants program, both funded through the Infrastructure Investment and Jobs Act. The state also received $98 million in American Rescue Plan funding and $107 million through the CARES Act.

2025 Grade: C+

Future Need and Innovation

Maryland airports would benefit from projects affecting operational reliability, capacity enhancements, and customer experience. Operational reliability improvements include new air traffic control towers, security fence improvements, critical system maintenance, and pavement maintenance. Capacity enhancement projects include terminal and baggage enhancements, new air carrier gates, airfield upgrades, runway extensions, and new aircraft hangars. Customer experience projects are terminal amenities, concession enhancement, hospitality improvements, security checkpoint improvements, and residential soundproofing. These projects have an estimated price tag of $8 billion over the next 20 years.

Several projects related to runway improvements, facility access, and air traffic control technology will need to be implemented in the near future in order to avoid falling behind system needs. According to the 2025-2029 NPIAS Report, Maryland has $990 million of development projects over the next five years at NPIAS airports. More than 64% of these projects are located at BWI Marshall. Projects are expected to include safety, capacity, environmental, and pavement improvements. Additionally, regional aviation in Maryland has a need of approximately $4 million per year. With an average of $3 million available per year, regional aviation has a funding gap of almost $1 million per year. Growing passenger forecasts combined with the need to implement a modernized system will continue to increase pressure and test the limits of Maryland's aviation network and funding streams.

Public Safety and Resilience

Maryland's ORAA fosters and promotes aviation through a series of activities designed to reduce accidents, provide information, and encourage growth in the industry. It publishes an aeronautical chart, an airport directory, and a series of smaller publications designed to keep the flying public informed of activities going on in Maryland.

Many of Maryland's airport facilities have been in existence for over 60 years; most of their roots trace back to simple grass landing strips, which evolved into public use facilities. As demand increases, these facilities face numerous challenges to meet user needs. Facilities must contend with larger and faster aircraft, the need for longer runways, local noise restrictions, community resistance, and environmental requirements. In most cases, relocating and establishing a brand-new airport facility to replace an aging facility isn't feasible.

The FAA's implementation of NextGen Performance Based Navigation (PBN) has resulted in new challenges for BWI Marshall and the communities surrounding the airport. Frequency and concentration of aircraft and noise over limited geography has drastically increased. Prior to NextGen, the typical air traffic control model utilized vectoring to allow for proper spacing and safety buffers between aircraft. Locally, this resulted in dispersed airplane operations at BWI Marshall. With the introduction of PBN, although vectoring is still available, it is no longer used in routine practice. Instead, GPS aligned waypoints are used to create replicable procedures and standardized flight paths. This approach increases the predictability of operations and reduces pilot/air traffic control interaction, thereby potentially increasing safety. It also increases the number of planes traversing the same geography day in and day out; this creates a nuisance for some and a painful burden for others. There have been numerous complaints from residents since the implementation of the PBN Air Traffic Control system at BWI Marshall. The FAA, MDOT MAA, state officials, and the community have set up a roundtable to help understand these issues and look for mutually beneficial solutions.

2025 Grade: C+

After considering the available information, aviation infrastructure in Maryland is assigned a grade of C+

Recommendations to Raise the Grade

The capacity of Maryland's aviation sector has been steadily growing to meet the state's passenger and cargo requirements. Over the next 20 years, Maryland faces an $8 billion price tag for capital improvements that ensure continued service and safety. Thus far, resources have been well prioritized to maintain and improve runway conditions such that none are in poor condition and to renovate all terminals at BWI Marshall. To continue this progress, Maryland should:

- Increase the Passenger Facility Charge with a mechanism for future automatic increases.
- Identify additional funding to meet the funding gap for regional airports.
- Accelerate and increase investment in airport improvement programs such as the pavement management program, projects that increase capacity, and MDOT's and MAA's asset management efforts to plan for and address state of good repair needs through condition assessment and risk-based prioritization.
- Implement and enhance technology related to FAA's NextGen initiative, including safety improvements.

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BRIDGES

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: B-

2020 Maryland: B 2025 National: C

Executive Summary

Since 2020, the proportion of Maryland's 5,484 bridges rated in fair condition has increased, consistent with national trends. Bridges across Maryland are aging beyond their design life, with 40% now over 50 years old and 15% over 75 years. Within five years, those figures are expected to reach 57% and 23%, respectively. Aging affects bridges of all sizes, including major crossings like the Chesapeake Bay and American Legion Bridges, whose replacements will be complex due to heavy traffic. The collapse of the Francis Scott Key Bridge in 2024 further strained Maryland's transportation network, demanding urgent investment ahead of the planned 2028 reopening. Maryland maintains strong bridge inspection and asset management programs, using innovative methods to extend the life of fair-rated bridges and prevent deterioration. However, these efforts require steady funding, which is threatened by declining gas tax revenues and rising construction costs.

Introduction

Maryland relies heavily on public bridges for transportation and commerce in support of intra- and interstate travel. Maryland's bridge system supports over 116 million daily crossings due to its dense population of over six million residents and central location along the mid-Atlantic coast through which several major interstate highways (I-95, I-70, and I-83) pass.

Condition and Capacity

According to 2024 statistics from the Federal Highway Administration's (FHWA's) National Bridge Inventory (NBI), of Maryland's 5,484 bridges, 1,771 (32.3%, down from 32.8% in 2020) are rated in good condition, 3,463 (63.1%, up from 62.4% in 2019) are rated in fair condition, and 250 (4.6%, down from 5.1% in 2020) are rated in poor condition. These trends are consistent with national trends, which also see numbers of bridges in fair condition increase while numbers of bridges in good and poor condition decrease. Figure 1 shows the distribution of Maryland bridges by condition over the past nine years.

When compared to national averages, Maryland bridges fare well, with the percentage of bridges rated in poor condition below the national average of 6.8%. In fact, Maryland has the 15th-lowest percentage of bridges in poor condition in the country. This is due to the sustained efforts of bridge owners – both the Maryland Department of Transportation (MDOT) and numerous local jurisdictions.

Of the 5,484 bridges in Maryland, about 53% are owned or maintained by MDOT and the remaining 47% are owned by local and other jurisdictions. More than 80% of the total bridge deck area in Maryland is state-owned and only 0.6% of state-owned deck area is in poor condition, according to 2024 NBI data. The state highway system carries the majority of traffic in Maryland, especially its heavy truck traffic, where it is important that bridges are kept in good working condition to facilitate the movement of goods and the population.

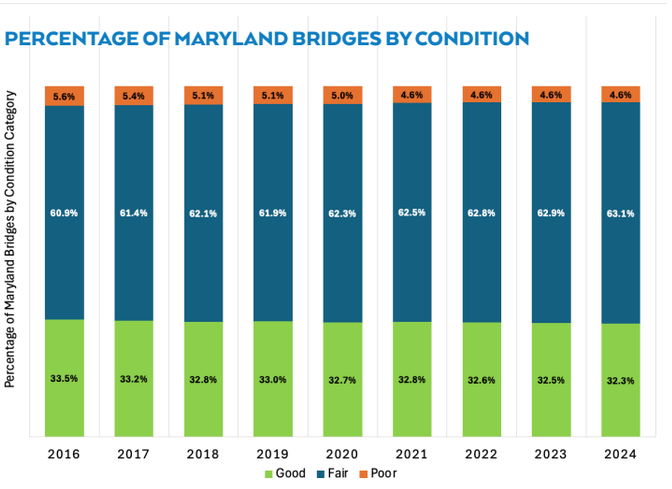

Figure 1. Distribution of Maryland bridges by condition from 2016 to 2024

A bridge rated as poor does not mean it is unsafe; however, it can require limitations on vehicle speeds and weights to ensure the structure remains open. The number of bridges posted for load, i.e., lacking the structural capacity to withstand the weight of vehicles representing the state legal loads in Maryland, has declined steadily over the past two decades. As of 2024, there are 395 (7.2% of Maryland bridges) load-posted bridges in Maryland, compared to 454 in 2018 and 737 in 2011. None of the posted bridges are on the National Highway System; most of the bridges with heavy traffic are not affected by load posting. However, posted bridges in rural areas or on less trafficked routes can still cause costly and lengthy delays for both freight traffic and local residents.

Operation and Maintenance

Maryland bridges are inspected in compliance with National Bridge Inspection Standards (NBIS), which call for inspections to be performed at a maximum of 24 months apart, excepting some newer bridges which can be inspected as far as 48 months apart. Bridges rated as poor are typically required to be inspected at least every 12 months.

MDOT is responsible for managing the bridge inspection process, as well as maintaining and repairing state-owned bridges and culverts. Within MDOT, the State Highway Administration (SHA) is the agency responsible for most of the state highways in Maryland. SHA's Office of Structures, consisting of the Bridge Design Division, Structure Inspection and Remedial Engineering Division, and Bridge Hydraulics Division, assists in operational oversight. The Maryland Transportation Authority (MDTA) is responsible for the state's nine toll facilities. MDTA has an Office of Engineering and Construction as well as individual facility managers who oversee bridge operation and maintenance. Each MDOT agency has a bridge inventory manual, specific inspection policies, and inspection procedures manuals based on their specific environmental and budget needs. Local jurisdictions across Maryland also have departments to oversee the inspection and operation and maintenance of the bridge inventory that is on local roads.

Altogether, MDOT's bridge assets total 2,893: 2,571 of those are owned by Maryland SHA and managed by the Office of Structures, and 322 are owned by MDTA. Of the remaining 2,591 bridges in Maryland, the majority are either county-owned (2,042) or city-owned (370). While counties and cities are responsible for their own assets, SHA is responsible for ensuring bridge inspection data is submitted to the NBI and is also involved in the replacement program for county-owned bridges.

SHA is proactive about performing routine maintenance and repairs (e.g., bridge painting, latex-modified concrete deck overlays, etc.) which can extend the service life of bridges. Additionally, strategic investments are necessary to ensure that critical projects are improved despite limited resources.

Funding and Future Need

Maryland's transportation funding needs are outlined in a six-year Consolidated Transportation Program (CTP), published annually and available on the MDOT website. The latest fiscal year (FY) 2025-FY2030 CTP budget for roads and bridges under SHA oversight is $6.76 billion, which is funded by Maryland's Transportation Trust Fund (TTF). The TTF is composed of dedicated state taxes and fees (54.8%), federal aid (21.7%), operating revenues (6.9%), and bond sales (4.8%). Unlike SHA, MDTA is a revenue-generating entity which typically puts it in better financial shape than other bridge owners. Historically, tolls have been sufficient to finance operations and maintenance of MDTA bridges, but recent large projects (e.g., the Nice Bridge and Francis Scott Key Bridge) cannot be funded by tolls alone and require investment by the state and federal governments, as well as the sale of bonds.

Increasingly, there are concerns about the sustainability of the TTF which relies heavily on the state's motor fuel tax and is expected to decline over time due to increased efficiency of internal combustion engine vehicles as well as increased electric vehicle ownership. In addition, inflation has made the cost of doing business increase at a rate that is out of step with increases in available funding. Legislation in 2013 tied the Maryland gas tax to both inflation and retail gasoline prices. The rates have decreased three

times since 2013, all within the past five years – decreases in FY2021 and FY2022 were a result of the COVID-19 pandemic and the most recent decrease in FY2025 (July 2024) was a result of lower wholesale prices despite the rise in inflation. At the time of writing this report, the tax is 46.10 cents per gallon, 7th highest in the nation. The federal gas tax remains at 18.4 cents per gallon, unchanged since 1993.

To alleviate an anticipated budget shortfall, Maryland's approved FY2026 budget includes a number of sources of increased revenue for the TTF – including a surcharge on capital gains over $350K, increased fees for vehicle titles, emissions tests, and registrations (for both heavy vehicles and electric vehicles), as well as an increase in taxes on car sales and rentals. Passage of the federal Infrastructure Investment and Jobs Act (IIJA) in 2021 is also helping fund bridge projects in Maryland, in particular those projects that aim to reduce the number of bridges owned by local jurisdictions that are rated in poor condition. As of January, 2025, nearly $355 million in funding via IIJA had been announced for bridge projects in Maryland.

The typical design life for an in-service bridge is between 50 and 75 years. More than 40% (2,368 bridges) of Maryland bridges are over 50 years old and about 15% (815 bridges) are over 75 years old. Maryland's bridge stock is not aging linearly, though. Heavy federal investment in the highway system starting in the 1950s means that within five years, without significant intervention, 57% of Maryland bridges will be over 50 years old and 23% will be over 75 years old. See Figure 2 for a distribution of Maryland bridges by year of construction. In 2023, FHWA estimated it would cost $631 million to replace, or $429 million to rehabilitate, bridges in Maryland rated as poor. In the current CTP, MDOT has plans for 24 major bridge projects, most of which are bridge replacements.

Several large bridge projects are currently being studied and will require significant investment when the time comes for their reconstruction, including the American Legion Bridge on I-495 over the Potomac River and the William Preston Lane Memorial Bridge over the Chesapeake Bay.

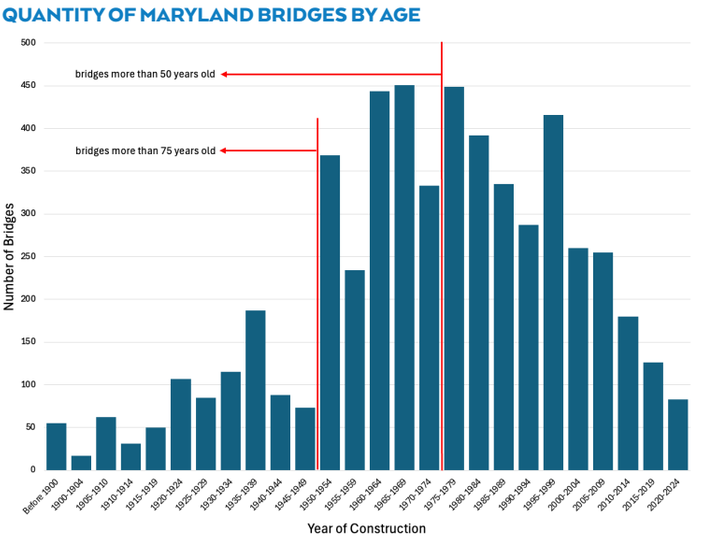

Figure 2. Distribution of in-service Maryland bridges by year of construction

Resilience

Maryland's rigorous asset management program relies on a tightly-managed bridge inspection program and includes an annual tour of 200-300 of the state's bridges with the greatest need as identified by those inspections. This tour helps prioritize funding, and it also provides a small group of experts with a holistic view of problematic bridge details. This system has led to the use of innovative materials and design details to improve bridge resilience. Built on a strong belief that bridge deck protection is key to a resilient bridge stock, MDOT has been experimenting with new types of deck reinforcement, from fiberglass to galvanized to stainless steel, as well as the broad application of latex-modified deck overlay.

MDOT is concerned with the impacts of climate change on bridges, whether that's sea-level rise affecting bridges in the coastal plain or increases to precipitation intensity/duration/frequency affecting bridges across the rivers. Since 1996 it has relied on guidance from a panel of hydrologic experts who publish their recommendations in the Hydrology Panel Report. The 2023 edition provides updated guidance on the use of precipitation projections in the design and analysis of highway structures, including bridges. This will ensure that new and existing bridges are designed to withstand future conditions, e.g., heavier rainfall and rising sea levels, resulting in safer travel, fewer disruptions, and reduced long-term costs for repairs and replacements.

The increase in vessel size and frequency in and out of U.S. ports has added a layer of complexity to the topic of resilience of state-owned bridges, especially for states like Maryland, a home to busy ports. The collapse of the Francis Scott Key Bridge in Baltimore on March 26, 2024 (Figure 3), demonstrated the vulnerability of existing bridges near ports, resulting in the tragic loss of six construction workers' lives, and a lasting impact on the daily lives of Marylanders. One year after the collapse, a survey conducted by Johns Hopkins University researchers found that more than 40% of people living within 15 miles of the bridge, and over 60% of people living within three miles of the bridge, felt the impact of its loss. The MDTA has federal approval to reconstruct the bridge and is currently overseeing pre-construction activities, which started in January 2025. The total cost of the bridge is expected to be $1.7 billion and will be financed by a mix of insurance proceeds, cash on hand, bond financing, litigation recoveries, and federal funds.

Figure 3. Francis Scott Key Bridge after its collapse in March 2024

Maryland was one of 19 states urged by the NTSB to perform vulnerability assessments due to vessel allisions with bridges over shipping channels. Aside from the Francis Scott Key Bridge, the NTSB identified the Chesapeake Bay Bridge and the Chesapeake City Bridge as needing assessment. While pier protection measures for the Chesapeake Bay Bridge will take time to implement, MDTA is installing operational methods (e.g., working with pilots) in the interim. Furthermore, as the Chesapeake Bay Bridge is approaching the end of its design life, MDTA has been conducting a study to identify alternate routes for a new Chesapeake Bay crossing.

Innovation and Public Safety

Maryland is experimenting with innovative materials such as using galvanized steel reinforcing in brackish environments and ultra-high performance concrete in critical bridge locations to increase strength and reduce maintenance, as well as flexible concrete (i.e., link slabs) at deck joints. MDOT is also employing innovative design details such as the elimination of deck joints and designing for drainage behind bridge backwalls. MDOT is implementing drones in bridge inspections, and non-destructive monitoring systems for bridges such as the Severn River Bridge to study the effects of temperature changes on the pin and hanger system. Maryland expects to see its first cable-stayed bridge when the Francis Scott Key Bridge is completed. To accelerate project completion, MDOT is using alternative delivery methods (e.g., construction manager at risk) and procurement strategies.

Innovations in safety have been at the forefront of MDOT operations since 2023 when six construction workers were killed at an I-695 construction site when a speeding vehicle lost control. Since that time, SHA has been developing methods to improve work zone safety and awareness as highlighted in their 2025 Northbound 2.0 Strategic Plan. In a different area of bridge safety, in 2022 MDOT undertook a study of suicide deterrent systems for the Governor Thomas Johnson Bridge, which sits at a height of 160' over the Patuxent River near Solomons, Maryland.

After considering the available information, bridge infrastructure in Maryland is assigned a grade of B–

Recommendations to Raise the Grade

The condition of Maryland bridges has been steadily improving, with fewer bridges in poor condition and fewer bridges posted for load, even just in the past five years. Officials in Maryland responsible for managing the bridge inventory have been excellent stewards of public funds, making the most of what is available to maintain and improve bridge conditions throughout the state. To continue this progress, Maryland should:

- Maintain the current robust bridge inspection program and asset management programs to identify and prioritize bridge maintenance and construction.
- Continue promoting innovative methods in construction and maintenance of existing bridges to stretch infrastructure funding.
- Advocate to elected officials to identify additional investment options to fill the gap between current and needed funding.

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DAMS

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: C

2020 Maryland: C- 2025 National: D+

Executive Summary

Maryland's 555 dams provide vital services, including flood control, water supply, renewable energy, recreation, and habitat. About 44% of Maryland dams are classified as high or significant hazard potential – meaning failure could cause loss of life, property damage, and disruption to critical infrastructure. Dam safety is the responsibility of individual owners, and 45% of Maryland dams are privately owned. The Maryland Department of the Environment Dam Safety Program (MDE-DS) regulates dam design, construction, operation, and maintenance. While MDE-DS outperforms many states for inspections and emergency action plans, further needs should be addressed through enhanced funding, staffing, and regulatory updates. A key achievement from the 2025 legislative session is the creation of a Private Dam Repair Fund, offering low-interest loans for repairs or removals, funded by new dam registration and permit fees. The legislation also reinstates authority to levy financial penalties, aiding enforcement and compliance.

Background

Maryland does not enjoy any natural lakes or ponds; all inland waterbodies are created by a dam. Maryland defines a dam as any obstruction, wall, or embankment constructed for the purpose of impounding, storing, or diverting water. The primary purpose of dams in Maryland is to serve as water resource management systems by providing essential benefits such as recreation, water supply, flood control, and stormwater management. To a lesser extent, dams and their respective impoundments in Maryland are used for irrigation, fire suppression, wildlife habitats, hydropower, are associated with surface mining, and contain materials dredged from shipping channels that help maintain the Port of Baltimore as a top U.S. port.

Condition and Capacity

Maryland dams range in height from six to 296 feet. Small impoundments that are less than 20 feet in height, have less than a square mile drainage area, have less than 50 acre-feet of storage, and whose failure will not cause loss of life or property damage (i.e., low hazard) are typically classified as small ponds, and as such, are not a specific consideration of this analysis.

The 555 dams in Maryland are owned by public entities such as state agencies, local governments, and federal agencies, as well as private owners. Private owners include individuals, homeowner associations, and utility corporations. Maryland dam locations are illustrated in Figure 1.

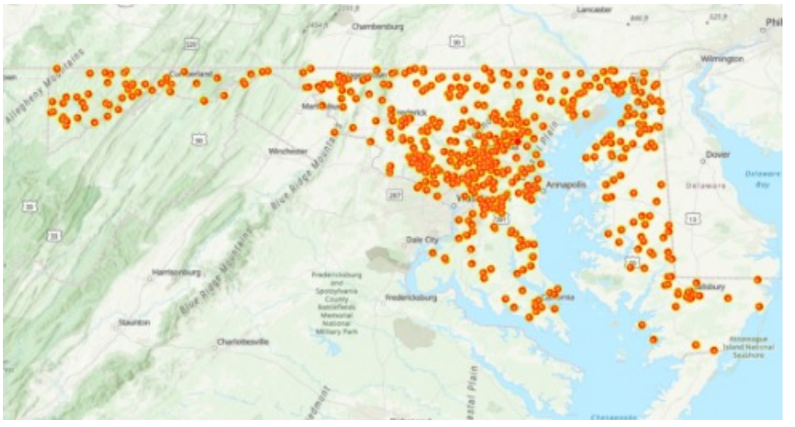

Figure 1. Maryland dam locations plan

Dam owners are responsible for maintaining their dams in accordance with Maryland laws, regulations, and permit conditions. Inadequate inspection, funding, and maintenance of dams can lead to dam failures with catastrophic consequences such as loss of life and property, infrastructure and environmental damage, and hindered economic activity.

DAMS

Maryland dams have significant variation in age, with some built over 300 years ago. The peak dam construction period occurred during the 1960s and 1970s when over 130 Maryland dams were built. The average age of Maryland dams is 63 years. However, many dams have been retrofitted or rehabilitated since their original construction. Considering this, the average age of the most recent retrofit/rehabilitation is about 37 years. While most infrastructure is designed with an anticipated service life, dams are expected to perform adequately for the duration of their useful life (which may be in perpetuity for dams providing certain benefits such as flood control or drinking water supply).

Accordingly, it is important that dam conditions are regularly reviewed to ensure that their design and operation is consistent with the evolution of the state of engineering practice and responsive to changing climate conditions. the Maryland Department of the Environment Dam Safety Program (MDE-DS) suggests that owners of high hazard dams engage qualified professional engineers to perform a comprehensive dam safety evaluation and screening level risk assessment at least once every ten years.

Based on data reported by MDE-DS, the trend of poor or unsatisfactory dams in recent years is as follows:

2024: **110 dams**
2023: **111 dams**
2022: **101 dams**
2021: **98 dams**
2020: **61 dams**

Dam deficiency is determined based on signs of deterioration, lack of regular maintenance, and adequacy of the spillway to safely convey the inflow design flood.

About 20% of the state regulated dams are currently considered to be in poor or unsatisfactory condition. This number is dynamic and in constant flux; however, it is expected to remain close to the same unless a significant influx of funding becomes available to address deficiencies. Of the 110 deficient dams, 33 are high hazard, and 50 are privately owned. Fourteen, including three high hazard, state-owned dams were identified as having deficiencies that require major reconstruction or repair.

Dam owners play a crucial role in maintaining their dams and preparing for and responding to emergencies. Dam owners are required to prepare and exercise their emergency action plan (EAP) (high and significant hazard dams only) and take appropriate actions during an emergency including obtaining materials and engineering and contracting support, as necessary, to render the dam safe.

Dams in Maryland are classified by their hazard potential, which is based on the consequences of failure that will occur downstream of the dam, and by the dam condition. The concept of population-at-risk, i.e., persons exposed to potentially lethal combinations of flood wave depth and velocity, is the primary driver of the hazard potential, although lifeline disruptions and environmental damage can also be considered. While the Code of Maryland Regulations (COMAR) refers to dam hazard classification potential as Categories I through IV, dams are conventionally classified as high, significant, or low hazard potential. Hazard potential classification guidelines are provided in guidance issued by MDE-DS.

Dam hazard classifications are explained as follows:

High Hazard Potential (HH): This classification is denoted when dam failure would likely result in loss of human life, extensive property damage to homes and other structures, or flooding of major highways such as state roads or interstates.

2025 Grade: C

Significant Hazard Potential (SH): A significant hazard dam is classified as such when dam failure could possibly result in loss of life or increase of flood risks to roads and buildings, with no more than two houses impacted and fewer than six lives in jeopardy.

Low Hazard Potential (LH): Failure of these dams could result in loss of the dam or damage to the floodplains, but not of life.

Table 1 provides the number of dams by hazard classification and the National Inventory of Dams (NID) data, and Table 2 provides a breakdown of ownership types.

Maryland has not experienced major incidents of dam failures in recent years. Incidents that have happened generally raise awareness locally (e.g., within local government or business units) for a period of time, but this has not created significant lasting change in regulations, funding, or dam safety program management.

Funding and Future Need

As Maryland dams age and significant downstream development continues, many dams will require repairs and significant investment to maintain their proper function as they may be reclassified as high hazard or significant hazard. Most dam owners do not have adequate or specific funds set aside for dam maintenance and/or replacement. It is imperative that dam owners have access to funding and/or low interest loans to fund major dam repairs, especially for high hazard and significant dams, to protect the health, welfare, and safety of the public. There are limited state-level funds that can be available for dam owners to rehabilitate their dams. This includes the Comprehensive Flood Management Grant Program and State Revolving Loan programs; both are highly competitive programs with limited funds. The Private Dam Repair Fund, established in 2025, will be funded by permit fees, annual registration fees, and penalties for violations with an estimated annual growth of approximately $600,000. The fund will become available to grant low-interest loans beginning in 2028. In general, more funding is needed both for state programmatic management (approximately $2 million per year) and for dam rehabilitation and removal.

DAMS BY HAZARD CLASSIFICATION

Hazard Classification	Total State Regulated	NID
High	109	101
Significant	133	149
Low	313	169
Total	555	419

Table 1. Numbers of dams by hazard classification

DAMS BY OWNERSHIP TYPE

Ownership Type	Total State Regulated	NID
State	58 (10%)	38 (9%)
Local Government	214 (38%)	179 (43%)
Federal	25 (5%)	13 (3%)
Private	248 (45%)	185 (44%)
Utility	11 (2%)	1 (1%)

Table 2. Percents of dams by ownership type

Dam owners in Maryland need an estimated $817 million to rehabilitate their dams to meet current standards. For high hazard dams alone, the estimate is about $309 million. Removal of dams in poor condition that are not providing a public function (e.g., drinking water supply or flood control) may be considered a more cost-effective long-term solution. The estimated repair costs or investments for Maryland dams are summarized in Table 3.

Federally-Owned Dams (25 dams): Because of its proximity to the nation's capital, Maryland has dams owned by multiple federal agencies including U.S. Army Corps of Engineers, U.S. Fish and Wildlife, U.S. Secret Service, Natural Resources Conservation Service, U.S. Army, U.S. Navy, National Park Service, and FEMA. Consistent funding is needed to ensure these dams are maintained in acceptable condition. Cash Lake Dam (US Fish & Wildlife) and Burba Lake Dam (US Army) are both known to need repairs. In addition, multiple federal dams no longer serve a purpose and are being studied for eventual removal, e.g., Atkisson and Van Biber Dams.

REPAIR COSTS BY CATEGORY

Dam Category	Repair Cost ($ Millions)
All Dams	$817
High Hazard Dams	$309
All Private Dams	$322
Municipal Dams	$400
Private Dams (High Hazard Only)	$54.6
Private Dams (Significant Hazard Only)	$90.4
State-Owned Dams (All)	$76.2
State-Owned Dams (High Hazard Only)	$36.2

Table 3. Repair costs for categories of dams

State-Owned Dams (58 dams): Repairs for state-owned dams are funded through agency appropriations made in the annual budget. If federal grant funding is available, then it is leveraged. Future funding will continue to be an issue given the burdensome price tag of dam maintenance on state government budgets.

Locally-Owned Dams (214 dams): Repairs, retrofits, and upgrades of locally-owned dams are funded at the county and municipality level. Future funding will continue to be an issue given the burdensome price tag of dam maintenance on local government budgets.

Privately-Owned Dams (248 dams): Private dam owners play a critical role in the operation and maintenance of their dams, including early identification of potential problems during routine inspections and events that may stress the dam, e.g., heavy rainfall. Very few private dam owners collect revenue that can be applied to dam operation and maintenance. This creates a significant gap between available funding and needs.

Operation and Maintenance

Safe operation and continued maintenance and upkeep are the responsibility of dam owners. MDE-DS has many components to supplement and assist owners and to keep the public safe. MDE-DS is charged with the following: performing periodic safety inspections; enforcement, permitting and design review; construction inspections; emergency planning, preparedness and response; and dam owner education to regulate the safety and security of dams in Maryland.

Dam inspections are an important way to assess the structural and operational conditions of the dam, identify any new conditions below the dam, and determine the need for repairs, modifications and/or rehabilitation. MDE-DS policy is to inspect high hazard dams annually, significant hazard dams triennially, and low hazard dams every five years. Dam owners are also charged with inspecting their dams annually and after significant rainfall events. In accordance with COMAR 26.17.04.05, "the owner is responsible for the safety of the dam and for the necessary surveillance and inspections. The surveillance shall be performed by the owner, or a representative of the owner, and shall provide a close watch on the conditions affecting the dam's safety. The owner shall promptly notify the Administration of significant changes in condition."

MDE-DS does not currently have sufficient resources, funding, or staff to conduct all dam safety inspections or to take appropriate enforcement actions. MDE-DS has grown from four full time employees in 2014 to 11 in 2024. MDE's DSD budget has increased from $444,138 in fiscal year (FY) 2014 to $1,994,190 for FY2024. While the number of dams per engineer is below the national average, MDE-DS estimates that a staff of 18 is needed to perform the work required for the existing dams and those added annually. MDE-DS is generally able to conduct 95% of planned inspections as compared to the national average of 79%.

Public Safety

Maryland has been assuring the safety of dams since 1934 through a permit and inspection program administered by MDE-DS; however, the responsibility and liability rests firmly on the shoulders of the dam owners. MDE-DS has many components including the following: annual and/or periodic safety inspections; dam monitoring; enforcement, permitting and design review; construction quality assurance/quality control oversight and reconstruction/rehabilitation; dam removals; emergency action planning; and dam owner education to regulate the safety and security of dams in Maryland.

The Department estimates that approximately 240,000 Marylanders live within a dam failure inundation area based on a 2023 consequence estimating effort. Prevention and preparation are critical to minimizing the costs associated with dam failures. The Maryland Department of Emergency Management has identified $16 billion in public critical facilities at risk due to potential dam failures. Montgomery and Prince George's counties face the most significant risks, with local facilities valued at $2.6 billion and $3.2 billion, respectively. State-owned facilities at risk amount to $12.9 billion, predominantly in Anne Arundel, Baltimore, and Prince George's Counties. These values exclude private property losses and secondary costs like dam reconstruction and interim mitigation.

Failure of dams used for drinking water supplies would result in numerous cascading effects that would affect hundreds of thousands of people reliant on the major water suppliers in Maryland (e.g., Washington Suburban Sanitary Commission and Baltimore City).

Environment Article 5-503.1 requires high and significant hazard dam owners to prepare an EAP, to update it on an annual basis, and to exercise the EAP once every five years. Most (107 of 109) high hazard dams have EAPs. The two dams without EAPs are federally owned (USACE), dredged material containment facilities that USACE contends are not subject to Maryland dam safety laws.

Resilience

Central Maryland has experienced two 1,000-yr storm events in Ellicott City and recently a significant flooding event in western Maryland. While these storms tested dams, none suffered significant damage. To ensure that dams are designed to withstand current and future storm events, MDE-DS requires updated hydrologic and hydraulic analyses using the current best available information every time a permit is applied for. If a dam is found to be inadequate, the necessary upgrades must be incorporated into the project.

The MDE Water and Science Administration has Climate Integration Policy and Guidance, as well as a strategic plan which includes sustainability and climate change elements. MDE-DS incorporates practices that are part of sustainability processes like Envision, such as quality-of-life elements and resilient design. Resilient design elements, such as the state-commissioned PMP study, offer improved data and processes when compared to the National Oceanic and Atmospheric Administration's

hydrometeorological reports developed in the early 1970s. MDE implements environmental laws and programs wherever possible in a manner that reduces existing inequities and avoids the creation of additional inequities in communities with environmental justice concerns. Permit applications are screened using an agency-developed environmental justice screening tool, which can then be used to drive enhanced community engagement.

MDE-DS uses two robust databases to maintain pertinent information on state-regulated dams and associated permit actions; these are not necessarily an asset management plan, as the regulatory program does not own or maintain the regulated structures.

MDE-DS maintains an ongoing relationship with Maryland Department of Natural Resources representatives who are tasked with aquatic barrier removal for fish passage as well as identifying and permitting fish and eel ladders, when appropriate. Notable successes with fish/eel ladders include the Conowingo Dam (Figure 2) on the Susquehanna River and eel ladder projects on the Potomac River Dams Nos. 4 and 5.

Figure 2. Conowingo Dam
Source: John Roche, PTAP Aerial

While funding for dam removals is often the limiting factor in completing such projects, MDE has released a dam removal guidance document and has provided technical assistance and permitting for multiple dam removal efforts. Significant dam removal efforts on the Patapsco River have had extraordinary success, with the Bloede Dam being most recently removed (2019) and initial grant funding for the removal of Daniels Dam (Figure 3) announced in 2024, which would remove the final blockage on the Patapsco River downstream of Liberty Dam.

Figure 3. Daniels Dam on the Patapsco River
Source: John Roche, PTAP Aerial

Innovation

MDE-DS continues to innovate and improve program efficiency and technical guidance. MDE-DS has recently developed operation and maintenance documents, dam removal guidance, and design policies to support dam owners, engineers, operators, and contractors in the shared mission of dam safety.

In early 2025 the program released an updated Probable Maximum Precipitation study and launched a webmap that offers a feature-rich

2025 Grade: C

set of information to support government decision making and inform the public. The program also has a robust aerial drone inspection and mapping program to improve inspections and add value to dam owners.

Select dam owners have launched innovative dam monitoring programs, providing real time information on precipitation and lake levels to support decision making during storm events.

After considering the available information, dam infrastructure in Maryland is assigned a grade of C

Recommendations to Raise the Grade

To address the current needs of MDE-DS and the safety and security of Maryland dams, Maryland should:

- Dedicate additional funding to kickstart the Private Dam Repair Fund and allocate additional resources to programs like the Comprehensive Flood Management Grant Program to bolster the ability of local governments to repair, retrofit, or upgrade their dams.
- Provide greater resources in the form of additional staff and budget for MDE-DS to modernize information management systems, update design standards, and educate and communicate with dam owners about the importance of performing the necessary operation and maintenance activities in a timely manner.
- Increase the amount of public education and outreach to dam owners to increase the number of updated and exercised EAPs and promote more frequent inspections and maintenance of dams.

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DRINKING WATER

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: C

2020 Maryland: C 2025 National: C-

Executive Summary

Maryland's drinking water infrastructure serves more than 5.5 million residents – nearly 89% of the state's population – through more than 3,200 public water systems regulated by the Maryland Department of the Environment. While Maryland maintains one of the highest Safe Drinking Water Act compliance rates in the nation, aging infrastructure, climate risks, and growing regulatory requirements threaten long-term system reliability. Many of the state's water mains exceed 50–75 years in age, and over 40% are past their intended service life. Small and rural systems face particular challenges in funding, staffing, and asset management. Maryland has made progress through the Water Infrastructure Financing Administration, distributing over $475 million in funding from the Infrastructure Investment and Jobs Act since 2022 for lead line removal, emerging contaminant mitigation, and system upgrades, yet the state's drinking water needs still approach $10 billion. Sustained investment, workforce development, and climate-resilient planning are essential to ensure safe, equitable, and reliable drinking water for all Marylanders.

Condition and Capacity

Maryland's public water systems include:

464 Community Water Systems

546 Non-Transient Non-Community Systems (e.g., schools, factories)

2,235 Transient Non-Community Systems (e.g., campgrounds, restaurants)

The Maryland Department of the Environment (MDE), through its Water Supply Program, ensures drinking water systems meet technical, managerial, and financial standards. Maryland's 2022 revision of its Capacity Development Strategy emphasizes targeted technical assistance, operator training, and system consolidation. However, many small and rural systems continue to struggle with limited staffing, outdated equipment, and insufficient financial resources to implement the Capacity Development strategies. These challenges are compounded by increasingly complex regulatory requirements, such as those related to emerging contaminants and cybersecurity, which require specialized expertise and investment.

Systems age and some of Maryland's drinking water infrastructure is exceeding its intended design life. See Table 1 for typical life expectancy by material for materials common in Maryland's drinking water infrastructure. Baltimore City's water mains average 75 years old. The average age of water mains in other jurisdictions exceeds 50 years.

Maryland has been strategically upgrading its systems, but the rate of replacement is slower than the rate of aging and at the low end of national benchmarks. The American Water Works Association cites that utilities often aim for a 1-2% per year minimum replacement rate of

LIFE EXPECTATION BY DISTRIBUTION MATERIAL

Material	Typical Life Expectancy
Cast Iron (CI)	75-100 yrs
Ductile Iron (DI)	75-100+ yrs
Asbestos Cement	50-70 yrs
PVC	50-80 yrs
HDPE	50-100 yrs
Copper	50-70 yrs
Galvanized Steel	40-50 yrs
Lead	75-100 yrs (hazardous)

Table 1. Common Maryland water distribution materials and estimated life expectancy

total system length to be a best practice benchmark. Baltimore City maintains 1500 miles and aims to replace 15 miles/year equating to 1% of its inventory. Similarly, the Washington Suburban Sanitary Commission (WSSC) plans to replace approximately 60 miles/year of its 5900-mile inventory, amounting to slightly over 1%. At a 1% rate, it will take 100 years to completely replace these systems. Many of the mains are already aged 50-100 years (40% are over 50 years old), making it difficult to catch up to an aging system.

Maryland's 89 surface water systems and more than 3,000 groundwater systems vary widely in condition. In older urban areas such as Baltimore City and Prince George's County, water mains frequently experience breaks and leaks, leading to service disruptions and increased maintenance costs; for example, during temperature drops, Baltimore City experiences dozens of water main breaks each week.

Lead service lines are still present in many older neighborhoods, posing persisting health risks despite targeted replacement programs. Maryland's requirement under the revised Lead and Copper Rule (LCRR) is pushing community water systems to develop inventories in 2025. These inventories will identify service line materials connected to the public water system and categorize them as 1.) lead, 2.) galvanized requiring replacement (GRR), 3.) non-lead or 4.) lead status unknown. Soliciting help from the public, Baltimore City and Baltimore County launched a collaborative program asking residents to complete a customer service line survey to help them identify their service line material. Select small communities, such as Hagerstown and Middletown, have published searchable maps that show lead, non-lead, and unknown material services by address. Inventories are still under review and statewide numbers are not yet issued.

While some utilities have adopted asset management practices to monitor and prioritize infrastructure upgrades, many systems lack comprehensive plans or digital tools to track condition, performance, and/or maintenance needs.

Funding

User rates are intended to fund daily operations to ensure water quality and service, maintenance and treatment plans, and financial stability and long-term infrastructure planning. Given the increased costs of managing aging infrastructure, external funding sources are needed.

Funding assistance is available to Maryland water systems through MDE's Water Infrastructure Financing Administration (MWIFA) and through the Environmental Protection Agency's Environmental Finance Centers to help communities navigate through federal funding opportunities.

Maryland has benefited from historic federal investment in drinking water infrastructure through the Infrastructure Investment and Jobs Act (IIJA). Since 2022, more than $475 million has been distributed from IIJA through MWIFA. Allocations have included the following:

- **$80.6 million specifically for addressing lead remediation**
- **$15.8 million specifically for addressing emerging contaminants such as per- and polyfluoroalkyl substances (PFAS)**
- **$60.1 million for Clean Water General Supplemental funds**

2025 Grade: C

DRINKING WATER

MWIFA provides low-interest loans and grants through programs like the Drinking Water State Revolving Fund and Water Supply Assistance Grant Program. Nearly half of federal funding is distributed as grants or principal forgiveness loans to disadvantaged communities. Despite these investments, Maryland's long-term funding needs approach $10 billion, and many utilities – particularly in rural and underserved areas – lack the revenue base to support necessary upgrades. The gap between available funding and infrastructure needs remains a significant barrier to progress.

Most of Maryland's water systems are municipal or government-operated. There are 22 water systems, serving approximately 11,000 residential customers, regulated by the Public Service Commission in Maryland. Maryland American Water, one of the state's largest private water providers, has invested $22 million over the past seven years in water systems and has filed a rate request in 2025 to support continued long-term investment. These efforts reflect a growing recognition of the need for investment in proactive infrastructure renewal and modernization.

Future Need

Looking ahead, Maryland faces substantial challenges in meeting future drinking water demands. EPA's 7th Drinking Water Infrastructure Needs Survey and Assessment from 2023 reports $14.6 billion in drinking water infrastructure investment needs over the next 20 years. Population growth, climate change, and increasingly strict water quality standards will place additional strain on existing systems. Lead service line replacement, PFAS mitigation, source water protection, resilient infrastructure design, and cybersecurity for water utilities are emerging priorities that will require coordinated planning and sustained investment.

Operation and Maintenance

Maryland's Water Supply Program plays a critical role in ensuring the safe operation of drinking water systems through inspections, operator certification, and technical assistance. However, many utilities lack resources to execute comprehensive asset management plans and continue to rely on reactive maintenance rather than predictive strategies, leading to higher costs and increased risk of service disruptions. Deferred maintenance is a persistent issue, particularly in systems with limited financial capacity. While digital tools such as geographic information system (GIS) mapping and smart sensors are being adopted in some jurisdictions, their use remains uneven across Maryland. Strengthening asset management practices and expanding access to technical resources is essential to improving operational efficiency and long-term sustainability.

Many licensed water and wastewater operators are aging, so there is forecasted need for interested people to enter the workforce as operators. The Maryland Rural Water Association (MRWA) estimates that 50% of the water and wastewater operator workforce will be retiring in the next five years. In an effort to combat the aging workforce, municipalities have launched programs to train a new workforce to become licensed operators. MRWA's Apprenticeship and Baltimore's B'More Wise programs have been designed to train a new group of workers to meet the demands of the current aging workforce and infrastructure and additional needs as Maryland's population grows.

Public Safety

Maryland maintains high (99%) compliance rates with the Safe Drinking Water Act, reflecting the state's commitment to protecting public health. Indeed, Maryland has maintained one of the highest compliance rates in the United States, despite aging infrastructure and ongoing leakage issues.

2025 Grade: C

DRINKING WATER

Rigorous monitoring and enforcement ensure that water systems meet federal standards for contaminants and treatment processes. Lead contamination in schools and childcare centers has prompted statewide testing and remediation programs, supported by targeted funding and public outreach. Maryland is also expanding its capacity to detect and treat PFAS, with new laboratory facilities and pilot treatment technologies underway.

Emergency response protocols are in place to address contamination events and service disruptions. Interagency coordination and public communication can be improved to enhance preparedness and transparency.

Resilience

Maryland's coastal geography and aging infrastructure make it particularly vulnerable to flooding, sea level rise, and extreme weather events. Recent investments have focused on enhancing climate resilience through flood-resistant infrastructure, backup power systems, system consolidation, and regional planning initiatives. Over the past few years, there have been several examples of recent investments in resiliency.

Since 2022, Maryland has invested over $300 million in projects statewide supporting resilient water supply planning through a combination of state, local, and federal funding. Key efforts include $10 million from the Resilient Maryland Loan Fund for flood tunnels and stormwater upgrades in Ellicott City, $11 million in 2025 for tidal wetland restoration and flood protection along Baltimore's Middle Branch, and nearly $20 million leveraged by the Resilience Authority of Annapolis and Anne Arundel County for shoreline protection and stormwater management. These targeted investments reflect Maryland's ongoing commitment to mitigating flood risks and strengthening climate resilience across communities. Furthermore, MDE's 2025-2027 Intended Use Plan lists funded projects for emergency backup systems and resilient retrofits and Maryland hosted the Critical infrastructure Cyber Resilience Workshop with focus on cybersecurity for water and wastewater systems in August 2025.

Consolidation of smaller systems and integration of climate risk assessments into infrastructure design are key strategies for improving long-term resilience. Continued investment in adaptive infrastructure and emergency preparedness will be critical as climate impacts intensify.

Innovation

Maryland's drinking water utilities are increasingly embracing innovation to improve service delivery and water quality. Smart metering, leak detection technologies, and GIS-based asset management systems are being deployed to enhance operational efficiency and reduce water loss. Maryland is piloting PFAS treatment technologies and expanding laboratory capacity to monitor emerging contaminants. Public-private partnerships and academic collaborations are driving research and development in areas such as energy efficiency, real-time water quality monitoring, and artificial intelligence-based predictive maintenance. These innovations offer promising solutions to longstanding challenges, but broader adoption will require sustained investment and technical support.

A Maryland Safe Drinking Water Study, led by the University of Maryland, is engaging residents across all counties to assess drinking water quality. By engaging residents to collect samples for testing of heavy metals, bacteria, persistent organic pollutants, and other chemical contaminants, the goal of the study is to build a statewide water quality database for advocation of policy improvements.

2025 Grade: C

DRINKING WATER

After considering the available information, drinking water infrastructure in Maryland is assigned a grade of C

Recommendations to Raise the Grade

To improve Maryland's drinking water infrastructure, Maryland should:

- Strengthen funding sources including MWIFA's Drinking Water State Revolving Fund and Water Supply Assistance Grant Program in addition to evaluation of user rates to meet growing infrastructure demands and support disadvantaged communities.
- Provide targeted technical and financial assistance to small and rural systems to enhance capacity and compliance.
- Accelerate lead service line replacement, with a focus on vulnerable populations and public institutions.
- Mandate comprehensive asset management plans and promote the use of digital tools for predictive maintenance.
- Incentivize the adoption of smart technologies and emerging treatment methods through grants and pilot programs.
- Integrate climate risk assessments into infrastructure design and planning to enhance resilience.
- Strengthen public communication and emergency response coordination to build trust and preparedness.
- Strengthen workforce pipelines by expanding apprenticeship programs, creating tuition incentives, and partnering with community colleges.

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ENERGY

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: D+

2020 Maryland: C- 2025 National: D+

Executive Summary

Maryland's energy system is facing a challenging transition period as it struggles to keep pace with demand while reducing fossil fuel dependence. This effort requires careful attention to appropriately manage risks in the face of increasing dependence. Emphasis is needed on continued adequacy, reliability, and affordability of electricity supply and transportation systems, as energy is vital to the Maryland economy and the public's health and safety. As supply sources shift and demand strains Maryland's aging electric grid, the state faces major challenges in replacing fossil fuels – particularly for transportation and heating – while accommodating rising energy use from artificial intelligence and data centers. To manage this transition, the grid must be expanded, reinforced, and interconnected with new clean and dispatchable sources before legacy fossil fuel plants retire. Without decisive action to strengthen supply, Maryland risks reliability issues, frequent load shedding, and rising costs that could negatively impact business continuity, safety, and affordability.

Condition and Capacity

The Maryland Public Service Commission (PSC) reviews the performance of each electric utility. The utilities report on their service quality and reliability performance against measures established by the PSC. If utilities fall short of the target for any measure, then they are required to submit a corrective action plan to the PSC. The reports and corrective action plans are reviewed in a legislative-style hearing before the commission issues its findings in an order. This process has resulted in improvements to the performance of each of the utilities. While this process is focused on distribution system performance and ensuring performance meets residents' expectations, the adequacy of generation and transmission capacity is overseen by the Independent System Operator (PJM) which regularly conducts planning studies to identify where capacity additions are needed on the generation and transmission system. Transmission capacity additions are addressed regularly through the regional transmission expansion plan. Generation capacity additions are managed through an auction process.

The results of PJM's 2024 and 2025 electric generation supply auctions identify the imminent constraints Maryland faces. The 2024 electric supply capacity auction included substantial price increases, which were a direct result of reduced generation supply during a time of increasing demand. The 2025 electric supply capacity auction showed that supply is marginally beginning to respond, but electric demand is growing rapidly, and prices have increased. Capacity prices in the central Maryland zone have increased more than five-fold and are higher than in any other PJM zone, reflecting the imbalance between supply and demand. Capacity prices throughout PJM increased ten-fold, signaling a potential looming shortage of generation in the surrounding states that Maryland is currently depending on for imports in order to meet its growing demand.

PJM's forecasted peak load for 2026/2027 increased by over 5,400 MW, driven largely by data center expansion, electrification and economic growth, while new generation capacity only added 2,669 MW. Maryland is a net importer of energy with summer peak loads of nearly 16,000 MW while Maryland based generation totals just under 12,000 MW.

Maryland relies heavily on imported energy. As of 2022, 27% of the electricity consumed in Maryland was imported, making Maryland the then fifth-largest electricity importer in the United States based on percentage of electricity sales. Only the District of Columbia, Massachusetts, Delaware, and Idaho exceed Maryland. At the time of writing this report, annual imports are at 40%. Maryland's few electric-generating facilities also rely on fuels imported from neighboring states. The percentage of imported fuel will sharply increase with the pending retirement of many existing generation plants.

Peak energy use during summer 2023 comprised fuel generated according to Table 1.

Continuous investments in the existing transmission electric infrastructure will help to ensure reliability and availability. However, these investments are not a substitute for additional generation capacity. The Federal Energy Regulatory Commission (FERC) monitors the reliability, performance, and maintenance practices of transmission asset owners to ensure system availability. Similarly, the PSC monitors the reliability performance and maintenance practices of distribution asset owners. The PSC performs an annual review of utility performance, which outlines corrective actions and potential fines for underperformance. The reliability of electric delivery in Maryland has dramatically improved since 2012 when annual reliability reporting requirements were established by law and regulation. Maryland's investor-owned utilities have each invested in reliability related capital projects that have produced measurable improvements. Maryland's utilities now boast top-tier national performance benchmarks, and the PSC dockets reflect a decade of steady progress.

FUEL USE BY TYPE

Primary Fuel Type	Capacity	
	Summer (MW)	Percent of Total
Coal	1,453.0	12.2%
Oil	1,656.3	13.9%
Natural Gas	5,632.7	47.3%
Nuclear	1,745.2	14.6%
Hydroelectric	514.9	4.3%
Other and Renewables	912.5	7.7%
Total	**11,914.6**	**100.0%**

Table 1. Fuel use by type during summer 2023

For electric distribution, Maryland is divided into 13 geographic electric utility service territories as shown in Figure 1. Each of these utilities is required to file a tariff with Maryland PSC.

Maryland's current energy needs are met through multiple sources. The transportation industry is supported by gasoline and diesel fuels. Home heating is supplied by electricity, natural gas, fuel oil, propane, and other sources. Maryland consumes almost six times more energy than it produces. In 2022, the transportation sector accounted for 33% of Maryland's energy consumption. Residential energy consumption accounts for 31%. Commercial sectors account for 29% and industrial sectors account for 7%. Most of the region's electric supply is imported through the electric transmission system and includes nuclear, petroleum, natural gas, and coal resources.

UTILITIES BY TERRITORY

Maryland's electric system includes three separate but integrated groups: generation, transmission, and distribution. As previously mentioned, PJM leads regional planning for generation supply and transmission reliability. Transmission and distribution utilities plan for adequacy of the local transmission and distribution networks. The entire electric system is moving away from thermal generation, and

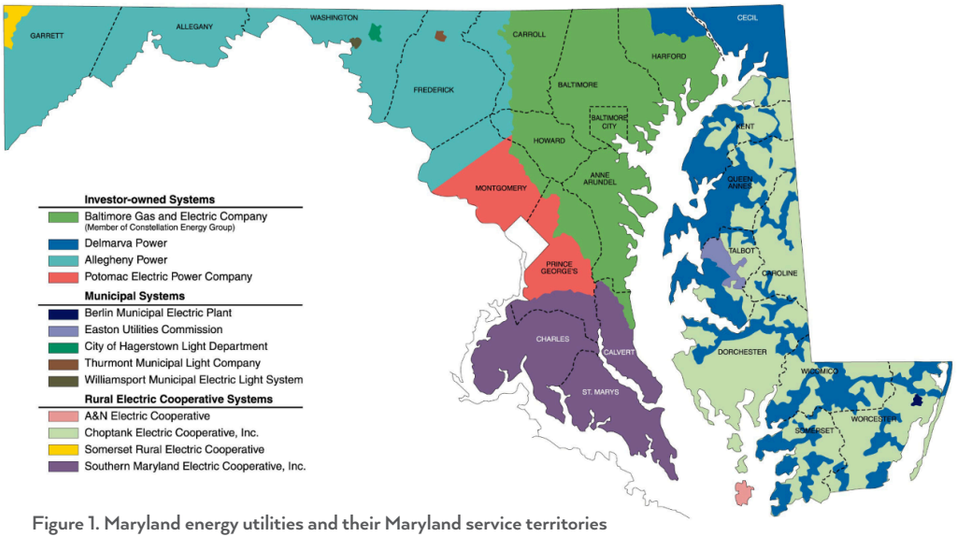

Figure 1. Maryland energy utilities and their Maryland service territories
Source: Maryland Office of People's Counsel

2025 Grade: D+

transmission and distribution systems are expanding and connecting to new generation sources to serve the increased electric loads created by the electrification of transportation and heating.

Maryland continues to see growth in the number of electric vehicles registered, passing 100,000 registrations in 2024. Of those, 71.6% are fully electric while 28.4% are plug-in hybrid electric vehicles.

System reliability is a particular concern as generation facility retirements outpace the construction of new facilities. Maryland's generation resources will decrease by over 75% with the pending retirement of coal-fired generation. This is a significant challenge made more significant by periods of increasing load, which heighten the risk of resource inadequacy at peak times. PJM has recommended continued operation of some thermal generation facilities to ensure reliability until replacement technology can be deployed at scale.

Figure 2. Brandon Shores generating station
Source: John Roche, PTAP Aerial

During this transition, legacy heat sources must remain online to ensure the public's health and safety until loads can be reliably supplied by the electric grid or other sources. The pace of this transition will be influenced by many factors, including permitting and construction timelines for electric grid projects, the pace of consumer adoption, and the cost of alternatives.

In April 2023, Talen Energy (the parent company of Brandon Shores LLC generation facilities) announced that its two-unit, 1,280 MW coal-fired generation facility in Anne Arundel County (Figure 2) would pursue deactivation on June 1, 2025. Subsequently, PJM initiated its standard generator deactivation process to determine whether the facility's retirement would affect the transmission system and/or require immediate transmission reliability solutions. PJM's analysis determined that transmission solutions are needed as early as 2025 to address reliability issues related to the facility deactivation. Transmission solutions include in-service estimates in the 2028–2029 period. As a result, PJM requested that the Brandon Shores units remain operational until the transmission system upgrades are complete.

In October 2023, Talen announced the impending deactivation of three oil-fired steam units and one gas combustion turbine (CT) at its H.A. Wagner Generating Station on June 1, 2025. These facilities have a combined capacity of 844 MW. PJM's analysis reaffirmed the need for immediate transmission reinforcements as early as 2025 and also determined that two of the station's units must run through 2028 while upgrades occur.

On April 18, 2024, Talen filed Reliability Must-Run (RMR) arrangements with FERC for both Brandon Shores and two units at the H.A. Wagner station. Intervenors petitioned FERC to consider energy storage and other solutions to avoid extending the life of these facilities. PJM noted that although a large battery solution could reduce the severity of reliability concerns after generation retirements, it would not replace the capacity of existing generation facilities until transmission upgrades are complete, nor address reliability needs in the near or long term.

2025 Grade: D+

Operation and Maintenance, Funding, and Future Need

Since permitting and constructing new assets is an expensive and time-consuming process given Maryland's regulatory environment and permitting processes, maintaining and upgrading assets is a priority solution to the challenge of increasing energy demands.

Indeed, to ensure adequate supply to support the growing demand for electricity, new generation resources must be built. Relying on imports alone is risky as surrounding states will face resource adequacy constraints of their own. If adequate generation investment is not secured through the current market framework, then consideration should be given to some form of regulated generation investment to ensure adequate energy to support Maryland's economic activity.

The electric transmission and distribution system in Maryland is ultimately funded by electricity customers as the utility investments are recovered in base distribution rates when determined just and reasonable by the PSC.

Maryland does not regulate the pricing of generation and supply; prices are set by the competitive marketplace. The regional transmission system operated by PJM Interconnection, LLC (PJM), an independent, non-profit system operator, is charged with ensuring sufficient supply and administers the wholesale energy market. The high-voltage bulk electric transmission system is a regulated monopoly and is subject to regulation by FERC. The distribution of electricity in Maryland is subject to price and quality-of-service regulations set by the PSC.

Generation investment must be recovered through the capacity and/or energy markets operated by PJM. Capacity prices have risen dramatically in recent years which should attract investment in generation.

While transmission and distribution systems meet Maryland's current needs, past performance will not help Maryland identify and prevent emergent issues since the energy generation landscape is rapidly changing. With no planned construction of coal, oil, natural gas, or nuclear generation facilities planned during the next five or more years, the transmission and distribution infrastructure will be forced to traffic additional volumes of energy as the regional economy grows. To avoid performance issues related to increased system loading from the electrification of heat and transportation, as well as artificial intelligence data center demands, substantial capacity investments are needed to supply the forecasted 12-14% increase in demand over the 2024–2033-time period.

These investment needs would be much higher without the significant demand-side management programs. The current average price for electricity in Maryland is slightly above the national average. With the investments in systems being made by the utilities to meet demand and the increasing generation prices in the region, Maryland rates will remain above average.

Resilience, Public Safety, and Innovation

In addition to increased loading, the electric transmission and distribution system is vulnerable to extreme weather conditions. This trend is expected to continue as global temperatures rise. Investments in targeted system hardening are needed to manage the risk of more frequent and/or extended outages.

If Maryland does not reinforce aging infrastructure to meet future needs, integrate resilience into infrastructure planning, incorporate renewable energy supplies, and develop dispatchable clean sources of electricity, then it will face:

- **Increased risk of power interruptions during peak demand times.**
- **Greater magnitude and longer-lasting grid impacts from storm damage.**

2025 Grade: D+

After considering the available information, energy infrastructure in Maryland is assigned a grade of D+

Recommendations to Raise the Grade

To improve Maryland's energy infrastructure, Maryland should:

- Ensure adequacy of electric supply through the transition period from fossil fuels to new energy sources. Expand, reinforce, and interconnect with new energy sources the electric transmission and distribution network. Construct and connect to the grid new, clean and dispatchable energy sources before legacy fossil fuel-burning sources are retired in order to effectively manage supply transition and meet new demands for energy.
- Develop infrastructure hardening programs to improve the resiliency of the electric transmission and distribution system, which will bear the brunt of increased energy demands as fossil fuels are phased out.
- Ensure proper maintenance of the natural gas delivery system, evaluate its continued use at substantially lower volumes (e.g., as a backup source to electric heat pumps at low temperatures) to temper electric peak demand as delivery switches to predominately electric heat.
- Pursue permitting and siting reform at state and federal levels supporting the generation, transmission, and distribution infrastructure expansions needed to maintain grid reliability and keep pace with rising peak demand.
- Evaluate the PJM capacity market to determine whether it provides sufficient price signals and incentives to attract development of supply resources. Consideration should be given to permitted regulated generation in Maryland, if the current market does not attract sufficient investment in generation.

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HAZARDOUS WASTE

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: C+

2020 Maryland: N/A 2025 National: C

Executive Summary

Maryland has an established hazardous waste program within the Maryland Department of the Environment's Land Management Administration. Maryland generates roughly 0.1% of the nation's hazardous waste and manages about 0.07%. The state's staffing levels and funding have been sufficient to effectively administer a hazardous waste program of this scale. Maryland currently has 20 superfund sites, including nine federal facilities. The remediation process has been wholly or substantially completed at many of Maryland's superfund sites. As with the rest of the nation, Maryland faces a major hazardous waste management challenge in addressing per- and polyfluoroalkyl substances (PFAS) as contaminants of concern. In response, Maryland developed a PFAS Action Plan to advance monitoring and testing protocols, set action levels, and implement mitigation strategies. The plan addresses drinking water, wastewater, sewage sludge, landfills, and industrial dischargers, and establishes a timeline for identifying industrial users of PFAS. Actions in the plan include cleaning up contaminated sites and investigating areas with a history of PFAS use.

Background

Hazardous waste management in Maryland is primarily the responsibility of the Land Management Administration (LMA) within the Maryland Department of Environment (MDE). There are two hazardous waste programs under the LMA: the Land Restoration Program (LRP) and the Hazardous Waste Program (HWP). The LRP focuses on cleaning uncontrolled hazardous waste sites throughout Maryland. The LRP leads the cleanup effort for non-Federal hazardous waste sites, whereas the Environmental Protection Agency (EPA) has primary responsibility for cleanup of federal hazardous waste sites designated as superfund sites under the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as the Superfund Program. For Federal superfund sites, Maryland works collaboratively with EPA and shares responsibility with EPA on planning and implementing the cleanup.

Within the LRP, the Controlled Hazardous Substance (CHS) Enforcement's Fund Lead Site Assessment Division oversees cleanups of historically contaminated hazardous waste at sites that are not on the National Priorities List (NPL). The CHS is responsible for managing environmental remediation at sites listed on the State Master List of sites known or reported to be contaminated by hazardous waste. This division also oversees the assessment of property on brownfields and other sites.

Brownfields are abandoned or underutilized industrial or commercial properties where environmental contamination from past uses is a barrier to reuse and redevelopment.

The LRP's Voluntary Cleanup Program (VCP) Brownfields Division encourages voluntary cleanup and redevelopment of brownfields sites. The goal of the VCP is to increase the number of sites cleaned by streamlining the cleanup process while ensuring compliance with existing environmental regulations. The VCP works hand in hand with the Brownfields Revitalization Incentive Program (BRIP) administered by the Maryland Department of Business and Economic Development within Maryland's Department of Commerce. The BRIP provides incentives including tax credits, loans, and grants for the redevelopment of eligible brownfields.

HAZARDOUS WASTE

The HWP regulates active sites that generate, store, ship, or manage hazardous waste sites, implementing requirements established under the Resource Conservation and Recovery Act (RCRA). RCRA regulates the management of hazardous waste as it is generated and governs the proper transport, storage, treatment, and disposal of hazardous waste.

The LMA also has an Emergency Response Division (ERD), whose responsibilities include receiving and tracking spill reports involving hazardous materials and oil. ERD provides 24-hour emergency response to spill incidents, as well as technical support to other programs within MDE. In 2023, ERD received 1,462 oil spill reports and responded to 456 surface spills and hazardous material emergencies.

Capacity and Condition

Superfund Sites in Maryland

Maryland appears to have adequate resources to conduct hazardous waste site cleanups and protect the public and the environment from exposure to toxic substances from superfund sites within the state. Table 1 shows the status of superfund sites at the national level and in Maryland. Table 2 lists Maryland's current superfund sites as well as former superfund sites that have been cleaned up and deleted from the NPL. The locations of Maryland's superfund sites are shown in Figure 1.

State Hazardous Waste Sites

The LRP also addresses hazardous waste sites that are not on the NPL (i.e., they are not superfund sites). Table 3 lists those where the LRP is currently engaged with cleanup activities.

Other Active Facilities

Facilities that generate, dispose or treat, or ship or receive hazardous waste require permits issued under the Resource Conservation and Recovery Act (RCRA). RCRA supports permitting, inspection and

National Priorities List Status	National	Maryland
Non-Federal NPL Sites	1,183	11
Federal NPL Sites	157	9
Total NPL Sites	1,340	20
Proposed NPL Sites	42	1
Deleted from the NPL (cleaned up and removed)	458	4

Table 1. Superfund sites nationally and in Maryland by NPL status

Site Name	City	County	NPL Status**
68th Street Dump/Industrial Enterprises	Rosedale	Baltimore	Proposed
Aberdeen Proving Ground (Edgewood Area)	Edgewood	Harford	Final
Aberdeen Proving Ground (Michaelsville Landfill)	Aberdeen	Harford	Final
Andrews Air Force Base	Andrews Air Force Base	Prince George's	Final
Bear Creek Sediments	Sparrows Point	Baltimore	Final
Beltsville Agricultural Research Center (USDA)	Beltsville	Prince George's	Final
Brandywine DRMO	Brandywine	Prince George's	Final
Bush Valley Landfill	Abingdon	Harford	Final
Central Chemical	Hagerstown	Washington	Final
Chemical Metals Industries, Inc.	Baltimore	Baltimore City	Deleted
Mid-Atlantic Wood Preservers, Inc.	Harmans	Anne Arundel	Deleted
Middletown Road Dump	Annapolis	Anne Arundel	Deleted
Southern Maryland Wood Treating	Hollywood	St. Mary's	Deleted
Curtis Bay Coast Guard Yard	Baltimore	Anne Arundel	Final
Dwyer Property Ground Water Plume	Elkton	Cecil	Final
Fort Detrick Area B Ground Water	Frederick	Frederick	Final
Fort George G. Meade	Odenton	Anne Arundel	Final
Indian Head Naval Surface Warefare Center	Indian Head	Charles	Final
Kane & Lombard Street Drums	Baltimore	Baltimore City	Final
Limestone Road	Cumberland	Allegany	Final
Ordnance Products, Inc.	North East	Cecil	Final
Patuxent River Naval Station	Patuxent River	St. Mary's	Final
Sand, Grave and Stone	Elkton	Cecil	Final
Sauer Dump	Dundalk	Baltimore	Final
Spectron, Inc.	Elkton	Cecil	Final
Woodlawn County Landfill	Colora	Cecil	Final

Table 2. Superfund sites in Maryland

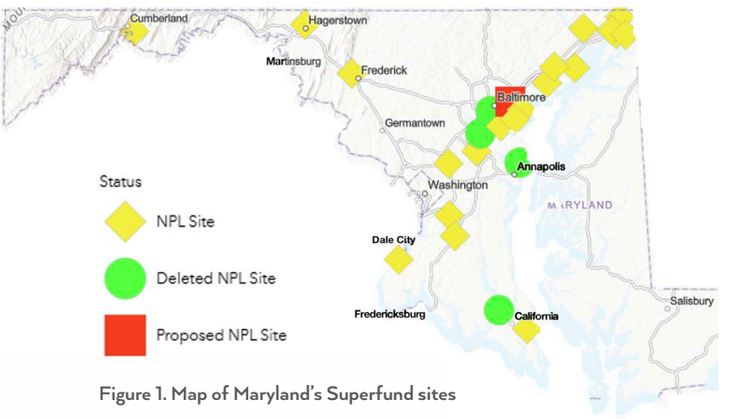

Figure 1. Map of Maryland's Superfund sites

2025 Grade: C+

enforcement, program management, and corrective action to prevent pollution and facilitate cleanup of environmental issues caused by waste mismanagement. The RCRA hazardous waste program is administered almost entirely by the state with significant funding support through federal grants.

Maryland's RCRA facilities are required to report the quantities of hazardous waste, breaking out hazardous wastewater from other hazardous waste (non-wastewater). Table 4 shows the amount of hazardous waste generated, managed (i.e., wastes are treated, stored, or disposed at the facility), shipped, or received by type of waste. Among the largest generators of hazardous waste are Honeywell (Baltimore), Clean Harbors (Baltimore), and Rust-Oleum (Hagerstown). Clean Harbors is also Maryland's largest receiver of hazardous waste.

EPA's RCRA database shows there is the following hazardous waste infrastructure in Maryland:

- **1,314 Large quantity generators (LQGs) of hazardous waste**
- **11 Treatment, storage, or disposal facilities (RCRA TSDFs) that receive hazardous waste**
- **280 hazardous waste transporters**
- **34 hazardous waste recyclers**

Anacostia River PCB Track-Down Studies
Chemical Metals Industries Site (MD-082)
Dark Head Cove
Frog Mortar Creek
Former Alcoa Eastalco Works
Former Weber Farms
Glenn Heights
KOP-FLEX
Manor Road Well Contamination Site
Martin State Airport/Middle River Complex
Montgomery Brothers Dumpsite
Port Covington
Stansbury Park
Takoma Park Shopping Center Off-Site Investigation

Table 3. Maryland Remediation Sites

RCRA Waste Origin/Type	Generated (Tons)	Managed (Tons)	Shipped (Tons)	Received (Tons)
State Totals-Wastewater	10,275	19,982	10,268	22,456
State Totals- Non Wastewater	21,617	4,137	26,493	9,948

Table 4. RCRA hazardous waste generation, management, shipping, and receiving in Maryland

Maryland contributes approximately 0.1% of the nation's hazardous waste generation (31,900 tons in Maryland vs. 32 million tons nationally) and manages approximately 0.07% of the nation's hazardous waste (24,100 tons vs. 35.4 million tons). Less than 0.001% of the national total of hazardous waste recycling occurs in Maryland (151 tons vs. 1.6 million tons). Table 5 compares national and Maryland hazardous waste management infrastructure across several criteria. Table 6 shows how ownership of Maryland's hazardous waste infrastructure includes all levels of government and the private sector.

Location Name	No. of Generators	Generated (Tons)	No. of Managers	Managed (Tons)	No. of Shippers	Shipped (Tons)	No. of Receivers	Received (Tons)
National	18,739	32,221,894	804	35,375,332	18,610	6,278,621	451	6,027,792
Maryland	347	31,891	9	24,119	347	36,760	5	32,403

Table 5. Hazardous waste management nationally and in Maryland

Under RCRA, TSDFs may be required to take corrective action for releases of hazardous waste. There are currently 44 RCRA sites in Maryland undergoing corrective action.

Releases of Hazardous Chemicals from Industrial Facilities in Maryland

Facilities that release hazardous chemicals are required to quantify releases and report them into the Toxic Release Inventory (TRI) database. On a national level, the most recent TRI results (2022) show that approximately 21,000 facilities released 3.3 billion pounds of hazardous chemicals. In Maryland, 156 facilities released approximately 4 million pounds of hazardous chemicals, approximately 0.12% of the national total. Figure 2 shows the locations of facilities reporting hazardous chemical

releases under TRI. Table 7 shows which facilities in Maryland have released or disposed of more than 100,000 lbs. of hazardous chemicals.

Ownership	No. of Generators	Generated (Tons)	No. of Managers	Managed (Tons)	No. of Shippers	Shipped (Tons)	No. of Receivers	Received (Tons)
Federal	44	1,239	4	109	44	1,089	1	**0**
State	56	5,409	0	0	56	5,407	1	**0**
Local	10	2,328	0	0	10	2,326	0	**0**
Private	237	22,914	5	24,009	237	27,938	3	**32,403**
Totals	**347**	**31,890**	**9**	**24,118**	**347**	**36,760**	**5**	**32,403**

Table 6. Hazardous waste infrastructure ownership in Maryland in 2023

Brownfields

Maryland has a robust brownfields program, with nearly 1,800 sites included in its Brownfield Master Inventory (BMI). One-quarter of the sites in the BMI are in an active assessment phase and approximately 3% are currently being remediated.

PFAS Contamination

Per- and polyfluoroalkyl substances (PFAS) are human-made chemicals that have been used since the 1940s in a range of products, including stain- and water-resistant fabrics and carpeting, cleaning products, paints, cookware, food packaging, and fire-fighting foams. The risk posed by exposure to PFAS is an emerging and evolving national concern. Maryland conducted monitoring of community water systems for PFAS from September 2020 through 2022 and found that 73 systems (about 16%) had PFAS levels above the EPA's proposed maximum contaminant level of 4 parts per trillion.

continued ...

Facilities with the Largest TRI Releases	Total On-Site Disposal or Release (lbs)	Total Off-Site Disposal or Release (lbs)	Total Disposal or Release (lbs)
Prince Specialty Products, LLC. 610 Pittman Road, Baltimore, Maryland 21226 (Anne Arundel County)	17,765	1,678,166	1,695,931
Darling Ingredients Inc. - Linkwood Facility 5420 Linkwood Road, Linkwood, Maryland 21835 (Dorchester County)	1,146,823	5,986	1,152,809
Perdue Agribusiness LLC – Salisbury 6906 Zion Church Road, Salisbury, Maryland 21804 (Wicomico County)	245,464	-	245,464
AES Warrior Run Inc. 11600 Mexico Farms Road SE, Cumberland, Maryland 21502 (Allegany County)	21,740	194,039	215,779
Grace Davison – Curtis Bay Works 5500 Chemical Road, Baltimore, Maryland 21226 (Baltimore City)	85,527	35,892	121,419
Xerxes Corp. 16404 Elliott Parkway, Williamsport, Maryland 21795 (Washington County)	109,615	-	109,615
Maryland Total	1,901,648	2,097,757	3,999,405

Table 7. Top six Maryland facilities by quantity of hazardous chemicals disposed of or released

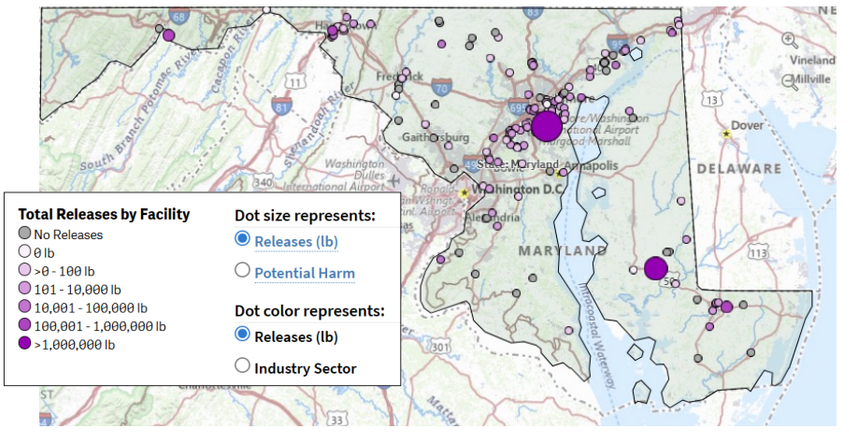

Figure 2. Maryland facilities reporting under the toxic release inventory

2025 Grade: C+

HAZARDOUS WASTE

PFAS Contamination continued ...

Addressing PFAS contamination will put significant pressure on Maryland's hazardous waste infrastructure, increasing future requirements for developing more sensitive detection methods, site investigations and remediation, treatment capacity, and the development of new treatment technologies. Since past fire-fighting training practices at military bases are a likely source for PFAS in the environment, MDE has worked with the Department of Defense and EPA to accelerate the assessment, remediation, and monitoring of military installations and of Federal superfund sites in Maryland where PFAS are present. Maryland developed its PFAS Action Plan in December 2023, and is implementing a series of actions to reduce historical and current sources of PFAS to the environment and to monitor for PFAS in water and wastewater systems, in sewage sludge, at landfills, and at industrial facilities.

Operation and Maintenance

Operation and maintenance requirements for facilities that generate hazardous waste are defined in the Code of Maryland Regulations (COMAR) 26.13, Disposal of Controlled Hazardous Substances. COMAR 26.13 was last amended in 2021 to maintain consistency with the federal hazardous waste management requirements. As previously described, compared to the national picture and to other states, Maryland generates, ships, and manages a small percentage of the nation's hazardous waste, has relatively few hazardous waste RCRA generators or TSDFs, and relatively few RCRA sites requiring corrective action. Maryland's regulatory oversight and enforcement structure appears to be well developed within MDE.

Funding and Future Needs

Funding for the investigation and cleanup of superfund sites comes primarily through settlement agreements with parties responsible for the pollution, from the Superfund Petroleum and Oil Superfund tax, the Chemicals Superfund tax, and the Hazardous Substances tax, and from Federal General Revenues. Maryland (and all other states) has a 10% cost-share requirement for long-term operation and maintenance of remediation systems at superfund sites if none of the parties responsible for the pollution are viable. MDE's Land and Materials Administration (LMA), which includes oversight and enforcement of hazardous waste management in the state, had a stable budget of $45.5 million in fiscal year (FY) 2024 and FY2025. For FY2026, the Governor's budget request for LMA is $54 million, an increase of over 18%. Within the LMA, funding for the LRP for Superfund cleanups in FY2025 included $659,000 in General and Special funds, $850,000 in EPA grant funds, and $1.8 million in Department of Defense grant funding.

Management of the RCRA program in Maryland is delegated from the EPA to the state. Authorized states, including Maryland, receive State and Tribal Assistance Grant (STAG) funding appropriated by Congress. The EPA oversees the grant allocation with federal grant funding intended to cover 75% of each state's program costs with the state providing a 25% match. Although specific data on Maryland's RCRA program costs were not available, most states are having to spend substantially more than the 25% match to meet their RCRA program requirements for corrective action, permitting, inspections, enforcement, and other program activities.

Maryland also helps communities access federal brownfields grants through the Department of Planning's Brownfield Redevelopment Assistance Program. In addition to federal grants for brownfields, the Maryland Department of Business and Economic Development (part of the Department of Commerce), working collaboratively with the VCP, administers the Brownfields Revitalization Incentive Program (BRIP), providing incentives including tax credits, loans, and grants for the redevelopment of eligible brownfields.

Understanding the nature and extent of PFAS contamination across Maryland and a broad range of environmental media and multiple facilities presents a significant future challenge for Maryland's hazardous waste infrastructure. Based on what is currently known, the effort, the cost, and the timeline for addressing PFAS contamination is not well understood. Through the

implementation of its PFAS Action Plan, MDE is collecting the data needed to define the scope of the PFAS contamination problem and estimate future funding and technical resource needs. Other emerging contaminants, such as pharmaceuticals, personal care products, microplastics, and newly formulated pesticides may also present future risks to public health and the environment.

Public Safety and Resilience

The core purpose of the nation's hazardous waste infrastructure is public safety – preventing the release of and exposure to dangerous and toxic substances. While the existing infrastructure is generally fit for that purpose, the resilience of the infrastructure is less certain. A study done by the General Accountability Office (GAO) in 2019 evaluated the resilience of Superfund sites, finding that about 60% of non-federal NPL sites are in areas that may be impacted by flooding, storm surge, wildfires, or sea level rise related to climate change effects. The GAO considered the following 13 of Maryland's 25 superfund sites (including proposed NPL sites and sites deleted from the NPL) to be susceptible to climate change impacts:

- Spectron, Inc.
- Central Chemical (Hagerstown)
- Mid-Atlantic Wood Preservers, Inc.
- Bush Valley Landfill
- Woodlawn County Landfill
- Limestone Road
- Southern Maryland Wood Treating
- Middletown Road Dump
- Sand, Gravel and Stone
- Kane & Lombard Street Drums
- Sauer Dump
- Ordnance Products, Inc.
- Dwyer Property Ground Water Plume

Since certain PFAS compounds have been designated as hazardous substances under CERCLA, addressing this type of public and environmental safety concern will put significant pressure on hazardous waste infrastructure with implications on future requirements for site investigations and remediation, treatment capacity, and the development of new treatment technologies.

On a site-by-site basis, the superfund program determines whether potential or actual human exposure to hazardous substances is under control, not under control, or uncertain (a finding of insufficient data to determine level of control). Nationally, the superfund program identifies 161 sites where human exposure is not under control (one in Maryland), and 176 sites where the data are insufficient to make a determination (five in Maryland). Table 8 is the subset of superfund sites in Maryland where it cannot currently be demonstrated that human exposure is under control.

TOP MARYLAND FACILITIES WITH INSUFFICIENT PERFORMANCE DATA

Superfund Site Name	Performance Measure Status
Fort Detrick Area B Ground Water	Insufficient Data (ID)
Brandywine DRMO	ID
Curtis Bay	ID
Dwyer Property Groundwater Plume	ID
Indian Head Naval Surface Warfare Center	ID
Sauer Dump	Not Under Control

Table 8. Top six Maryland facilities by quantity of hazardous chemicals disposed of or released

Innovation

Remediation technologies continue to improve, and more effective site characterization and cleanup strategies are employed to emphasize adaptive management and optimization of treatment systems in Maryland. Maryland is implementing an ambitious PFAS Action Plan that focuses on understanding risk to the public and environment through sampling, science, assessment, and implementation of a science-based plan to identify PFAS exposures in Maryland and work collaboratively with the Department of Defense's PFAS Task Force to reduce exposures to safe levels.

2025 Grade: C+

HAZARDOUS WASTE

After considering the available information, hazardous waste infrastructure in Maryland is assigned a grade of C+

Recommendations to Raise the Grade

To improve Maryland's hazardous waste infrastructure, Maryland should:

- Accelerate and increase investment in PFAS research aimed at characterization, treatment, and analysis, and apply that research to inform a protective and scientifically sound regulatory framework for managing PFAS in the environment through implementation of Maryland's PFAS Action Plan.
- Promote continued focus on the removal of PFAS chemicals from manufacturing processes and product formulations.
- Strengthen Maryland's existing recycling system through investments and innovations in consumer education, collection systems, and sorting technologies to move forward in the direction where products reaching the end of their use are recycled and productively reused.

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PORTS

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: B

2020 Maryland: B- 2025 National: B

Executive Summary

Maryland's ports are vital to the state's economy and transportation network, serving as gateways for national and international trade. The Port of Baltimore – the largest facility – handles nearly 50 million tons of cargo annually, including automobiles, containers, and bulk goods, and supports over 51,000 direct, induced, and indirect jobs. In total, the port system is linked to more than 273,000 jobs and generates $63 billion in economic activity, representing roughly 10% of Maryland's workforce and 12% of its GDP. Inland waterways on Maryland's Eastern Shore also play an important role in the state's maritime economy, serving as regional freight corridors that complement the Port of Baltimore and strengthen Maryland's overall competitiveness. While recent capital investments have advanced dredging, modernization, and resilience, the operating budget has not kept pace with inflation, requiring continual efficiency improvements. Investment in dredged material management, reuse, and infrastructure expansion are essential to maintain Maryland's port competitiveness.

Capacity and Condition

Maryland ports are vital hubs for freight movement, combining strategic location, deep channels, and multimodal access. The Port of Baltimore leads the East Coast in efficiency and handles a diverse mix of cargo, while Eastern Shore rivers and smaller terminals support regional goods movement despite limited infrastructure. Cruise operations add economic and tourism value but face size and capacity constraints. Rail and roadway improvements, terminal modernization, and dredging are essential to maintaining competitiveness and supporting future growth.

The Port of Baltimore

Baltimore started attracting attention as a port in 1670 as a transfer point for Maryland's tobacco exports to England. The Port of Baltimore, shown in Figure 1, benefits from a deep, naturally sheltered harbor and is the closest East Coast port to key Midwest markets, offering shortened inland transit times. Its inland location within the Chesapeake Bay provides protection from ocean storms, while proximity to major highways and rail lines enables access to one-third of the US population within an overnight drive. These geographical advantages make it a strategic hub for both domestic and international freight movement. Today, The Port of Baltimore, Maryland's largest port, is recognized as a leader in container port efficiency leading the East Coast in peak berth productivity, with more than 80 moves per hour, and is among the highest in its sustained average of 40 moves per hour.

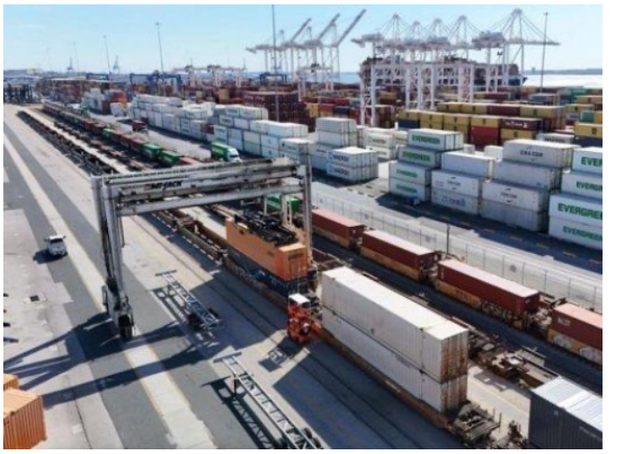

Figure 1. Port of Baltimore
Source: MDOT MPA

The Port of Baltimore features a diverse mix of public terminals with specialized landside infrastructure to handle containers, autos, breakbulk, and general cargo. Seagirt Marine Terminal serves as the primary container hub, equipped with Neo-Panamax cranes, rubber-tired gantry cranes, and a 50-foot channel depth supported by direct rail and highway access. Dundalk Marine Terminal provides extensive acreage for autos, roll-on/roll-off (RoRo) cargo, and project cargo, while Locust Point terminals offer capacity for forest products, steel, and other breakbulk. The Intermodal Container Transfer Facility enhances efficiency by linking port operations directly to the national rail network.

PORTS

In 2024, the Port of Baltimore was ranked the 11th largest U.S. port by tonnage and 10th largest by dollar value, handling 45.9 million tons of cargo across its public and private terminals. This marked the port's second-highest year on record, following a record-setting 52.3 million tons in 2023, when it also ranked 3rd among East Coast ports by total tonnage. The Port of Baltimore recently set records for general cargo (2023), containerized cargo (2023), and non-containerized cargo (2022), underscoring its strong and diversified performance. It also ranked first nationally for roll-on/roll-off farm and construction machinery, imported forest products, and gypsum, and second in the nation for cars, light trucks, salt, and exported coal. The value of cargo moving through the port in 2024 reached $62.2 billion, the third highest in its history. The overall tonnage at the Port of Baltimore fell in fiscal year (FY) 2024 due to the collapse of the Francis Scott Key Bridge, which blocked ships from key portions of the port and resulted in cargo diversions to other ports. See Figure 2 for a recent history of commerce through the Port of Baltimore.

PORT OF BALTIMORE FOREIGN WATERBORNE COMMERCE (MILLIONS OF TONS)

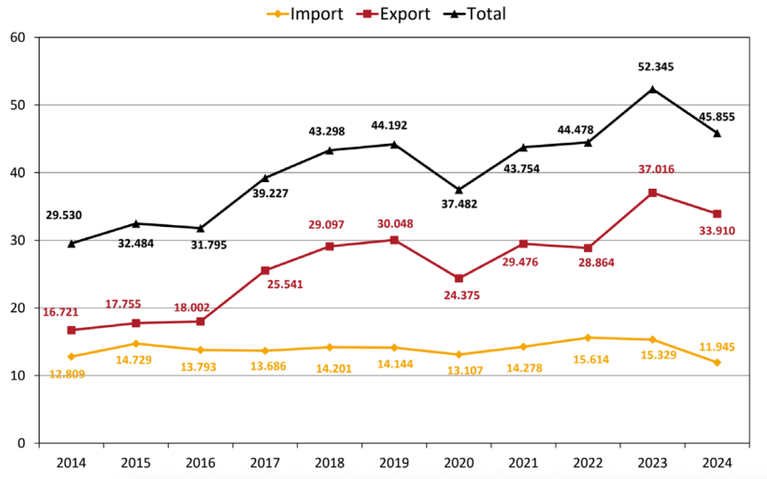

Figure 2. Foreign waterborne commerce, millions of tons
Source: Maryland Department of Transportation, Maryland Port Administration

The Port of Baltimore primarily relies on truck-based freight movement, but terminal access is constrained by the lack of dedicated truck routes, mandatory tolls, and peak-hour congestion, often pushing truck traffic onto local streets and causing significant congestion. This not only disrupts surrounding communities but also reduces overall port efficiency. The Port of Baltimore has made investments to reduce truck loading and unloading times, which have been steadily decreasing since 2020, falling below 60 minutes in 2023 and 2024.

Historically, rail access has also faced challenges due to infrastructure limitations, including low-clearance tunnels that restrict the movement of modern, double-stack container trains. In October 2024, the launch of double-stack rail service to the Port of Baltimore via a temporary route marked a transformative milestone, significantly expanding the port's capacity and operational flexibility. Several projects are now underway to make double-stack service permanent. With a lowered tunnel floor to accommodate trains with containers stacked two high, the recently re-opened Howard Street Tunnel establishes a direct, efficient rail corridor into the port and will deliver long-term operational efficiencies, reduce truck dependency, and improve overall cargo throughput. Economically, it is projected to create thousands of jobs, enhance regional competitiveness, and position the Port of Baltimore as a premier gateway to Midwest markets. To complete this effort, CSX Corp. is removing 22 additional clearance obstructions along the corridor between Baltimore and Philadelphia, with completion targeted for late 2026. This effort will strengthen supply chain connectivity and lower freight transportation costs across the region.

Complementing the removal of obstructions, the Maryland Port Administration (MPA) received $15.6 million from the Federal Railroad Administration's Consolidated Rail Infrastructure and Safety Improvements (CRISI) program in June 2022 to modernize Seagirt Marine Terminal's intermodal rail yard. The funding supported the construction of four new working rail tracks totaling 17,670 linear feet and two crane rail beams extending 7,000 linear feet, as well as the conversion of diesel-powered yard equipment to electric alternatives. These upgrades are essential to accommodate double-stack container trains, increase cargo capacity, and enhance environmental sustainability.

2025 Grade: B

Continued investments in aging marine terminals will position the Port of Baltimore for long-term growth and competitiveness. One critical example is the Dundalk Marine Terminal, where severe deterioration at Berth 11 has reduced operational capacity and threatens to cut in half berthing at Berths 11–13. These berths handle approximately 35% of the terminal's cargo and are essential to sustaining port operations. MPA is advancing a six-phase reconstruction plan, starting with Phase 1 to rehabilitate 597 feet of wharf with structural, utility, drainage, and flood protection upgrades. However, the future of the project remains uncertain, as it relies on a federal grant and matching state funds that are contingent on legislative approval.

Maintaining the Port of Baltimore's 50-foot channel depth through frequent and extensive dredging is critical for accommodating larger post-Panamax vessels and sustaining the port's competitiveness. The recently launched Mid-Chesapeake Bay Island Project will provide a sustainable placement site for dredged material for the next 30 years while also enhancing critical island habitats for wildlife, though many of these efforts rely on securing external funding.

Maryland's Eastern Shore

At least five rivers on Maryland's Eastern Shore (Choptank, Nanticoke, Pocomoke, Tred Avon, and Wicomico) serve as active corridors for goods movement, collectively transporting over two million tons of petroleum, grain, and aggregates each year, with roughly half of this cargo passing through Salisbury, Maryland's second-largest port, on the Wicomico River. While there are currently six privately owned marine terminals in Salisbury handling about 1 million tons per year – a volume deemed economically significant by the U.S. Army Corps of Engineers (USACE) – the city lacks a centralized port with multiple berths, cranes, and warehouses that can serve several shipping companies at once. As a result, cargo is handled at smaller or private facilities, limiting capacity and efficiency compared with fully developed multi-user ports like Baltimore.

A 2021 feasibility study conducted by the City of Salisbury highlighted strong market demand, economic benefits, and opportunities for community redevelopment tied to establishing a multi-user port terminal. The city is actively pursuing policies and projects to transform the port, aiming to expand operations, enhance regional competitiveness, stimulate economic growth on the Eastern Shore, and reduce truck traffic to deliver environmental and community benefits.

The remaining waterborne freight is primarily moved using the Chester, Choptank, Nanticoke, Pocomoke, and Tred Avon rivers. Similarly to the Port of Baltimore, the waterways of the Eastern Shore are challenged with frequent dredging needs to maintain channels, lack of sufficient truck and rail access, and neighboring development impacting waterborne facilities.

Cruise Terminal

In 2023, more than 444,000 passengers cruised from the Port of Baltimore, the third-highest total in the port's history and the most since 2012. In 2025, Carnival Cruise Lines signed a five-year contract to continue providing cruise services at the Port of Baltimore while Royal Caribbean International announced it would be leaving the Port of Baltimore with no clear plans to return.

Cruise terminal capacity at the Port of Baltimore is constrained by the inability to accommodate more than one vessel per day and by air draft restrictions caused by the Chesapeake Bay Bridge, which has a clearance of approximately 185 feet. As cargo and cruise ships continue to grow in size – some reaching air drafts of up to 230 feet – this limitation increasingly restricts the types of vessels the port can serve. While the Francis Scott Key Bridge previously posed similar constraints, the new bridge currently in design will raise the clearance to 230 feet, improving access and aligning with the trend toward larger vessels.

2025 Grade: B

Funding and Future Need

The Port of Baltimore has a $1.6 billion, six-year capital improvement plan to invest in its infrastructure. This includes $1.1 billion in Maryland State Transportation Trust Funds, $336 million in federal funds, $105 million in state funds, as well as funding from private companies, including CSX. With these investments, the Port of Baltimore's capital budget has soared from less than $100 million in 2015 to more than $350 million in 2025, allowing the port to make investments that will allow continual growth including the Howard Street Tunnel project and Mid-Chesapeake Bay restoration project.

While capital improvements to the port are heavily reliant on appropriations and private investment, the MPA does not rely solely on appropriations to operate. Annual Port of Baltimore revenue of more than $50 million is generated through lease agreements and fees assessed on imported/exported cargo, an amount that offsets annual expenditures. The MPA budget also supports capital expenditures, such as dredging, that benefit both the public and private marine terminals. See Table 1 for the expense distribution in MPA's budget and Figure 3 for its actual spend versus annual budget in recent history.

The MPA's operating budget has not kept pace with inflation or increasing cargo volumes, placing strain on the agency's ability to maintain service levels and modernize infrastructure. Despite expanded operational demands, staffing levels have remained largely unchanged over the past decade at approximately 218 regular positions, raising concerns about the system's long-term resiliency, safety, and economic performance.

OPERATING BUDGET BY CATEGORY

Category	Percentage
Personnel	42%
Contracted Security Services	27%
Other Contractual Services	15%
Fuel and Utilities	8%
Other	4%
Rent/Other Charges	3%
Facilities Maintenance	1%

Table 1. Operating budget for MPA

Operation and Maintenance

Maryland ports rely on coordinated operations, preventive maintenance, and modernization to keep cargo and cruise activity moving safely and efficiently. Managed by the MPA, state-owned terminals work alongside private facilities to handle a diverse mix of containers, vehicles, and bulk commodities. Federal funding, technological upgrades, and routine upkeep ensure critical infrastructure – from berths to cranes – remains resilient and capable of supporting both daily operations and long-term growth. These efforts together sustain Maryland's ports as reliable, competitive gateways for domestic and international trade.

OPERATING BUDGET VS. INFLATION

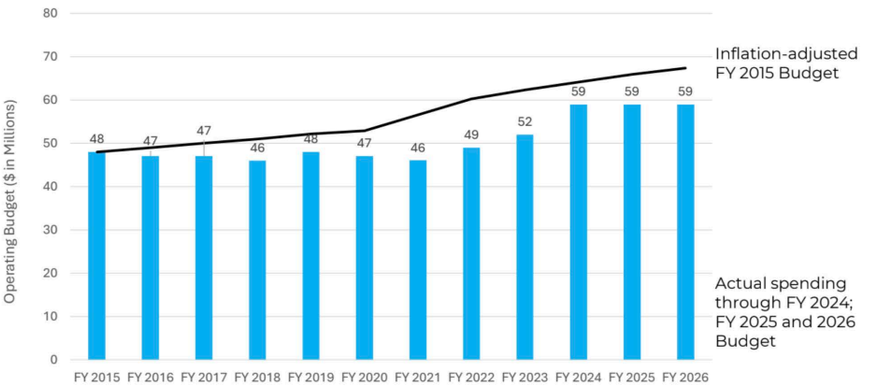

Figure 3. MPA annual operating budgets and expense totals
Source: MDOT

The MPA maintains a rigorous preventive maintenance program for its public terminals, conducting regular inspections of berths, cranes, storage areas, and other critical infrastructure to ensure safe, uninterrupted operations. Routine upkeep and timely repairs

reduce equipment downtime, extend the service life of assets, and help sustain reliable service for domestic and international trade. Private terminals, while independently managed, also play a vital role in overall port operations, contributing additional capacity and specialized handling services that enhance operational flexibility and efficiency.

Operations and maintenance are supported by federal funding through the USACE, including the general fund, Harbor Maintenance Trust Fund, and Inland Waterways Trust Fund. Annual USACE funding for Maryland-related projects has grown from $50.4 million in 2015 to $154.5 million in 2024, reflecting increased investment in port infrastructure and navigation improvements. Key projects include $71.9 million for the Mid-Chesapeake Bay Island Project and $61 million for routine operations and maintenance, including dredging the 50-foot shipping channels from the Chesapeake Bay mouth to Baltimore Harbor. On the Eastern Shore, USACE appropriations for Wicomico River dredging have increased from $1.5 million in 2015 to $5 million in 2025, supporting navigation for Maryland's second busiest port. These investments ensure both public and private terminals can operate efficiently and safely.

To enhance operational efficiency and resilience, the MPA integrates technology and modernization into both public terminal operations and coordination with private operators. Upgrades to container cranes, reinforcement of bulkheads, predictive maintenance systems, digital monitoring, and automated cargo-handling equipment improve real-time situational awareness, reduce operational delays, and enable rapid response to disruptions. By combining federal investment, routine maintenance, technological innovation, and collaboration with privately operated terminals, Maryland ports maintain reliable, resilient, and efficient operations that support economic growth and competitiveness in the global maritime industry.

Public Safety and Resilience

Maryland ports play a critical role in regional and national commerce, handling millions of tons of cargo each year and supporting tens of thousands of jobs. Ensuring these facilities remain secure, resilient, and capable of adapting to emerging challenges is essential for economic stability and public safety. The MPA has made significant investments in physical security, cybersecurity, and infrastructure improvements, while also pursuing innovative strategies to mitigate risks from climate change, extreme weather, and evolving operational threats. This commitment positions Maryland ports to continue serving as reliable, modern gateways for trade well into the future. Events such as the 2024 Francis Scott Key Bridge collapse underscore the importance of robust emergency planning and resilient infrastructure to maintain reliable port operations and national supply chain continuity.

Francis Scott Key Bridge Collapse

On March 26, 2024, the Francis Scott Key Bridge in Baltimore collapsed after being struck by a container ship (Figure 4), resulting in the tragic loss of six construction workers and the closure of the Port of Baltimore's main shipping channel. As a vital part of both the region's transportation infrastructure and maritime logistics network, the collapse caused immediate and wide-reaching disruptions. The Port of Baltimore experienced a significant slowdown in operations. Vessel traffic was halted, supply chains were delayed, and industries dependent on timely shipments faced mounting costs. The event exposed vulnerabilities in port access infrastructure and underscored the economic risks of single points of failure.

continued ...

For the 16th consecutive year, the Port of Baltimore received positive results from a U.S. Coast Guard security assessment for its six state-owned marine terminals. In recent years, the MPA has installed high-mast lighting and fencing, strengthened gate and fence lines, added signage, and implemented other physical security measures. Heightened cybersecurity and access control initiatives, coupled with the MPA's closed-circuit television network, have strengthened an already robust and effective security program. Federal Emergency Management Agency grants continue to enhance security and resilience. These grants include a recent award of nearly $500,000 for security improvements designed to prevent unauthorized physical and digital access to terminals and critical computer systems. Such projects reduce the

2025 Grade: B

Francis Scott Key Bridge Collapse continued ...

In the wake of the disaster, federal and state agencies mobilized to clear debris, restore limited marine traffic, and begin planning for a replacement bridge. The replacement bridge, with an estimated cost of nearly $2 billion, is scheduled to open in fall 2028 and will feature higher navigational clearance and modern design standards to enhance resilience against future incidents.

Figure 4. Wreckage from the Francis Scott Key Bridge collapse
Source: USACE

The response also highlighted the need for more coordinated emergency planning and redundancy in freight networks. While other ports were able to accommodate cargo bound for Baltimore and temporary access channels have helped resume partial operations, capacity at the Port of Baltimore will remain constrained until the bridge is rebuilt (i.e., due to construction activity), impacting not only Maryland's economy, but also national freight flows.

likelihood that the port will be vulnerable to targeted attacks and promote rapid recovery in the event of a disaster.

Maryland ports, including the Port of Baltimore, face increasing threats from sea level rise and extreme weather, which can flood terminals, roads, and rail connections, disrupt cargo operations, and damage cranes, warehouses, and other infrastructure. In response, the MPA has undertaken several initiatives to improve resilience. In 2020, the MPA received a $10 million U.S. DOT BUILD grant to protect the Dundalk Marine Terminal from flooding and storm damage. The project included upgraded drainage systems, heavy-rain pumps, and barriers designed to block storm surges. Dundalk is particularly vulnerable, with up to 72% of the 318-acre cargo storage area potentially affected by flooding, threatening valuable vehicles and equipment. These improvements are expected to reduce the risk of major flood damage by 70% and prevent up to two feet of flooding in critical areas. The project also incorporates measures to prevent polluted water from entering the Patapsco River, supporting both resilience and environmental responsibility.

Innovation

The MPA has been a national leader in the beneficial reuse of dredged materials, creating sustainable solutions through its Innovative Reuse and Beneficial Use Program that transforms dredged material into valuable resources. These efforts have restored and expanded Chesapeake Bay islands such as Hart Miller, Poplar, Cox Creek, and the new Mid-Chesapeake Bay project (Figure 5). This initiative repurposes dredged sediments into products such as geotechnical fill, manufactured soils, and construction materials, thereby reducing reliance on traditional containment methods and extending the capacity of existing facilities like Cox Creek. Collaborating with the Innovative Reuse Committee, MPA has launched several demonstration projects to test and refine these applications, ensuring they meet environmental and public health standards. These efforts not only support the long-term viability of the Port of Baltimore but also contribute to climate resilience by restoring critical habitats and reducing environmental footprints. Through ongoing research and development, MPA continues to lead in integrating innovative dredged material reuse into sustainable port operations, habitat restoration, and long-term infrastructure resilience projects.

Figure 5. Mid-Chesapeake Bay Island project
Source: MDOT MPA

2025 Grade: B

After considering the available information, ports infrastructure in Maryland is assigned a grade of B

Recommendations to Raise the Grade

To meet current and future demands of port infrastructure, Maryland should:

- Ensure port operating budgets scale with growth in order to avoid a do-more-with-less mentality that could compromise safety, efficiency, and long-term competitiveness.
- Look for land expansion opportunities or creative ways to improve internal port capacity without the need for physical expansion.
- Ensure Maryland ports develop and execute comprehensive disaster preparedness plans, with increased investment in resilient infrastructure, more robust navigational safety systems, and operational redundancies that allow commercial activity to continue in the face of disaster or disruption.
- Continue efforts on Maryland's Eastern Shore to present the movement of bulk commodities through inland waterways as an economically advantageous alternative to road and rail transport.
- Evaluate long-term strategies to increase available air draft for ships transiting to the Port of Baltimore, including future-proofing capital investments to be prepared for long-term growth.
- Increase the utilization of cruise terminal infrastructure within existing infrastructure constraints, such as attracting smaller boutique cruise ships.

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RAIL

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: B-

2020 Maryland: C+ 2025 National: B-

Executive Summary

Maryland is home to one of the first railroads in the United States, the Baltimore and Ohio Railroad, which began construction in 1828. Today, the Maryland rail network consists of approximately 886 miles of active track and carries over 21 million tons of freight, with an economic impact of $372 million. Passenger rail in Maryland carries over 6.2 million passengers each year, while short line freight railroads provide first and last mile connections linking local businesses to the national rail network, supporting economic development, efficient freight movement, and regional jobs. Maryland rail infrastructure is primarily privately owned by freight operators who make significant investments in infrastructure upgrades, with annual investments of $51 million by CSX Corp. and more than $7 million by Norfolk Southern Corp. However, freight and passenger rail collectively face a more than $36 billion dollar funding gap to fully modernize infrastructure and meet growing demand.

Capacity and Condition

Maryland's rail network encompasses both freight and passenger operations, with significant overlap where commuter and freight services share infrastructure under trackage rights agreements. Maryland's rail system is dominated by four major owners (Amtrak, CSX, Norfolk Southern, and the Maryland and Delaware Railroad Company) who collectively own and control three-quarters of statewide track. Freight rail, carried by Class I, II, and III railroads, moves millions of tons annually and is poised for substantial growth, necessitating major infrastructure investments such as tunnel and corridor upgrades to improve capacity and efficiency. Passenger rail, provided by Amtrak and MARC, faces challenges from aging infrastructure, capacity constraints, and post-pandemic ridership recovery, prompting ongoing modernization projects.

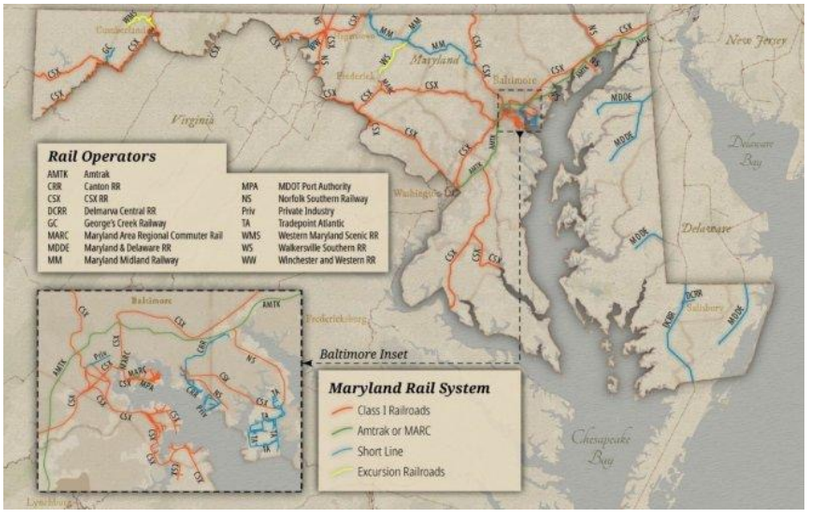

Figure 1. Maryland Class I and passenger railroad
Source: Maryland State Rail Plan, 2022

The dominant rail categories include privately owned freight rail and passenger rail. However, there are overlaps with Maryland Area Regional Commuter (MARC) service operating on some freight infrastructure and Norfolk Southern operating on passenger infrastructure due to trackage rights. The remaining 25% of track is owned by the former Maryland and Delaware Railroad (120 miles of track) and 92 miles of track owned by the Maryland Department of Transportation (MDOT). The remaining infrastructure includes excursion railroads, short lines, rails within ports, and tracks reserved for future use. Figure 1 shows rail classification and ownership throughout Maryland.

Freight Rail

Freight rail infrastructure is divided into three classes based on operating revenue, as shown in Table 1. Maryland has two Class I (CSX and Norfolk Southern), one Class II, and four Class III railroads. Maryland rail moved nearly 21 million tons of freight in 2021, which represents 8% of the total freight moving to/from, through and within Maryland. With freight volumes expected to increase by more than 50% by 2050, improvements to rail infrastructure capacity are needed to meet the demand.

Type	Definition*
Class I	Revenue of at least $1.07 billion
Class II	Revenue of at least $48.2 million
Class III	Revenue of less than $48.2 million

*U.S. DOT Surface Transportation Board, 2025

Table 1. Railroad classification

CSX and Norfolk Southern are making major infrastructure investments in Maryland. CSX's National Gateway project aims to better connect Mid-Atlantic ports with the Midwest and will open up double-stack clearance between Chambersburg, Pennsylvania and ports in Virginia via Maryland; in Maryland, this includes lowering track, replacing bridges, and modifying tunnels. A nearly $500 million infrastructure project, funded by Maryland, Pennsylvania, federal grants, and CSX, increased the 125-year-old Howard Street Tunnel's clearance and will modify 22 additional obstructions along the route, including 11 in Maryland, to accommodate double-stack cargo, now the industry standard. The project will allow twice as many containers per rail trip to and from the port, improving freight movement along the East Coast and enhancing the Port of Baltimore's competitiveness. Substantial completion is planned for the end of 2026.

Norfolk Southern's Crescent Corridor aims to connect NY/NJ with southeastern United States and will include a major terminal near Hagerstown, Maryland.

Norfolk Southern accesses the Port of Baltimore via a route that includes the Amtrak Northeast Corridor between Perryville and Baltimore. However, low clearances along this corridor, originally designed for electric passenger trains, prevent the company from operating double-stack freight trains. Freight service is also limited to off-peak hours to avoid conflicts with frequent passenger trains. As passenger traffic and train speeds continue to rise, there is growing pressure to separate freight and passenger operations. Achieving this will require significant infrastructure improvements along both the Northeast Corridor and the Norfolk Southern route north to Harrisburg, Pennsylvania, to ensure safe, efficient, and competitive freight rail access to the port.

Rail infrastructure on Maryland's Eastern Shore includes approximately 92 miles of state-owned track, of which about 65 miles are actively used for freight service, primarily by the short line Maryland and Delaware Railroad Company. The infrastructure is generally in poor condition, with many segments limited to lighter-weight railcars and some classified as excepted track, which restrict speeds and the transport of hazardous materials. These deficiencies limit economic development potential and operational efficiency. Stakeholders have consistently advocated for major upgrades and the creation of a dedicated state freight rail assistance program. In response, MDOT is pursuing a public-private partnership to lease, improve, and modernize the Eastern Shore rail corridors, with implementation targeted for 2026.

Passenger Rail

Maryland's intercity passenger rail is provided by Amtrak and MARC, which operate on heavy or commuter rail (as opposed to light rail). During fiscal year (FY) 2024, Amtrak served 2.5 million Maryland passengers, which represents an increase from pre-pandemic levels. MARC ridership, however, has been slower to recover. In FY2018, MARC served 9.4 million Maryland passengers. By November of 2023, ridership was at 41% of pre-pandemic levels. In the first half of 2025, ridership surged exponentially, increasing by 58% overall.

In Maryland, Amtrak operates 80 trains daily across six stations – of which are in the top 13 of Amtrak's busiest stations nationwide – with ridership growing at all Maryland stations. Baltimore Penn Station (BPS), Amtrak's busiest in Maryland, serves

more than 1.3 million passengers annually. Heavy usage of both rail and station infrastructure creates capacity and reliability challenges for the aging infrastructure along Amtrak's Northeast Corridor.

Amtrak's BPS renovation and expansion was paused due to escalating construction costs. This portion of the project, aimed at modernizing the station and creating new retail and office spaces, is now awaiting revised funding plans and timelines. Meanwhile, essential infrastructure upgrades at this station continue to move forward. In early 2024, Amtrak completed BPS Platform Five, a new high-level boarding platform designed to serve high-speed trains and improve passenger accessibility. A second platform opened in fall 2024, which enhances operational flexibility and supports the growing number of riders. These improvements are critical steps toward modernizing the station and preparing it for future transportation demands.

Figure 2. Frederick Douglass Tunnel improvements
Source: Amtrak

The more than 150-year-old Baltimore and Potomac (B&P) Tunnel in Baltimore is the oldest Amtrak tunnel. Serving nine million Amtrak and MARC passengers annually, it is the largest bottleneck on the Northeast Corridor between Washington, D.C., and New Jersey. Its aging structure suffers from water infiltration, a sinking floor, and a sharp curve that limits trains to 30 miles per hour, causing delays nearly every day. The tunnel cannot be modernized to meet current safety standards and requires excessive maintenance. To address this critical vulnerability, the $6 billion Frederick Douglass Tunnel Program (Figure 2) is underway, with major contracts awarded in early 2024 and construction slated to begin by the end of 2025. Funded by the Infrastructure Investment and Jobs Act (IIJA) and state resources, this new, electrified tunnel will improve speed, reliability, and safety for passenger rail along one of the nation's most vital corridors.

THE FUTURE MARC SYSTEM - UNCONSTRAINED PHASE

Figure 3. The future MARC system
Source: Maryland Department of Transportation

Built in 1906, Amtrak's two-track Susquehanna River Bridge, which links Havre de Grace and Perryville, is a critical but outdated link on the Northeast Corridor, requiring trains to slow significantly and creating a major bottleneck. Its manually operated swing-span disrupts both rail and marine

2025 Grade: B-

traffic and limits overall capacity. To address these constraints, the $2.7 billion Susquehanna River Bridge Project will replace the structure with two new fixed-span bridges featuring four tracks, enabling high-speed rail and improved reliability. The project, supported by a Federal-State Partnership for Intercity Passenger Rail Program grant, Amtrak, and Maryland, began construction in 2024 following environmental approvals and contractor selection.

The MARC Growth and Transformation Plan identifies $13.7 billion in capital investments to support expanded service across the Penn, Camden, and Brunswick lines. Key infrastructure requirements include adding track capacity on the Penn Line (e.g., sidings and a second track west of Monocacy), upgrading stations, modernizing storage yards and maintenance facilities, improving the accessibility of platforms, and incorporating new rolling stock. These upgrades (Figure 3) are necessary to accommodate increased train frequencies, achieve off-peak and weekend service, improve reliability on shared Amtrak and CSX corridors, and advance service extensions into Delaware, Virginia, and western Maryland.

Funding and Future Need

Many key components of Maryland's rail infrastructure date to the late 1800s or early 1900s and have not been replaced or modernized to meet the demands of modern railroad demand. Rail infrastructure is funded through a combination of federal grants, state transportation investments, and private railroad capital. The Maryland Department of Transportation (MDOT) Asset Management Plan shows an annual investment of $91 million is needed to keep Maryland's rail (freight and passenger) infrastructure in a state of good repair. However, current budgets fall short of this target. The Maryland Transit Administration's FY2025 budget included state-of-good-repair funding to meet general mandates, but this funding is shared across all transit modes, including light rail, metro, commuter rail, and buses and is allocated from broader capital pools, not specifically rail. While MDOT's six-year Consolidated Transportation Program (CTP) commits new annual state funding of $420 million starting in 2026, it's spread across the entire transportation network and may not fully cover the rail-specific need of $91 million. As a result, dedicated annual funding for maintaining rail infrastructure remains insufficient to meet the Asset Management Plan's recommended target.

Freight Rail

While freight infrastructure is largely owned and funded by private railroads, public investment, particularly through competitive federal grants, is crucial to advancing projects. The majority of freight rail funding in Maryland comes from private freight carriers, with federal and state programs providing supplemental support for major improvements and public-benefit projects. CSX operates 1,338 miles of track in Maryland and as of 2023 has invested $51 million in capital investments. Norfolk Southern operates 269 miles of track in Maryland and has an average annual investment of $7.3 million in infrastructure improvements.

Figure 4. Howard Street Tunnel
Source: Port of Baltimore

MDOT's 2022 State Rail Plan identifies over $350 million in priority rail capital needs, including $214 million to enhance capacity and fluidity on CSX and Norfolk Southern lines, $85 million for highway-rail grade crossing and safety improvements, and $55 million to support short line freight railroads. Maryland does not currently offer a dedicated state freight rail funding program; this is unlike neighboring states. Stakeholders have called for the creation of such a program to support rehabilitation and access improvements.

2025 Grade: B-

Passenger Rail

Of the 6.2 million rail passengers boarding or alighting in Maryland each year, nearly 4.2 million utilize the MARC train service, while the remaining 2 million utilize Amtrak.

One-fifth of Amtrak's 33 million passenger trips and one-third of its $3.4 billion revenue depend on travel through Baltimore, making Maryland a significant component of the Northeast Corridor. Baltimore's Penn Station is the sixth busiest station in the Amtrak system.

The State Rail Plan identifies nine priority projects totaling more than $8 billion, most of which are already in design or construction phases, with funding secured for approximately $6 billion. The IIJA provided significant federal support for upgrades that directly impact passenger rail service. Major projects include the $6 billion Frederick Douglass Tunnel to replace the aging B&P Tunnel, the $1.1 billion Susquehanna River Bridge replacement, and the replacement of the Bush River and Gunpowder Falls Bridges, estimated at $447 million and $614 million, respectively. Additional improvements include a fourth track between Washington and Baltimore, signal modernization, and capacity enhancements north of Baltimore. Station upgrades are also advancing, including a $36 million platform addition at New Carrollton and a $600 million platform and track expansion at BWI Marshall rail station.

The MARC Growth and Transformation Plan identifies a baseline capital need of over $7 billion to maintain current service levels through 2050, with an additional $500 million required for service expansion in the next five years. Current funding projections reveal an approximate $2.5 billion gap for baseline services between FY2026 and FY2050. Beyond this, expanding and transforming MARC service to improve access, frequency, and reliability will require roughly double the baseline investment. Achieving these goals will demand significant additional resources beyond current funding commitments.

Operation and Maintenance

Maryland's rail system faces ongoing operational and maintenance challenges, driven by the competing demands of freight and passenger services.

Freight rail in Maryland continues to face service challenges. Delays and operational issues can affect transit times, reduce service reliability, and increase costs for businesses that depend on rail shipping. These challenges underscore the need for infrastructure investment, improved coordination between freight and passenger operations, and enhanced network resiliency to support Maryland's freight-dependent industries and regional economic activity.

In FY2024, Amtrak reported the following 80.4% customer on-time performance (C-OTP) for the Northeast Regional and 77.8% C-OTP for Acela. These figures reflect the likelihood of customers traveling on a given route arriving at their destinations on time. Aging infrastructure, limited track capacity and congested corridors through Baltimore and Washington, D.C., can reduce on-time performance. In addition to Amtrak services, Maryland's MARC commuter rail system plays a crucial role in regional transportation. In November 2024, MARC's Camden Line achieved a record high on-time performance of 96%, while the Penn Line and Brunswick Line reported on-time performances of 92% and nearly 97%, respectively. These figures indicate a strong commitment to maintaining reliable service for Maryland commuters.

Maintenance capacity is critical to sustaining safe and reliable rail service in Maryland. Amtrak has invested heavily in Northeast Corridor infrastructure, including $240 million in upgrades in 2024 that directly benefit Maryland routes. These improvements include track and signal modernization, bridge and tunnel repairs, and enhanced safety systems. Federal funding from the IIJA supports expansion of maintenance facilities and workforce development programs, including the Mechanical Craft Workforce Development Apprenticeship. Amtrak's ongoing hiring initiatives, which filled more than 4,800 positions in FY2023, ensure sufficient staffing to maintain the system, while training programs provide employees with the skills needed to operate and maintain increasingly complex infrastructure.

2025 Grade: B-

Looking ahead, Maryland's rail operations will rely on continued investments in infrastructure modernization, workforce development, and operational coordination. By addressing these challenges, Maryland can improve service reliability, reduce delays, and ensure the safety and resilience of both passenger and freight rail systems.

Public Safety, Resilience and Innovation

Ensuring the safety, reliability, and resilience of Maryland's rail network is a critical priority for both freight and passenger operations. Maryland's rail system faces a range of challenges, from accidents and operational hazards to vulnerabilities posed by extreme weather and aging infrastructure. In response, Maryland rail operators have pursued a combination of safety initiatives, legislative proposals, infrastructure upgrades, and innovative project delivery methods to enhance public safety, reduce risks, and improve operational efficiency.

Since 2016, Maryland has experienced over 1,200 reportable rail accidents and incidents, according to Federal Railroad Administration data. These events, including derailments and collisions, have resulted in more than $21 million in total damages. While many incidents involved freight rail, some affected passenger services and public safety, underscoring the need for continued investment in rail infrastructure and safety systems. Key events include two on duty conductor fatalities in 2023, a deadly all-terrain-vehicle collision with an Amtrak train in 2024, and multiple train-vehicle crashes that caused injuries and service disruptions. While most derailments resulted in no injuries, these incidents highlight ongoing safety challenges on Maryland's rail network and the importance of continued infrastructure and safety improvements.

Maryland is actively enhancing rail public safety and resiliency through federal funding, state programs, and legislative action. In 2024, $800,000 in federal funds was allocated to reduce railroad trespassing injuries and fatalities. Although Maryland legislators recently proposed the Maryland Railway Safety Act of 2025 which would have included comprehensive safety measures for rail operations, including crew size requirements, restrictions on blocking highway-rail grade crossings, train length limitations, installation of wayside detectors, and provisions for labor union investigations, it did not advance past the committee stage and did not become law.

Maryland faces significant concerns regarding railroad infrastructure vulnerability to flooding and extreme weather events. It has experienced severe flooding incidents, such as the flash floods in western Maryland in May 2025, which caused widespread damage to infrastructure, including railroads, leading to widespread delays to freight and passenger trains. Additionally, MDOT has identified climate-related risks, including flooding and extreme temperatures, as significant threats to the state's transportation infrastructure. MDOT's Transportation Resilience Improvement Plan emphasizes the need to address these vulnerabilities to ensure the reliability and safety of the transportation system.

CSX's $40 million Cumberland Yard Modernization project incorporated several safety enhancements to protect rail workers and improve operational efficiency. Key improvements included removing the outdated hump and hump tower to reduce high-risk switching operations, reconfiguring tracks for flat switching to minimize worker exposure to moving cars, adding modern signaling and control systems, and improving yard lighting and sightlines to enhance visibility. Together, these upgrades significantly lower the risk of accidents while allowing the yard to handle higher volumes safely.

Alternative project delivery methods are increasingly recognized in Maryland as effective strategies to reduce the schedule and cost of freight infrastructure projects. These methods integrate design and construction phases, allowing for earlier identification and resolution of potential issues, which can lead to significant time and cost savings. For example, the Howard Street Tunnel project in Baltimore used a progressive design-build approach. This method allowed the design and construction teams to collaborate from the early stages, fostering innovation, flexibility, and problem-solving while keeping the project on schedule and within budget; the project finished ahead of schedule.

2025 Grade: B-

After considering the available information, rail infrastructure in Maryland is assigned a grade of B–

Recommendations to Raise the Grade

To meet current and future demands of rail infrastructure, Maryland should:

- Establish a dedicated and sustainable funding source specifically for rail infrastructure maintenance and expansion. Maryland should aim to meet or exceed the $91 million annual investment identified in MDOT's Asset Management Plan by leveraging state appropriations, federal grants, and public-private partnerships.
- Prioritize the completion of major projects, such as the Frederick Douglass Tunnel Program, Susquehanna River Bridge upgrade, and other key chokepoint eliminations to enhance capacity, reliability, and safety along the Northeast Corridor and statewide freight lines.
- Continue planned upgrades and expansions of Baltimore Penn Station and the BWI Marshall rail station, which are critical hubs for MARC and Amtrak operations, ensuring improved passenger experience and operational efficiency.
- Identify and allocate dedicated funding to support both baseline maintenance needs and the long-term expansion of MARC commuter rail service.
- Invest in community outreach, trespass prevention, and infrastructure upgrades at grade crossings to reduce fatalities and injuries, complemented by enforcement efforts and safety education initiatives.
- Develop targeted grant and financing programs to help short line freight railroads rehabilitate track and equipment to modern standards, thereby supporting economic growth in rural and industrial regions.
- Evaluate and adopt alternative project delivery methods that reduce costs, shorten implementation timelines, and mitigate risks.

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ROADS

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: C-

2020 Maryland: C 2025 National: D+

Executive Summary

Maryland's 30,000-mile road network supports the state's economy by efficiently moving people and goods. Managed by Maryland Department of Transportation's (MDOT's) State Highway Administration, traffic volumes remain below pre-pandemic levels, yet congestion and associated costs have increased. While the highway system is generally in good condition, deterioration is expected to accelerate despite strong maintenance efforts. Roadway fatalities have risen slightly, with bicycle and pedestrian deaths and injuries increasing more sharply, costing an estimated $32.5 billion in 2024. Highway funding comes from the Transportation Trust Fund, the state General Fund, and federal grants, but inflation and rising costs have reduced purchasing power. The backlog of unfunded state-of-good-repair projects grew from $2.2 billion in FY2023 to $3.8 billion in FY2024. Through the Transportation Resilience Improvement Plan, MDOT is identifying and mitigating threats to the network and implementing new technologies and practices to maintain performance in a budget-constrained environment.

Introduction

Traversing Maryland are 29,579 miles of public roads, including 480 miles of the Interstate Highway System and a network of local, urban, and other freeways and expressways. Maryland's road network comprises approximately 58% urban roads and 42% rural roads. The Maryland Department of Transportation's (MDOT) State Highway Administration (SHA) manages the state's network.

Roads support Maryland's economy in myriad ways, including getting people to and from employment, providing the means for raw materials and finished products to move between production and retail sites, and allowing residents to access recreation and social sites. When the road system is in good repair, motorists can move freely and enjoy the benefits of economical transport. When roads are crowded or in poor repair, motorists incur inflated costs as they drive. Roads that are deteriorated, congested, and lack some desirable safety features cost Maryland drivers a total of $12 billion each year, or about $3,500 per driver.

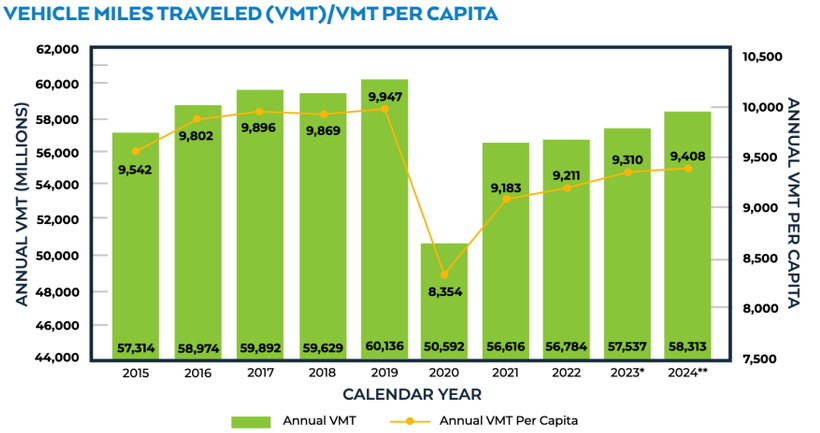

Figure 1. Vehicle miles traveled (VMT) and VMT per capita
Source: MDOT 2025 Attainment Report

Past analyses of road transportation statistics have focused on multi-year trends to show how the highway system has changed over time. The COVID-19 pandemic and the resulting, precipitous decline in traffic volume interrupted nearly all commonly cited trend measures. Foremost among these is the number of Vehicle Miles Traveled (VMT). The 2025 MDOT Attainment Repot shows this decline in Figure 1. Although VMT has rebounded somewhat in the subsequent years, the volume of travel has still not returned to pre-pandemic levels. The interruption of trends is mirrored in many other statistics, including the number of fatalities and serious injuries on the roads, the number of person hours of delay, the number of truck hours of delay, the cost of congestion, and others. This interruption makes it difficult to compare pre-pandemic statistics to those from the years after 2020.

Capacity and Condition

The capacity of a highway to move vehicles is crucial for efficient transportation. Reduced capacity slows traffic flow, lengthens travel times, increases fuel consumption, and creates increased safety risks.

As noted previously, VMT declined sharply (by almost 16%) in 2020, as did the number of person hours of delay from congestion (by over 40%).

> Person hours of delay means the daily person hours of delay per mile during peak travel period.

These measures rebounded somewhat following 2020 but have yet to return to their pre-pandemic levels. VMT for 2024 is still roughly 3% lower than 2019 levels. Despite reduced VMT and delay, the cost of congestion is higher in the post-pandemic years, primarily due to rising inflation.

The 2023 Maryland State Highway Mobility Report shows that congestion is increasing. On both the freeway system and the arterial system and for both the AM and PM commute periods, the number of miles subject to heavy or severe congestion increased substantially (by 5% for AM peak and 3% for PM peak) between 2021 and 2022.

While the number of delay hours and the travel time reliability for personal travel have remained relatively stable over the past three years (Figure 2), the number of truck delay hours has increased. The cost of congestion (for all users) for FY2024 was higher than the pre-pandemic levels ($5.1 billion in 2019 versus $5.5 billion in 2024). From 2021 to 2022, the cost due to congestion experienced by freight operations increased by approximately 17%.

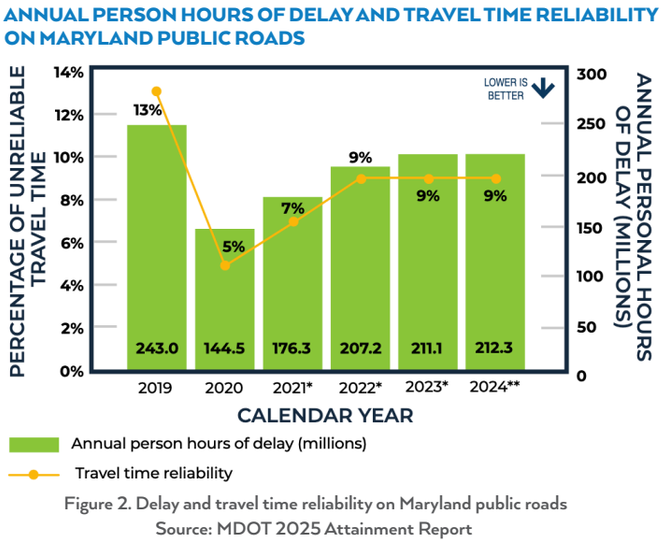

Figure 2. Delay and travel time reliability on Maryland public roads
Source: MDOT 2025 Attainment Report

MDOT is attempting to mitigate congestion and delays through software, sensors, traffic cameras, and message signs. The SHA also reviews the signal timing and operations on select corridors each year. These review efforts reduced delays by over 650,000 hours (roughly 13%) from 2021 to 2022, which saved users some $30.2 million annually.

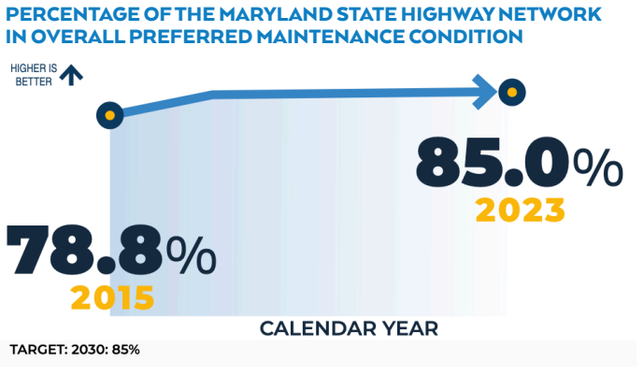

Figure 3. Percentage of MDSHA network in overall preferred maintenance condition over time. Source: MDOT 2025 Attainment Report

A roadway's surface condition has many ramifications for the traveling public. Good road conditions are crucial for safety, economic activity, and quality of life. Overall, Maryland's highway system is in good condition, but it is showing signs of deterioration. The percentage of the network that is in MDOT's Preferred Maintenance Condition remained steady at 85% from 2023 to 2024 and has been stable for the past ten years (Figure 3). Although the percentage of pavement in the network that is in Acceptable condition is 91% for 2024, MDOT forecasters expect this figure to decline to 82% after 2027. Of the total network, 49% of major roads are in poor or mediocre condition, but the percentage in poor condition is expected to double due to potential budget shortfalls.

2025 Grade: C-

Operation and Maintenance

Operation and maintenance (O&M) activities are essential for ensuring a reliably safe, efficient, and cost-effective transportation system. The American Association of State Highway and Transportation Officials Committee on Transportation System Operations shared this definition of operations, "transportation operations are the intentional strategies, tools, and real-time actions needed for the system to serve all road users safely and reliably." SHA defines maintenance as "removing highway litter, mowing grass that blocks highway visibility, cleaning roads and preventing water from overflowing ditches, keeping our fleet in good repair and responding forcefully to winter weather." Effective O&M helps prevent crashes, reduces traffic congestion, and minimizes the overall cost of road upkeep by addressing issues before they escalate.

Year	Percent of Network Resurfaced	Percent of Network to which Preventive Maintenance Applied
2021	4.7	10.0
2022	3.8	2.6
2023	5.1	10.2

Table 1. Operations and maintenance results by year

MDOT addresses O&M through its Transportation Systems Management and Operations (TSMO) program. The program uses an integrated approach to optimize planning, engineering, and O&M. SHA's O&M efforts have achieved good results, as show in Table 1.

While these efforts are good and the percentage of pavement in acceptable condition has remained relatively stable (92% in 2015 to 91% in 2023), the latter is expected to fall to 82% after 2027. The current Remaining Service Life is expected to decrease from 17 years currently to 15 years after 2027. The percentage of pavements in Poor condition is expected to double in coming years, making the cost of restoring the pavement to a state of good repair more expensive. These declines are due to expected budget shortfalls.

In 2023, MDOT's operating needs were approximately 45% of its total needs. In 2024, MDOT reported the percentage of projects delivered on time was 31% and the percentage of projects delivered on budget was 77%.

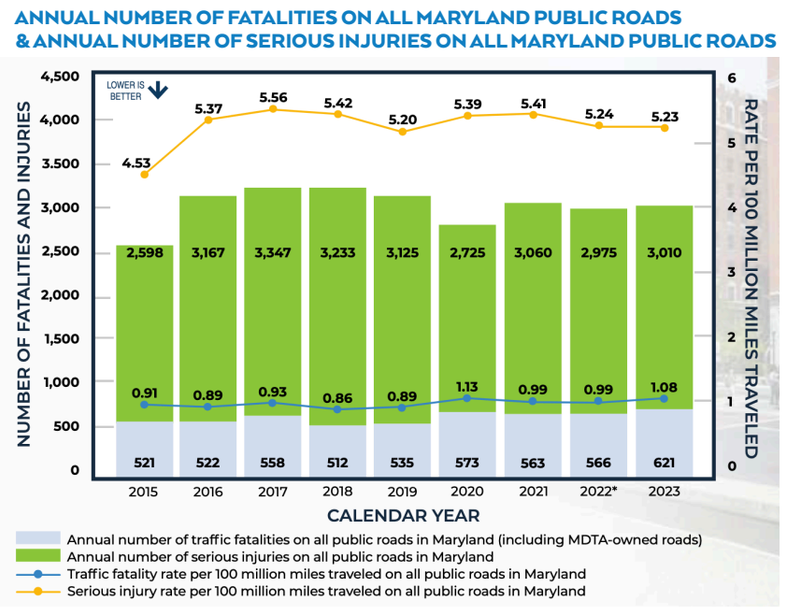

Figure 4. Fatalities and serious injuries on Maryland public roads by year
Source: MDOT 2025 Attainment Report

Public Safety

When roads are safe, road users (especially pedestrians and cyclists) are protected, crashes (as well as injuries and fatalities) are reduced, road users feel more confident and comfortable using the roads, and economic activity is enhanced.

2025 Grade: C-

In Maryland, the rate of roadway fatalities has risen slightly in recent years while the rate of injuries has remained relatively stable, as shown in Figure 4. The former trend may be shifting according to a TRIP report from July 2025 which shows that the Maryland fatality rate for 2024 was 1.02 with total fatalities of 579. While Maryland's traffic fatality rate is lower than the national average of 1.20 (for 2024), it is much higher than the state's target of 0.647.

The number of bicycle and pedestrian fatalities and serious injuries rose sharply in 2023, as shown in Figure 5.

Traffic crashes cost money as well as lives. A recent TRIP report estimates that crashes cost Marylanders $32.5 billion in 2024. This total comprises $8.1 billion in economic costs and $24.4 billion in quality-of-life costs.

Maryland has a strong public safety plan and program. As part of the program this year, MDOT will update its 2021-2026 Strategic Highway Safety Plan (SHSP) and its Triennial Highway Safety Plan. The SHSP incorporates and tracks five safety performance measures from the FHWA and shows that MDOT is far from meeting those targets.

ANNUAL NUMBER OF BICYCLE AND PEDESTRIAN FATALITIES AND SERIOUS INJURIES ON ALL MARYLAND PUBLIC ROADS

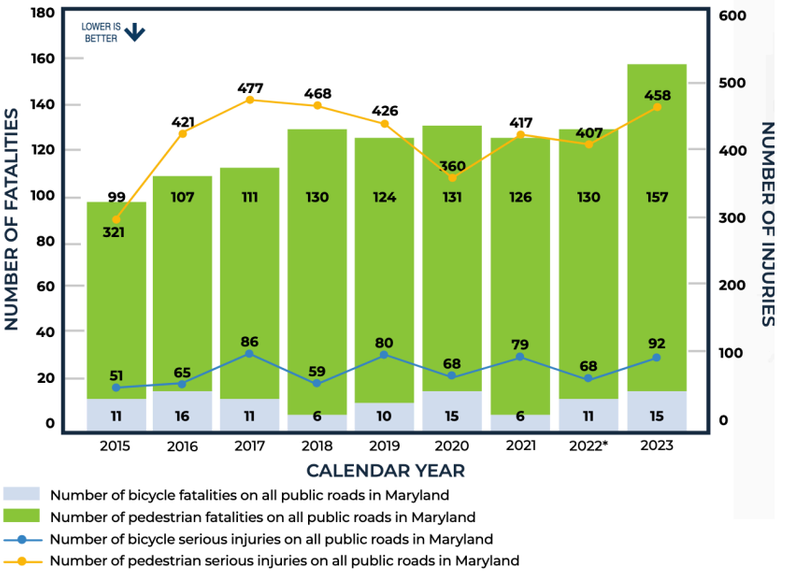

Figure 5. Bicycle and pedestrian fatalities and serious injuries on Maryland public roads by year
Source: MDOT 2025 Attainment Report

Maryland addresses highway safety through several programs and efforts. MDOT has established a Vision Zero program with the goal of achieving zero roadway deaths and serious injuries. This program uses a multidisciplinary approach to preventing crashes and reducing their severity. It includes strategies that address roadway design, driving behaviors, technology, and policies. Despite this and other programs, in 2023 almost 10% of Maryland drivers remain unrestrained and almost half of those killed in crashes were not wearing seat belts. In 2023, Governor Wes Moore allocated more than $11.5 million in safety grants to organizations with the aim of preventing crashes and eliminating fatalities. Maryland also promotes a Complete Streets program intended to improve bicycle and pedestrian safety by upgrading facilities, starting with improvements in three urban corridors in Baltimore City and Washington, DC, suburbs. In its 2050 Maryland Transportation Plan, MDOT reports it will work to meet its future safety targets by addressing six safety emphasis areas (distracted driving, impaired driving, speed and aggressive driving, infrastructure, occupant protection, pedestrians and bicyclists) and developing action plans for each area.

Funding

Funding enables construction, O&M, repairs, and upgrades to roadway facilities. Without adequate funding, roads and their support structures deteriorate, and crashes and congestion increase.

Maryland funds its highway operations mainly through the Transportation Trust Fund (TTF), which receives revenue from motor fuel taxes, vehicle titling taxes, tolls, and motor vehicle fees. The current tax rate is 46.1 cents per gallon for gasoline and 46.85

cents per gallon for diesel. This rate was tied to the Consumer Price Index in 2013. The national average rates are 52.64 cents per gallon for gasoline and 60.29 cents for diesel. Maryland also contributes funding to transportation through the General Fund. Additional funding comes from federal grants and programs, such as the Federal-Aid Highway Program and initiatives supported by the Infrastructure Investment and Jobs Act (IIJA) and Inflation Reduction Act (IRA). The IIJA was expected to provide $4.7 billion to Maryland for highway and bridge investments in formula funding alone over five years, including a 42% increase in funding for the first three years – fiscal year (FY) 2022 to FY2024. As of April 2025, a total of $63.5 million in IIJA funds had been awarded to the SHA for highway and bridge projects, with another $8.3 million in pending awards.

Maryland presents and reports on highway funding in the Consolidated Transportation Program (CTP). While the six-year rolling average budget level for the past two periods (2023-2028 and 2024-2029) shows significant increases over previous levels, the inflation-adjusted budget levels for these years show a steady decline in purchasing power.

MDOT reports that it is facing continuing budget challenges because of increasing materials and labor costs, high inflation, changing (mostly reduced) commute and personal travel behavior, and the reduced revenue generated by the fuel tax. Fuel tax revenues have been decreasing in recent years due to reduced vehicle travel, increased fuel efficiency, and increased use of electric or other, alternate-fuel transport. A bill to change the fuel tax formula to a mileage-based one and revise some user fees was introduced in the 2025 Maryland General Assembly session. The bill was not passed.

Recognizing the importance of transportation, Maryland's current administration has approved a supplement from the General Fund to the TTF of $420 million annually, beginning in FY2026. Without additional funding, Maryland would lose $900 million in federal funding because it would not be able to supply the state match needed. Overall, for the 2025-2030 budget level, Maryland expects to receive 37% of the Consolidated Transportation Program funding from federal sources, a drop from the previous year. Federal support for transportation is still estimated to furnish $8.6 billion for operating and capital projects.

The transportation budget is not keeping up with Maryland's needs. Money to address the state of good repair backlog has been limited, so the number of projects aimed at improving the road network has decreased. MDOT's budget sustained a major impact with the unplanned need to replace the Francis Scott Key Bridge in Baltimore, although it appears that a major portion of that cost will be covered by federal funds. Because of budget constraints, MDOT modal administrations have reduced their operating budgets by 8%. Combined funding from state and federal sources for the 2024-2029 period amounts to $38.6 billion, which does not fully fund the mounting investment needs required to adequately maintain Maryland's transportation system. Maryland's backlog of state of good repair projects had unfunded projects totaling $2.2 billion in FY2023 increasing to $3.8 billion in FY2024. Specifically, the TTF expects a $1.3 billion shortfall over the next six years.

As part of its plan to address budget shortfalls, Maryland established the Commission on Transportation Revenue and Infrastructure Needs (TRAIN) in 2023. The Commission reviews, evaluates, and makes recommendations on the prioritization and funding of transportation projects. In its interim report issued in January 2024, the commission made recommendations regarding the motor fuels tax, tolls, and the CTP. These recommendations include having the Maryland General Assembly consider options to collect additional revenue, having the Motor Vehicle Administration explore different fees, adjusting toll rates, developing a new project prioritization process with expanded performance metrics, and standardizing the local (county) prioritization process.

Future Need

The road system is not static. Road conditions change and the demand for highway connections changes as population levels

and economic activity increase or decrease. Patterns of freight movement change and adjust to new commercial and industrial development. Meanwhile, technological advancements such as electric and autonomous vehicles and smart roads change how people use their vehicles. These factors and others mean that road operating agencies must plan and prepare for the future.

Maryland examines and anticipates future needs in part through the Maryland Transportation Plan, which is its blueprint for future growth of the transportation network. It uses the principles of equity, resilience, preservation, modernization, and experience to guide decision making and establishes a set of goals (enhance safety and security, promote environmental stewardship, deliver system quality, and serve communities and support the economy) to measure achievement.

MDOT also addresses future needs in each section of the annual Attainment Report. The Attainment Report examines MDOT's work through a set of performance measures. Each performance measure discussion includes a future strategies section that presents ways in which MDOT is currently addressing the issues as well as how to address them in the future. MDOT is updating its Strategic Asset Management Plan to identify strategic goals and key needs and develop plans to address them. SHA plans to invest in a new asset management system that will track individual asset performance at a more granular level, which will enable SHA to allocate funding based on a pragmatic/individual asset approach.

Resilience

The highway system must be designed and built so that it can quickly resume operations in the event of extreme weather or other disruptions. In these situations, roads must be able to maintain (or resume) connections, enable economic activity, and ensure public safety. Designing and building for resilience also protects the original capital investment made in the network by strengthening or protecting individual components, making them less likely to be damaged or destroyed.

MDOT created and released its Transportation Resilience Improvement Plan in 2024. This plan defines MDOT's resilience objectives and guides investments in critical infrastructure. The plan identifies several threats to the transportation system. It uses this identification to rate the potential for disruption and develop mitigation strategies. The highway system might be impacted by hazards, such as rising sea levels, floods, soil movement, fires, winter storms, and traffic crashes as captured in Table 2.

Natural Hazards	
Coastal hazards	Thunderstorms
Dam failures	Tornadoes
Drought	Wildfires
Extreme temperatures	Wind
Floods	Winter storms
Soil movement	Public health emergencies
Human-caused Hazards	
Terrorism	Civil unrest
Active shooters	Cyberattacks
Nuclear incidents	Transportation accidents

Table 2. Types of hazards affecting road infrastructure
Source: Maryland Emergency Management Agency, 2021.

MDOT addresses resilience and incorporates resilience planning in several documents. Most directly, MDOT produces the Transportation Resilience Improvement Plan, which identifies risks to the transportation system, incorporates resilience into the planning phase of project development, and makes recommendations for resilience investments. Resilience is also addressed in the 2050 Maryland Transportation Plan as one of its guiding principles and the annual MDOT Attainment Report. MDOT tracks and evaluates factors impacting the recovery of operations after an event.

The Attainment Report collects information and evaluates resiliency performance measures. The performance measure Average Time to Restore Normal Operations After a Weather Event for the 2023-2024 winter season improved by 46% over the

previous season to 2.51 hours. The Attainment Report explains that, "Both an increase in resource use (salt/brine) and below average snowfall accumulations contributed to a reduction in the time required to achieve bare pavement statewide." The time to respond to a crash remained constant in 2023 at 12 minutes, while the average time to clear a crash decreased slightly. The performance measure Percentage of Lane-Miles/Fixed Guideway Transit-Miles Subject to Flooding and Storm Surge was 11% in 2023 and 2024. This measure was evaluated as "facing challenges."

MDOT has established an inventory of assets susceptible to flooding and storm surge to manage and monitor the prospective risks and take proactive actions to mitigate hazards. SHA developed a statewide coastal vulnerability ArcGIS Online viewer which enables consideration of risk into all aspects of planning, programming, and project development. It conducts assessments of its infrastructure and tries to identify mitigation measures to improve resiliency. MDOT has created a Resiliency Task Force to support its ongoing resiliency improvement program.

Innovation

Operating agencies for roads, like the SHA, are constantly looking for ways to accomplish their functions more efficiently. As new technologies, materials, and design approaches emerge, road agencies must take advantage of them to enhance safety, improve efficiency, and increase sustainability.

SHA is developing and implementing an enhanced asset management system to more effectively inventory and manage its assets. The system will track each asset's performance at a detailed level and allocate funding based on specific information for each asset.

SHA is also implementing numerous new technologies and processes. It is expanding the use of rubber plow blades to improve snow clearance and reduce salt usage. It has installed intelligent transportation systems technology on one highway as part of an Innovative Technology Corridor Project. MDOT is evaluating a new prioritization process to more effectively direct funding to projects. These and other technologies and processes are intended to improve operations and make effective use of funding.

As the number of electric vehicles (EV) on the road increases, Maryland is building out EV charging infrastructure to support this transition. As of October 2025, there were over 1,700 chargers with over 5,300 publicly available Level 2 and DC Fast Charging ports in the state. This build out is supported in part by the investment of $63 million over five years through the National Electric Vehicle Infrastructure (NEVI) program as a part of the IIJA. Continued expansion of public charging infrastructure is essential to ensure EV drivers can travel the state's roads with the same convenience and confidence as drivers of gasoline-powered vehicles.

After considering the available information, roads infrastructure in Maryland is assigned a grade of C-

Recommendations to Raise the Grade

While capacity and condition have suffered and safety metrics have declined, O&M is strong, and Maryland has a robust program to address future needs and resilience. Funding remains a looming concern. To meet current and future demands of road infrastructure, Maryland should:

- Increase emphasis on and funding for the Vision Zero program and other safety initiatives.
- Maximize applications for grants for general and specific projects under the IIJA, the IRA, and other federal programs to free up state funds for state of good repair projects.
- Ensure sufficient state matching funds to qualify for federal loans and grants.
- Work with the Maryland General Assembly to change the Transportation Trust Fund formula for highway funding to move away from the current fuel tax toward a formula that generates revenue from Vehicle Miles Traveled.
- Increase the use of traditional and non-traditional practices to extend the service life of road pavements.
- Continue to expand the network of electric vehicle charging stations to meet the rapidly growing use of this type of vehicle.

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2025 Grade: C-

SOLID WASTE

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: B

2020 Maryland: B- 2025 National: C+

Executive Summary

Maryland's solid waste infrastructure remains robust yet faces emerging challenges that demand strategic action. In 2023, Maryland generated over 12 million tons of solid waste, with nearly 30% exported, primarily via a single rail corridor, creating a critical vulnerability. While landfill capacity has increased significantly, aging infrastructure and climate risks, particularly in coastal areas, underscore the need for resilience planning. Maryland achieved a 40% waste diversion rate and 36% recycling rate, surpassing national averages, and advanced sustainability through food waste diversion legislation and removal of trash incineration from the Renewable Portfolio Standard. Investments in modernization, per- and polyfluoroalkyl substances mitigation, and recycling infrastructure, supported by state and federal funding, reflect strong policy momentum. Future success hinges on expanding transportation redundancy, conducting climate risk assessments, and fostering innovation in recycling markets and Zero Waste strategies. With coordinated planning and targeted investment, Maryland can strengthen its leadership in sustainable waste management.

Capacity and Condition

Landfills in Maryland are owned by various entities, including local county governments, such as Prince George's County and Anne Arundel County, and private companies like Waste Management, Inc. Ownership varies by facility – some are municipally owned and operated and others are privately owned and managed. Facilities are permitted by the Maryland Department of the Environment (MDE).

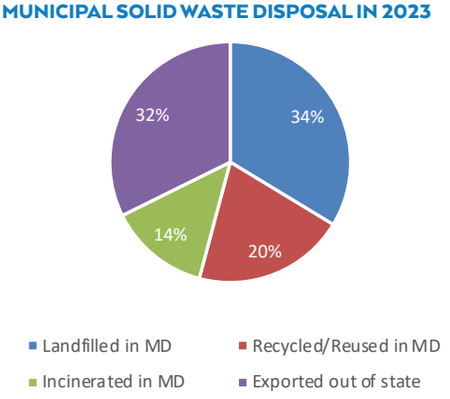

Figure 1. Maryland municipal solid waste disposal in 2023
Source: MDE

In 2023, Maryland generated over 12 million tons of solid waste comprising municipal solid waste (also known as Class II waste) and industrial waste from non-private, industrial waste facilities (also known as Class I waste). The quantity is a slight increase from previous years – approximately 13% in five years or averaging almost 4% each year – and represents 6.28 lbs of waste generated per person per day. Of this, approximately 31% is landfilled in Maryland, 19% is recycled in Maryland, 12.5% is incinerated in Maryland, and nearly 30% was exported to out of state facilities – primarily in Virginia. See Figure 1 for a distribution of the subset municipal solid waste disposal. See Figure 2 for a history of Maryland's solid waste production and export.

Rail remains the dominant method of waste export, whereby nearly 77% of outbound waste is transported via a single corridor. While this system has proven efficient, it also exposes Maryland to significant risk if disruptions occur. Maryland's reliance on one rail line underscores the need for redundancy and alternative infrastructure to ensure long-term resilience.

Maryland's solid waste infrastructure includes 81 permitted facilities, ranging from municipal landfills to industrial and construction debris sites. These facilities are regulated by MDE, which enforces design, operation, and reporting standards. Many of Maryland's landfills have service lives exceeding 100 years, but aging infrastructure and climate-related vulnerabilities, particularly in coastal regions, highlight the need for updated engineering standards and proactive maintenance.

SOLID WASTE

Maryland has 25 municipal solid waste landfills with about 69 million tons of capacity. In 2023, roughly 2 million tons were disposed, leaving about 34 years of capacity at the current rate. This represents a 40% increase from capacity in 2022, primarily due to the expansion of the Brown Station Road Area C facility, which was permitted with 30 million cubic yards of capacity. There are four industrial landfills in Maryland with about 8 million tons of capacity. Based on the approximately 73,000 tons disposed in 2023, capacity would last over 100 years. Maryland has six construction and demolition landfills that have about 10 million tons of capacity. Given that about 836,000 tons were disposed in 2023, about 12 years of capacity remain. These projections don't account for future population growth, waste generation changes, or facility closures/ openings. Table 1 summarizes Maryland's solid waste facilities by type and age.

SOLID WASTE (MILLION TONS) PRODUCED IN AND EXPORTED FROM MARYLAND BY YEAR

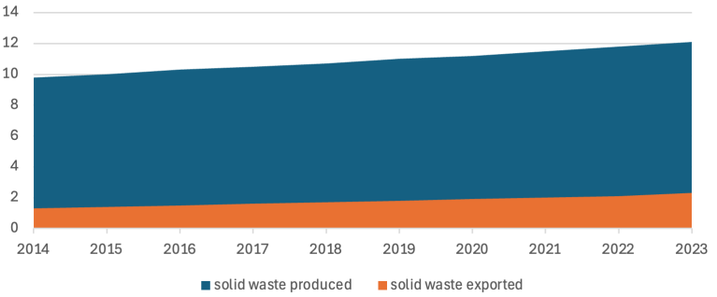

Figure 2. Solid waste produced in and exported from Maryland by year

Maryland has 13 material recovery facilities (MRF), and three additional out-of-state MRFs (one each in Delaware, Virginia, and Pennsylvania) accept recyclable materials from Maryland. Most facilities were built over 15 years ago for dual-stream processing and have since been retrofitted for single-stream operations. Most facilities plan to upgrade or replace equipment and possibly add new processing lines within three years..

Operation and Maintenance

The condition of Maryland's solid waste facilities is generally stable, with ongoing investments in modernization and environmental protection. Anne Arundel County's fiscal year 2026 budget, for example, allocates $515,000 for solid waste infrastructure upgrades, including per- and polyfluoroalkyl substances (PFAS) mitigation and landfill renovations. Baltimore City's 2024 Solid Waste Management Plan outlines a comprehensive 10-year strategy focused on operational improvements, climate adaptation, and community engagement. These efforts reflect a growing recognition of the need to align solid waste infrastructure with broader sustainability and resilience goals.

QUANTITY, AVERAGE AGE AND ESTIMATED CAPACITY OF SOLID WASTE FACILITIES

Landfill Type	No. of Landfills	Estimated Total Capacity
Municipal Solid Waste	25	~34 years
Industrial Landfills	4	100+ years
Construction and Demolition Landfills	6	~12 years

Table 1. Quantity, average age, and estimated capacity in years of Maryland's solid waste facilities

Maryland has established clear regulations to manage landfill leachate and ensure long-term environmental protection. Municipal, rubble, and industrial landfills must be constructed with liners and leachate collection systems designed to prevent contamination of surrounding soil and groundwater. These systems typically include perforated pipes, sumps, and pumps installed over composite liners. Collected leachate is either pretreated on-site or transported to a publicly owned treatment facility for additional treatment. In 2024, MDE issued new guidance for sampling and testing landfill leachate for PFAS in wastewater, reflecting on and addressing growing concerns over emerging contaminants.

2025 Grade: B

Maryland also sets requirements for landfill closure and post-closure care. Once a landfill stops receiving waste, closure activities must begin within 24 months of the final lift and be completed within 36 months, unless extended by MDE. After capping, facilities are subject to at least five years of post-closure monitoring and maintenance, with extensions possible at the discretion of MDE. Monitoring responsibilities include regular inspections of cover integrity, drainage systems, leachate collection, and groundwater wells to ensure continued protection of public health and the environment.

Funding and Future Need

Funding for solid waste programs in Maryland is derived from tipping fees, enterprise funds, and revenues from recycled commodities. Tipping fees range from under $25 per ton in Montgomery, Baltimore, and Harford Counties to over $100 per ton in Carroll, Howard, St. Mary's, and Cecil Counties. Maryland's tipping fees remain above the national average and provide a stable source of revenue for facility operations and upgrades. Recent legislative efforts, such as the Solid Waste Disposal Surcharge and Wasted Food Reduction Fund (HB 42/SB 134), propose up to $14 million annually for food waste diversion infrastructure. Although the final funding levels remain discretionary, the legislation signals a strong commitment to reducing organic waste and supporting composting initiatives. Additionally, Maryland received $4 million in Environmental Protection Agency grants to enhance recycling infrastructure and organics management, bolstering its capacity to meet future needs.

Equipment upgrades are needed across municipal recycling facilities, with some relying on outdated systems from defunct vendors. Recommended upgrades include advanced sorting technologies like artificial intelligence, optical sorters, and magnets, which improve efficiency and material recovery. Estimated costs for these upgrades range from $9.2 million to $10.3 million, potentially adding up to 190 tons per year of recycling capacity. Two new MRFs are also planned, with projected investments of $77–87 million.

Public Safety, Innovation, and Resilience

Public safety remains a cornerstone of Maryland's solid waste strategy. Maryland's permitting system ensures environmentally sound disposal practices that protect surface and groundwater resources. In a significant policy shift, Maryland removed trash incineration from its Renewable Portfolio Standard in 2025, ending subsidies for these facilities and redirecting funds toward alternatives. This move aligns with broader public health and environmental justice goals, particularly in communities historically impacted by incineration.

Maryland's Recycling Act of 1988 requires counties with over 150,000 residents to recycle at least 35% of municipal solid waste and smaller counties to recycle 15%. State government is required to recycle at least 20% of its own waste. Building on this foundation, Maryland has advanced a series of policies to promote sustainable materials management.

In 2017, Executive Order 01.01.2017.13 established Maryland's first sustainable materials management policy. The Order seeks to minimize environmental impacts across the full lifecycle of materials, emphasizes resource recovery and reuse, and calls for ambitious goals supported by comprehensive data tracking. It also encourages partnerships across state agencies, industries, and environmental groups, while directing state agencies to provide technical support and demonstrate innovative recycling technologies. A 2019 report outlined strategies to implement the Order, recommending voluntary statewide goals for 2035, such as reducing per capita waste by 10%, cutting greenhouse gas emissions from materials management, and achieving material-

specific recycling targets (e.g., 60% for food scraps, 75% for metals). The plan calls for improved business waste diversion reporting, updates to the source reduction credit system, and new initiatives like materials exchanges to foster reuse. Together, these efforts mark a shift toward lifecycle-based sustainable materials management in Maryland.

In May 2025, SB 901 was signed into law, making Maryland the sixth state with an Extended Producer Responsibility (EPR) program. This law shifts the financial and management responsibility for post-consumer packaging and paper products from consumers and local governments to producers. Producers will pay fees to a third party, which then funds the collection, recycling, and composting of these materials. The law gradually phases in greater cost for producers – 50% of costs by July 2028, 75% by 2029, and 90% by 2030.

Innovation continues to play a vital role in Maryland's solid waste strategy. The 2025 Statewide Recycling Needs Assessment identified opportunities to expand access to recycling programs, develop end markets for recycled materials, and promote participation by minority- and women-owned businesses. Pilot programs in Baltimore and Montgomery County are exploring school-based food waste minimization toolkits, fostering education and community engagement. These initiatives reflect a broader shift toward Zero Waste infrastructure, emphasizing reuse, composting, and sustainable materials management.

Despite these advances, Maryland's solid waste infrastructure faces growing challenges related to climate resilience. The primary environmental risks to solid waste infrastructure in Maryland are from coastal storms and inland flooding. Landfills in coastal or low-lying areas face erosion, liner system damage, and leachate release during severe storms or hurricanes. MDE has not yet conducted a comprehensive sea-level rise risk assessment and mitigation plan for solid waste facilities, leaving coastal infrastructure vulnerable to flooding and storm surge. Baltimore City's Solid Waste Management Plan highlights the need for climate adaptation measures including stormwater controls, slope stabilization, and leachate system resilience. Hotter summers also increase odors, leachate generation, and methane emissions, requiring stronger controls and monitoring. MDE's recycling needs assessment calls out the need for resilient infrastructure investment. Integrating climate forecasting tools from the Maryland Department of Transportation into MDE's planning processes would help address these risks and ensure long-term viability.

In addition, Maryland's dependence on a single rail corridor for waste exports poses a critical vulnerability, underscoring the need for investment in alternative routes and intermodal infrastructure.

2025 Grade: B

After considering the available information, solid waste infrastructure in Maryland is assigned a grade of B

Recommendations to Raise the Grade

To meet current and future demands of solid waste infrastructure, Maryland should:

- Fund and implement climate risk assessments for vulnerable facilities, particularly in coastal zones, to enhance resilience.
- Sustain support for food waste diversion programs, modernization of facility design standards, and development of regional recycling plans to optimize resources.
- Strengthen recycling mandates under the Maryland Recycling Act and enforce municipal compliance to improve diversion rates.
- Foster innovation through public-private partnerships and market development for recycled materials to position Maryland as a national leader in sustainable waste management.
- Expand rail and road infrastructure to support waste exports and reduce dependency on a single corridor.

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STORMWATER

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: C+

2020 Maryland: C 2025 National: D

Executive Summary

Maryland's stormwater management program, administered by the Maryland Department of the Environment (MDE), is one of the most advanced in the nation. The program plays a critical role in protecting the Chesapeake Bay and local waterways from pollution, flooding, and erosion. MDE oversees municipal stormwater permits, maintains a robust database through StormwaterPrint, and has implemented innovative design standards and green infrastructure practices that serve as models for other states. However, Maryland continues to face challenges related to water quality, aging infrastructure, and the growing impacts of climate change. Statewide compliance with stormwater regulations is estimated to cost more than $7 billion, with much of the financial burden falling on local jurisdictions. While recent federal funding from the Infrastructure Investment and Jobs Act and Inflation Reduction Act has supported resiliency and flood mitigation projects, significant investment is still needed to upgrade stormwater systems and protect Maryland's communities and natural resources for the future.

Introduction

Stormwater management is crucial for protecting the Chesapeake Bay and local waterways from pollution, mitigating flood damage, and preserving natural habitats. Before the Clean Water Act was enacted in 1972 by the Environmental Protection Agency (EPA), stormwater was often untreated, flowing into waterways like the Chesapeake Bay and collecting pollutants. Beginning in the 1980s, regulations mandated stormwater treatment for water quantity, and from the 1990s, both water quality and quantity treatments have been mandated. Since 2010, treatments have aimed to mimic pre-hydrologic conditions.

Various best management practices (BMPs) are employed in stormwater treatment facilities to remove pollutants and control flooding. Common stormwater infrastructure in Maryland used to manage water quantity includes storm drains, open channels, roadway conveyance, ponds, and detention basins. Green infrastructure practices that manage water quality and provide water quantity control include rain gardens, bioretentions, green roofs, permeable pavement, and other environmental site design features. Stormwater infrastructure must be maintained and improved in Maryland in order to mitigate flood risk and protect the health of the state's receiving waters.

Capacity

Federal stormwater regulations establish minimum treatment requirements nationwide. The National Pollutant Discharge Elimination System (NPDES) Storm Water Program is administered by the EPA. NPDES Phase I regulates stormwater discharges from medium and large municipal separate storm sewer system (MS4) programs, while Phase II applies to smaller MS4 programs. As of the 2014 EPA Stormwater Program Review, Maryland has 11 Phase I permits, and over 90 Phase II MS4 permits, of which at least 36 are Federally-owned facilities. Maryland's MS4s in aggregate have restored 40,956 acres of impervious area (24% of total impervious acre baseline) as of FY2022 according to MDE's *Annual Report on Financial Assurance Plans and the Watershed Protection and Restoration Program*.

STORMWATER

According to MDE data collected during fiscal year (FY) 2024 and provided via email by MDE, 97.3% of MDE's stormwater management facilities received a passing assessment after completion of triennial visual inspection. In addition to MDE, the Maryland Department of Transportation (MDOT) handles MS4 permitting to regulate stormwater drains connected to the state road network through their Drainage and Stormwater Asset Management Program. According to MDOT State Highway Administration (SHA) data from 2020 to 2024, 94.6% of the stormwater management facilities received a passing assessment, via the triennial visual inspections performed on the facilities.

The capacity of stormwater management systems in Maryland is being challenged by climate change. Increased intensity of rainfall over the past 20 years and an increased number of flash flood events have negatively impacted conveyance systems. MDE is taking steps to combat the effects of climate change on stormwater systems' capacity, including updating Environmental Site Design Regulations and requiring the usage of the most recent Atlas 14 precipitation statistics.

Readily available to the public is StormwaterPrint – an interactive map published by MDE. This online catalog has a database of a comprehensive list of parameters related to Maryland's Phase I stormwater facilities. Specifically, the database contains informative parameters such as drainage area, impervious area, and rainfall treated.

Condition

The Chesapeake Bay is a major waterbody into which approximately 95% of the land in Maryland drains. Recent trend data from MDE shows that there is a decrease in nitrogen and phosphorus in the Chesapeake Bay (Figures 1 and 2). Maryland also achieved its statewide 2023 targets for sediment.

MDE published a comprehensive report, approved by EPA, on surface water quality in Maryland in 2024 – Maryland Final 2024 Integrated Report of Surface Water Quality. Maryland has a total of 2,071 current assessment records documenting water quality status, 59% of which indicate impairment, 9% of which require more information to assess whether standards are met, and 32% of which indicate some water quality standards are met. Nutrients, sediment, temperature, and bacteria pollution are some of the leading causes of impairments in Maryland. In the FY2024 cycle, MDE delisted 71 waters that were previously listed as impaired and are now meeting water quality standards.

The Maryland Final 2024 Integrated Report of Surface Water Quality discussed the increase of

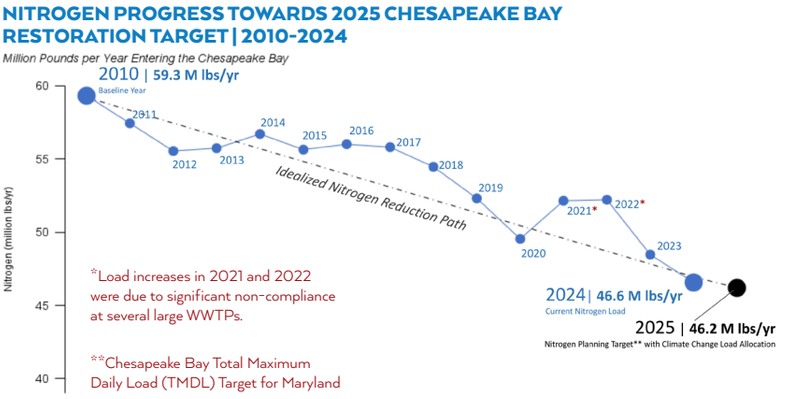

Figure 1. MDE StoryMap of nitrogen trend data
Source: CAST23 (05/09/2025)

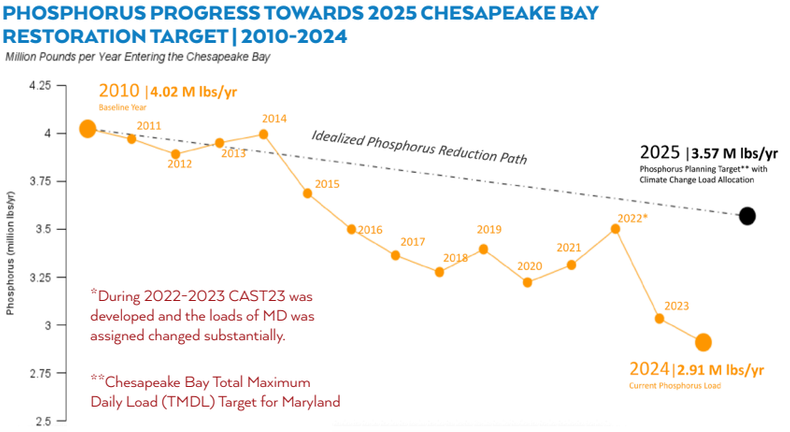

Figure 2. MDE StoryMap of phosphorous trend data
Source: CAST23 (05/09/2025)

2025 Grade: C+

chloride in non-tidal streams. Winter salt runoff is the primary source of chloride impairment in 28 of Maryland's watersheds. Chlorides are harmful to ecosystems and affect water quality due to the increase in heavy metals. MDE has developed a chloride reduction strategy and has been collaborating with the public, counties, and SHA to reduce salt application. According to the report, SHA has already reduced total salt usage on its roadways by nearly 50%.

Furthermore, SHA has taken action to improve the condition of its stormwater management facilities. According to MDOT's ninth annual report on MS4, during the FY2024 reporting period, a total of 59 existing stormwater management facilities (such as wet ponds and bioretentions) in the MS4 permitted areas were rehabilitated by SHA. In FY2024, SHA worked toward equalizing the number of preventative maintenance inspections it performs each year by completing inspections earlier than required, and plans to complete the equalizing initiative in FY2025. This effort greatly improves the efficiency and safety of inspections.

Operation and Maintenance

Assessing the operation and maintenance (O&M) of stormwater facilities in Maryland proves to be a difficult task since the responsibilities belong to property owners (i.e., agencies, jurisdictions, and private entities who take ownership and are in charge of carrying such duties). For example, in communally owned areas, the homeowner association (HOA) property manager is responsible for coordinating maintenance and repairs of stormwater facilities. Documentation of inspections performed and passed, such as the SHA inspections described, continues to be a good indicator of the health of stormwater O&M efforts.

In Maryland, stormwater infrastructure is maintained according to plans approved by MDE or the governing local jurisdiction, stormwater easements and covenants, and any maintenance agreements, as well as per the associated stormwater permits. Prior to approval and issuance of a stormwater permit, stormwater construction plans must include a maintenance schedule specific to each type of BMP. MDE defines minimum requirements for state and federal BMP maintenance schedules. For example, a bio-swale must be checked monthly for debris, trash, plant health, and vegetative cover. Bio-swales also have annual and seasonal inspection requirements including those for after a major storm. The MDE guidelines suggest remedial actions if a BMP is found to be in improper condition upon inspection.

Funding and Future Need

Funding for stormwater management comes from several different sources in Maryland. MDE issues state-level grants and loans to local municipalities via the Water Quality Revolving Loan Fund. The Maryland Water Infrastructure Financing Administration issues revenue bonds to provide low-interest loans to local governments to fund stormwater management projects.

Since 2015, when SB 863 was passed with several amendments, the once-state-mandated stormwater remediation fee or rain tax is no longer required, and counties and other jurisdictions have more creativity to fund and facilitate achievement of the minimum Total Maximum Daily Load (TMDL). While flexibility is provided to individual jurisdictions, the responsibility of funding to meet the Chesapeake Bay TMDL still falls on these jurisdictions. Financial assurance plans, indicating a detailed five-year plan of how stormwater runoff will be treated and paid for in Maryland's ten largest urban jurisdictions, are required. Each jurisdiction must provide annual reports to the Governor and Maryland General Assembly and demonstrate financial ability to pay for restoration practices for a minimum of the following two years.

2025 Grade: C+

The global COVID-19 pandemic had a profound impact on the available budgets for stormwater-related design, construction, maintenance, and other activities in Maryland. According to SHA's seventh annual report on MS4, SHA budget constraints that began in FY2021 (due to the COVID-19 pandemic), continued to have impacts on SWM facility inspection activities during FY2022.

Maryland has been awarded more than $300 million in stormwater-related infrastructure funding via the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA) as of September 2025. MDE has secured IIJA funding for initiatives of federal programs such as flood assistance, pollution prevention, building resilient infrastructure and communities, and more. The IIJA and IRA provided grant funding for MDE, SHA, and many more state and county entities within Maryland to improve stormwater programs and infrastructure.

Over the past five years, Maryland's population has risen, particularly in areas surrounding the urbanized centers of Baltimore and Washington, D.C. According to the EPA's Clean Watersheds Needs Survey (CWNS) published in 2022, Maryland has a reported need of more than $10.6 billion for future investment in water infrastructure that has not already been funded. Of that amount, more than $1.3 billion is needed for future investment in gray infrastructure (e.g., storm drainage), green infrastructure, and general stormwater management. The need was estimated for a problem that existed as of January 1, 2022, or is expected to occur in the next 20 years. While IIJA funding has lessened the gap in funding, it has not been enough to eliminate the gap in funding needed to upgrade and improve stormwater infrastructure.

Public Safety

Residents can be exposed to deadly threats when flooding occurs. Floods are the most common, and among the most deadly, natural disasters in the United States. Maryland had 45 flash flood warnings in 2024, and at least 51 flash flood warnings in 2025 – the most flash flood warnings since 2020.

MDE's flood hazard mitigation program helps communities identify and understand their flooding risks. MDE posts maps of flood risk areas to its website and gives support to affected communities through a variety of programs like the Comprehensive Flood Management Grant Program, which helps provide funding to projects that will reduce risk and improve the safety for people and property. Infrastructure proposed in the projects funded by this program include elevating flood-prone structures, installation of high-water sensors, tidal wetland restoration, and shoreline protection. As an example, the Annapolis City Dock Resiliency Project, currently in the design phase, involves phased construction of flood barriers, a raised elevated park, and a new Maritime Welcome Center to combat sea-level rise and frequent flooding in the historic downtown waterfront.

Maryland must consider not only increasing flood disasters and flash flooding throughout the state, but also rising sea levels and their impacts on 3,200 miles of coastline. Maryland cities such as Baltimore and Annapolis are experiencing an increasing number of days of high tide flooding annually. According to National Oceanic and Atmospheric Administration (NOAA), high tide flooding (or nuisance flooding) is three to nine times more frequent than it was 50 years ago, which is detrimental to vulnerable coastal communities. Coastal protection projects will reduce shoreline erosion and aid in the preservation of inland communities.

Resilience

While there is no clear trend related to total annual precipitation in Maryland, the annual number of extreme precipitation events (i.e., two inches or more of rainfall) averaged 2.5 days per year in 2005-2020 versus 1.8 days per year during the preceding

55 years. This is concerning because current infrastructure is not capable of containing water from increasingly frequent heavy storms. Sea-level rise adding to flood potential is also a major concern for Marylanders living on the 3,200 miles of tidal shoreline. Shoreline flooding exacerbates flooding in low-lying areas, causing shoreline erosion, deterioration of tidal wetlands, and saline contamination of low-lying farm fields. Maryland launched the latest version of its Coastal Atlas in 2016, which allows planners and the public to view, query, and download data on physical characteristics, human uses, and ecological resources, and shows data on sea-level rise vulnerability, coastal resiliency assessments, and more. Maryland is raising the one-year, 24-hour design storm rainfall from 2.0 inches to 2.7 inches due to predictions for future climate change presented by the Mid-Atlantic regional Integrated Sciences and Assessments.

The shorelines of Maryland are not the only geographic region that is at risk of flooding due to severe storms. In May 2025, several creeks in Western Maryland rose over 8 feet above major flood stage. More than $33 million in damages and additional costs was estimated after this severe storm event, and is an indicator of the need for Federal Emergency Management Agency public assistance.

The Maryland General Assembly passed SB 227 in June 2021 and, with it, tasked MDE with developing plans to evaluate current flooding risks and update regulations to improve urban stormwater flood management.

The Maryland Department of Emergency Management's Maryland 2021 Hazard Mitigation Plan updates the 2016 Hazard Mitigation Plan and includes new hazards (e.g., public health emergencies, soil movement, extreme temperatures, dam failure, and human-caused hazards and threats). The goals of the plan prioritize flood risk occurrences outside floodplains, reducing flood hazards in areas of high risk with repetitive flooding, addressing inequities to provide Marylanders access to resources to stay informed with relation to emergencies, and more. As Maryland continues to increase its resilience through updated infrastructure, officials urge communities to make sure they are prepared for emergencies and know how to respond.

Counties in Maryland have their own flood mitigation hazard plans, and coastal counties, such as Calvert County, have prepared other plans such as the High Tide Flood Mitigation Plan to address tidal flooding. Montgomery County's Comprehensive Flood Management Plan aims to prevent, prepare for, respond to, and recover from flooding. These county-level plans include stormwater infrastructure improvements and projects, emergency response strategies, and highlight the importance of improving climate resiliency.

Innovation

Maryland's stormwater management efforts through MDE are regarded as some of the most innovative nationwide. Since 2000 when MDE began upgrading its then-outdated stormwater management plan, its forward-thinking vision has been reflected in both Maryland stormwater policies and databases. MDE developed the 2000 Maryland Stormwater Design Manual, Volumes I and II, to establish stormwater design criteria and provide specific procedures for local jurisdictional use in improving existing programs for non-point source pollution control within the Chesapeake Bay. Many other states have designed their stormwater plans based on this design manual because of its innovative approach to stormwater management. In addition to the Stormwater Design Manual, MDE outlined new documentation as a direct result of SB 227. MDE released its report, Advancing Stormwater Resiliency in Maryland (A-StoRM), that provides a roadmap towards modernizing stormwater management in Maryland. Following the publication of A-StoRM, in 2023 MDE developed a document of new regulations, Proposed Stormwater Management Regulatory Requirements for New Development and Redevelopment in Maryland. The stricter requirements for using environmental site design practices that are outlined in this document will go into effect in January 2027.

2025 Grade: C+

Technological advances have also helped support strong stormwater management planning in Maryland. As an example, MDE's Habitat Connectivity Network (previously known as the Green Infrastructure Assessment) mapped an ecological network using satellite imagery which allowed experts to characterize land cover, Geographic Information System data on road, stream, wetland and other resource features, and biological databases for 38% of Maryland's total area. Outside of MDE, the University of Maryland (UMd) conducts groundbreaking research on stormwater management. In 2022, UMd received a patent for a new way to remove pollutants from stormwater using adsorbent media – High permeability media mix (HPMM) for phosphorus and nitrogen removal from contaminated waters. The combination of innovative technological and management approaches shows promise for the future of stormwater treatment to improve water quality in Maryland.

After considering the available information, stormwater infrastructure in Maryland is assigned a grade of C+

Recommendations to Raise the Grade

Maryland's stormwater management program is one of the most advanced and innovative in the nation. While there have been notable nutrient reduction improvements in the Chesapeake Bay, the water quality of some of Maryland's watersheds has been steadily declining over the past few decades, increasing the cost that local municipalities and the state will have to invest in for improvements. In order to continue leading in the stormwater sector, Maryland should:

- Encourage dedicated funds from state and local governments for maintenance and replacement of stormwater infrastructure through user fees or other measures.
- Urge state agencies and localities to seek additional resources for stormwater improvements and infrastructure upgrades including from the Hazard Mitigation Grant Program and funding sources via the Federal Emergency Management Agency.
- Continue local-led asset management efforts in order to effectively maintain stormwater infrastructure.
- Implement the transfer of knowledge via workshops and presentations to spread useful information regarding simple mistakes in stormwater design that hinder operations and maintenance and could easily be avoided.
- Work closely with local representatives and legislators in vulnerable counties, cities, and towns to assess and understand the biggest threats on a local scale and to create activities and solutions that will mitigate the risks related to stormwater events.
- Improve infrastructure resilience and lifespan through increased consideration of climate impacts, storm event intensities, sea level rise, future population growth, and other factors in flood mitigation designs and regulations.
- Incentivize the upgrade of any best management practice that does not treat a minimum of 1-inch of rainfall using environmental site design.

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TRANSIT

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: D+

2020 Maryland: D+ 2025 National: D

Executive Summary

Maryland's transit infrastructure is a cornerstone of the state's mobility, equity, and economic vitality. The Maryland Transit Administration (MTA), Washington Metropolitan Area Transportation Authority, and 22 Locally Operated Transit Systems serve over 13 million residents across urban and suburban communities. While ridership gains, targeted investments, and strategic planning offer promise, systemic challenges from aging assets, deferred maintenance, and funding gaps undermine and slow progress. Over 20% of MTA's assets are operating beyond their useful life, with farebox recovery rates and on-time performance below national benchmarks. Major capital projects like the Purple Line and Red Line promise improved connectivity, but long-term funding remains uncertain. Workforce shortages further strain operations. A renewed commitment to maintaining the asset portfolio in a state of good repair, modernization, and sustainability is essential to ensuring Maryland meets the needs of residents today and in the future.

Introduction

Transit in Maryland is served by a network of two major transit agencies and 22 Locally Operated Transit Systems (LOTS) to provide regional/statewide coverage (Figure 1). The Maryland Department of Transportation (MDOT) Maryland Transit Administration (MTA) and the Washington Metropolitan Area Transit Authority (WMATA) are located in the state's most highly populated and urbanized areas, providing critical mobility to the Baltimore and Washington, D.C metropolitan regions. These agencies provide access for Maryland residents to job, education, healthcare, and economic opportunities. Of the nearly 3,000 U.S. agencies that report to the National Transit Database (NTD), both MTA and WMATA rank among the top 25 transit agencies in the United States for service consumption and cost metrics.

MDOT Maryland Transit Administration

MTA is the 18th busiest transit agency in the United States, according to 2023 NTD data. MTA offers a broad network of transit alternatives which include the following:

- **Local bus in mixed traffic and dedicated busways**
- **Commuter bus**
- **Light rail**
- **Metro subway**
- **Maryland Area Rail Commuter (MARC) train (commuter rail service)***
- **Mobility (paratransit service)**
- **Taxi access system**

*See Rail Chapter of the Maryland Infrastructure Report Card related to MARC rail service. MTA's service area covers 2,560 square miles, encompassing a population of 7.8 million people. The local bus, light rail, and metro subway systems are jointly branded as BaltimoreLink.

Maryland's Locally Operated Transit Systems (LOTS)

MTA manages funding for and provides technical assistance to 22 locally operated transit systems, across Maryland's counties, Baltimore City, Annapolis, and Ocean City. The larger LOTS systems include the following:

- **RideOn – Montgomery County**
- **TheBus – Prince George's County**

- **Beach Bus – Ocean City**
- **Charm City Circulator – Baltimore City**
- **Regional Transit Agency of Central Maryland – Howard, Anne Arundel, and Northern Prince George's County and the City of Laurel**

LOTS provide a combination of fixed-route bus and demand response and paratransit services. They provide a critical first-mile/last-mile connection to Maryland's larger regional transit systems while ensuring mobility for residents in areas that are not directly served by MTA or WMATA. They are especially important for older adults, people with disabilities, and low-income households who may have limited access to personal vehicles.

Washington Metropolitan Area Transit Authority (WMATA)

WMATA is the 5th busiest transit agency in the United States, serving portions of Maryland, Washington, D.C., and Virginia. WMATA divides its service into four modes of transportation as follows:

- **bus**
- **heavy rail**
- **demand response / paratransit**
- **demand response taxi**

WMATA's service area covers 1,295 square miles and a population of over 5 million (including Maryland, Washington D.C., and Virginia). Service in Maryland is primarily located in Montgomery and Prince George's Counties, with metro stations located along the Red, Green, Blue, and Orange lines. WMATA's Metrobus network in Maryland provides local and commuter service between suburban communities and rail stations.

TRANSIT SERVICE AREAS

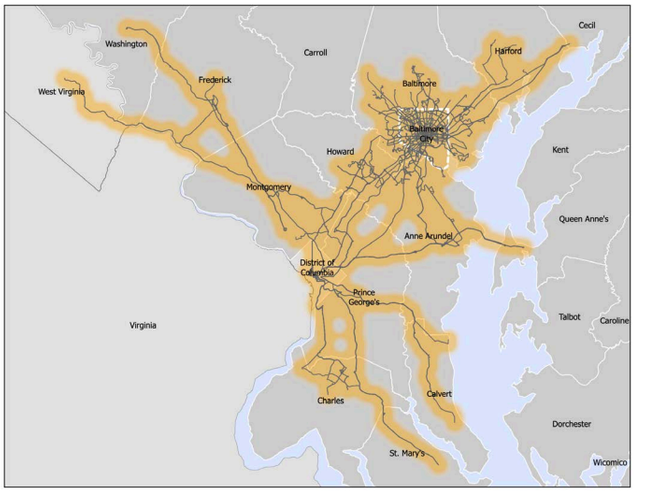


Figure 1. Transit service areas in Maryland

While WMATA serves an important transit function in Maryland, its service area also spans Washington, D.C. and Virginia. WMATA often reports system-wide, state-spanning data. As much as possible, this analysis will narrow the focus to the portion of the WMATA transit system that is within Maryland.

Capacity and Condition

Currently MTA owns and maintains over 1,700 revenue vehicles including buses, light rail vehicles, heavy rail cars, vans, and mobility cars. The system includes 15.5 miles of subway track, 30 miles of light rail service, and over 90 bus routes including local and commuter service. These accommodated more than 147 million unlinked passenger trips in 2024 across the seven modes.

WMATA's metro rail includes six metro rail lines and 128 miles of track, and their bus service includes 11,000 stops in Maryland, Virginia, and Washington D.C.

Transit ridership is still recovering and adjusting from the impacts of the COVID-19 pandemic. MTA ridership peaked in 2010, at 120.6 million

MTA boserved an 11.5% increase in ridership between 2023 and 2024, the largest year-over-year change among the top 25 transit agencies in the United States.

2025 Grade: D+

unlinked trips, and saw steady decline up to the pandemic as other alternatives such as Uber and Lyft became more prominent. This mirrored a national trend. The pandemic led to a significant drop in transit use and a low of only 40.5 million passengers. Ridership has rebounded since 2021, but it has not yet returned to pre-pandemic levels. MTA's total ridership in 2024 was 61.2 million (approximately 150% its low during the pandemic and 50% of its peak in 2010).

WMATA's Maryland-only ridership had a dramatic decrease in ridership during the pandemic, dropping nearly 75% in 2021. While ridership has generally gradually increased since that time, a small decrease (-2.1%) was observed from 2023 to 2024. This decrease was not evident systemwide.

ANNUAL TRANSIT RIDERSHIP (THOUSANDS)

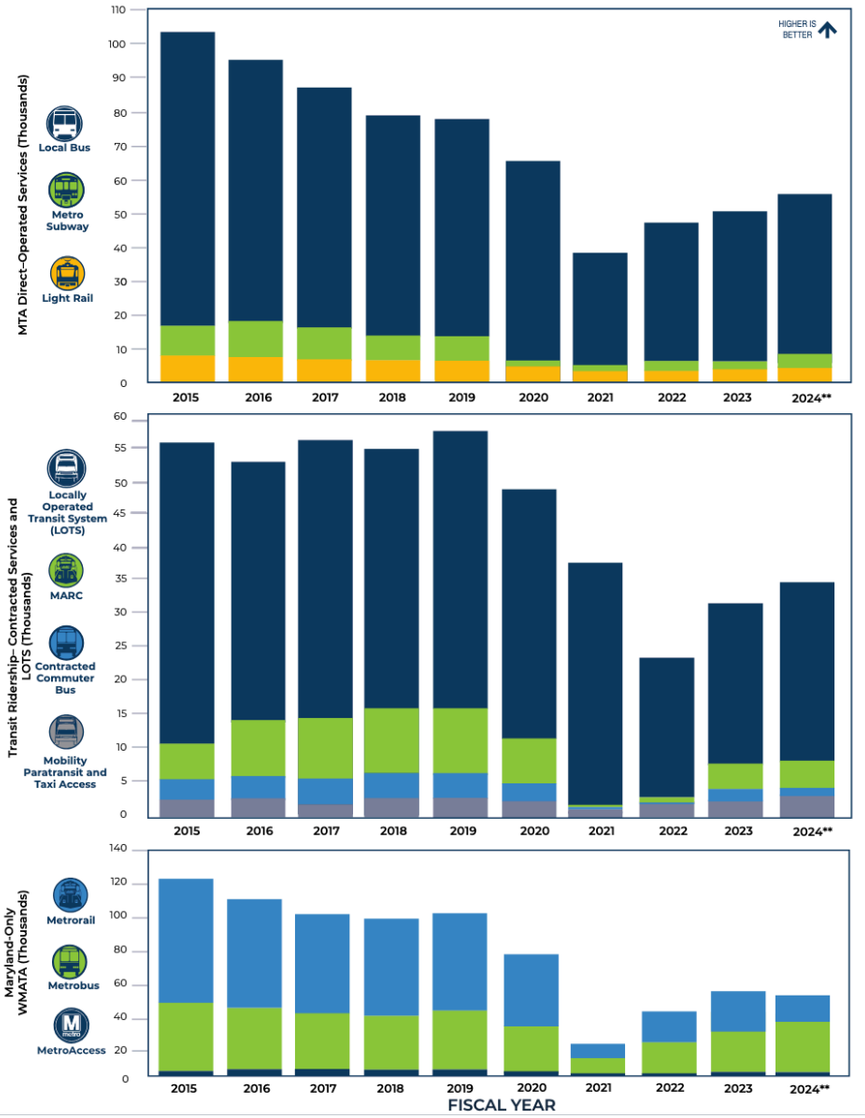


Figure 2. Transit ridership trends since 2015

Maryland has seen population growth and anticipates continual growth in the coming decades. Since 2019, population has increased by 3.5% statewide, with greater dispersion into suburban areas. This trend is consistent with changes to work patterns, including increased work-from-home opportunities. As people move farther from city centers, need and demand for expansion of transit systems increase to reach out to growing communities.

Ridership data (Figure 2) indicates a faster rebound within the core bus and mobility services, consistent with the shifting needs and demands on transit networks. Commuter-focused modes like MARC and commuter buses have seen slower growth with more off-peak usage, indicative of more people working from home and taking advantage of flexible work schedules. A 2025 study completed by MTA related to its MARC service, the MARC Growth and Transformation Plan, highlighted the top priorities from the nearly 4,700 survey respondents: expanded weekend service, increased frequency, and improved connectivity.

MDOT's 2050 Transportation Plan calls for improving connectivity and equitable access to affordable and accessible transportation for all communities. This access is critically important for historically under served and overburdened communities.

2025 Grade: D+

TRANSIT

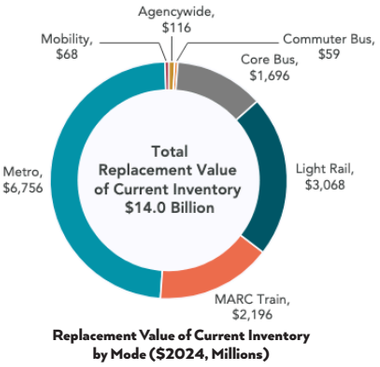
Maryland's transit infrastructure includes a $14 billion portfolio of assets, which include vehicles, guideway elements, systems, facilities, and stations as shown in Figure 3. WMATA owns, operates, and maintains over $42 billion in transportation related assets. Table 1 summarizes the volume and age of assets by mode.

On-time performance measures the reliability of transit service. Specifically, it tracks when a transit vehicle arrives at its stop within a designated time frame of its scheduled arrival time. Since the measure is directly experienced by users, it is a metric that is most related to patron satisfaction.

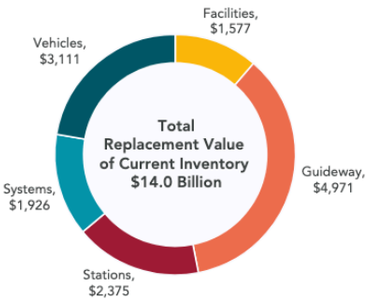
MTA					
Asset Type	**No. Vehicles in Service**	**Total No. Vehicles**	**Percent Spare Vehicles**	**Average Fleet Age (yrs)**	**National Average Age (approx. yrs)**
Bus	642	680	5.9%	6.7	7
Commuter Bus	92	120	30.4%	0	8
Commuter Rail	149	201	34.9%	22	23
Demand Response	610	657	7.7%	4.2	5
Heavy Rail	40	50	25.0%	39	24
Light Rail	17	25	47.1%	28.8	20

WMATA					
Asset Type	**No. Vehicles in Service**	**Total No. Vehicles**	**Percent Spare Vehicles**	**Average Fleet Age (yrs)**	**National Average Age (approx. yrs)**
Bus	1148	1556	35.5%	7.9	7
Rail	904	1148	27.0%	4.3	24
Demand Response	675	718	6.4%	17.2	5

Table 1. Average revenue fleet age by agency and mode
Source: 2023 Reporting to NTD



Replacement Value of Current Inventory by Mode ($2024, Millions)



Replacement Value of Current Inventory by Asset Category ($2024, Millions)

Figure 3. MTA asset valuation

CURRENT TRANSIT CAPITAL PROJECTS

PURPLE LINE

MTA's Purple Line is currently under construction and expected to open in 2027. The 16-mile, east-west light rail project enhances transit access, with essential connections to WMATA Metrorail (Red, Green, and Orange lines), local bus services, MARC, and Amtrak. In 2025,

RED LINE

The Baltimore Red Line project would provide a critical east-west connection through Baltimore. The project is a 14-mile east-west light rail service providing connectivity between Woodlawn, west of Baltimore, and the Bayview Medical Campus, east of Baltimore. The project provides key investments in equitable transit to communities that were previously underserved in transit with connectivity to other transit lines, such as the north-south light rail and metro subway corridors. While project planning and engineering efforts have resumed, construction funding is still unknown for this project.

BETTER BUS NETWORK

WMATA enacted the Better Bus Network, a major overhaul of the entire bus system. Improvements were made to connectivity with many underserved communities, including connectivity to 20,000 additional residents in Maryland, Washington, D.C., and Virginia. The routes were strategically changed to connect to LOTS within Maryland counties. To avoid the need for additional budget resources, WMATA eliminated some under-utilized stops along routes, drawing some public opposition.

SOUTHERN MARYLAND RAPID TRANSIT

The Southern Maryland Rapid Transit (SMRT) study is evaluating a potential rapid transit line to southern Maryland, connecting communities along the MD 5/US 301 corridor, with connection to the Branch Avenue Metrorail Station in Prince George's County and the Waldorf-White Plains area in Charles County. Possible solutions include bus rapid transit, light rail transit, and other transit alternatives. The project only exists in the planning stage with no long-term strategy funding or implementation.

2025 Grade: D+

MTA's on-time performance standard is when a transit vehicle arrives at the scheduled stop within two minutes early to seven minutes late of the scheduled time. MTA established goals to be achieved by 2030 are 99% on-time for all modes except for local bus and 90% on time for local bus.

Recent on-time performance has shown marked improvement of light rail service, increasing from 84% to 89% on-time service, while other modes have remained relatively flat. The collapse of the Francis Scott Key Bridge has impacted travel times and disrupted some MTA services. Figure 4 illustrates MTA on-time performance over the last decade.

PERCENT OF ALL MDOT TRANSIT SERVICE PROVIDED ON-TIME

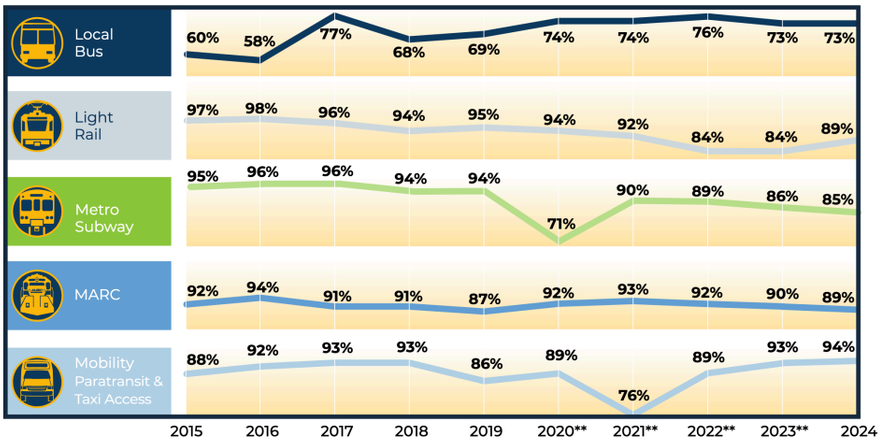


Figure 4. MTA on-time performance results

WMATA's on-time actual and target performance for fiscal year (FY) 2025 is summarized as follows:

- **Metrorail: 88.1% actual vs. 91% target**
- **Bus: 76% actual vs. 78% target**
- **Demand Service: 88% actual vs. 92% target**

From December 7th to 23rd in 2023, MTA's light rail service was temporarily suspended (systemwide) to perform emergency inspections of the entire fleet of vehicles. The shutdown followed a fire that occurred in October as a result of electrical conduit damage on the aging cars.

Funding

Maryland transit services are supported by a combination of state funds, directed from the Transportation Trust Fund (TTF), federal formula and discretionary grants, dedicated regional contributions, and local support for LOTS. MTA and WMATA represent the largest share of transit investment needs, with multi-billion dollar, long-range, capital programs for State of Good Repair (SGR) reinvestments, enhancements, and expansion. Significant funding is also required to provide continual maintenance and upkeep of the many vehicles, equipment, and facilities necessary to provide reliable transit services. While recent budgets and federal Infrastructure Investment and Jobs Act funding have helped close immediate gaps, long-term projections continue to show structural shortfalls.

Maryland state funding is provided through the TTF, a non-lapsing special fund dedicated to transportation. The fund is supported by taxes and fee revenues, operating revenues, bond proceeds, and fund transfers. MDOT issues bonds, which are backed by TTF revenues, and invests the TTF fund balance to generate investment income. MTA generates operating revenues that cover a portion of its operating expenditures. The tax and fee revenues are generated from motor fuel taxes, rental car sales taxes, titling taxes, vehicle registration fees, a portion of the corporate income tax, and other miscellaneous motor vehicle fees. TTF funds may be used for capital and operating costs, and for debt service.

2025 Grade: D+

Within Maryland's $21.2 billion Consolidated Transportation Plan (CTP) six-year funding for FY2025-FY2030, 22% is allocated to MTA projects and 15% is dedicated to WMATA funding.

For FY2026, MTA's capital budget totals $775.2 million, with $362.7 million, or 46.8%, coming from federal sources. $377.6 million is allocated from the Maryland TTF.

WMATA's FY2026 capital budget totals $523.6 million; this includes $184.7 million in Maryland TTF funds and $167 million in other Maryland dedicated funds.

Maryland's FY2026 allowance for transportation operating expenses totals nearly $3.1 billion, an increase of 7% over the FY2025 working appropriation. This includes 43% ($1.3 billion) to MTA and 22% ($680 million for WMATA).

According to the Comptroller of Maryland's *State Spending Series: Transit Costs* assessment in March 2025, Maryland faces a $1.3 billion deficit (across all transportation modes) over the next six (6) years. Operating costsw are rising faster than revenues, and federal support remains uncertain.

A portion of the operating expenses for transit is covered by passenger fare revenues. Fare revenues also factor into evaluations of system efficiency and function reflected by total number of paying passengers and the overall operating costs per revenue mile.

MTA and WMATA farebox recovery rates by mode for FY2020 through FY2024 are shown in Figures 5 and 6. Recovery rates fell dramatically in FY2021 due to the COVID-19 pandemic. While transit ridership is continuing to increase, escalating operating costs have outpaced ridership growth, causing the farebox recovery ratio to remain flat or decrease for most modes since 2021.

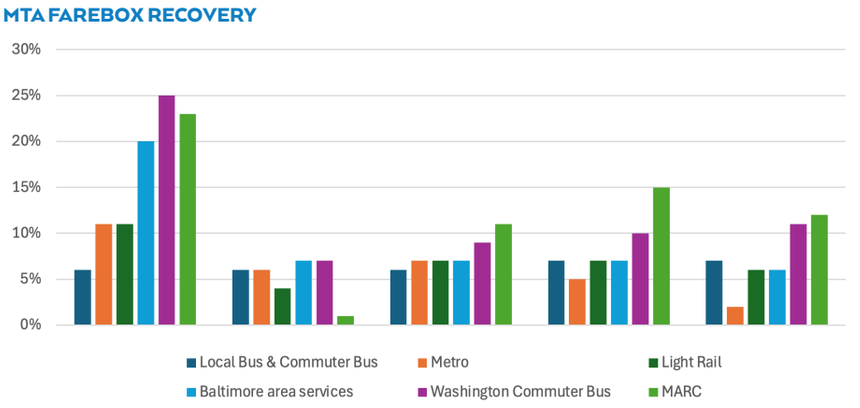


Figure 5. MTA annual farebox recovery by mode

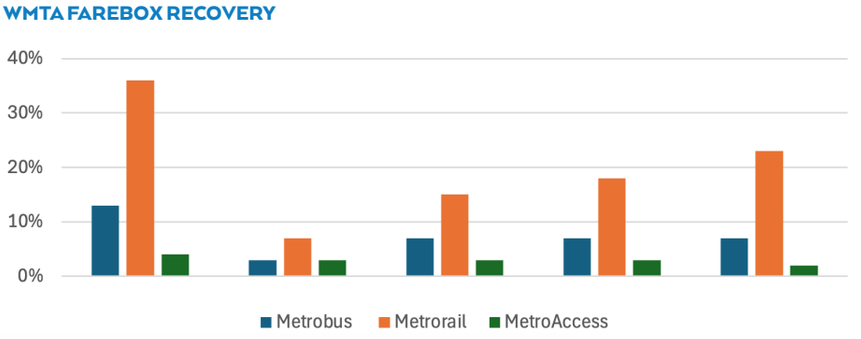


Figure 6. WMATA annual farebox recovery by mode

Future Need

Planning agencies anticipate ridership will continue to rise during future years, supported by anticipated population increases of more than 13% predicted between 2023 and 2050.

MTA's 2025 Capital Needs Inventory and Prioritization Report identifies a ten-year total investment need of $9.9 billion. Of this amount, approximately $670 million reflects modernization costs tied to projects such as metro fleet and train control replacement, light rail vehicle and systems modernization,

2025 Grade: D+

and new MARC maintenance facilities. These capital investments are designed to restore reliability, improve accessibility, and position MTA to reduce its backlog of deferred needs. More than $6 billion of the ten-year total investment need is to maintain assets in SGR. SGR funding is critical to keeping Maryland's transit system operating safely and efficiently. Between 2022 and 2025, the relative size of the SGR backlog for MTA increased from 14.5% to 20.1%. Based on anticipated funding levels, MTA expects to cover about 90% of the identified SGR needs through 2030 with a funding gap of approximately $1.5-$2.5 billion over the next ten years. The gap increases significantly in years 6-10, due to need for availability payments for the Purple Line and for MARC obligations. The allocation and gap mean that, while MTA can maintain its current infrastructure, it lacks funding to expand service coverage, modernize aging systems, and improve accessibility and rider experience. Given the deferred upgrades and maintenance needs of MTA's inventory, significant investment is needed to maintain SGR and for modernization requirements.

MTA received $213.7 million in grant funding from the U.S. DOT's Federal Transit Administration's Rail Vehicle Replacement program to replace all 52 aging light rail vehicles in its fleet with modern, low-floor cars. The grant is complemented by $90 million in state matching funds and $127.6 million in federal formula funds. This project will improve accessibility, safety, and performance on the light rail system.

WMATA's 2024 SGR Needs Outlook identifies a reinvestment need of $15.2 billion over the coming ten years, requiring an annual SGR need of $1.5 billion. Maryland provides annual contributions to WMATA comprising approximately one-third based on population, ridership, footprint, and negotiated adjustments of jurisdictional (i.e., shared with Washington, D.C. and Virginia) contributions to both operating budget and capital budget and amounting to approximately $695 million in FY2024. Total funds from jurisdictional subsidies, fares, advertising, etc. are insufficient to meet growing demand. WMATA's FY2024 was approximately 25% shy of its total funding needs. WMATA forecasts that by 2030, SGR needs will outgrow funding projections, representing a period of underinvestment in the coming years.

The Maryland Commission on Transportation Revenue and Infrastructure Needs (TRAIN Commission) was established in 2023 by the Maryland General Assembly to address the state's growing transportation funding crisis. It has not yet delivered a final report, leaving the future of the TTF in limbo. The commission will also recommend improvements to how transportation projects are prioritized and delivered, assess long-term needs across all modes, and explore sustainable funding options.

As part of the 2026 budget process, $420 million in annual revenue was added to support transportation infrastructure in Maryland. This effort helps to fund critical projects like MTA's light rail modernization program. However, long-term, sustainable solutions are still needed to address declining revenue sources. To affect real change, a sustained program of investment, policy realignment, and efforts to build grass-roots public support is necessary.

Operation and Maintenance

Operations and maintenance (O&M) is the backbone of any transit system, ensuring that buses, trains, and supporting facilities are fully functional every day. MTA and WMATA are responsible for the maintenance and repair of thousands of vehicles,

2025 Grade: D+

hundreds of miles of track, and numerous stations, while meeting required performance standards for safety, accessibility, and customer service. O&M encompasses everything from daily service delivery and scheduling to preventive maintenance, emergency repairs, and long-term lifecycle management.

As MTA's rolling stock fleet ages, it demands greater levels of maintenance, particularly with the light rail and subway cars which have both reached the end of their service life. Deferred maintenance contributes to service disruptions, speed restrictions, and reliability concerns. Workforce shortages, supply chain delays, and the added complexity of transitioning to zero-emission buses further strain O&M capacity. In addition, employee salaries continue to rise rapidly, exceeding budget increases.

In response to federal mandates, MTA, WMATA and LOTS have made significant efforts to modernize maintenance practices, including methodologies to track asset condition, prioritize reinvestment, and extend asset life cycles. However, without consistent funding and staffing, deferred O&M risks remain high, directly impacting on-time performance, service frequency, and rider confidence. MTA's most recent Asset Management Report was issued in 2021, with asset conditions noted in Figure 7; note that these assets have aged another four years since this report was issued.

MTA ASSET CONDITION SUMMARY

Asset Classes	Asset Type	Average Condition		Asset Operating Past Useful Life
Vehicles	Revenue Vehicles	3.11	3.18	26%
	Non-Revenue Vehicles		3.00	41%
	Equipment/Parts		1.97	59%
Rail	Guideway	2.67	3.21	15%
	Bus Guideway		4.86	0%
	Special Structures		2.87	0%
	Trackwork		2.30	67%
Systems	Communications	2.72	3.04	19%
	Electrification		2.21	57%
	Intelligent Transportation Systems (ITS)		2.25	97%
	Revenue Collection		2.44	83%
	Train Control		2.98	26%
	Uninterruptible Power Supplies (UPS)		3.31	25%
	Utilities		2.91	10%
Facilities	Buildings	2.42	2.60	49%
	Central Control		3.75	0%
	Equipment		2.38	69%
	Storage Yard		3.36	10%
Stations	Access	2.78	2.59	41%
	Building		2.19	77%
	Complete Station		3.54	4%
	Platform		2.68	30%
	Signage & Graphics		2.33	85%

Figure 7. MTA asset condition summary

Workforce personnel shortages can have significant impact on the level of service at a transit facility. Maryland noted a particular issue with bus operator vacancies in past years and correspondingly low performance on timeliness of bus routes. MTA undertook a robust recruitment program, including expedited wage progression for rail and bus operators, an aggressive hiring and social media campaign, and an accelerated training and onboarding process.

In FY2025, MTA included 108 new positions to improve transit reliability, including managers and administrative staff to support frontline workers and operators. MTA also added planning/engineering positions to support major projects like the Red Line and Southern Maryland Rapid Transit. MTA's vacancy rate dropped from 8.8% in 2023 to 5.2% in 2024. In FY2026, MTA is allocating 171 new positions, primarily within the operating program (i.e., maintenance, operators, human resources, procurement, etc.). Many new MTA Police positions will be needed in FY2026 in association with the new Purple Line project coming online next year.

2025 Grade: D+

Public Safety

OPERATOR ASSAULTS BY MODE AND AGENCY

Mode	MTA	WMATA (Maryland only)	LOTS	Total
Bus	79	35	15	129
Metro	9	10	-	19
Demand Response	6	1	-	7
Light Rail	1	-	-	1
Commuter Rail	-	-	-	-
Commuter Bus	-	-	-	-
Total	**95**	**46**	**15**	**156**

Table 2. MTA and WMATA operator assaults by mode in 2023

Transit remains one of the safest modes of transportation as noted by the American Public Transportation Association; transit is estimated to be ten times safer per mile than travelling by car. Transit service requires trained operators, working with properly maintained and inspected equipment and following rigid safety protocols. Moreso, increased transit usage results in fewer cars on the road, enhancing roadway safety for users, including vulnerable pedestrians and bicyclists.

Transit safety is paramount to restoring transit ridership for the future, and it is essential to restore and maintain trust with communities and with staff/operators. Agencies must ensure that riders, operators, and the public are protected from harm in order to sustain economic vitality. Safety is tracked and monitored in many ways, from transit passenger fatalities and at-grade rail crossing incidents to preventable accidents per vehicle mile across bus, rail, and paratransit services.

MTA and WMATA report low fatality rates, consistent with national trends showing transit is one of the safest modes of travel. In FY2024 there were two transit passenger fatalities, more than MTA's target: zero and less than recent years. The annual count of at-grade crossing incidents resulting in injury or fatality is also decreasing. Preventable accident rates are based on NTD-reported incidents per vehicle revenue mile and vary by mode. Rates are consistent for the past five years and below targets except for MTA's local bus – 1.8 versus 1.6 target preventable incidents per 100,000 vehicle miles traveled.

Assaults on operators are a major concern for transit agencies, which must ensure their personnel are safe and protected from violence. Assaults on operators are rising nationally, prompting federal safety initiatives. Table 2 is a summary of 2023 data related to assaults on transit operators in Maryland among MTA, LOTS, and WMATA (Maryland-only). Over 80% of assaults occurred on fixed route bus routes. Based on ridership data, the number of assaults per million rides is tracked, with MTA at 1.86 and WMATA (Maryland-only) at 2.21 (based on 2022 data). When comparing MTA with similar metropolitan areas, like Houston and Atlanta, MTA had more assaults than those cities combined in 2022.

While agencies have seen safety improvement, through decrease in crime rates across MTA and WMATA, it is imperative to remain vigilant to improve public perception and trust.

Resilience and Innovation

Maryland's transit infrastructure is increasingly vulnerable to climate-related hazards. Between 2011 and 2021, Maryland experienced ten climate disaster declarations (ranking Maryland 18th in the United States in terms of Federal Emergency Management Agency post-disaster relief spending). MDOT's 2024 Transportation Resilience Improvement Plan (TRIP) identifies threats,

MTA developed the *Adaptation and Resiliency Toolbox* (ARToolbox) to aid in implementing adaptation measures at vulnerable sites. The ARToolbox provides a central repository for all efforts leading to the implementation and resilience measures that may be applied to MTA assets.

2025 Grade: D+

including coastal flooding, extreme temperatures, and severe weather. The plan outlines strategies for integrating resilience into asset management, capital planning, and hazard mitigation. For transit, resilience is measured not only in terms of physical assets like tracks, vehicles, tunnels, and stations, but also in the continuity of operations, emergency response capabilities, and the flexibility of agencies to adapt service during disruption. High-profile system interruptions in recent years – such as the MTA Light Rail shutdown for emergency fleet inspections in 2023 and extended WMATA Red Line closures tied to capital projects – demonstrate how vulnerabilities can significantly disrupt mobility for thousands of riders.

MTA aims to replace 60 of its buses every year as part of its overall asset management program and MDOT's larger goal to reduce greenhouse gas emissions. In 2025, MTA announced the purchase of 117 new hybrid electric buses which will be added to the fleet. These new hybrid vehicles are part of MTA's plan for conversion to zero emission buses (ZEBs) in the future. Maryland implemented a mandate that new bus procurements are to be ZEBs starting in 2023; however, due to budget challenges, the implementation has been delayed twice. The mandate has now been pushed back to 2032, with a goal of 100% conversion by 2040. To date, MTA has purchased a total of seven ZEBs under a pilot program. Infrastructure and facility upgrades have also begun, including new charging stations at the Kirk Bus Facility. WMATA has included orders for new electric buses withing the upcoming CTP.

Asset Management is an important and evolving tool for MTA, WMATA, and LOTS. MTA uses a suite of digital systems (Maximo, TERM-Lite, Optram, FleetWatch) under its asset management program to move toward predictive maintenance. These systems allow for tracking of inventory, maintenance schedules, and repair work. The systems are used for bus and rail management.

In 2024, MTA received a $1.2 million federal grant from the U.S. DOT's SMART program to install and test new cloud-based transit signal priority (TSP) technology at 90 intersections across four high-frequency bus routes in Baltimore City. The technology can improve reliability by adapting signal controls to minimize wait times.

WMATA's Better Bus Network is integrating data-driven route planning, stop consolidation, and improved bus priority corridors through this new program. The bus program also is expanding real time bus tracking to improve interface with mobile transportation planning applications.

MTA is leveraging innovative alternative procurements for the upcoming Light Rail Modernization Project. Alternative delivery using design-build should expedite the design and construction process and foster design innovation. Progressive design-build (PDB) has been proposed for the Light Rail Station Upgrades.

MTA and WMATA are taking steps to modernize operations and improve rider experience.MTA has deployed mobile fare payment platforms like CharmPass, to allow riders to purchase fares digitally. While not a new technology, it was an important step for MTA to meet customer expectations and demands and improve experience. The mobile application has been expanded to also include paratransit services.

In 2023, WMATA installed new faregates at metro stations to reduce fare evasion within the system. The new faregate models include advanced safety features and modernized displays and allow for quicker pass-through at the gate. As of June 30, 2024, new gates were installed at about 50% of all stations, resulting in a 79 percent decrease in fare evasion at these locations. WMATA has focused on additional metro station upgrades to enhance rider experience and on integrated performance dashboards to enhance transparency for users.

Broader innovation is constrained by funding limitations and institutional inertia. To remain competitive, Maryland must accelerate adoption of smart technologies, data-driven planning, and customer experience enhancements.

2025 Grade: D+

After considering the available information, transit infrastructure in Maryland is assigned a grade of D+

Recommendations to Raise the Grade

To improve Maryland's transit infrastructure, Maryland should::

- Look for opportunities to accelerate modernization projects, particularly MTA light rail and subway metro systems, leveraging the latest procurement strategies and streamlining state and local approval processes.
- Expand and adapt service frequency and geographic coverage to support shifting transit needs, particularly for MARC and commuter bus options.
- Continue to elevate resilience planning, mandating climate adaptation into capital projects, and planning for the future.
- Continue to invest in fare equity and accessibility, including low-income and youth programs.
- Protect the Transportation Trust Fund and consider innovative ways to address rising capital and operating costs coupled with declining fuel tax revenue. Recommendations from the TRAIN Commission must be carefully considered and appropriate action taken.
- Leverage federal and private partnerships to close funding gaps and support innovation.

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2025 Grade: D+

WASTEWATER

2025 REPORT CARD FOR MARYLAND'S INFRASTRUCTURE

2025 Grade: C+

2020 Maryland: C+ 2025 National: D+

Executive Summary

Maryland's wastewater infrastructure includes a range of systems, from household septic systems to large-scale wastewater treatment plants. These systems are intended to efficiently manage daily operations while accommodating wet weather flows for individuals and communities across Maryland. Some older systems have been in place for over 150 years and have been upgraded and expanded several times. Despite improvements in water quality, Maryland still faces considerable challenges, such as minimizing sanitary sewer overflows, tackling leaks from aging urban infrastructure, and managing inadequate or failing privately owned septic systems. The ongoing management and maintenance of wastewater treatment facilities particularly challenges Maryland. In some cases, utilities in Maryland may operate within a regional system, such as the Washington Suburban Sanitary Commission, or through inter-municipal agreements, like the one between Baltimore City and its surrounding counties, which can integrate different types of utilities.

Condition and Capacity

Maryland's wastewater system protects public health and the environment, especially within the Chesapeake Bay Watershed illustrated in Figure 1.

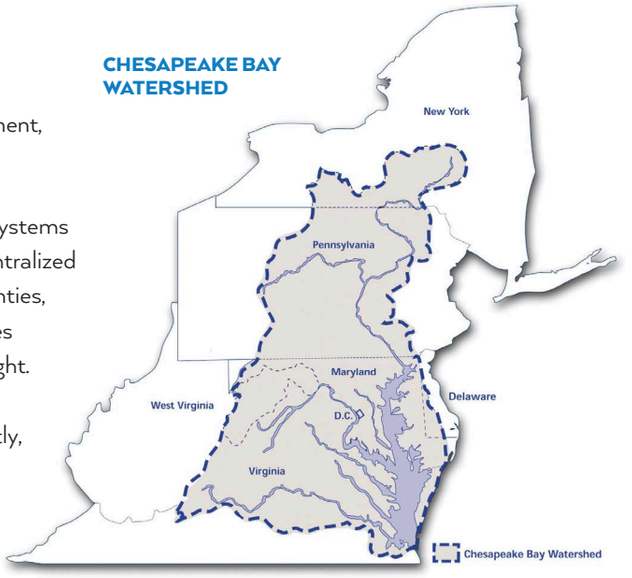


Figure 1. Chesapeake Bay watershed
Source: ChesapeakeBay.Net

Maryland's wastewater system includes centralized sewage collection systems like sewer networks, wastewater treatment plants (WWTPs), and decentralized systems such as septic systems and leach fields. Various agencies, counties, and municipalities manage these sewer systems and treatment facilities under the Maryland Department of the Environment's (MDE's) oversight. This oversight is based on authority from the U.S. Environmental Protection Agency (EPA) in accordance with the Clean Water Act. Lastly, the Maryland Public Service Commission regulates privately operated, decentralized wastewater systems.

Unlike adjacent areas, including Washington, D.C., Maryland mainly employs separate sewer systems for sewage and stormwater, effectively reducing combined sewer overflows. Additionally, Maryland is leading the way in implementing advanced wastewater treatment techniques, such as enhanced nutrient removal, which significantly lowers nitrogen and phosphorus, nutrients known to enable algae growth in water bodies. Figures 2 and 3 illustrate the primary sources of nutrients and their contributions to Maryland's waterways.

As of the 2020 census, Maryland's population slightly exceeded 6 million (18th largest in the country), with a population growth rate of at least 7% every decade. While Maryland's wastewater infrastructure is designed to handle increasing population levels, there are also challenges.

The central metropolitan regions within the Chesapeake Bay Watershed, i.e., Baltimore and Washington, D.C., have launched extensive and expensive long-term sewer rehabilitation initiatives aimed at eradicating sanitary sewer overflows (SSOs), and, in

Washington, D.C.'s case, combined sewer overflows. Maryland's official records list the total number of SSOs between 2023 and 2025 at 2,357.

The deteriorating condition of aging sewer infrastructure leads to inevitable failures that result in inflated treatment costs, penalties for non-compliance, and increased instances of sewer overflow events, which limit recreational water use and fishing. Infiltration tends to worsen over time due to pipe and joint degradation. This deterioration results in chronic sanitary sewer issues rather than the sudden, catastrophic failures typical of pressurized water mains. Furthermore, failures caused by the deterioration of concrete at the top of sewer pipes have resulted in road collapses above these pipes; these problems can primarily be detected through video inspections.

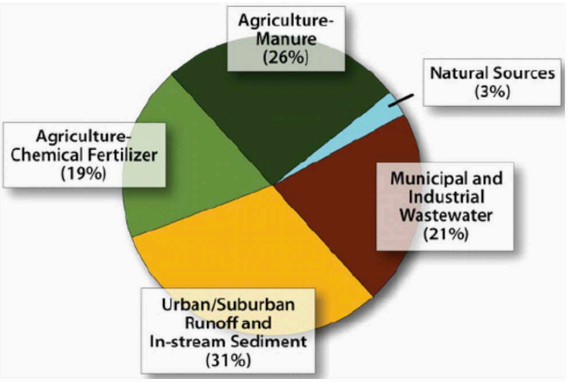


Figure 2. Sources of phosphorus to Chesapeake Bay watershed
Source: nap.nationalacademies.org

Chesapeake Bay Total Maximum Daily Load regulates the quality of effluent from WWTPs in line with strict nutrient reduction goals. This shifts the focus to pollution control from non-point sources like agricultural runoff and urban stormwater. Failing individual septic systems and leaking sewers add to non-point source pollution.

An effective utility asset management program often includes condition evaluations for larger systems. Mid-sized and larger utilities increasingly implement integrated asset management strategies to track system conditions and proactively allocate resources for maintenance or replacement tasks. For instance, Baltimore has invested significantly over the past two decades to develop a continuous assessment and maintenance framework for its utility infrastructure. However, due to the high costs of creating and maintaining Geographic Information System-based asset management frameworks, smaller utilities have not yet widely adopted modern asset management practices.

The condition of collection systems and WWTPs across Maryland varies greatly. Sanitary sewer systems generally fall behind the operational state of treatment facilities. Larger WWTPs usually have better conditions than smaller systems, while privately operated systems serving smaller developments, such as mobile home parks, often show signs of neglect.

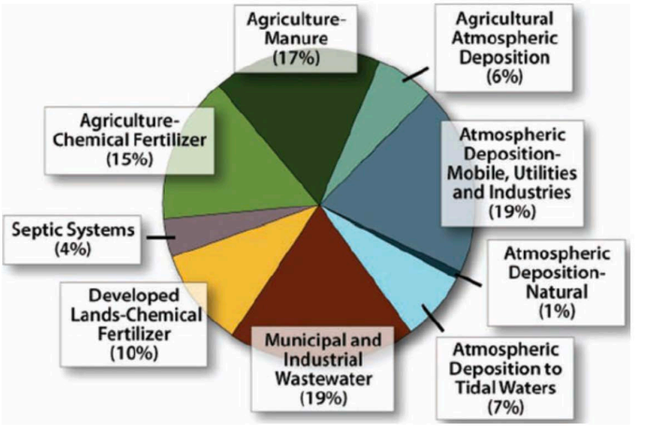


Figure 3. Sources of nitrogen to Chesapeake Bay watershed
Source: nap.nationalacademies.org

Operation and Maintenance

In some circumstances, utilities in Maryland may operate as part of a regional system, like the Washington Suburban Sanitary Commission, or through an inter-municipal agreement, similar to the arrangement between Baltimore and its adjacent counties, which can consolidate various types of utilities.

The Maryland Public Service Commission supervises and regulates a limited number of utilities (22) that serve approximately 11,000 residents. MDE regulates all systems from an environmental standpoint.

2025 Grade: C+

In the past, in order to respond to shortages in operator staffing as well as the lack of available training opportunities, Maryland implemented a certification program for WWTP operators, which required ongoing education. Additionally, local industry organizations such as ASCE, the Chesapeake Water Environment Association, and the Water and Wastewater Operators Association actively partner with the Maryland Center for Environmental Training to provide training support.

One unique operational and maintenance benefit in Maryland is the presence of an independent, quasi-state agency known as the Maryland Environmental Service (MES). MES serves as a statewide resource for operations and maintenance, either temporarily or through long-term contracts. MDE has the legal power to instruct MES to take over operations of any Maryland WWTP during emergencies or other situations as determined by the Secretary of the MDE.

A significant issue has been the operational and maintenance difficulties at wastewater treatment facilities in the Baltimore area. In 2021, MDE raised concerns about the operational issues at the Back River (Figure 4) and Patapsco wastewater treatment plants, as indicated in publicly accessible inspection reports. In response, MDE filed legal action against the city in January 2022 to ensure that these plants returned to compliance, incurring daily fines in the meantime. A settlement was reached on November 2, 2023, after which Baltimore collaborated with MDE to guarantee that the plants adhered to pollution permits. Over the next few years, the situation improved considerably, and by late 2024, city officials announced that the department was achieving record levels of permit compliance for wastewater treatment.

Figure 4. Back River WWTP
Source: John Roche, PTAP Aerial

Funding and Future Need

Each wastewater utility is responsible for its own financing capital and operational costs, typically relying on a tiered structure of user fees. In cases where wastewater infrastructure covers multiple jurisdictions, inter-jurisdictional agreements are put in place to cover the costs for constructing, operating, and maintaining these facilities. Alongside this cross-jurisdictional cost-sharing, MDE provides the majority of external funds and financing for wastewater-related capital enhancements.

To function as self-sustaining entities funded by user fees or dedicated local tax revenues, wastewater utility agencies typically utilize integrated utility asset management principles and capital depreciation. Capital investment is essential due to evolving regulatory standards, population growth and development, and, in some instances, previous neglect. Maryland offers specific funding mechanisms such as grants and loans, each designed with particular goals and program requirements.

The Bay Restoration Fund (BRF), commonly referred to as the flush tax, was introduced in 2004 to encourage more extensive facilities to upgrade to ENR treatment standards. Legislation passed in 2017 broadened the scope of the BRF to include funding for biological nutrient removal as well as ENR. Annually, the BRF allocates approximately $75 million for enhancements to WWTPs, combined sewer overflows, sanitary sewer overflows, stormwater management, and the connection of septic systems to WWTPs. Additionally, about $15 million is reserved for septic system enhancements. The BRF does not fund increased treatment capacity; therefore, the utility must finance any necessary capacity expansion, typically through user fees.

2025 Grade: C+

The Infrastructure Investment and Jobs Act has supported over $11.7 billion in Clean Water State Revolving Funds, providing funding for grants, principal forgiveness loans, and low-interest loans. This funding supports a broad spectrum of water projects, including wastewater treatment. For example, this funding supported an initiative to upgrade 67 wastewater treatment plants in Maryland to enhanced nutrient removal functionality.

In addition, Maryland's Water Quality Revolving Loan Fund benefits from an annual grant from the EPA through the Drinking Waters State Revolving Fund, supplemented by matching funds from the state. This funding and recycled funds from previous loan repayments are used to finance new projects.

With over 420,000 of its households utilizing on-site wastewater treatment systems, Maryland established the BRF On-site Disposal Systems Fund to help homeowners cover the costs of upgrading or replacing failing systems. Each user of an on-site system pays an annual fee of $60, which generates an estimated revenue of around $27 million each year, with 60% allocated for system upgrades and 40% dedicated to agricultural vegetation efforts (e.g., crop cover activities) to enhance nutrient removal. MDE has successfully upgraded over 12,000 conventional septic systems by either connecting homes to public sewer lines or installing nitrogen-removing best available technology through the BRF On-site Sewer Disposal System grant program and regulatory measures.

Wastewater utility service costs are typically determined by connection type (i.e., domestic or industrial), size, and the volume of metered drinking water consumed. In certain instances, dedicated enterprise funds paid by users are designed to guarantee sufficient funds for the proper operation and maintenance of the collection and treatment systems. Often, connection fees are incorporated into the annual property tax bill.

User rate increases are usually necessary to sustain the expected level of service over time. Affordability is crucial when planning the implementation and enforcement of regulations and the schedule. However, many smaller utilities frequently encounter challenges relying on general funds to cover significant maintenance expenses.

Projected capital costs for Maryland's wastewater infrastructure over the next two decades range from $10 billion to $12 billion. From a capacity perspective, substantial funding is required to enhance the infrastructure of collection systems. Much of this funding is expected to focus on developing new capacity for centralized collection and treatment and replacing failing septic tanks, particularly in rural coastal areas.

Future funding needs will also encompass the rehabilitation and expansion of centralized wastewater collection and treatment systems, the investigation into leak detection and treatment methodologies, management of contaminants of emerging concern, and systematic upgrades for non-point source systems across the watershed. Upgrades to wastewater treatment facilities are also necessary.

Public Safety

In Maryland, public alerts are issued during sewage overflow events to inform residents to steer clear of specific, affected areas. In addition, water contact warnings are communicated via social media, TV broadcasts, and newspapers. Between approximately 650 and 1,000 sewer overflows have been reported annually during each of the past five years. For example, in May 2025, approximately 21 million gallons of partially treated wastewater were released from Baltimore's Patapsco Wastewater Treatment Plant after a structural failure bypassed nitrogen-removal systems. The overflow discharged into the Patapsco River, prompting

the Anne Arundel County Department of Health to issue a recreational water contact advisory warning the public to avoid direct contact with affected waters. While officials stated the incident did not pose an "immediate health hazard," environmental groups such as the Chesapeake Bay Foundation cautioned that the overflow likely increased risks of exposure to fecal bacteria and other pathogens, as well as nutrient pollution that can worsen algal blooms and degrade water quality. The event highlighted the aging infrastructure and operational challenges facing Maryland's wastewater systems and renewed calls for stronger oversight and capital investment to prevent similar public-health threats.

Sewage backups in homes can happen due to hydraulic overload from heavy rain, but they can also result from the buildup of fats, oils, and grease or root infiltration in sewer lines. These problems usually occur on private properties, requiring the services of professional plumbing contractors to restore normal function.

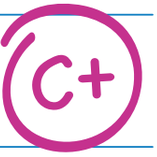
Resilience and Innovation

Maryland requires that WWTPs have backup power systems on-site to maintain critical operations, such as pumping and aeration. The conversation about resilience to climate change is growing, especially in light of rising sea levels, which increase the risk of WWTP flooding and the more frequent occurrence of severe storm events that lead to more significant infiltration and inflow in sewer systems. Wastewater utilities broadly acknowledge the need to tackle climate change through vulnerability assessments and comprehensive studies and seek additional funding sources to strengthen these initiatives.

The advancement of nutrient removal technology is highlighted as a key innovation within Maryland's wastewater utility sector. For instance, many WWTPs in Maryland are mandated to lower nitrogen levels to a point even more stringent than drinking water standards. Additionally, innovative solutions, such as phosphorus removal from wastewater via a method called struvite harvesting, transform the perception of wastewater from a pollutant to a valuable resource. Substances like PFAS, pharmaceuticals, and plastic microfibers may require enhanced wastewater treatment levels.

Many facilities aspire to achieve net-zero energy consumption through enhancements in energy efficiency, water conservation, energy recovery from sludge digester gas, and incorporating other renewable energy sources like solar energy.

After considering the available information, wastewater infrastructure in Maryland is assigned a grade of



Recommendations to Raise the Grade

Maryland possesses legacy wastewater systems and treatment plants that have been successfully upgraded and expanded to comply with increasingly strict water quality regulations and population needs. The anticipated capital expenses for rehabilitating the remaining wastewater collection systems statewide range from $10 billion to $12 billion over the next two decades. To continue the efforts in maintaining, rehabilitating, updating, and expanding its wastewater systems, Maryland should:

- Invest in less populated and underserved areas, such as Western Maryland and the Eastern Shore of Maryland. Future grant funding should focus on these rural areas and encourage improvements in their asset management.
- Consider consolidation of smaller utilities to address wastewater challenges of these small rural communities.
- Direct funding mechanisms towards high-impact projects. Funding should concentrate on initiatives that deliver maximum overall benefits for residents and users (including industry and manufacturing) while minimizing unaffordable monthly cost increases.

2025 Grade: C+

- Tackle contaminants of emerging concern. Both federal and state governments should explore funding opportunities for scientific research to address these contaminants.
- Invest in facility operations and staff training. The state and local agencies should prioritize enhancing operations and developing staff capabilities.
- Evaluate utility fees which should cover the full cost of service including operation, maintenance, and capital needs.

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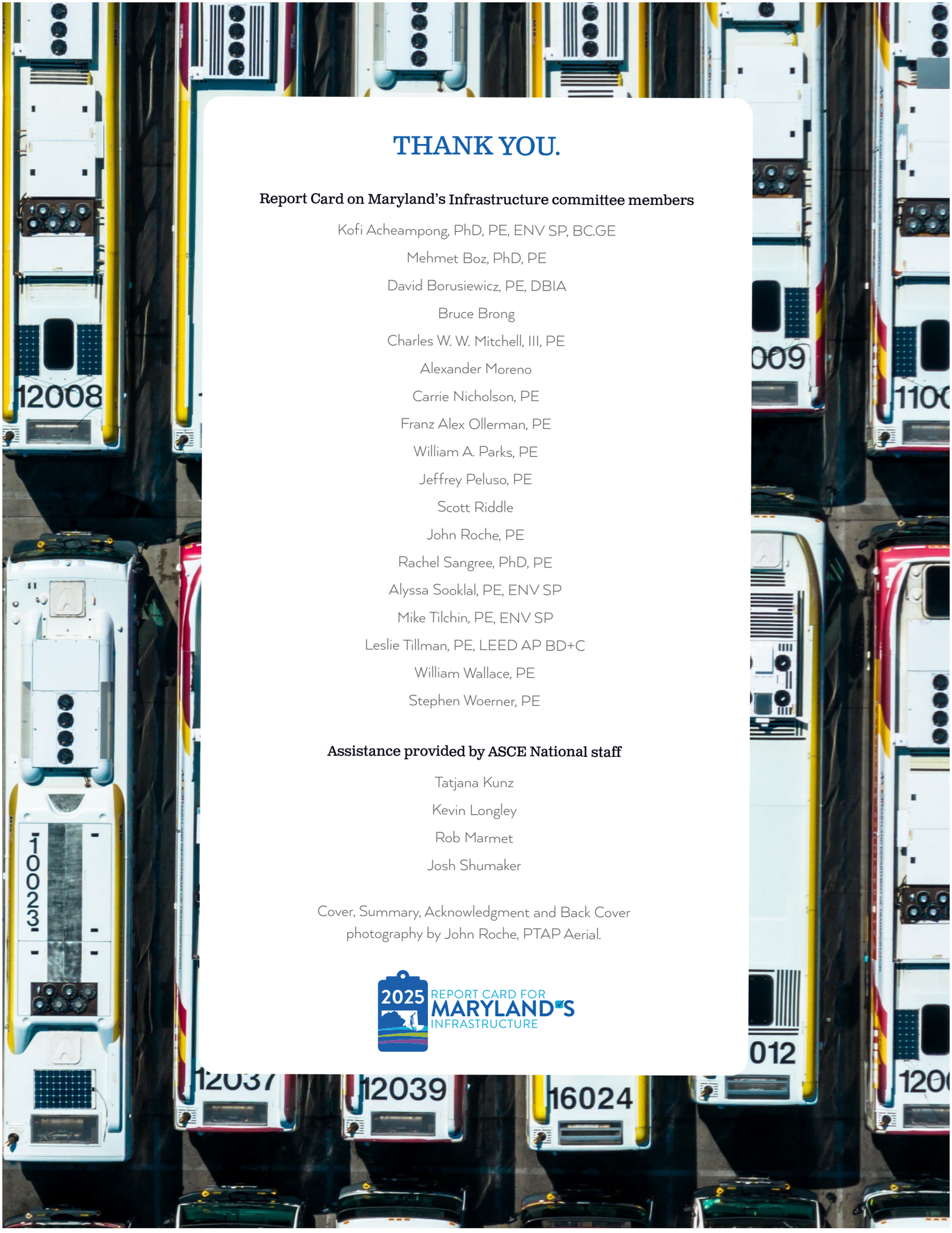

THANK YOU.

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