TRANSIT TRACK INSPECTION CONSULTING SERVICES

REVIEW AND EVALUATION OF THE PERFORMANCE AND MANAGEMENT OF THE MBTA MAINTENANCE OF WAY (MOW) INSPECTION AND MAINTENANCE ACTIVITIES

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EXECUTIVE SUMMARY

The Massachusetts Bay Transportation Authority (MBTA), following investigations and related reports by the Federal Transit Administration (FTA) and the Massachusetts Department of Public Utilities (DPU), was required to undertake corrective actions focused on addressing safety incidents and safety related concerns identified by the FTA and the DPU, exercising their respective responsibility and authority for transit safety.

One immediate action by the MBTA was implementation of a systemwide speed restriction on the Red, Orange, Blue and Green Lines in early March 2023. The systemwide speed restriction was implemented after evaluation of Maintenance of Way records indicated that documentation was missing and/or insufficient for verification, evaluation and appropriate action associated with several recent cycles of vendor testing (track geometry, optical rail wear and ultrasonic rail testing). Shortly after implementation of the systemwide speed restriction, the MBTA commenced inspections to verify and document the track defects identified in the most recent vendor tests. During these verification and documentation inspections, an additional issue was identified related to the quality of visual inspections being performed by MBTA System Repairpersons under the supervision of Section Forepersons.

This evaluation and report were commissioned by the MBTA to review available information and sources related to MOW visual inspection, vendor testing and field verification for the purpose of identifying the root cause(s) for the gaps between expected and actual process and execution. By design, the scope was limited because many other activities focused on performance improvement for the MBTA are already underway.

The project tasks incorporated review of available information including the FTA and DPU reports, vendor inspection reports, MBTA Asset Management reports, MBTA track standards and MBTA maintenance manuals. The information review was supplemented by interviews with current MBTA Maintenance of Way staff and several MBTA Maintenance of Way retirees.

Following the review, interview and evaluation tasks, the root cause of the issues that have been described fall into two categories.

The first and primary cause is systemic in the form of lack of complete clarity regarding the roles and responsibilities of positions within the MBTA's Maintenance of Way organization, particularly System Repairpersons and Section Forepersons, regarding track inspections. Contributing to the situation is the limited track maintenance experience of individuals with track inspection responsibility, inadequate training for these individuals, the absence of a Standard Operating Procedure (SOP) for the visual and vendor inspections and a vendor inspection process that does not adequately engage the MBTA individuals with front line responsibility for timely verification and action associated with track defects.

The second category of root cause is individuals within the MOW organization not completely fulfilling the responsibilities detailed in the Track Maintenance and Safety Standards for the Blue, Orange, and Red Lines (See Appendix 1) and for the Green Line. Inconsistent inspection outcomes, such as missing documentation for verification of vendor identified defects and instances of previous defects not being verified in subsequent inspection cycles, provide evidence that the Track Maintenance and Safety Standards are not a substitute for an SOP and that the expressed understanding of responsibilities by MBTA MOW staff is not comprehensive.

Addressing these two root causes will go a long way toward addressing the identified issues. There are other factors that add to the problem including adequate staffing, the experience, and qualifications of other members of the MOW staff, support of the MOW function within the organization including positional influence and the priority of MOW activities against capital and other internal MBTA activities. Lastly, the issue of access to efficiently inspect and repair defects deserves additional consideration.

Several of these additional factors have been the subject of previous studies by the MBTA. The MBTA has implemented some of the recommendations from these studies, with perhaps the most progress made in implementation of the Asset Management system and some elements of training. However, inadequate executive/management staffing levels to allow adequate time to fully develop other recommendations has slowed progress. When adequate staff are available to focus on implementation, these previous recommendations should be revisited, prioritized, and progressed.

INTRODUCTION

The Massachusetts Bay Transportation Authority (MBTA) engaged Charles L. O'Reilly, Jr., doing business as Carlson Transport Consulting, LLC, to conduct a review and evaluation of the management and performance of the inspection and maintenance activities conducted by MBTA Maintenance of Way (MOW), often referred as the Track Department.

The scope of this review and evaluation is limited to a narrow focus on the track inspection function and related follow-up activities based on the objectives of identifying root cause(s) of the inspection process failure. The work activities were significantly supplemented by materials provided by the MBTA that are relevant to this assignment including the Federal Transit Administration (FTA) Safety Management Inspection Final Report dated August 31, 2022, Special Directives issued by the FTA, associated Corrective Action Plans and responses to the Massachusetts Department of Public Utilities (DPU). The supplied information also included recent visual and vendor inspections, workflows, and standards. This information was reviewed as part of the scope of services for this review.

The scope of services for the engagement includes collection and review of materials provided by the MBTA including the information described in the preceding section, review of relevant track standards, review of inspection procedures, review of the MBTA's Asset Management System relative to MOW functions, and interviews with current and retired MBTA MOW and current Engineering and Maintenance (E&M) staff.

Following the collection of information and interviews, the remaining tasks include evaluation of the acquired information and a summary report of conclusions and recommendations.

BACKGROUND

The Safety Management Inspection (SMI) performed by the FTA, and summarized in the August 31, 2022, Final Report, was initiated due to safety issues that go across MBTA departments, labeled by the FTA as a "pattern of safety incidents" including derailments, train collisions, grade crossing fatalities and other incidents involving employees and passengers. While performing the SMI, the FTA issued

four special directives on June 15, 2022 that require the MBTA to address key safety concerns on a priority basis. The deficiencies associated with maintenance of way (MOW) that needed immediate action in advance of the Final Report were included in Special Directive 22-4, which required actions in three (3) distinct categories related to MOW including actions to address deficiencies in personal protective equipment (PPE) and right of way (ROW) safety; to correct defective track condition; and to address management practices that negatively impact track repair.

The findings in these three categories were structured as nine (9) separate required actions. Collectively, these critical and time sensitive findings are supportive of an overall conclusion that the MBTA needs to refocus on activities that create and maintain a culture of safety, including inspections.

After the release of the SMI, additional evaluations by the DPU and MBTA management resulted in concerns regarding the quality of track inspections and the subsequent actions plans associated with identified track defects. The initial concerns were related to vendor testing, primarily track geometry tests, but also included ultrasonic rail tests and optical rail wear and profile tests. The visual track inspection process performed by MBTA staff was later identified as another area for evaluation. The concerns included missed defects and prior defects that were not being reviewed and recorded in subsequent visual inspections, as well as missing documentation of verification of vendor testing including entry of verified defects into the MBTA asset management system.

This engagement has been commissioned to review and evaluate the performance and management of the inspection and associated maintenance activities conducted by MBTA MOW.

PROCESS

The MBTA provided access to information directly related to the track inspection, including but not limited to:

- Federal Transit Administration Safety Management Inspection Final Report
- MBTA Corrective Action Plans responding to DPU Immediate Action letters
- Geometry test reports from vendor testing

- Ultrasonic rail inspection reports
- Draft Standard Operating Procedures for Track Inspections
- Roadmap to Deliver 2023 Construction Plan
- FTA-TRA-22, Corrective Action Plans (CAP) 1-9
- Status updates on CAP's 1-9
- MBTA Engineering and Maintenance Directorate Management Plan 5/30/2018
- MBTA Track Maintenance and Safety Standards 2008 (7/08)
- MBTA Engineering and Maintenance Directorate organization charts including MOW
- Track Inspection process flow diagram

Other information obtained during interviews included:

- MBTA Track Network Schematics
- Systemwide track charts
- NetworkRail – MBTA: The Case for Increased Access – v1, Executive Summary, 7 September 2017

In July 2023, the MBTA also provided the Final Report of the Safety Review Panel dated December 9, 2019

This information was reviewed with an emphasis on the information closely related to the inspection process including the asset management system, work order process and track condition quality trends related to inspections.

At the conclusion of the review, a series of interviews were held with MBTA staff currently holding positions within the Engineering and Maintenance Directorate including the MOW Department. The positions included Superintendents, Supervisors, Section Forepersons and System Repairpersons. Interviews also included two retired MBTA employees that previously served as Director Maintenance of Way.

DISCUSSION

The interviews with the current and retired MBTA employees were structured to focus on the MBTA track inspection process and procedures and organized with

the objective of getting the participant's views regarding the selection, duties and training for System Repairpersons (visual track inspection) and Section Forepersons (all inspection activities including vendor testing) and on the internal process for inspections. All individuals that were interviewed cooperated fully.

Given the range of positions interviewed, the professional and operational experiences of those interviewed and other factors, the responses were somewhat varied across the different areas of inquiry. It is also important to acknowledge that the focus on the failure of the inspection system likely created a bias toward processes and even positions that need improvement and may not capture all inputs regarding the stronger contributors and positions meeting performance expectations. However, several consistent themes developed, summarized as:

1. **Experience qualification for System Repairpersons:** The position of System Repairperson (SR) is most often filled, based on seniority, by a MOW Laborer. The minimum technical requirements/qualifications, contained in a recent Job Bulletin for System Repairperson (position posting/advertisement) provided for review, include two (2) years of experience in track maintenance and completion of the System Repairer training program. These individuals have typically been in the Laborer position for two years and are then eligible for training based on the longest tenured (most senior) individual that seeks the position.

   While an MBTA MOW laborer may participate in elements of trackwork, the level of exposure to track maintenance is generally limited. The duties and responsibilities for an MBTA Track Laborer, listed in a position posting dated 06/24/22, are narrower than the requirements for qualification for the System Repairperson. Some in the Laborer category may be focused on non-trackwork activities such as maintenance tasks like landscaping. This situation may create a potential gap between actual experience and required qualifications. Reviewing the MBTA Job Bulletin for a Trackperson, recently opened on 6/30/2023, shows that the responsibilities for MBTA Trackperson are more closely aligned with the qualification requirements for MBTA System Repairperson.

By way of comparison, the MBTA's Commuter Rail system has inspection qualification requirements that appear to be similar to the Transit requirements, although, as required by the Federal Railroad Administration, designated qualified persons to inspect track must have one (1) year of experience in railroad track inspection, or a combination of experience in track inspection and training from a course in track inspection or from a college level educational program related to track inspection. Under the Commuter Rail approach, inspections are performed by a Foreperson and assisted by a trained Assistant Foreperson who is becoming qualified by experience over time.

The American Public Transportation Association (APTA) under the APTA Standards Development Program, published a revised version of their standard for Rail Transit Track Inspection and Maintenance (APTA RT-FS-S-002-02, Rev 1) on April 7, 2017. The stated purpose of that standard "is to verify that tracks are operating safely and as designed through periodic inspection and maintenance, thereby increasing reliability and reducing risks of hazards and failures."

That document, in Article 2. Qualified persons, contains article 2.3 Minimum qualifications of qualified persons. Those qualifications, while seemingly similar to the MBTA's transit requirements for qualified persons, are generally higher than the ones used by the MBTA including the requirement for two years of satisfactory related experience inspecting, constructing, or maintaining track and special work.

2. **Experience and qualification of Section Forepersons:** The position of Section Foreperson is most often filled by individuals promoted from the roster of System Repairpersons. In the case of the Section Forepersons, the selection for these positions is not solely based on seniority and includes a test-in requirement.

Those interviewed indicated that the limited track maintenance experience required to become a System Repairperson sometimes carried over into Section Forepersons that also lacked experience and the expertise needed to make judgements regarding track defects and appropriate actions. This is most evident when vendor testing information is collected and distributed, and the need arises for MOW Engineers and/or Supervisors to become directly engaged in assessment and resolution of identified defects.

3. **MOW Training:** The training and instruction staff at the MBTA have a wide range of duties that include training and associated recertification. The MBTA has recently made changes to the training group, including adding staff. In the past, due to the workload, the interview participants believed training specific to track inspection has been limited resulting in the ability to only provide training at a relatively high level. The introduction of handheld data collection devices, use of Trapeze (asset management tool) and the design attributes of some of the MBTA track structure (direct fixation, restrained curves, tight radius curves, vehicle dynamics, etc.) presents an environment that is complex.

   The training for System Repairpersons continues after the introductory training and is provided through on-the-job training (OJT) where newer SRs are teamed with more experienced individuals. Impacting the effectiveness of the OJT approach is the necessity for one of the SR's to be on watch for trains operating within and approaching the area of inspection because most of the inspections are conducted during daytime service hours.

4. **Standard Procedures:** Most of the interview participants stated that System Repairpersons and Section Forepersons have a general understanding of the standard steps associated with the visual inspection process, gained through training and verbal on-the-job training. However, none interviewed are aware of a Standard Operating Procedure that governs visual inspections.

   Drawing a distinction between understanding the expected responsibilities and fully executing those responsibilities, the MBTA's records reviewed

from the asset management system indicate that most System Repairpersons and Section Forepersons are following the prescribed steps for visual inspections, although, as described elsewhere in this report, the quality of execution varies and needs improvement.

The same is true regarding a lack of knowledge concerning a Standard Operating Procedure for vendor testing. The situation with vendor testing is further complicated by inconsistent engagement of the Section Foreperson in real time during testing. The vendor testing is generally witnessed by a MOW Engineer who then compiles defect information and distributes it to others in MOW. The information, after compilation, is emailed to the Section Foreperson, Supervisors and Superintendents, usually the morning following the test. This has led to a level of disconnect and delay in responding to and verifying identified defects, primarily around vendor provided track geometry tests.

The lesser understood next steps following the email distribution of vendor identified defects is that the Section Foreperson is responsible to verify the defects and then act using the appropriate track criteria for the defect category. While some defects can be addressed during the verification process, most action will be deferred until a later date and the Section Foreperson is expected to log these defects in the MBTA asset management system and implement a speed restriction if required.

This process, inclusive of using email for distribution of the information has inherent weaknesses including a lack of a consistent approach to document receipt of the information and lack of a consistent approach to track and document the verification activities and actions to correct the deficiencies or log the defect into the asset management system. The email distribution has an additional weakness when a Section Foreperson position is filled on a temporary assignment basis and the assigned individual does not have access to the MBTA email system and the ability to receive the reports. While this situation is rare, intervention is required by the Line Supervisor.

5. **Staffing:** Indirectly linked to the subject of inspection is the subject of MOW staffing and prioritization. The FTA Safety Management Inspection documents this issue well in Category 1, Finding 1. The interview participants agreed that staffing levels have greatly impacted MOW's ability to support the increased emphasis on an expanded capital program while at the same time focusing on track maintenance and correcting growing safety critical track defects.

FINDINGS

The inspection and maintenance of all infrastructure is fundamental to providing safe and reliable MBTA service. The level of safety incidents that have occurred on the MBTA over the past several years, such as personal injury, derailments, vehicle failures, station infrastructure deterioration and traction power cable fires, provides evidence that both fundamental components are not being adequately managed. The subject of maintenance is covered by the FTA Safety Management Inspection report and there are many Corrective Action Plans under development or underway, with oversight by the DPU, that deal with that area. These findings are more narrowly focused on the inspection and maintenance responsibilities of the Maintenance of Way Division.

After issue of the FTA Final Report, it was discovered that follow up and verification of vendor track geometry testing performed in the third and fourth quarter of CY 2022 had not been performed when the next round of vendor testing was conducted in the first quarter of CY 2023. When that issue became known, the MBTA immediately placed systemwide speed restrictions and then commenced an inspection verification process that engaged MBTA staff and rail engineering consultants. While verification results vary by line and section, they indicate some patterns:

- The inspections by System Repairpersons do not consistently identify all track defects.
- The inspections by System Repairpersons do not consistently identify/verify previously reported defects.

- The potential defects identified by geometry vendor testing are not consistently verified by Section Forepersons using a standard and documented process.
- Oversight and quality control of the inspection process is not sufficient for this important, safety-critical function.

These patterns are cause for significant concern and the MBTA, with the implementation of the independent verification, was able to confidently confirm and document actual track geometry defects as well as eliminate some reported defects as false positives. Following that process, the MBTA then lifted the systemwide speed restrictions and placed an appropriate speed restriction or applied other mitigation measures on specific segments as required by the MBTA's maintenance manual and associated criteria.

It is appropriate to include some discussion around the issue of defects identified as "false positives" or in MBTA vernacular, "ghosts". These false positives are defects identified by vendor testing, usually track geometry, that cannot be located or duplicated during the verification process performed by the Section Foreperson or other MBTA staff and/or consultants. A high-level review of this subject leads me to conclude that the cause of some of the false positive defects is, in part, due to the criteria selected by the MBTA for geometry testing.

The MBTA system, particularly the Green Line, was constructed within physical constraints that still exist and include geometric conditions that are atypical of most U.S. systems, specifically very tight radius curves, tight turnouts, and very limited clearance to tunnel structures. When introducing geometric vendor testing, the MBTA utilized track maintenance criteria for defect definition and the vendors have tested against those criteria. Those criteria are commonly used by freight rail and commuter rail under the oversight of the Federal Railroad Administration, as well as many transit systems. Given the MBTA's system characteristics, the detection of geometry defects may be overstated and may lead to lack of confidence by MOW staff in the results over time. The APTA guidance for inspection criteria allows for optional testing and maintenance criteria. The MBTA should consider utilizing alternative criteria for geometry defect definition on all or part of the MBTA's transit system geometry testing.

Following many of the tasks performed for this evaluation and completion of a draft report, a review was conducted of the Final Report of the Safety Review Panel dated December 9, 2019. That report, authored by three external transit industry experts (Carmen Bianco, Carolyn Flowers, and Ray LaHood), was based on a comprehensive review of the MBTA's safety performance, safety leadership and culture. Deferring review of the report allowed this evaluation to be done without the influence of the previous work.

That report and its recommendations, while broader in scope than this evaluation, touched on many of the items that continue to challenge the MBTA almost four years later including the emphasis on capital delivery, inability to accomplish required maintenance and inspections due to inadequate staffing levels, insufficient planning that balances maintenance of the system while accelerating the capital program, lack of Key Performance Indicators, specifically regarding the Track Department's PMI's (Preventative Maintenance and Inspections) as well as suboptimal internal teamwork and communications. Review of the report provides support for many of the conclusions developed for this report as well as in support of the additional factors identified as contributing to the two root causes.

The Safety Review Panel report provided thirty-four (34) recommendations and sixty-one (61) individual corrective actions in their recommendation. Once again, some progress has been made but more effort is needed to fully implement the recommendations. It is this author's belief that lack of progress is primarily due to the need to address other priorities within available fiscal and staffing conditions.

CONCLUSIONS

Following the review, interview and evaluation tasks, the root cause of the issues that have been described fall into two categories:

The first and primary cause is a systemic lack of clarity regarding the roles and responsibilities of most positions within the MBTA's Maintenance of Way organization regarding track inspections. Contributing to the situation is the absence of a Standard Operating Procedure (SOP) for the visual and vendor inspections, limited track maintenance experience of many individuals with track inspection responsibility, inadequate training for these individuals, and a vendor inspection process that does not adequately engage the MBTA individuals with front line responsibility for verification and action associated with track defects.

Development of these SOP's has commenced and when issued, should provide the basis for a consistent approach to the activities associated with visual and vendor inspections including the specific responsibilities and timeline expectations for actions by MBTA MOW staff. The SOPs will also form a valuable tool for development of additional inspection training with an emphasis on skill set development for MBTA MOW inspection staff focused on System Repairpersons and Section Forepersons. The introduction of a quality assurance element should be included as part of the SOPs.

The second category contributing to the problem is individuals within the MOW organization not completely understanding and/or fulfilling their responsibilities. The primary document that governs MBTA Maintenance of Way inspection criteria and responsibility is the Maintenance of Way Division, Track Maintenance and Safety Standards, Blue, Orange and Red Lines, Edition 2008 (7/08) and the Green Line – Light Rail Transit, Track Maintenance and Safety Standards, Edition 2008.1 (7/08). These two documents provide minimum maintenance and safety requirements for track including maintenance limits and the requirements for the frequency and nature of track inspections.

Within the Track Maintenance and Safety Standards, the Duties and Responsibilities of Supervisors, Section Foremen (Forepersons) and System Repairpersons are detailed in Part T212.243 and Part LRT212.243 of the respective documents. The two documents are similar except for the internal

references within each document. The document applicable to the Blue, Orange and Red Lines is used for illustrative purposes and the narrative of the assigned responsibilities for Supervisors, Section Forepersons and System Repairpersons are listed in the Track Maintenance and Safety Standards for the Blue, Orange, and Red Lines (See Appendix 1) and is similar for the Green Line.

While all MBTA MOW staff that were interviewed have been introduced to these documents and those interviewed provided feedback that they generally understood the inspection process and their responsibilities detailed in the Track Maintenance and Safety Standards, inconsistent inspection outcomes and independent validation inspections provide evidence that the Track Maintenance and Safety Standards is not a substitute for an SOP and that the actual understanding of responsibilities is not comprehensive.

Addressing these two issues will go a long way toward addressing the identified issues.

However, there are other factors that contribute to the problem including inadequate staffing, the limited experience and qualifications of the staff, support of the MOW function within the organization including organizational influence and priority of MOW activities against capital and other internal MBTA priorities. Lastly, the issue of access to efficiently inspect and repair defects deserves additional consideration.

Some of these additional factors have been the subject of previous studies by the MBTA, and consultants engaged by the MBTA such as Network Rail Consultants. The MBTA has implemented some recommendations from these studies, with perhaps the most progress made in implementation of the Asset Management system and some elements of training.

Staffing of executive/management positions in Engineering & Maintenance and MOW needs to be accelerated to levels that allows adequate time to fully develop other recommendations where progress has not met expectations. Once staff are available to dedicate themselves, these previous recommendations should be revisited, prioritized, and progressed.

RECOMMENDATIONS

As described in the Findings section, many activities that will result in improvement of the MBTA inspection process are underway. The FTA Safety Management Inspection (SMI) identified findings and required actions. In describing certain situations and the development of associated findings, the report describes several issues that are consistent with issues discussed by interview participants.

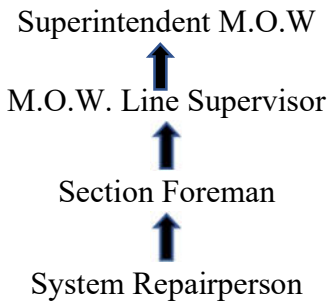
Supplementing the report narrative, I offer the following recommendations:

- Complete the Standard Operating Procedures for visual and vendor inspection including a clear procedure for documentation of defects identified during vendor testing.
- Elevate the inspection (System Repairperson and Section Forepersons) positions in the MOW organization.
- Modify the selection process and qualification requirements necessary for the inspection roles.
- Further enhance training, certification, and recertification for System Repairpersons.
- Provide Section Forepersons with ability to witness vendor testing in real time.
- Evaluate using alternative criteria for track geometry testing as suggested by APTA.
- Adequately staff MOW to levels that support managing SOGR activities including assessment and maintenance activities.
- Assess the responsibility and compensation parity across functional departments.
- Engage highly qualified, experienced MOW engineers to participate in developing the program and priorities for a long-range improvement plan.

APPENDIX 1

T213.243 Duties and Responsibilities of Supervisors, Section Foremen and System Repairpersons.

The organizational reporting structure of the M.O.W Division is as shown below:



The *Superintendent M.O.W* oversees the activities of a Supervisor or Supervisors. The Superintendent is responsible for planning and policy making decisions.

The *M.O.W Line Supervisor* generally is assigned to one of the four lines (Blue, Orange, Red or Green) and is responsible for all track/M.O.W. related issues on the line. From an inspectional standpoint, the Supv. Monitors and maintains records of daily, every other monthly and bi-annual track and turnout inspections. The Supervisor must personally inspect every turnout and special trackwork location in his/her territory twice a year. Records of these inspections shall be maintained under **T213.241**.

Section Foremen are assigned a territory for which they assume responsibility for the activities of all System Repairmen (track inspectors) in that territory. The System Certification process is the direct responsibility of the Section Foreman. The Section Foreman must ensure that all track inspection and System Certification documentation is correctly completed in a timely fashion. The Section Foreman is responsible for bringing to the attention of the Line Supervisor track deficiencies noted on daily inspectional reports or discovered by him/her during System Certification.

System Repairpersons or Track Inspectors are the individuals who perform vital inspectional functions on a daily basis. System Repairpersons should not just walk track, but must be able to recognize exceptions to the Track Maintenance Standards. System Repairpersons are responsible for daily track inspection forms and must communicate any abnormalities or exceptions to the Track Maintenance Standards to their Section Foreman and/or Supervisor. System Repairpersons must be qualified per DPU regulations Section 151.08(4)(b).[1]

[1] This citation is used in the reviewed documents. The current DPU regulation is Section 151.11(4)(b)