OFFICE OF THE STATE AUDITOR

DIANA DIZOGLIO

Official Audit Report – Issued March 10, 2025

Massachusetts Bay Transportation Authority

For the period January 1, 2021 through December 31, 2022

OFFICE OF THE STATE AUDITOR

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March 10, 2025

Monica Tibbits-Nutt, Secretary and Chief Executive Officer
Massachusetts Department of Transportation
State Transportation Building
10 Park Plaza, Suite 4160
Boston, MA 02116

Dear Secretary Tibbits-Nutt:

I am pleased to provide to you the results of the enclosed performance audit of the Massachusetts Bay Transportation Authority (MBTA) as it relates to the safety of certain subway assets. This report details the audit objectives, scope, methodology, findings, and recommendations for the audit period, January 1, 2021 through December 31, 2022.

This report is part of a series of reports that the Office of the State Auditor (OSA) is issuing as part of a performance audit of the MBTA. Among other topics, we have chosen to examine areas such as contract performance, operational concerns, and spending. While all part of one audit, these topics are best addressed in incremental reports.

OSA audits over 200 state agencies as part of our statutory mandate. In doing so, we examine areas of risk, including program integrity, funding sources, spending, and potential operational weaknesses, including safety. We also reexamine previous audits to determine whether the agency has implemented our recommendations.

Based on our research, the MBTA is a “high-risk” agency that warrants consistent oversight due to the size of its budget, the complexity of its operations, and the risks related to the services it provides. While our resources are limited, making it difficult to provide the needed level of oversight, we continue to advocate for funding that would support the creation of a transportation audit unit within OSA. This unit would allow us to provide the MBTA with recommendations that help it provide for safer, more efficient, and more cost-effective programming for Massachusetts riders and taxpayers.

The mission of OSA is to provide oversight and insight to improve performance and make government work better. In this report, we found several issues regarding the MBTA’s preventive maintenance and inspection activities for certain subway assets that require attention to ensure the safe and effective provision of service to the people of Massachusetts.

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In the "Other Matters" section of this report, we identify issues warranting attention that, while not part of our original objectives at the beginning of this audit, came to light during the course of our work. These findings highlight the need for additional improvements to enhance safety for pedestrians at commuter rail stations with grade crossings.

It is our team's hope that you find this report helpful as we work together to improve services, now and in the future.

We welcome the opportunity to discuss the findings and recommendations of this and our future reports with you.

Best regards,

Diana DiZoglio
Auditor of the Commonwealth

cc: Thomas McGee, Chair of the Massachusetts Bay Transportation Authority Board of Directors
Phillip Eng, General Manager and Chief Executive Officer of the Massachusetts Bay Transportation Authority

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LIST OF ABBREVIATIONS

FRA	Federal Railroad Administration
FTA	Federal Transit Administration
MBTA	Massachusetts Bay Transportation Authority
MOW	Maintenance of Way
PM	preventive maintenance
TAMP	Transit Asset Management Plan

EXECUTIVE SUMMARY

In accordance with Section 12 of Chapter 11 of the Massachusetts General Laws, the Office of the State Auditor has conducted a performance audit of the Massachusetts Bay Transportation Authority (MBTA) for the period January 1, 2021 through December 31, 2022.

This is part of a series of reports that the Office of the State Auditor has issued as part of a comprehensive performance audit of the MBTA, examining high-risk areas, such as Keolis[1] contract provisions, Automated Fare Collection 2.0[2] contract provisions, and additional topics focused on ensuring the safety of MBTA riders, employees, and the general public. This is the second report related to ensuring the safety of MBTA riders and employees, with the first report being issued on July 7, 2024 (Audit Report Number 2023-0583-3A).

The purpose of this second report was to determine the following:

- whether the MBTA ensured that visual inspections of its subway tracks were performed in accordance with Section 151.11(2)(a) of Title 220 of the Code of Massachusetts Regulation;
- whether the MBTA ensured that defects identified during visual inspections of subway tracks were remediated within the requirements of MBTA's Track Maintenance Standards;
- whether the MBTA ensured that preventive maintenance (PM) inspections of its subway cars were performed in accordance with its "Equipment Engineering and Quality Assurance Vehicle Inspection Guidelines";
- whether the MBTA ensured that defects identified during PM inspections of subway cars were remediated within the requirements of the MBTA's Preventive Maintenance Inspection and Documentation Policy; and
- to what extent the MBTA performed visual inspections of its subway station facilities in accordance with Section 6.2.2 of its 2018 and 2022 Transit Asset Management Plans.

Although not within the scope of our original objectives, we also identified an issue that we believe warrants attention, which we outlined in the "Other Matters" section of this report. This issue relates to pedestrian safety at MBTA commuter rail stations with at-grade crossings.

1. This is the company contracted by the MBTA to operate its commuter rail services.
2. This is the MBTA's ongoing project to replace its automated fare collection system.

Below is a summary of our findings, the effect of those findings, and our recommendations, with links to each page listed.

Finding 1 **Page 19**	The MBTA did not ensure the timely completion of preventive maintenance work orders for visual inspections of its subway tracks.
Effect	Open work orders can skew the accuracy of the MBTA's enterprise asset management system, on which it relies to monitor the condition of its infrastructure. This makes it difficult to track whether these PM tasks have actually been carried out and whether any potential maintenance trends and/or backlogs exist. This undermines the reliability of the MBTA's enterprise asset management system. Further, not performing inspections on their scheduled date increases risks to people and the MBTA's physical assets and increases the risk of noncompliance with regulatory requirements, particularly those related to inspection frequency.
Recommendations **Page 20**	1. The MBTA should ensure that visual inspections of its subway tracks are conducted on time. 2. The MBTA should establish a formal policy or procedure that provides clear guidelines for when PM work orders should be opened, completed, and closed. The MBTA should ensure that its staff members adhere to this policy when performing PM activities. 3. Once the PM work order system is an accurate reflection of the MBTA's work in this regard, management should use the PM work order system to effectively monitor ongoing performance and progress in addressing related maintenance of its physical assets.
Finding 2 **Page 22**	The MBTA did not ensure that defects identified during inspections of subway tracks were remediated in accordance with its Track Maintenance Standards.
Effect	Recent incidents involving derailments on the MBTA's Red and Green Lines, which caused injuries and significant delays for passengers, highlight the importance of promptly remediating track defects to prevent future occurrences. The MBTA may be unable to effectively prioritize and address safety hazards if it does not address track defects discovered during inspections according to its Track Maintenance Standards, or if it does not subsequently verify that the defects have not deteriorated further. This could ultimately lead to safety hazards for both MBTA riders and employees.
Recommendations **Page 24**	1. The MBTA should ensure that defect codes in the MBTA's enterprise asset management system are able to be traced to its Track Maintenance Standards to ensure the consistent remediation of each type of defect. 2. The MBTA should ensure that speed restrictions for defects that require them are documented in its enterprise asset management system and that systems are in place to ensure that trains abide by these restrictions. 3. The MBTA should ensure that its track inspectors are consistently documenting the verification (physical condition) of existing track defects. 4. The MBTA should implement adequate monitoring controls to ensure that expected remedial action is completed within the required time frame and that this performance is reviewed by appropriate management.
Finding 3 **Page 25**	The MBTA did not always perform PM inspections on its subway cars at the required intervals.

Effect	Regular inspections of subway cars are critical to ensuring the safe and efficient operation of the MBTA's subway system. Without timely inspections, mechanical issues could go unnoticed, increasing the likelihood of equipment failures, potentially leading to accidents or derailments. This could jeopardize the safety of riders and the general public. Failure to conduct timely inspections can also increase the complexity and cost of addressing problems that exist.
Recommendation Page 27	The MBTA should implement adequate monitoring controls to ensure that inspections of its transit subway rail cars occur at the required intervals.
Finding 4 Page 28	The MBTA did not consistently document deferred defects found during subway car inspections and did not always accurately record their associated severity codes.
Effect	If the MBTA does not accurately and consistently document deferred defects and their associated severity codes found during subway car PM inspections, it cannot ensure that all deferred defects are monitored and addressed in a timely manner and in accordance with its Preventive Maintenance Inspection and Documentation Policy. In addition, if the MBTA does not ensure the accuracy of this information, the MBTA's ability to evaluate the effectiveness of its employees' efforts to identify and address maintenance needs is limited.
Recommendations Page 30	1. The MBTA should enhance its monitoring controls to ensure accurate and consistent documentation of deferred defects and their associated severity codes found during PM inspections of its subway cars. 2. The MBTA should use technology systems to improve the efficiency and effectiveness of its work, including maintenance, to ensure that it has ready access to maintenance, cost, performance, and other data.
Finding 5 Page 31	The MBTA did not ensure that visual inspections of its subway station facilities were performed.
Effect	A lack of regular inspections increases the risk that safety hazards and maintenance needs may not be identified in a timely manner, affecting the safety of the MBTA's riders, employees, and the general public.
Recommendations Page 32	1. The MBTA should conduct visual inspections of stations on a regular basis to identify and address safety hazards and maintenance needs. The MBTA should maintain records of these inspections. 2. The MBTA should implement formal, comprehensive policies and procedures for subway station facility visual inspections, including a monitoring component. 3. The MBTA should track and analyze the results of visual inspections to determine trends, manage performance, and conduct other management duties.
Finding 6 Page 32	The MBTA did not ensure that all of its information system users completed cybersecurity awareness training.
Effect	If the MBTA does not ensure that all of its information system users complete cybersecurity awareness training, then the MBTA is exposed to an elevated risk of cybersecurity attacks, which may cause financial and/or reputational losses.
Recommendation Page 34	The MBTA should ensure that all of its information system users complete cybersecurity awareness training as part of initial training and annually thereafter and should maintain records of this training.

OVERVIEW OF AUDITED ENTITY

The Massachusetts Bay Transportation Authority (MBTA) was created in 1964, pursuant to Chapter 161A of the Massachusetts General Laws. The agency provides the following: a rapid transit system, commuter rail services, bus services, ferry routes, and transit services for people with disabilities. According to its website, the MBTA is "one of the largest public transit systems in the country, serving nearly 200 cities and towns and over 1 million daily riders."

According to Section 7 of Chapter 161A of the General Laws, the MBTA is governed by a nine-member board of directors. This section states,

> *The board shall consist of: secretary [of Transportation], who shall serve ex officio; 1 person to be appointed by the mayor of the city of Boston; 1 person to be appointed by the advisory board who shall have municipal government experience in the service area constituting the authority and experience in transportation operations, transportation planning, housing policy, urban planning or public or private finance; provided, however, that said person shall not represent the city of Boston; and 6 persons to be appointed by the governor, 1 of whom shall have experience in safety, 1 of whom shall have experience in transportation operations, 1 of whom shall have experience in public or private finance, 1 of whom shall be a rider as defined in section 1 [of the General Laws] and a resident of an environmental justice population as defined in section 62 of chapter 30 [of the General Laws], 1 of whom shall be a municipal official representing a city or town located in the area constituting the authority representing the service area . . . and 1 of whom shall be selected from a list of 3 persons recommended by the president of the Massachusetts State Labor Council.*
>
> *Not less than 2 of the appointed members shall also be members of the board of directors of the Massachusetts Department of Transportation.*

The MBTA is also overseen by the Massachusetts Department of Transportation board of directors, whose 11 members are appointed by the Governor. According to Section 3(d) of Chapter 161A of the General Laws, the General Manager of the MBTA is hired by the Secretary of Transportation and oversees the MBTA's day-to-day activities.

Preventive Maintenance of Subway Assets

Performing preventive maintenance (PM) inspections on subway assets is critical for ensuring the safety, efficiency, and reliability of the MBTA's rail system. Subway infrastructure—including tracks, trains, station facilities, signaling systems, and other assets—operate under high stress and frequent use and are exposed to all types of weather conditions. Over time, wear and tear can accumulate, leading to potential safety hazards, service disruptions, and costly repairs. Regularly performing PM inspections can help

identify and address issues before they escalate, improving both the operational lifespan of assets and the quality of service for passengers while reducing the cost and inconvenience of addressing these issues later, when they have grown in severity or complexity.

Visual Inspections of Subway Track

The MBTA's subway system includes 166 miles of track, featuring five primary lines that link riders throughout downtown Boston. Three of these lines operate as heavy rail[3] lines (the Red, Orange, and Blue Lines) while the other two operate as light rail[4] lines (the Green Line and Mattapan High-Speed Trolley Line). The Red and Orange Lines and a majority of the Blue Line are powered by an electric third rail, whereas the Green Line, Mattapan Line, and a section of the Blue Line use overhead wire systems for power.

The Massachusetts Department of Public Utilities, the federally designated State Safety Oversight agency for the MBTA's subway operations, has set standards for the inspection of MBTA track. According to the Department of Public Utilities' regulations, specifically Section 151.11 (2)(a) of Title 220 of the Code of Massachusetts Regulation, visual inspections of MBTA track must be made according to the schedule below.

Type of Track	Required Frequency
Light Rail Passenger-service Track	Three times per week with at least one calendar day interval between inspections
Heavy Rail Passenger-service Track	Twice weekly with at least one calendar day interval between inspections

The MBTA's Maintenance of Way (MOW) Department is responsible for the maintenance and repair of MBTA track. The MBTA's enterprise asset management system is programmed to automatically generate work orders every week for visual inspections based on the required frequency mentioned above. During a visual inspection[5] of MBTA track, inspectors within the MOW Department walk each section of track looking for visible signs of damage or wear, such as cracks, misalignments, or other anomalies. Inspectors

3. According to the American Public Transportation Association, a nonprofit group of public and private organizations that promotes the interests of public transportation in the United States, heavy rail is an electric railway with the capacity to handle a heavy volume of traffic.
4. According to the American Public Transportation Association, light rail usually handles a smaller volume of passengers.
5. According to MBTA officials, in addition to visual inspections, the MBTA uses third-party vendors to perform ultrasonic and optical inspections of track. Ultrasonic inspections use sound waves to detect internal flaws in the track. Optical inspections use a laser to detect defects, wear, and measure track geometry. On August 30, 2023, the MBTA released a report conducted by an independent consultant that covered the ultrasonic and optical inspection processes. To avoid duplicating efforts, we limited the scope of our audit work to only include visual inspections of track conducted by the MBTA, according to the schedule set forth by the Department of Public Utilities.

use a phone equipped with a software application (separate from the enterprise asset management system) to record inspections and any defects found during those inspections. The software application is equipped with GPS technology, allowing inspectors to mark the location of any defects or other problems they observe during the inspection. Once the inspection is complete, the software application generates a Track Inspection Report that details the results of the inspection. The Track Inspection Report is emailed to the inspector's supervisor for review. The supervisor attaches the Track Inspection Report to the relevant work order in the enterprise asset management system and closes the work order, indicating that the PM has been completed.

Subway Track Defect Reporting and Remediation

The MBTA uses severity codes to categorize the extent of defects or issues observed on the tracks. These codes help prioritize maintenance and repair actions based on the criticality of the defect and its potential impact on safety, train operations, and infrastructure longevity.

The MBTA's Track Maintenance Standards establish three severity thresholds for identifying defects in both light and heavy rail lines: green, yellow, and red. Green conditions are those that do not necessarily require immediate remedial action but do need to be monitored. Yellow conditions indicate that maintenance limits have been reached or are closely approaching the threshold for trains operating at normal speed. Remedial action is required for yellow conditions, typically within 30 days, depending on the type of defect. Red conditions represent the highest repair priority and necessitate speed restrictions. These defects often require immediate remedial action and may involve removing the track from service until repairs are completed.

All defects found during inspections are recorded in the MBTA's enterprise asset management system. When a defect is identified, a service request is created. A supervisor then generates a work order based on that service request. The work order is executed, and the defect is to be repaired in accordance with the specifications outlined in the MBTA's Track Maintenance Standards.

Inspections of Subway Cars

Periodic vehicle inspection and PM is one of the most important activities for vehicle reliability and passenger safety. These recurring inspections address critical safety components as well as other components that ensure reliability, performance, and passenger comfort.

The MBTA performs PM inspections at predetermined intervals based on mileage or time, which are determined individually for each fleet of vehicles.[6] Inspection intervals have been developed by the MBTA's Engineering Evaluation & Quality Assurance Department, taking into consideration the manufacturer's recommendations, component performance, and MBTA maintenance policies. The inspection process includes checks of both critical systems (e.g., braking, suspension, and structural integrity) and supplementary systems (e.g., lighting, HVAC, and interior condition). These inspections are recorded and tracked in the MBTA's enterprise asset management system.

Each day, a Periodic Mileage Inspection Report is automatically emailed to forepersons at each MBTA car house.[7] This report identifies the next rail cars that are due for inspection based on the current mileage for the vehicle. The car house foreperson orders that the appropriate vehicles be temporarily removed from service so that they can undergo the necessary inspection. The car house foreperson assigns repair personnel and creates a work order in the asset management system, indicating the current mileage. Repair personnel complete the inspection and document any defects found (and their corresponding severity codes) on a hardcopy Mileage Inspection Form. Once completed, the Mileage Inspection Forms are sent to the car house foreperson, who reviews the information and inputs it into the asset management system. The hardcopy Mileage Inspection Forms are stored in file cabinets at MBTA car houses. Upon completion of each vehicle inspection, the work order is closed in the asset management system, indicating the PM has been completed. The MBTA's enterprise asset management system automictically calculates the mileage or date at which the next PM inspection is due.

According to the MBTA's Equipment Engineering and Quality Assurance Vehicle Inspection Guidelines, the following is the lifecycle management strategy for inspection and PM for subway cars:

6. Each MBTA subway line has its own fleet of vehicles.
7. The MBTA performs service, inspections, and repairs on its subway cars at 13 facilities (car houses) located throughout the Commonwealth.

Lifecycle Management Strategy	Frequency
Red Line PM Inspections—Number 1 and 2 cars	8,500 miles
Red Line PM Inspections—Number 3 cars	15,000 miles
Orange Line PM Inspections—Number 12 cars	12,000 miles or 90 days
Orange Line PM Inspections—Number 14 cars	15,000 miles
Blue Line PM Inspections—Number 4 cars	7,500 miles
Blue Line PM Inspections—Number 5 cars	12,000 miles
Green Line PM Inspections—Type 7 cars	7,500 miles
Green Line PM Inspections—Type 8 cars	10,000 miles or 180 days
Green Line PM Inspections—Type 9 cars	10,000 miles
Green Line PM Inspections—Presidents' Conference Committee cars	30 days

Subway Car Defect Reporting and Remediation

The car house foreperson reviews all deferred defects[8] found during an inspection and assigns a defect severity code to each. As previously mentioned, this information is input into the MBTA's enterprise asset management system. According to MBTA officials, if the car house foreperson believes that the severity of a defect is different from what was initially recorded on the inspection report, the inspection report should be revised to reflect this assessment. According to the Heavy Rail and Light Rail section of the MBTA Subway Operations Preventive Maintenance Inspection and Documentation Policy, the following are the defect severity codes for subway cars:

Code A (Safety Critical / Hold for Repair)	*This status is assigned to defects that would pose an immediate safety threat to the passengers, operators or others, as determined by the car house foreperson. A vehicle with this type of defect is not returned to service until the safety critical / Code A defect(s) is (are) repaired.*
Code B (Schedule for Repair) [45 days]	*Class B repairs need to be completed within 45 days from the inspection. These defects are not a safety concern but must be addressed in the near term to avoid reducing the vehicle's reliability. This Class indicates that the vehicle may be returned to service temporarily but is scheduled for repair of the defect in the short term.*
Code C (Serviceable)	*Code C repairs are for cars awaiting delivery of parts that may take longer than 45 days to deliver. This is assigned to defects that are not expected to have a significant effect on safety or reliability but which are recommended to be addressed to keep the vehicle in a state of good repair. This indicates that the vehicle may be returned to service, and the defect will be repaired at the next opportunity.*

8. A deferred defect is a problem or issue identified during an inspection that is not immediately addressed or repaired. Instead, the repair of the defect is postponed—deferred—to a later time.

The car house foreperson schedules the repair of deferred defects through a new service request and work order in the MBTA's enterprise asset management system. The PM inspection is performed by the line superintendent and Quality Department before a car is released and returned to service.

Inspections of MBTA Subway Station Facilities

A routine visual inspection of a subway station is an important part of maintaining safety, functionality, and cleanliness within the station's infrastructure. It ensures that the station remains safe for both passengers and staff members and that all facilities and equipment are in good working condition.

According to the MBTA's 2022 Transit Asset Management Plan (TAMP), the MBTA's Transit Facilities Maintenance Department conducts monthly, quarterly, and annual visual inspections of MBTA stations. Although the MBTA's TAMP does not specify what components and areas are inspected during a visual inspection, Section 3.1.3 of the American Public Transportation Association's "Rail Transit Station, Shop, and Yard Inspection and Maintenance" standard states the following:

> *Routine inspections and maintenance procedures shall be designated for all structural components and equipment, including but not limited to the following:*
>
> - *tripping hazards*
> - *missing pieces of platform edges or tactile warning strips*
> - *loose sections of overhead concrete*
> - *broken handrails*
> - *cracked stairway nosings*
> - *peeling surface coatings*
> - *defects noted during regular testing of shop equipment*
> - *any other inspectional observation having the potential to cause injury or bodily harm to people*
> - *structural cracks or shifting*
> - *severely corroded structural members*
> - *structural deterioration of platform overhangs*
> - *significant widening of expansion joints*
> - *critical concrete slab protrusions*

- *falling section of overhead concrete*
- *significant bulging of platform walls or partitions*
- *heavy water infiltration*
- *any other inspection observation having the potential to cause injury or bodily harm, or to generate a costly investment by the transportation provider to remediate the defect*

AUDIT OBJECTIVES, SCOPE, AND METHODOLOGY

In accordance with Section 12 of Chapter 11 of the Massachusetts General Laws, the Office of the State Auditor has conducted a performance audit of certain activities of the Massachusetts Bay Transportation Authority (MBTA) for the period January 1, 2021 through December 31, 2022.

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Below is a list of our audit objectives, indicating each question we intended our audit to answer; the conclusion we reached regarding each objective; and, if applicable, where each objective is discussed in the audit findings.

Objective	Conclusion
1. Did the MBTA visually inspect its subway track in accordance with Section 151.11(2)(a) of Title 220 of the Code of Massachusetts Regulation?	**No; see Findings 1 and 6**
2. Were defects identified during visual inspections of subway track remediated within the requirements of MBTA's Track Maintenance Standards?	**No; see Finding 2**
3. Did the MBTA perform preventive maintenance (PM) inspections of its subway cars in accordance with its "Equipment Engineering and Quality Assurance Vehicle Inspection Guidelines"?	**No; see Finding 3**
4. Were defects identified during PM inspections of subway cars remediated within the requirements of the MBTA's Preventive Maintenance Inspection and Documentation Policy?	**No; see Finding 4**
5. To what extent did the MBTA perform subway station facilities inspections in accordance with Section 6.2.2 of its 2018 and 2022 Transit Asset Management Plan (TAMP)?	**To an unsatisfactory extent; see Finding 5**

To accomplish our objectives, we gained an understanding of MBTA's internal control environment relevant to our objectives by reviewing applicable policies and procedures and by interviewing officials at the MBTA.

To obtain sufficient, appropriate evidence to address our audit objectives, we performed the following procedures.

Scope Limitations

Section 9.12 of the US Government Accountability Office's Government Auditing Standards states, "Auditors should . . . report any significant constraints imposed on the audit approach by information limitations or scope impairments." During our audit of the MBTA, there were significant constraints on our ability to obtain the information necessary to achieve our objectives, as follows.

Subway Track Visual Inspections

To determine whether the MBTA ensured that visual inspections of its subway tracks were performed in accordance with Section 151.11(2)(a) of Title 220 of the Code of Massachusetts Regulation, we requested from MBTA management a list of all subway track visual inspections conducted during the audit period. The MBTA informed us that it could not provide the data for the period January 1, 2021 through April 4, 2021 because the MBTA's enterprise asset management system, used to record subway track inspections, was only implemented in April 2021. According to MBTA officials, all records before this implementation were maintained manually, and retrieving these records would result in excessive delays to our audit work. As a result, we limited the scope of our audit for Objective 1 to the period April 5, 2021 through December 31, 2022.

We interviewed the MBTA's director of maintenance of way (MOW), the senior director of MOW, the MBTA's director of reliability and engineering configuration, and a section foreperson to discuss the process of visual inspections of subway tracks that was in place during the audit period. The MBTA provided us with an inventory list of all subway tracks by inspection segment as well as a list of all subway track inspections for the period April 5, 2021 through December 31, 2022 (a total of 6,373 track inspections). We then analyzed the data to ensure that a track inspector performed the inspection three times a week with at least one calendar day interval between inspections for light-rail subway track and twice weekly with at least one calendar day interval between inspections for heavy-rail subway track.

Based on the results of this analysis, we found that 4,309 of the PM work orders were not reviewed or were closed on the same day as the inspection. We then selected a sample of 60 inspections for further testing as follows. We first selected a random, nonstatistical sample of 30 inspections from the 4,309 PM work orders. We then selected an additional, judgmental sample of 30 inspections based on the longest duration between when the PM work order was opened and when it was closed. For

each of the inspections in our sample of 60, we compared the date of actual inspection that was reported on the hardcopy Track Inspection Report to the scheduled date of the PM inspection found in the MBTA's enterprise asset management system.

We noted that the MBTA did not ensure the timely completion of preventive maintenance work orders. See Finding 1 for information on the results of this testing.

Subway Track Defect Reporting and Remediation

To determine whether the MBTA ensured that the subway track defects identified during visual inspections were remediated within the requirements of the MBTA's Track Maintenance Standards, we requested from MBTA management a list of all subway track defects reported during the audit period. We interviewed the MBTA's director of MOW, the senior director of MOW, the MBTA's director of reliability and engineering configuration, and a section foreperson to discuss the subway track defect reporting and remediation process that was in place during the audit period. The MBTA provided us with a list of 5,998 track service requests that detailed information and issues found during visual inspections during the audit period. The MBTA also provided us a list of 22,674 subway track defects for the period May 14, 2021 through December 31, 2022. MBTA officials informed us that they could not provide track defect verification data for the period January 1, 2021 through May 13, 2021 because the MBTA's electronic defect module was not implemented until May 14, 2021. According to MBTA officials, before implementing the defect module, all records were maintained manually and retrieving them would have resulted in excessive delays to our audit work. As a result, our testing of the verification of existing defects was limited to the period May 14, 2021 through December 31, 2022. Lastly, the MBTA provided a mapping file that we used to determine which defect criteria to use for testing.

From the list of track asset service requests, we selected a random, statistical sample[9] of 60 out of 5,998 track asset service requests, using a 95% confidence level, a 0% expected error rate,[10] and a 5%

9. Auditors use statistical sampling to select items for audit testing when a population is large and contains similar items. Auditors generally use a statistical software program to choose a random sample when sampling is used. The results of testing using statistical sampling, unlike those from judgmental sampling, can usually be used to make conclusions or projections about entire populations.
10. Expected error rate is the number of errors that are expected in the population, expressed as a percentage. It is based on the auditor's knowledge of factors such as prior year results, the understanding of controls gained in planning, or a probe sample.

tolerable error rate.[11] For each track asset service request in our sample, we reviewed the priority level of each defect and determined whether the MBTA could substantiate that it had performed the remedial action required by the MBTA Track Maintenance Standards. Specifically, we determined whether a speed restriction, if required, was documented in the MBTA's enterprise asset management system and whether the repairs were scheduled or completed within the required time frames. We also determined whether all existing defects were being verified and/or updated by track inspectors during subsequent inspections.

We noted that the MBTA did not ensure that defects identified during inspections of subway tracks were remediated in accordance with its Track Maintenance Standards. See Finding 2 for information on the results of this testing.

Subway Station Facility Inspection

To determine to what extent the MBTA performed visual inspections of its subway station facilities in accordance with Section 6.2.2 of its 2018 and 2022 Transit Asset Management Plans, we took the actions described below.

We interviewed the MBTA's director of transit facilities maintenance to discuss the MBTA's process for routinely inspecting its subway station facilities. Specifically, we discussed the various types of routine inspections performed, the frequency of such inspections, what each inspection entailed, how each inspection was documented, and the defect remediation process, including timelines. We requested documentation to substantiate that the MBTA performed these inspections for all 122 subway stations throughout the MBTA system during the audit period. In response to our request for documentation, the MBTA only provided annual inspection reports for 50 (41%) of the 122 stations for the year 2021. The MBTA could not demonstrate that any monthly or quarterly inspections were conducted for any stations in 2021. Furthermore, no visual inspections for subway stations could be substantiated for the year 2022. As a result, our review was limited to the 50 annual inspection documents that were made available to us for 2021. We inspected the 50 annual inspection reports for 2021 to determine when each inspection was performed and whether the reports included clear

11. The tolerable error rate (which is expressed as a percentage) is the maximum error in the population that is acceptable while still using the sample to conclude that the results from the sample have achieved the objective.

documentation of the inspection results, identifying any deficiencies and the remediation efforts taken to address those deficiencies.

We noted that the MBTA did not ensure that visual inspections of its subway station facilities were performed. See Finding 5 for information on the results of this testing.

Subway Car Inspection

To determine whether the MBTA ensured that PM inspections of its subway cars were performed in accordance with its Equipment Engineering and Quality Assurance Vehicle Inspection Guidelines we took the following actions:

- We interviewed the MBTA's chief mechanical officer, the director of MOW, the deputy director of vehicle maintenance, and the project manager of transit applications to discuss the subway car PM inspection process that was in place during the audit period. The MBTA provided us with a list of all MBTA subway cars and all PM inspections for the audit period.
- During the period January 1, 2021 through December 31, 2022, we analyzed all 4,965 PM inspection work orders, comparing the mileage and day intervals between each scheduled inspection, to determine whether each subway car received an inspection in accordance with the intervals outlined in the MBTA's Equipment Engineering and Quality Assurance Vehicle Inspection Guidelines.

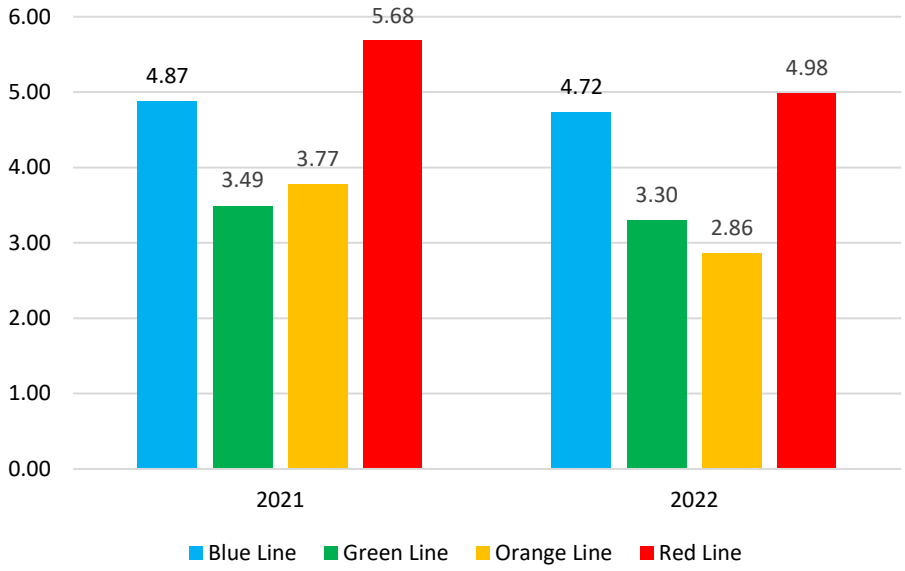
We noted that the MBTA did not always perform preventive maintenance on its subway cars at the required intervals. See Finding 3 for information on the results of this testing.

Subway Car Defect Reporting and Remediation

To determine whether the MBTA ensured that subway car defects identified during PM inspections were remediated within the requirements of the MBTA's Preventive Maintenance Inspection and Documentation Policy, we took the actions described below.

We interviewed the MBTA's chief mechanical officer, the director of MOW, the deputy director of vehicle maintenance, and the project manager of transit applications to discuss the defect remediation process of its subway cars that was in place during the audit period. The MBTA provided us with a list of all 5,681 subway car PM work orders from the audit period. The chart below shows the average number of PM work orders per car, broken down by subway line, for calendar years 2021 and 2022.

Average Number of Work Orders per Car per Subway Line



From this list, we selected a random, statistical sample of 60 work orders, using a 95% confidence level, a 0% error rate, and a 5% tolerable error rate. Within this sample of 60 work orders, we identified 390 total deferred defects (averaging 6.5 deferred defects per work order, with a range of 1 to 19 defects per work order). We then performed the following tests:

- Based on the severity code of each reported defect, we determined whether MBTA performed prescribed remedial action based on the MBTA Preventive Maintenance Inspection and Documentation Policy as follows[12]:
    - For Code A, we inspected the mileage report to determine whether the subway car was held from service until repaired.
    - For Code B, we inspected asset service request and work order records to determine whether the subway car was inspected within 45 days from the date of PM.
    - For Code C, we inspected asset service request and work order records to determine the date that the subway car was repaired, if at all.

We noted that the MBTA did not consistently document deferred defects found during subway car inspections and did not always accurately record their associated severity codes. See Finding 4 for information on the results of this testing.

12. Please see the severity code table in the Overview for a description of each severity code.

We used a combination of statistical and nonstatistical sampling methods for testing, and we did not project the results of our testing to the corresponding populations.

Data Reliability Assessment

MBTA Enterprise Asset Management System

To determine the reliability of the data that we obtained from the MBTA's enterprise asset management system for the audit period, we interviewed MBTA officials who were knowledgeable about the data. We also reviewed select system controls related to access controls, configuration management, contingency planning, segregation of duties, and security management. Through this testing, we found that the MBTA did not ensure that all its information system users completed cybersecurity awareness training. See Finding 6 for more information regarding the results of our review of the information system controls.

From the MBTA's enterprise asset management system, we obtained a list of all subway track inspections for the period April 1, 2021 through December 31, 2022; a list of all subway track asset service requests and a list of all subway car inspections during the audit period. We also reviewed the enterprise asset management system work order interface data field mapping to gain an understanding of the tables and fields available within the system. For each of these data sets, we reviewed the parameters used in generating the list from the system. We also checked the list for missing data, blank fields, meaningful or expected values, and dates outside the audit period.

To determine the reliability of the list of subway track inspections, we judgmentally selected a sample of 20 track inspection work orders from the list and compared the work order number, work order location identification number, work order year, PM service track segment, date of PM schedule, and user identification number of the employee who closed the work order to the source document (inspection work orders). Further, we performed a reconciliation to match the data from the enterprise asset management system to the list of track inventory by inspection segment received from the MBTA's track inspection and defect verification system.

To determine the reliability of the list of subway track asset service requests, we judgmentally selected 20 service requests from the list and compared the equipment number, status, line, date, priority, unique identification number, problem, and description to the original documents. Further, we

performed a reconciliation to match the subway track asset service requests to the list of defect verifications received from the MBTA's track inspection and defect verification system.

To determine the reliability of the list of subway car inspections, we judgmentally selected a sample of 20 subway car inspections from the list and compared the line, unit, labor date, mileage meter at the time, work order, task description, and employee identification number to the original documents, (inspection forms and work orders). Further, we judgmentally selected a sample of 20 subway car inspection forms and traced the line, unit, labor date, meter at the time, work order, task description, and employee identification number to the list of subway car inspections received from the MBTA's enterprise asset management system.

MBTA Defect Module

To determine the reliability of the defect verifications received from the MBTA's defect module for the period May 14, 2021 through December 31, 2022, we interviewed MBTA officials who were knowledgeable about the data. We also reviewed select system controls related to access controls, configuration management, contingency planning, segregation of duties, and security management. Through this testing, we found that the MBTA did not ensure that all its information system users completed cybersecurity awareness training. See Finding 6 for more information regarding the results of our review of the information system controls. Further, we reviewed the query documentation to ensure that all records and requested fields were included in the received data. We also checked the list for missing data, blank fields, and dates outside the audit period. In addition, we judgmentally selected a sample of 20 defect verifications from the list and compared the unique identification number, status, priority, problem, description, date, rail, line, and track segment to the original documents (subway track inspection reports). Further, we judgmentally selected a sample of 20 defect verifications from the subway track inspection reports and traced the unique identification number, enterprise asset management identification number, status, priority, problem, description, date, rail, line, and track segment to the list of defect verifications received from the MBTA's defect module.

Based on the results of the data reliability procedures described above, we determined that the information obtained for the audit period was sufficiently reliable for the purposes of our audit.

DETAILED AUDIT FINDINGS WITH AUDITEE'S RESPONSE

1. The Massachusetts Bay Transportation Authority did not ensure the timely completion of preventive maintenance work orders for visual inspections of its subway tracks.

The Massachusetts Bay Transportation Authority (MBTA) did not ensure the timely completion of preventive maintenance (PM) work orders for visual inspections of its subway track. Our analysis of 6,373 subway track visual inspection work orders revealed that some work orders remained open for several days or even weeks after the scheduled completion date. In addition, we found that some inspection work orders were closed before the scheduled inspection dates, suggesting that either the work was completed before being formally assigned or that the work orders were closed prematurely without the necessary inspections being conducted. Specifically, we noted the following:

- Of these 6,373 work orders, 1,026 (16%) work orders remained open for 6 to 40 days beyond the scheduled PM completion date.
- Of these 6,373 work orders, 26 (0.41%) work orders were closed 1 to 10 days before the date that the PM was scheduled to be completed.

In addition, from our extended sample of 60 scheduled PM work orders, we found 26 (43%) instances where the MBTA had performed the actual inspection on a date other than the date the inspection was scheduled. In 23 of these instances, the inspection had occurred after the scheduled inspection date, meaning that track inspections, including re-inspections of known problems, were delayed. For the remaining 3 instances, the inspection had occurred before the scheduled inspection date.

Open work orders can skew the accuracy of the MBTA's enterprise asset management system, on which it relies to monitor the condition of its infrastructure. This makes it difficult to track whether these PM tasks have actually been carried out and whether any potential maintenance trends and/or backlogs exist. This undermines the reliability of the MBTA's enterprise asset management system. Further, not performing inspections on their scheduled date increases risks to people and the MBTA's physical assets and increases the risk of noncompliance with regulatory requirements, particularly those related to inspection frequency.

Authoritative Guidance

According to Section 151.11 (2)(a) of Title 220 of the Code of Massachusetts Regulation, each track inspection must be made according to the following schedule:

Type of Track	Required Frequency
Light Rail Passenger-service Track	*Three times per week with at least one calendar day interval between inspections*
Heavy Rail Passenger-service Track	*Twice weekly with at least one calendar day interval between inspections*

Reasons for Noncompliance

We asked MBTA employees for an explanation regarding the issues identified with their work order management system, but they failed to provide a response. The MBTA has not established a formal policy or procedure detailing the expected time frames for opening and closing PM work orders. We asked MBTA officials on multiple occasions to provide clarity on the expected time frames, but they failed to do so. The MBTA did not have adequate monitoring controls to ensure that visual inspections of passenger service track occur on the scheduled date of inspection.

Recommendations

1. The MBTA should ensure that visual inspections of its subway tracks are conducted on time.
2. The MBTA should establish a formal policy or procedure that provides clear guidelines for when PM work orders should be opened, completed, and closed. The MBTA should ensure that its staff members adhere to this policy when performing PM activities.

3. Once the PM work order system is an accurate reflection of the MBTA's work in this regard, management should use the PM work order system to effectively monitor ongoing performance and progress in addressing related maintenance of its physical assets.

Auditee's Response

As discussed in the Draft Report, the MBTA was in the process of implementing a new digital system for the recording and documentation of track inspections throughout the calendar year 2021, the first year of the audit period. As such, and due to the level of effort in retrieving paper records, the SAO's team was only able to review digital records for the audit period. Over the course of 2021 and 2022, and continuing, the MBTA did a significant amount of training with the Maintenance of Way ("MOW") teams to ensure that all personnel understood the use of the mobile application and the Enterprise Asset Management System ("EAMS"). Therefore, the MBTA attributes the majority of the non-compliance raised in the Draft Report to training and on-boarding issues in moving to the new digital system. The MBTA acknowledges and agrees with SAO's recommendations and over the past 3 years the MBTA has addressed these findings and advanced its use of the EAMS and mobile track inspection applications significantly. For each of the SAO's recommendations for Finding 1, the MBTA provides the following responses:

- *SAO Recommendation: The MBTA should ensure that visual inspections of its subway tracks are conducted on time.*
    - *MBTA Response: In the draft report, the SAO provided the following analysis: Of the 6,373 work orders, 1,026 (16%) remained open for 6 to 40 days beyond the scheduled preventative maintenance ("PM") completion date and 26 (0.41%) of work order were closed 1 to 10 days before the date that the PM was scheduled to be completed. The MBTA notes the audit period coincides with the training and implementation period for the EAMS, so data in this system may not be an accurate representation of all inspections conducted in the field. Since the audit period concluded, the MBTA and MOW employees have significantly advanced their use of the EAMS and mobile track inspections. Over the last 90 days, the same statistics are: Of the 1,203 visual track inspection work orders completed, 35 (2.91%) were finished 6 to 40 days beyond the PM completion date and 23 (1.91%) were finished earlier than the scheduled completion date. The MBTA notes that a schedule deviation does not always indicate non-compliance. As stated in the Draft Report, the requirement for light and heavy track inspections is three and two times per week respectively with at least one calendar day interval between inspections. Inspection schedules may shift at times due to weather, staff availability, or other circumstances.*
- *SAO Recommendation: The MBTA should establish a formal policy or procedure that provides clear guidelines for when PM work orders should be opened, completed, and closed. The MBTA should ensure that its staff adhere to this policy when performing PM activities.*
    - *MBTA Response: In September 2023, the MBTA issued a Standard Operating Procedure ("SOP") for Visual Track Inspections. The MBTA has provided the SAO a copy of this SOP with this response.*
- *SAO Recommendation: Once the PM work order system is an accurate reflection of the MBTA's work in this regard, management should use the PM work order system to*

effectively monitor ongoing performance and progress in addressing related maintenance of its physical assets.

- *MBTA Response: The MBTA maintains a preventative maintenance and inspection ("PM&I") dashboard that is reviewed weekly and monthly at various meetings with MOW leadership. The PM&I dashboard includes all safety critical and system critical PM&I that are completed digitally across all infrastructure divisions. The MBTA has provided the SAO with a screenshot of the PM&I dashboard with this response.*

Auditor's Reply

Given its response, including the enhanced training for Maintenance of Way employees on the use of critical information systems, the development of a standard operating procedure document for visual inspections, and the implementation of a PM and inspection dashboard used to monitor the completion and on-time status of safety-critical inspections, we believe that the MBTA is taking appropriate steps to resolve this issue. We will review progress on this issue, including the sufficiency of any new policies and procedures developed by the MBTA, in our post-audit review in six months.

2. The Massachusetts Bay Transportation Authority did not ensure that defects identified during inspections of subway tracks were remediated in accordance with its Track Maintenance Standards.

The MBTA did not ensure that subway track defects were remediated in accordance with its Track Maintenance Standards. Specifically, we found the following issues:

- For 42 out of 60 track defects (70%), the MBTA could not demonstrate that it had assessed and verified the condition of the previously identified defect.
- For 22 out of 60 defects (37%), the MBTA could not demonstrate that the required speed restriction had been recorded in the MBTA's enterprise asset management system.
- For 21 out of the 60 defects (35%), the expected remedial action was not completed within the required time frame.

Recent incidents involving derailments on the MBTA's Red and Green Lines, which caused injuries and significant delays for passengers, highlight the importance of promptly remediating track defects to prevent future occurrences. The MBTA may be unable to effectively prioritize and address safety hazards if it does not address track defects discovered during inspections according to its Track Maintenance Standards, or if it does not subsequently verify that the defects have not deteriorated further. This could ultimately lead to safety hazards for both MBTA riders and employees.

Authoritative Guidance

According to Section T213.3 of the MBTA's Track Maintenance Standards,

> *Green coded track conditions are not exceptions to the MBTA Track Maintenance Standards and do not necessarily require immediate remedial action. Green coded conditions, which have degraded and are approaching the Yellow level should be, at a minimum, verbally communicated to the responsible Section Foreperson and/or Supervisor. Green coded conditions should be monitored on an ongoing basis to prevent deterioration to the next level.*
>
> *Yellow coded track conditions (or Y) have reached or are closely approaching the maintenance limit for train operation at normal posted speed. As such, Yellow coded conditions are classified as track defects and remedial action should be scheduled to correct the deficiency before it escalates to the next level.*
>
> *Red coded track conditions (or R) are defects which in every case generate speed restrictions (slow orders) and at the most severe level are grounds for removing effected track from service until repairs can be made. In most cases, Red coded defects should be scheduled for immediate remedial action. These defects are by definition the highest repair priority.*

According to the MBTA's *Defect Module Mobile Training Manual*, "If [the previously identified defect] has already been recorded, users need to verify the existing defect record is accurately reflected in the field."

Reasons for Noncompliance

We found inconsistencies between the track maintenance defect codes in the MBTA's enterprise asset management system and the symptom codes[13] outlined in the MBTA's Track Maintenance Standards. The MBTA could not explain why the codes do not match. Additionally, the MBTA does not use the tools available within its enterprise asset management system to document and monitor speed restrictions when necessary. During our audit work, MBTA officials provided contradictory information regarding the process for verifying existing defects. Multiple times throughout the audit, MBTA officials indicated that defect verifications were being recorded electronically in the MBTA defect module. However, when the issue was raised during testing, they suggested that these verifications could have been completed visually and did not necessarily need to be documented in the MBTA defect module. Lastly, the MBTA did not have adequate monitoring controls to ensure that expected remedial action was completed within the required time frame.

13. Symptom codes are the specific codes the MBTA uses to identify and categorize various issues or conditions observed on subway tracks during inspections.

Recommendations

1. The MBTA should ensure that defect codes in the MBTA's enterprise asset management system are able to be traced to its Track Maintenance Standards to ensure the consistent remediation of each type of defect.

2. The MBTA should ensure that speed restrictions for defects that require them are documented in its enterprise asset management system and that systems are in place to ensure that trains abide by these restrictions.

3. The MBTA should ensure that its track inspectors are consistently documenting the verification (physical condition) of existing track defects.

4. The MBTA should implement adequate monitoring controls to ensure that expected remedial action is completed within the required time frame and that this performance is reviewed by appropriate management.

Auditee's Response

As discussed in the Draft Report and above, the MBTA was in the process of implementing the new digital system for the recording and documentation of track inspections and integrating that with EAMS throughout the calendar year 2021. Over the course of 2021 and 2022, and continuing, the MBTA did a significant amount of training with the MOW teams to ensure that all personnel understood the use of the mobile application and EAMS. Therefore, the MBTA attributes the majority of the non-compliance raised in the Draft Report to training and on-boarding issues in moving to the new digital system. The MBTA acknowledges and agrees with SAO's recommendations and over the past 3 years the MBTA has addressed these findings and advanced its use of the EAMS significantly. For each of the SAO's recommendations for Finding 2, the MBTA provides the following responses:

- *SAO Recommendation: The MBTA should ensure that defect codes in the MBTA's enterprise asset management system are able to be traced to its Track Maintenance Standards to ensure the consistent remediation of each type of defect.*
    - *MBTA Response: The MBTA was in the process of implementing new priority coding systems during the audit period to ensure defect codes are aligned with the MBTA's track standards. The MBTA is currently in the process of revising its track standards, with the update scheduled to be completed in the summer of 2025. EAMS will be updated to ensure all defect codes align with any updates to track standards.*
- *SAO Recommendation: The MBTA should ensure that speed restrictions for defects that require them are [documented] in its enterprise asset management system and that systems are in place to ensure that trains abide by these restrictions.*
    - *MBTA Response: Between 2022 and 2024, the MBTA has made significant improvements in documentation and monitoring of speed restrictions. This work culminated in the creation of the Track Conditions Dashboard, which allows employees throughout the MBTA, from the MOW division to Senior Leadership*

such as the COO and General Manager to monitor speed restrictions throughout the system.

- *SAO Recommendation: The MBTA should ensure that its track inspectors are consistently documenting the verification (physical condition) of existing track defects.*
    - *MBTA Response: The MBTA agrees with the SAO's position on the importance of documenting existing track defects. The MOW division has formally incorporated defect verification into the training curriculum and recertified all systems repairpersons, who are responsible for visual track inspections, throughout the calendar year 2024.*
- *SAO Recommendation: The MBTA should implement adequate monitoring controls to ensure that expected remedial action is completed within the required timeframe and that this performance is reviewed by appropriate management.*
    - *MBTA Response: As discussed above, the MBTA is in the process of revising its track standards and anticipate completing the update in the summer of 2025. This revision will contain updates to expected remedial actions and timeframes based on defects identified.*

Auditor's Reply

Based on its response, the MBTA is taking measures to address our concerns in this area. We will review progress on this issue in our post-audit review in six months.

3. The Massachusetts Bay Transportation Authority did not always perform preventive maintenance inspections on its subway cars at the required intervals.

The MBTA did not always perform required PM inspections on its subway cars at the required intervals. Our analysis revealed that 24 (0.5%) out of the 4,965 completed work orders we examined failed to meet the required inspection intervals based on either time or mileage. Specifically, we found the following:

- One Green Line Number 8[14] car was not inspected within the 90-day interval.
- Seven Green Line Number 8 cars were not inspected within the 10,000 mile or 180-day interval.
- One Green Line Number 9 car was not inspected within the 10,000-mile interval.
- Six Green Line Presidents' Conference Committee cars were not inspected within the 30-day interval.

14. The MBTA uses a sequential numbering system for its subway car fleet based on the vehicle's date of implementation. For example, the first fleet of Red Line rail cars deployed are designated as Number 1 cars, the next fleet of cars would be Number 2, and so on.

- Three Red Line Number 1 cars were not inspected within the 8,500-mile interval.
- Three Red Line Number 2 cars were not inspected within the 8,500-mile interval.
- Two Red Line Number 3 cars were not inspected within the 15,000-mile interval.
- One Orange Line Number 14 car was not inspected within the 15,000-mile interval.

Regular inspections of subway cars are critical to ensuring the safe and efficient operation of the MBTA's subway system. Without timely inspections, mechanical issues could go unnoticed, increasing the likelihood of equipment failures, potentially leading to accidents or derailments. This could jeopardize the safety of riders and the general public. Failure to conduct timely inspections can also increase the complexity and cost of addressing problems that exist.

Authoritative Guidance

According to the MBTA's Equipment Engineering and Quality Assurance Vehicle Inspection Guidelines, the following is the lifecycle management strategy for inspection and PM for subway cars:

Lifecycle Management Strategy	Frequency
Red Line PM Inspections—Number 1 and 2 cars	8,500 miles
Red Line PM Inspections—Number 3 cars	15,000 miles
Orange Line PM Inspections—Number 12 cars	12,000 miles or 90 days
Orange Line PM Inspections—Number 14 cars	15,000 miles
Blue Line PM Inspections—Number 4 cars	7,500 miles
Blue Line PM Inspections—Number 5 cars	12,000 miles
Green Line PM Inspections—Number 7 cars	7,500 miles
Green Line PM Inspections—Number 8 cars	90 days (effective until September 30, 2021)
Green Line PM Inspections—Number 8 cars	10,000 miles or 180 day (effective as of September 30, 2021)
Green Line PM Inspections—Number 9 cars	10,000 miles
Green Line PM Inspections—Presidents' Conference Committee cars	30 days

Reasons for Noncompliance

The MBTA did not have adequate monitoring controls to ensure that inspections of its subway cars occurred at the required intervals. According to MBTA officials, the Federal Transit Administration (FTA) allows for a 10% compliance variance for PM activities. Although the MBTA was operating well below this

threshold during the audit period—with a variance of only 0.5%—we believe that any level of noncompliance increases risk to the safety of riders and employees and indicates that the process in place during the audit period needed improvement. We also note that the MBTA did not adopt this 10% standard as its own standard, meaning that the MBTA failed to meet its own standard, regardless of what was permitted by the federal government's more lax standards.

Recommendation

The MBTA should implement adequate monitoring controls to ensure that inspections of its transit subway rail cars occur at the required intervals.

Auditee's Response

The MBTA disagrees with the SAO's finding that the MBTA performed preventative maintenance on its subway cars at the required interval "to an unsatisfactory extent." The MBTA agrees that regular inspections of subway cars are critical to ensure the safe and efficient operation of the MBTA's system and the SAO's themselves have made it clear that the MBTA is [overwhelmingly] successful in completing its preventative maintenance inspections. Understanding the practical realities of operating a transportation system, especially one as large as the MBTA's system, the Federal Transit Administration ("FTA") allows for a 10% variance in conducting preventative maintenance inspections on subway cars. Nonetheless, over the two-year audit period, the MBTA completed 4,941 out of 4,965 or 99.5% of preventative maintenance inspections. The MBTA disagrees with the SAO's statement that the MBTA "failed to meet its own standard." The FTA standard and allowance of 10% variance is the standard the MBTA must meet for the preventative maintenance of subway cars, which the MBTA far and away exceeded. Further, the subway cars referenced in the Draft Report were immediately removed from service upon discovery of the need for the required preventative maintenance inspections. Finally, in line with the SAO's recommendation, the MBTA now has a system in place which notifies the maintenance team when any subway car gets within certain mileage ranges of the next required preventative maintenance.

Auditor's Reply

We acknowledge that the FTA allows for a 10% variance in conducting PM inspections of its subway cars. However, the MBTA's Equipment Engineering and Quality Assurance Vehicle Inspection Guidelines state that "mileage-based inspections are to be conducted within 1,000 miles of that scheduled" and "time-based inspections are to be conducted within 10 days of that scheduled." The MBTA developed these guidelines to satisfy the requirements of the Department of Public Utilities (DPU), which regulates the preventive maintenance that is audited by the FTA. This standard is, at times, more and less stringent than the FTA's 10% variance. For example, for Red Line PM inspections for number 1 and 2 cars, the MBTA

standard allows for up to 9,500 miles (8,500[15] + 1,000) before an inspection is considered noncompliant. However, using the FTA's 10% variance, it is allowed up to 9,350 miles (8,500 + 850) before an inspection is considered noncompliant. Additionally, for Blue Line PM inspections for number 5 cars, the MBTA standard allows for up to 13,000 miles (12,000[16] + 1,000) before an inspection is considered noncompliant. However, using the FTA's 10% variance, it is allowed up to 13,200 miles (12,000 + 1,200) before an inspection is considered noncompliant. If the MBTA intends to adhere to the FTA's 10% variance guidance, its own standards should not contradict this allowance. In the examples provided, the MBTA's standards for Red Line number 1 and 2 cars permit a greater variance than the FTA's guidelines, making them less stringent. However, for Blue Line number 5 car, the MBTA's standard is more stringent and does not meet the 10% variance allowed by FTA.

We appreciate the MBTA's acknowledgment of our recommendation and commend the agency for installing a system that addresses our concerns regarding the PM inspections of its subway cars, which were not being performed at the required intervals. As part of our post-audit review process, we will follow up on this matter in approximately six months.

4. The Massachusetts Bay Transportation Authority did not consistently document deferred defects found during subway car inspections and did not always accurately record their associated severity codes.

From our sample of 60 out of 5,681 rail car PM work orders, we identified a total of 390 deferred defects. Our review of these 390 deferred defects found the following:

- Of these 390 deferred defects, 26 (7%) were documented on the rail car PM inspection report were not documented in the MBTA's enterprise asset management system, making it impossible for us or the MBTA to verify that the necessary repairs were completed.
- Of these 390 deferred defects, 59 (15%) were documented in the MBTA's enterprise asset management system were not documented on the rail car PM inspection report, meaning that work was conducted without having been identified by inspectors as being required. Additionally, 160 deferred defect priority codes (41%) did not match between the rail car PM inspection report and the MBTA's enterprise asset management system.

15. Red Line PM Inspections—Number 1 and 2 cars have a frequency of 8,500 miles between PM inspections.
16. Blue Line PM Inspections—Number 5 cars have a frequency of 12,000 miles between PM inspections.

We also found that the MBTA did not follow its Preventive Maintenance Inspection and Documentation Policy for all Green Line subway car PM inspections. All codes were considered Code A, regardless of severity, instead of assigning the appropriate severity codes for serviceable deferred defects.

If the MBTA does not accurately and consistently document deferred defects and their associated severity codes found during subway car PM inspections, it cannot ensure that all deferred defects are monitored and addressed in a timely manner and in accordance with its Preventive Maintenance Inspection and Documentation Policy. In addition, if the MBTA does not ensure the accuracy of this information, the MBTA's ability to evaluate the effectiveness of its employees' efforts to identify and address maintenance needs is limited.

Authoritative Guidance

According to Figure 8 in Section 8 of the MBTA's Subway Operations Preventive Maintenance Inspection and Documentation Policy, Heavy Rail and Light Rail, the following are the defect severity codes:

Code A ***Safety Critical / Hold for Repair***	*This status is assigned to defects that would pose an immediate safety threat to the passengers, operators or others, as determined by the Car House Foreperson. A vehicle with this type of defect is not returned to service until the safety critical / Code A defect(s) is (are) repaired.*
Code B ***Schedule for Repair (45 days)***	*Class B repairs need to be completed within 45 days from the inspection. These defects are not a safety concern but must be addressed in the near term to avoid reducing the vehicle's reliability. This Class indicates that the vehicle may be returned to service temporarily but is scheduled for repair of the defect in the short term. An example of a Code B maybe wheel truing for a flat spot that is not condemnable, but needs to be scheduled for a future date.*
Code C ***Serviceable***	*Code C repairs are for cars awaiting delivery of parts that may take longer than 45 days to deliver. This is assigned to defects that are not expected to have a significant effect on safety or reliability, but which are recommended to be addressed to keep the vehicle in a state of good repair. This indicates that the vehicle may be returned to service and the defect will be repaired at the next opportunity.*

According to Section 11.1 of MBTA's Subway Operations Preventive Maintenance Inspection and Documentation Policy, Heavy Rail and Light Rail, "The Inspection Foreperson will review hard copies and verify that all information was entered into [the MBTA's enterprise asset management system] correctly."

Reasons for Noncompliance

The MBTA indicated that, upon completion of a PM inspection, a foreperson reviews the inspection report to ensure the accuracy of the findings. If any updates or corrections are required, the foreperson will make those changes in the enterprise asset management system. However, it was noted that these updates are not always reflected in the actual inspection report itself. This creates a discrepancy between the data in the MBTA's enterprise asset management system and the inspection report. We were also told that the physical inspection report was the most reliable information concerning PM inspections, rather than the MBTA's enterprise asset management system. This requires the MBTA to rely on paper records, not its technology system, as the system of record.

Recommendations

1. The MBTA should enhance its monitoring controls to ensure accurate and consistent documentation of deferred defects and their associated severity codes found during PM inspections of its subway cars.

2. The MBTA should use technology systems to improve the efficiency and effectiveness of its work, including maintenance, to ensure that it has ready access to maintenance, cost, performance, and other data.

Auditee's Response

The MBTA agrees that it can improve the documentation for deferred defects found during subway car inspections. As discussed with the SAO's team during the audit, most of the issues with respect to both documentation and properly applying severity codes can be traced to the use of paper inspection forms. These paper inspection forms were completed by hand and discrepancies arose due to different documentation standards at the various car houses. To address these issues, the MBTA is in the process of implementing a Digital Periodic Mileage Inspection to have a consistent process for documenting all inspections across all lines. This will ensure consistency between car houses. This new tool was demonstrated for the SAO's team and the SAO's team stated that this was an appropriate solution to address the issues raised.

Auditor's Reply

Based on its response, the MBTA is taking measures to address our concerns regarding this matter. We believe the effective use of technology tools, along with consistent monitoring of the documentation process, will help address our concerns regarding the inconsistent documentation of the deferred defects in each car house. As part of our post-audit review process, we will follow up on these matters in approximately six months.

5. The Massachusetts Bay Transportation Authority did not ensure that visual inspections of its subway station facilities were performed.

According to the MBTA's 2022 Transit Asset Management Plan (TAMP), the MBTA's Transit Facilities Maintenance department conducts monthly, quarterly, and annual visual inspections of MBTA stations. However, during the audit period, MBTA could only provide limited documentation—in some cases, no documentation—to substantiate the extent to which it had performed these visual inspections.

According to MBTA officials, there are approximately 122 subway stations throughout the MBTA system. In response to our request for documentation supporting the completion of monthly, quarterly, and annual inspections, the MBTA was only able to provide annual inspection reports for 2021, covering 50 of the 122 stations (41%). For 2021, the MBTA was unable to demonstrate that it had performed monthly or quarterly inspections of any of its subway stations (0%). Furthermore, the MBTA could not demonstrate that it performed visual inspections of any of its subway stations during 2022.

A lack of regular inspections increases the risk that safety hazards and maintenance needs may not be identified in a timely manner, affecting the safety of the MBTA's riders, employees, and the general public.

Authoritative Guidance

According to Section 6.2.2 of MBTA's 2018 TAMP, the following is the inspection and assessment activity for stations/facilities:

Inspection / Assessment Activity	***Frequency***
Detailed System Inspections	*Monthly*

Effective October 31, 2022, the MBTA's 2022 TAMP included the following station/facility inspection requirements:

Inspection / Assessment Activity	***Frequency***
Stations – Structural Inspections	*Annually*
Station and Platform Pit – Inspections	*Annually*
Stations – Cleaning Inspections	*Monthly*
Stations – Visual Inspections	*Monthly, quarterly, and annually*

Reasons for Noncompliance

The MBTA does not have formal, comprehensive policies and procedures for subway station facility visual inspections.

Recommendations

1. The MBTA should conduct visual inspections of stations on a regular basis to identify and address safety hazards and maintenance needs. The MBTA should maintain records of these inspections.
2. The MBTA should implement formal, comprehensive policies and procedures for subway station facility visual inspections, including a monitoring component.
3. The MBTA should track and analyze the results of visual inspections to determine trends, manage performance, and conduct other management duties.

Auditee's Response

The MBTA acknowledges and agrees with the SAO's recommendations with respect to needing better documentation of inspections of stations. The Transit Facilities Maintenance ("TFM") was unable to provide evidence of the monthly, quarterly, and annual visual inspections as stated in the 2022 Transit Asset Management Plan ("TAMP"). The MBTA and TFM recognize that, while inspections have been carried out as part of TFM's ongoing maintenance efforts, improvements are required in the form of formalized documented processes and policies for these inspections, which are essential for compliance and ensuring a consistent approach to monitoring the safety and condition of the MBTA's facilities. The MBTA is committed to continuing developing and implementing a formalized process for conducting and documenting station inspections. This includes establishing a clearer policy with respect to the frequency of inspections, improved record keeping practices, and ensuring visual inspections are documented and readily accessible for review.

Auditor's Reply

In response to our concerns, the MBTA is taking steps to address the issue. We strongly recommend that the MBTA establish and implement a formal process to ensure that visual inspections of its subway station facilities are conducted regularly. As part of our post-audit review, we will follow up on this matter in approximately six months.

6. The Massachusetts Bay Transportation Authority did not ensure that all of its information system users completed cybersecurity awareness training.

The MBTA did not ensure that all of its information system users completed cybersecurity training.

Specifically, for the MBTA's enterprise asset management system, 5 out of 35 randomly sampled existing employees (14%) did not complete annual refresher cybersecurity awareness training, and 5 out of 10 randomly sampled newly hired employees (50%) did not complete new hire cybersecurity awareness training.

For the MBTA defect module, 15 out of 35 randomly sampled existing employees (43%) did not complete annual refresher cybersecurity awareness training.

If the MBTA does not ensure that all of its information system users complete cybersecurity awareness training, then the MBTA is exposed to an elevated risk of cybersecurity attacks, which may cause financial and/or reputational losses.

Authoritative Guidance

Section AT-2 of the National Institute of Standards and Technology's Special Publication 800-53 Revision 5 states,

> *a. Provide security and privacy literacy training to system users (including managers, senior executives, and contractors):*
>
> *1. As part of initial training for new users and . . . [organization-defined frequency] thereafter.*

The Executive Office of Technology Services and Security's Information Security Risk Management Standard IS.010 that was in effect during the audit period stated,

> *6.2.3 New Hire Security Awareness Training: All new personnel must complete an Initial Security Awareness Training course. This course shall be conducted via web-based learning or in class training and shall be included in the new hire orientation checklist. The New Hire Security Awareness course must be completed within 30 days of new hire orientation.*
>
> *6.2.4 Annual Security Awareness Training: All personnel will be required to complete Annual Security Awareness Training. Once implemented, automatic email reminders will be sent to personnel 12 months after course completion, alerting personnel to annual refresher training completion deadlines.*

Reasons for Noncompliance

The MBTA did not provide a reason why the cybersecurity awareness training certificates for the sampled employees could not be provided to us.

Recommendation

The MBTA should ensure that all of its information system users complete cybersecurity awareness training as part of initial training and annually thereafter and should maintain records of this training.

Auditee's Response

The MBTA agrees with the SAO's Draft Report that cyber security training for all MBTA employees is essential and the MBTA is investigating the failures to complete such training as discussed in the Draft Report. The MBTA notes that, as a quasi-public authority, the MBTA is only required to follow guidelines from the Executive Office of Safety and Security (EOTSS) when shared resources are involved. Nonetheless, the MBTA's current cybersecurity training requirements match or exceed EOTSS requirements. The MBTA's cybersecurity training included, but is not limited to: (1) annual attestation to the MBTA's acceptable use policy for all employees; (2) annual cybersecurity awareness training for all employees; (3) additional annual cybersecurity training for employees handling specific data; (4) annual tabletop training in compliance with the MBTA's cybersecurity liability insurance requirements; (5) annual Cyber Day which includes speakers from across the MBTA and key outside partners discussing the current state of cybersecurity in critical infrastructure. Additionally, the MBTA conducts phishing training throughout the year and specific group trainings, including additional training for front line workers, most attacked users, and senior leadership. The MBTA also continues to review and update its cybersecurity training, as evidenced by the development of its AI Awareness training beginning in 2025.

Auditor's Reply

Based on its response, the MBTA is taking measures to address our concerns regarding this matter. As part of our post-audit review process, we will follow up on this matter in approximately six months.

OTHER MATTERS

The Massachusetts Bay Transportation Authority must take steps to improve the safety of pedestrians at Commuter Rail stations with at-grade crossings.

In recent years, there has been an increase in safety incidents occurring at Massachusetts Bay Transportation Authority (MBTA) Commuter Rail stations that have pedestrian at-grade crossings.[17] These incidents have led to serious injuries and, in some cases, fatalities. We found several examples of safety incidents that occurred during and shortly after the audit period:

- On August 30, 2021, a pedestrian was killed after being struck by an MBTA Commuter Rail train at Montello Station in Brockton.[18]
- On January 18, 2022, a pedestrian was struck by an MBTA Commuter Rail train at the West Concord MBTA Station.[19]
- On April 6, 2022, a pedestrian was struck by an MBTA Commuter Rail train in Ayer.[20]
- On August 31, 2022, a pedestrian was struck by an MBTA Commuter Rail train at the West Concord MBTA Station.[21]
- On October 31, 2022, a pedestrian was struck by an MBTA Commuter Rail train at Montello Station in Brockton.[22]

While the safety incidents mentioned above occurred at pedestrian crossings at MBTA Commuter Rail stations, similar incidents have also been identified at crossings outside these stations, including those at highway intersections.

- On January 21, 2022, a driver was killed after a car was struck by an MBTA Commuter Rail train in Wilmington.[23]
- On Friday, May 12, 2022, a pedestrian was killed after being struck by an MBTA Commuter Rail train in Abington.[24]

17. A pedestrian at-grade crossing is a place where a pedestrian walkway intersects with railroad tracks at the same level. Pedestrians and bicyclists are invited to cross the station tracks to get from one side of the station to another.
18. For more information on this incident, see this article from Boston 25 news.
19. For more information on this incident, see this article from WCVB Boston.
20. For more information on this incident, see this article from NBC10 Boston.
21. For more information on this incident, see this article from NBC10 Boston.
22. For more information on this incident, see this article from the Enterprise News, a Brockton Massachusetts daily news outlet.
23. For more information on this incident, see this article from WCVB Boston.
24. For more information on this incident, see this article from Boston 25 News.

- On April 26, 2023, a driver was killed after a car was struck by an MBTA Commuter Rail train in Abington.[25]
- On December 2, 2024, an MBTA Commuter Rail train collided with a minivan in Abington.[26]

a. The Massachusetts Bay Transportation Authority should ensure that its inventory of railroad crossings is complete and accurate.

The MBTA is required to maintain an inventory of its railroad crossings and report the information to the Federal Railroad Administration (FRA). This inventory includes details about the location, type of crossing (public or private[27]), and existing safety features such as lights, signals, gates, and signs. We requested that the MBTA provide us with an inventory of its at-grade pedestrian crossings at Commuter Rail stations. It took the MBTA more than a month to supply this information to us, raising concerns about the adequacy of its record-keeping practices. When the MBTA was able to provide us the inventory, we found discrepancies between the MBTA's inventory and the data we found in the FRA's grade crossing database.

The inventory provided by the MBTA contained 57 at-grade pedestrian crossings. We identified an additional 38 at-grade pedestrian crossings listed in the FRA at-grade crossing database that did not appear on the list provided by the MBTA. In addition, we noted that the inventory the MBTA provided included several crossings that were not directly related to MBTA Commuter Rail stations, such as highway crossings. This raises questions about the MBTA's recordkeeping system, specifically the accuracy and reliability of the data maintained by the MBTA regarding pedestrian crossings at MBTA Commuter Rail stations.

Accurate inventory data is critical for analyzing trends, identifying high-risk areas, and developing strategies to improve at-grade crossing safety. To ensure that it has accurate and current data, we believe that the MBTA should conduct a comprehensive inventory of all at-grade crossings (vehicular and pedestrian) on its Commuter Rail system. This inventory should capture the location of each crossing, the crossing identification number, the physical characteristics of the crossing (including safety mechanisms), whether the crossing is public or private, and whether the crossing is active or passive.

25. For more information on this incident, see this article from MassLive.
26. For more information on this incident, see this article from WCVB Boston.
27. A private crossing is a location where a private highway, road, or street crosses one or more railroad tracks.

b. The Massachusetts Bay Transportation Authority should convert all Commuter Rail station at-grade crossings into active crossings.

Railroad crossings are categorized as either active or passive crossings, depending on the safety features existing at each location. Passive crossings are those without lights, gates, or any other type of active (electrical or mechanical) warning devices to alert pedestrians about an approaching train. Instead, passive crossings rely entirely on signage and/or pavement markings (see Appendix A for examples). Active crossings have more advanced safety devices, such as bells, flashing lights, and gates that automatically activate when a train is approaching (see Appendix A for examples). Active crossings are usually supplemented with the same signs and/or pavement markings used for passive crossings. Active crossings definitively tell pedestrians when it is no longer safe to cross a railroad track. In comparison, passive crossings rely on the pedestrian's ability to visually observe the crossing, and accurately gauge when it is safe to cross (based on the speed and distance of an approaching train) making them much more dangerous than active crossings.

The Federal Rail Safety Improvement Act of 2008 directed the FRA to provide guidance to railroads concerning pedestrian safety at or near passenger stations. According to Section 201 of the Federal Rail Safety Improvement Act,

> *Not later than 1 year after the date of enactment of this Act, the Secretary shall provide guidance to railroads on strategies and methods to prevent pedestrian accidents, incidents, injuries, and fatalities at or near passenger stations, including—*
>
> *(1) providing audible warning of approaching trains to the pedestrians at railroad passenger stations;*
>
> *(2) using signs, signals, or other visual devices to warn pedestrians of approaching trains;*
>
> *(3) installing infrastructure at pedestrian crossings to improve the safety of pedestrians crossing railroad tracks;*
>
> *(4) installing fences to prohibit access to railroad tracks; and*
>
> *(5) other strategies or methods as determined by the Secretary.*

As a result of this legislation, in 2012, the FRA published a document entitled "Guidance on Pedestrian Safety at or near Passenger Stations," which stresses the importance and value of having active warning devices present at stations. This document states, that "audible and visual warnings should be used at or near passenger stations, where appropriate, to guide pedestrians to proper crossing

points, and also to indicate when it is appropriate to cross the tracks in order to get to the correct station platform to board the desired train."

According to the *Federal Highway Administration's Railroad-Highway Grade Crossing Handbook*, a document containing best practices as well as adopted standards relative to highway-rail grade crossings, "active traffic control devices have proven an effective method of improving safety and operations at highway railroad grade crossings." *The Railroad-Highway Grade Crossing Handbook* cites crossing accident data over a period of 30 years that shows that accident rates declined more than 80% when railroad at-grade crossings are upgraded from passive to active.

The use of active warning devices appears to also be an internal requirement of the MBTA. Section 3(7)(b)(1) of the MBTA's "Commuter Rail Design Standards Manual, Volume I, Section II, Stations and Parking" states the following:

> *Provide fully automated crossing warning systems at each pedestrian crossing on main line tracks. Secondary and other low speed tracks may be exempted from this requirement on a site specific basis. Locate warning signs on all crossings to be visible from each entry to the crossing. These signs should have the phrase "Look Before Crossing" on both sides.*

During our audit, we received information from a stakeholder. This information evidenced a public record indicating that on April 8, 2020, the MBTA Commuter Rail Safety Department was provided with a list from Keolis train engineers that identified the top 20 most problematic stations containing at-grade crossings in the Commonwealth. (See Appendix B.) According to this public record, it appears that the MBTA Commuter Rail Safety Department had identified low-cost safety improvements that it could implement at these 20 most problematic stations and then implement them at all Commuter Rail stations with at-grade crossings. The MBTA Commuter Rail Safety Department believed these safety improvements would be installed in August 2020. However, as of the time of our fieldwork, these safety improvements have still not been implemented.

Despite the fact that using active warning devices appears to not only be the MBTA's own internal requirement, but also a recommended best practice by the FRA and the Federal Highway Administration, we found that 40 (70%) of the 57 at-grade pedestrian crossings on the inventory provided by the MBTA remain passive crossings. We believe that the MBTA should follow its own policy as well as the guidance issued by the federal government and convert all Commuter Rail station at-grade crossings into active crossings.

As part of this audit, we also performed a visual inspection of 35 at-grade pedestrian crossings located at MBTA commuter rail stations to document the type and physical condition of the safety features existing at each location. We observed the following issues that we believe could increase the risk of accidents and fatalities:

- Crossings with worn-out or faded pavement markings (see Appendix A), making it difficult for pedestrians to recognize.
- Crossings with signage that was obstructed (see Appendix A), reducing its visibility to approaching pedestrians.
- Crossings with "Look before crossing" signage only on one side of the crossing (see Appendix A).

c. The Massachusetts Bay Transportation Authority should conduct diagnostic reviews of all the Commuter Rail stations containing at-grade crossings.

MBTA officials advised that the FRA requires a diagnostic site review be performed for "high-risk" crossings. The FRA has identified high-risk crossings as those that have five or more accidents over a five-year period or two or more fatal accidents over a five-year period. During a diagnostic review of a crossing, representatives from the FRA, the MBTA, the Massachusetts Department of Transportation, the Massachusetts Department of Public Safety,[28] and Keolis identify potential hazards and vulnerabilities at the crossing, determine the adequacy of existing safety measures, and recommend improvements to reduce the risk of future accidents or incidents. According to MBTA officials, there was only one diagnostic review conducted of one station during the audit period.[29]

Rather than waiting for a trend of accidents to develop, we believe the MBTA should immediately conduct diagnostic reviews of all its at-grade pedestrian crossings. This approach would identify hazards and vulnerabilities before they lead to accidents, enhancing safety for both rail operators and the public. Both the FRA and the American Public Transportation Association endorse such a practice. The FRA's "Guidance on Pedestrian Safety at or near Passenger Stations" document recommends that the hazard management techniques used by railroads not be a one-time task. Instead, the FRA recommends the periodic re-evaluation of pedestrian crossing safety at or near passenger stations. Further, the American Public Transportation Association "Rail Transit Grade Crossing Safety

28. The Massachusetts Department of Public Utilities regulates grade crossing safety in the state.
29. This diagnostic review of the Brockton MBTA station occurred on April 19, 2022.

Assessment," a best practice document for grade crossings, states that a full, systemwide review of new and existing grade crossings should be done on a regular basis. This review should "identify factors at crossings that may have changed or are emerging that may create the potential for new hazards not previously addressed."

Auditee's Response

The MBTA agrees with the SAO that pedestrian safety around at-grade crossing is critical to its operation of the commuter rail and appreciates the suggestions made in the Draft Report. The MBTA is actively engaged, with its commuter rail provider Keolis Commuter Services, LLC ("Keolis"), in improving safety at commuter rail grade crossing and raising public awareness of railroad safety around grade crossings. The MBTA also actively engages with Operation Lifesaver, a non-profit organization and nationally recognized leader of rail safety education, to educate communities and raise awareness of grade crossing safety across the commuter rail network. For pedestrian at-grade crossings at commuter rail stations, train engineers observe a special operating rule (121-S1), which goes beyond Northeast Operating Rules Advisory Committee (NORAC) operating rules and allows only one train at a time to enter the station, ensuring that pedestrian can safely transverse the at-grade crossing while a train is stopped at the station.

The MBTA tracks and analyzes every incident involving the collision of commuter rail trains with pedestrians or motor vehicles. With respect to the incidents raised in the Draft Report, the MBTA notes the following:

- *Of the five safety incidents identified by the SAO that occurred at pedestrian at-grade crossings, a majority of were determined to be the result of intentional acts that could not have been prevented by the types of safety improvements discussed in the Draft Report.*
- *Of the three safety incidents identified by the SAO that occurred at highway intersections, all of which are equipped with active warning systems and crossing gate mechanisms, two out of three incidents resulted from motorists failing to yield at the crossing while the active warning systems and crossing gate mechanisms were activated and functioning as intended.*

In 2023, the MBTA invested in safety enhances at all its highway grade crossings, including painting fog lines across the tracks to delineate the roadway and installing reflectorized pavement markers and 4-foot-high reflective delineators. The next phase of this work will include upgrading to 12-inch LED lights and adding a hash-marked paint scheme at all crossing to enhance visibility and draw motorists' and pedestrians' attention to the crossing areas. To further improve safety at pedestrian at-grade crossings, the MBTA and Keolis are reviewing all commuter rail stations with pedestrian at-grade crossings and/or lack of inter-track fencing, identifying strategies to eliminate these safety risks. Some of the recommended upgrades include removing pedestrian crossings where alternative paths exist, closing gaps in inter-track fencing, and in some cases building Americans with Disability Act compliant walkways between platforms. At some stations, where pedestrian crossings cannot be eliminated, for accessibility reasons, active warning systems are being considered as a potential solution. The MBTA will tailor the solution to the characteristics of

each station, as there is no one-size-fits-all approach. The MBTA has updated its inventory of pedestrian crossing to ensure accuracy, completeness, and consistency. In addition, MBTA staff are also reviewing all pedestrian crossings to ensure each location has the markings, signage, etc. that meet the relevant safety standards.

Auditor's Reply

The MBTA has stated that it, along with Keolis, is reviewing Commuter Rail stations with pedestrian at-grade crossings to identify strategies for eliminating safety risks. However, this process was also mentioned in 2020, yet no significant improvements have been made. Rather than just meeting "the relevant safety standards," as the MBTA suggests in its response, the agency should go beyond basic requirements and take stronger, more proactive measures to better protect pedestrians and potentially save lives. Given the clear guidance to eliminate all passive crossings, it is essential that the MBTA replace them with active safety measures such as gates, lights, and bells. There is an urgent need for decisive action and a clear timeline to ensure that these necessary improvements are implemented. A clear, specific, and well-resourced timeline would reflect the stated commitment of the MBTA and Keolis to address this critical issue, especially in light of prior inaction on this issue.

We urge the MBTA to fully implement our recommendations, and we will follow up on this matter in approximately six months.

APPENDIX A

The photographs included below show various active and passive crossings at Massachusetts Bay Transportation Authority Commuter Rail stations.

Example of active crossing—Halifax Station

Example of passive crossing—Manchester Station

Worn-out or faded pavement markings—Ayer Station

Worn-out or faded pavement markings—Brandeis/Roberts Station

Worn-out or faded pavement markings—Wellesley Hills Station

"Look before crossing" signage only on one side of the crossing—Manchester Station

Obstructed signage—Roslindale Village Station

Obstructed signage—Walpole Station

APPENDIX B

According to Keolis, these are the top 20 most problematic Massachusetts Bay Transportation Authority Commuter Rail stations with at-grade crossings.

Ayer	Belmont Center
Beverly Depot	Brandeis
Braintree	Brockton
Montell – Brockton	Concord
Dedham	Gloucester
Hersey – Needham	Melrose Highlands
Needham Center	North Billerica
Norwood Central	Roslindale Village
Wellesley Hills	West Concord
West Medford	West Natick