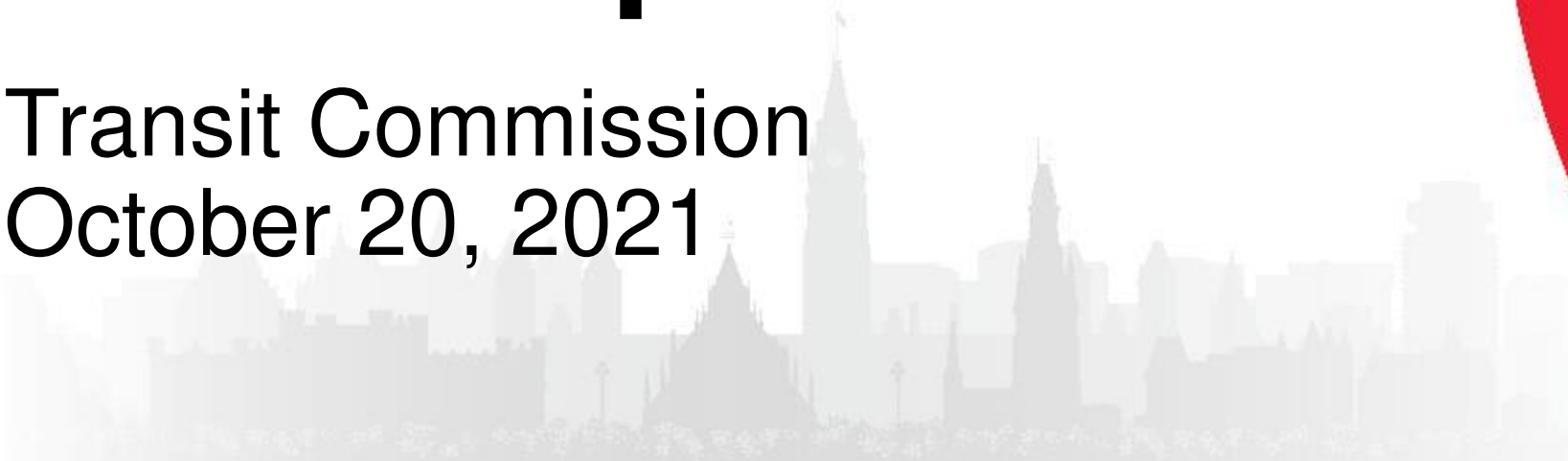




O-Train Confederation Line 1 Update

Transit Commission
October 20, 2021



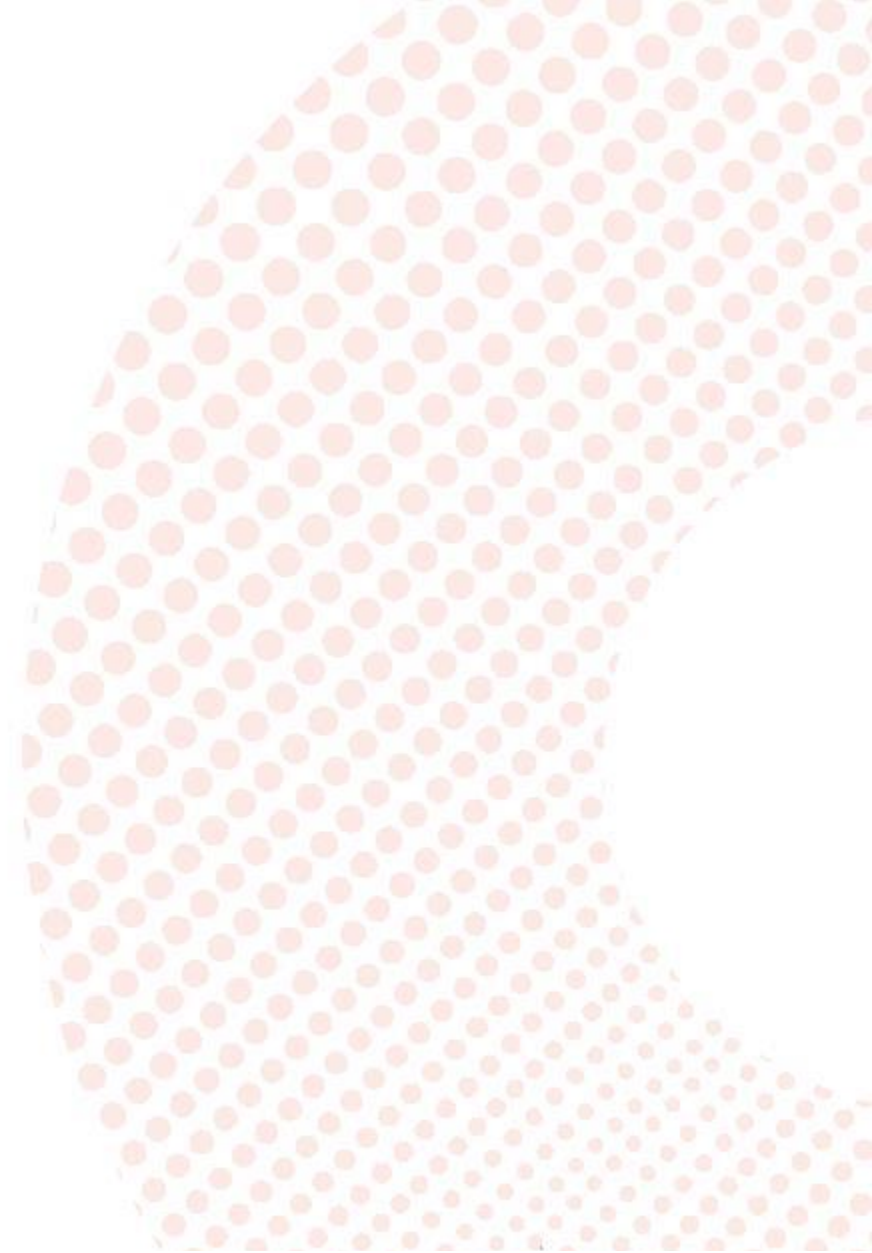
Agenda

- Context
- Update on Safe Return-to-Service Plan
- Reliability and Safety Incidents
- September 19 Derailment Update
- R1 Replacement Bus Service

Context

- Line 1 experienced derailments on August 8 and September 19 resulting in suspension of service.
- In both events, all OC Transpo emergency response protocols outlined in OC Transpo's Safety Management System were implemented.
- R1 bus replacement service was implemented immediately and will remain in place until O-Train Line 1 resumes operations.
- Line 1 service will resume following confirmation that Rideau Transit Group's (RTG) return-to-service plan adequately addresses all safety and service requirements.
- The safety of our customers and staff remains our top priority.

Update on Safe Return to Service Plan



RTG's Proposal

- On October 15, RTG provided a return-to-service plan to the City.
- The plan is currently under review with Transportation Research Associates (TRA) in consultation with the Regulatory Monitor and Compliance Officer (RMCO).
- To meet expectations, the plan must include both immediate actions for service to resume safely and long-term actions to sustain a safe and reliable operation.
- Subject to TRA review and validation process, RTG is targeting a partial return to service with a fleet of seven trains (14 cars), plus a spare, the week of November 1, 2021.
- Based on the steps required to verify the safety of the LRT system, the City anticipates that partial service will resume within the first two weeks of November.
- All dates are considered tentative, are subject to an intensive inspection program on the entire fleet and TRA's concurrence that the plan is robust, is supported by safety and quality reports and will sustain a safe and reliable return to service.

RTG's Plan

Core elements of the safe return to service plan have been informed by the results of the root cause analyses for the recent derailments. RTG's core plan is as follows:

- Complete root causes analyses to assess the appropriate short term and long-term mitigations.
- Confirm that repairs to the track, signals and systems are complete, validated and tested.
- Undertake an intensive fleet inspection program of all critical safety components and hardware.
- Implement a Quality Assurance / Quality Governance process for the overall return to service plan.
- Critically, the City will be looking to ensure the following:
 - Introduction of additional quality control checks, increased oversight, and increased vehicle inspections.
 - Confirmation that staff are properly trained to perform the additional tasks, are adequately resourced and the necessary process improvements including quality checks and sign-offs are in place.
 - Confirmation that all elements of the plan are supported with appropriate documentation, safety and quality reports, checklists and approvals of all work performed.
 - Confirmation that trains, track and rail systems including the computer-based train control system have been tested and following a period of trial operations deemed safe to return to service.

Additional Alstom Commitments

Separate to the return-to-service plan, RTG's subcontractor Alstom, has committed to a four-tiered approach to correcting issues and sustaining a safe and reliable system:

1. Uplift competencies of the leadership and supervision teams.
2. Separate maintenance and vehicle modification activities.
3. Improve process and tools for the maintenance of vehicles and infrastructure.
4. Strive to regain a professional and productive work environment by injecting fresh, qualified resources.

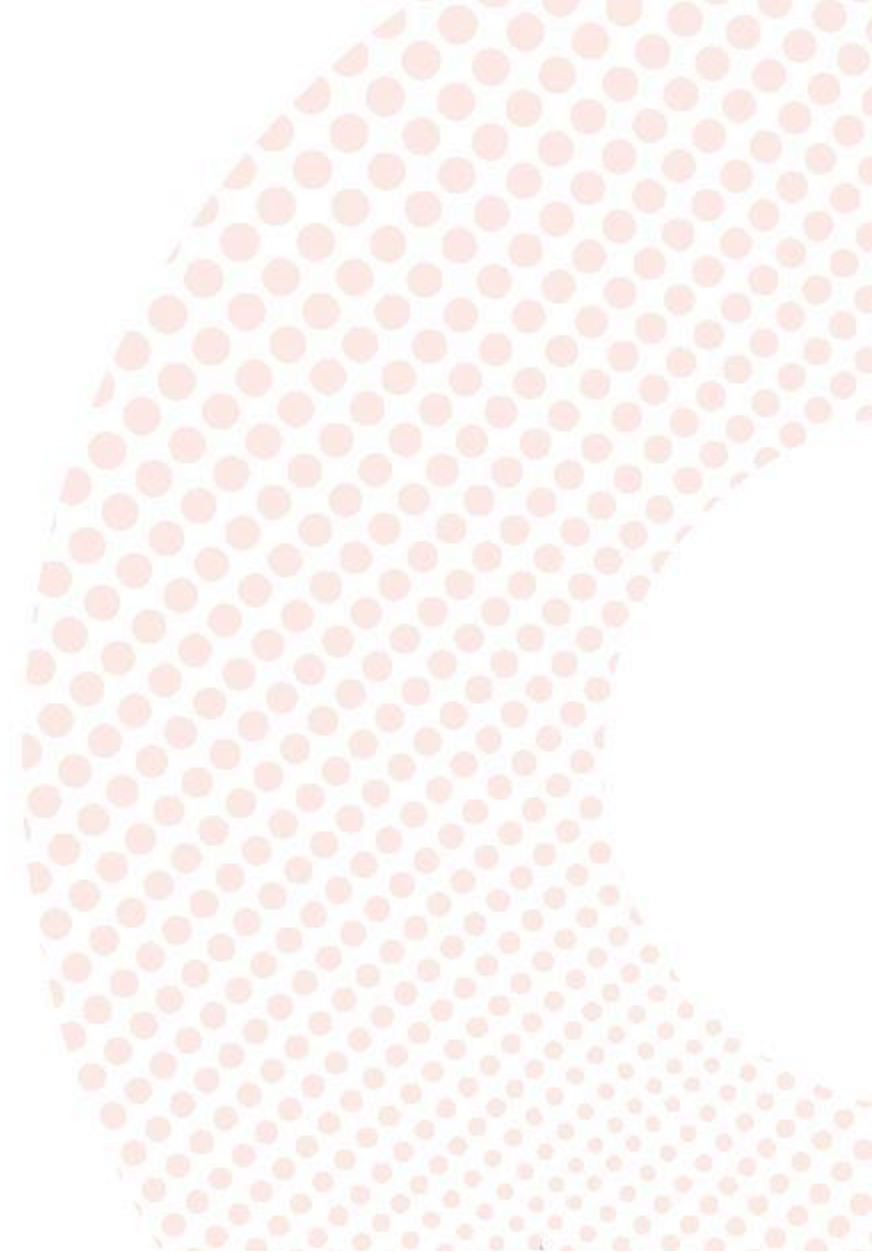
Independent Safety Review

- The City hired Transportation Research Associates (TRA) to undertake an independent, third-party safety review.
- TRA will review RTG's relaunch plan and make recommendations to the City on the proposed LRT relaunch service plan.
- RTG is responsible for implementing the return-to-service plan.
- TRA will monitor the effective execution of RTG's plan.

Safe Return-to-Service Requirements

- The final return-to-service date will only be determined once all due diligence has been taken and that we are satisfied it is safe.
- Sam Berrada, (the RMC0), remains engaged and is reviewing the safety of the system and soundness of the City's overall approach.
- The Transportation Safety Board of Canada (TSB) has been actively engaged since the derailment. Their investigation is ongoing and is independent of the City's review.
- Once TRA recommends to the City that RTG is ready to resume service, the City will verify RTG's ability to safely and reliably relaunch the LRT system. This will include one to two days of testing.
- The final date for return-to-service will be determined once the City is satisfied it is safe to do so.
- A technical briefing by the TRA team will be provided in advance of Line 1's return to service.

Reliability and Safety Incidents



Reliability Monitoring

- RTG's previous rectification work to address reliability and technical issues resulted in approximately a year of service reliability in the 97% to 99% range.
- Strong winter performance followed the installation of gas-powered switch heaters in the east end and improved remote monitoring capability.
- Due to the braking systems adjustments, wheel flats and associated impacts on fleet availability have not recurred.
- Modifications to the line inductors and line contactors have resolved the arcing issues that impacted service in the winter of 2019 / 2020.
- SIL2-certified door software implemented resolved door sensitivity challenges and associated service impacts.

Reliability Monitoring *(Cont'd)*

- Service impacts due to Train Control and Management System (TCMS) and Vehicle Onboard Controller (VOBC) train communication issues as a result of software modifications and updates have been addressed and are no longer a significant contributing cause of in-service failures.
- HVAC systems continue to be monitored in extreme weather events and have performed to expectations over the past summer and winter months.
- As a result of repairs and maintenance changes to the Overhead Catenary System (OCS), service disruptions have not recurred due to OCS breakage.
- All modifications and rectification work are subject to third-party validation to ensure solutions are resolved and can be sustained.

Reliability Monitoring *(Cont'd)*

- The following reliability and technical items continue to be tracked by staff:
 - Trackwork Performance: Significant grinding and ballast work was undertaken in 2021, however, a wheel-rail interface study is required to assess vehicle noise and vibration through curves. Additional items such as track slow orders and track performance continue to be monitored.
 - Vehicle Auxiliary Power Equipment (CVS units): This item is still outstanding from the original RTG rectification plan and Alstom is changing equipment suppliers in order to help address this issue.
 - Cracked Wheels: The process to replace cracked wheels on the fleet is continuing. There are seven (7) vehicles remaining with wheels to be replaced. Refer to Transportation Safety Board (TSB) Report [R20H0079](#) for additional details.

August 8 Derailment

- Following the derailment on August 8, near Tunney's Pasture Station, the Alstom Citadis fleet was grounded to enable a fleetwide inspection.
- The TSB report R21H0099 is noted as completed on the TSB website and Rail Safety Advisory Letter 617-02/21 was issued to the City.
- The root cause investigation for this matter is continuing and involves the following:
 - Grease lab analysis (ongoing)
 - Metallic part analysis (ongoing)
 - Finite element modelling and Design Analysis
 - Track load survey (track conditions and operating modes)
 - Vendor root cause analysis
- RTG is expected to provide updates on the root cause investigation in December 2021.
- In order to mitigate failures, Alstom has implemented an increased inspection frequency (every 7,500 kms) to detect potential axle failures and a specific test (axial play verification) that is indicative of the axle failure mode.

August 8 Derailment *(Cont'd)*

- The Transportation Safety Board (TSB) in their feedback to the City, noted that the use of onboard thermal monitoring technology for detection of axle failures should be reviewed.
- As part of the original design, RTG was required to provide safety certification for the complete system including identification of hazards and identification of the mitigations for the hazards. The list of mitigations did not include onboard thermal monitoring.
- Given the incident in August and the supplemental inspections that are now required, additional condition monitoring tools and long-term solutions are being assessed.
- Specifically, onboard changes to enable thermal detection or slip/slide reporting to the Operator as well automated tools on the wayside, thermal detection or other targeted solutions, are currently being assessed.
- Concurrently, the City is looking more holistically across the entire system to assess opportunities for increased condition monitoring on catenary, vehicles, and track.

September 19 Derailment

- A derailment on September 19, 2021, between Tremblay and Hurdman stations caused significant infrastructure damage.
- Service on O-Train Line 1 was suspended in order to undertake a thorough review of the event and to assess requirements for a safe return to service.
- The City's RMCO is engaged in the review of the investigation, and the City Manager has engaged TRA to review RTG's return to service plan.
- Preliminary TSB investigation R21H0121 provides additional photographs and information on this incident. The investigation is noted as active.
- The following slides provide an overview of this event.

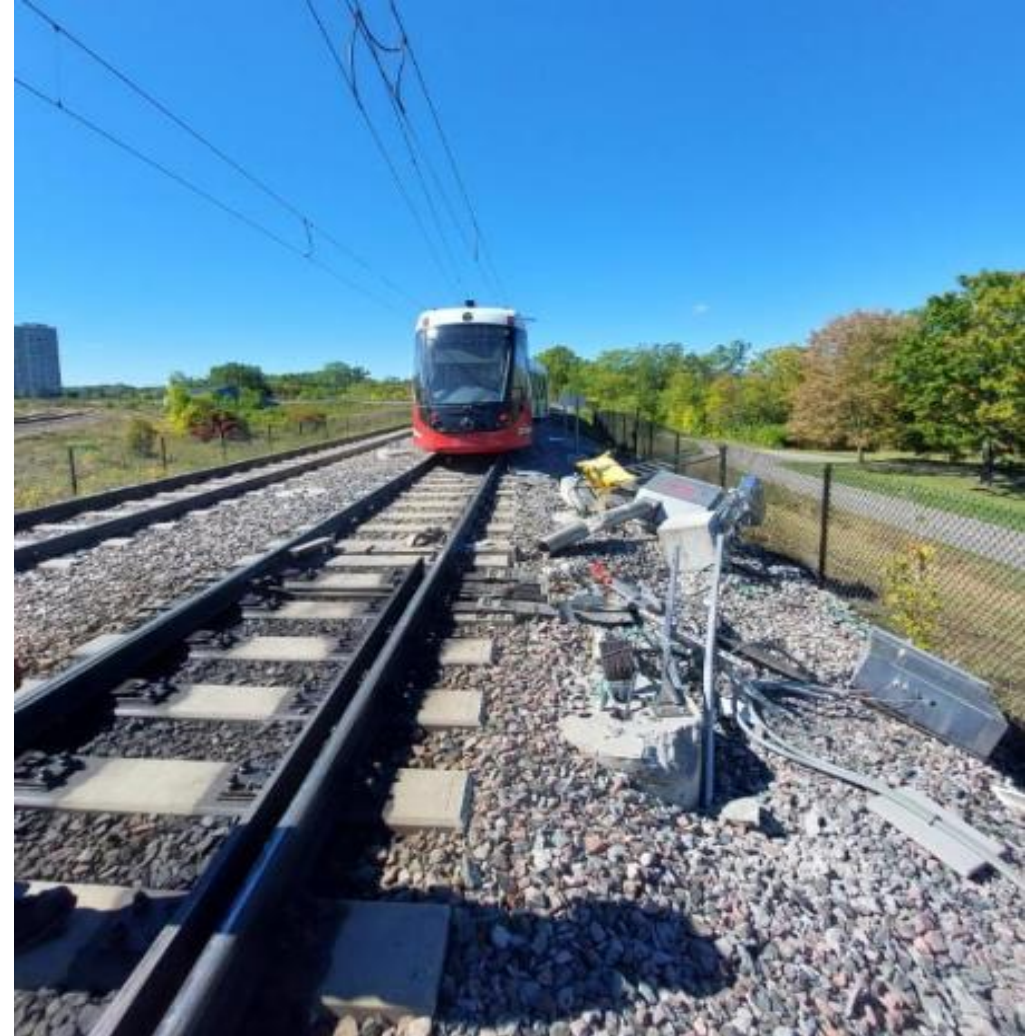
September 19 Derailment (Cont'd)

- At approximately 12:15 p.m., a westbound train came to a stop due to a derailed bogie (*2 axles, 4 wheels*) between Tremblay and Hurdman stations.
- All stakeholders were engaged immediately: RTM, Chief Safety Officer, RMCO, TSB and Transport Canada.
- At approximately 12:45 p.m., Line 1 service was suspended and all trains were stopped at the nearest stations.
- At approximately 1:00 p.m., customers on board the derailed train were provided assistance to exit the vehicle.
- Full R1 bus replacement service was implemented end-to-end from the time of the incident to present.



Incident Response

- At approximately 12:50 p.m., customers were notified of a stopped train and R1 bus service from Rideau to Blair.
- At approximately 1:25 p.m., customers were notified that train service was unavailable and full R1 bus service was operating from Tunney's Pasture to Blair stations.
- OC Transpo, OPS, and OFS responded to assist customers from the train; no injuries were reported.
- OC Transpo staff, RTM, and TSB officials began investigating the cause of the derailment.
- A media availability was held at 5:30 p.m.



Incident Response (Cont'd)

- Each non-impacted train was inspected by a technician prior to being returned to the Maintenance and Storage Facility (MSF).
- Vehicles were driven back at a reduced speed with technicians on board.
- As part of TSB's review of the incident, the City was informed that the affected and any related materials on the guideway were to stay in position, until further notice.
- On September 21, TSB cleared the site, and as a result, the train could be returned to Belfast Yard and infrastructure repair work could start.



Incident Response *(Cont'd)*

- The train was re-railed and inspected by Alstom technicians prior to being moved at a slow speed under its own power back to Belfast Yard for further analysis and investigation.
- The vehicle was returned to Belfast Yard on September 22.
- Staff walked alongside the train to ensure that the movement was done safely and without any additional damage to the train, tracks and rail infrastructure.



Customer Service Response

- Daily website updates, tweets and SMS messages were issued to customers.
- On-site staff supported customers in person across the system at all times of the day.
- Signs placed outside stations pointing to R1 bus stops.
- Council, Transit Commission and media were informed regularly:
 - First update to Council and Transit Commission issued on Sunday, September 19 at approximately 12:50 pm.
 - More than 10 updates to Council and media availabilities were held on September 19 and 20.

Preliminary Findings

The investigation into the root cause and damage as a result of the derailment indicates:

- Prior to the train arriving at Tremblay Station, a gearbox located on the outside of the body started to drop.
- As the gearbox began to drop, it started making intermittent contact with the railroad ties, leaving marks in advance of Tremblay Station.
- The wheels on one of the motor bogies were in a derailed state when the train left Tremblay Station.



Preliminary Findings (Cont'd)

- No abnormalities were noted by the Operator when the train departed the station.
- The train travelled from Tremblay Station to just west of Riverside Drive when the gearbox made contact with a signal mast and a switch heater.
- Communications-based train control (CBTC) system brought the train to a stop.
- There was significant damage to the train and rail infrastructure.
- The LRV passenger door above the affected bogie was damaged.



Preliminary Findings *(Cont'd)*

A damage assessment was conducted following vehicle inspection and a complete walkthrough of the rail line.

Track and Infrastructure:

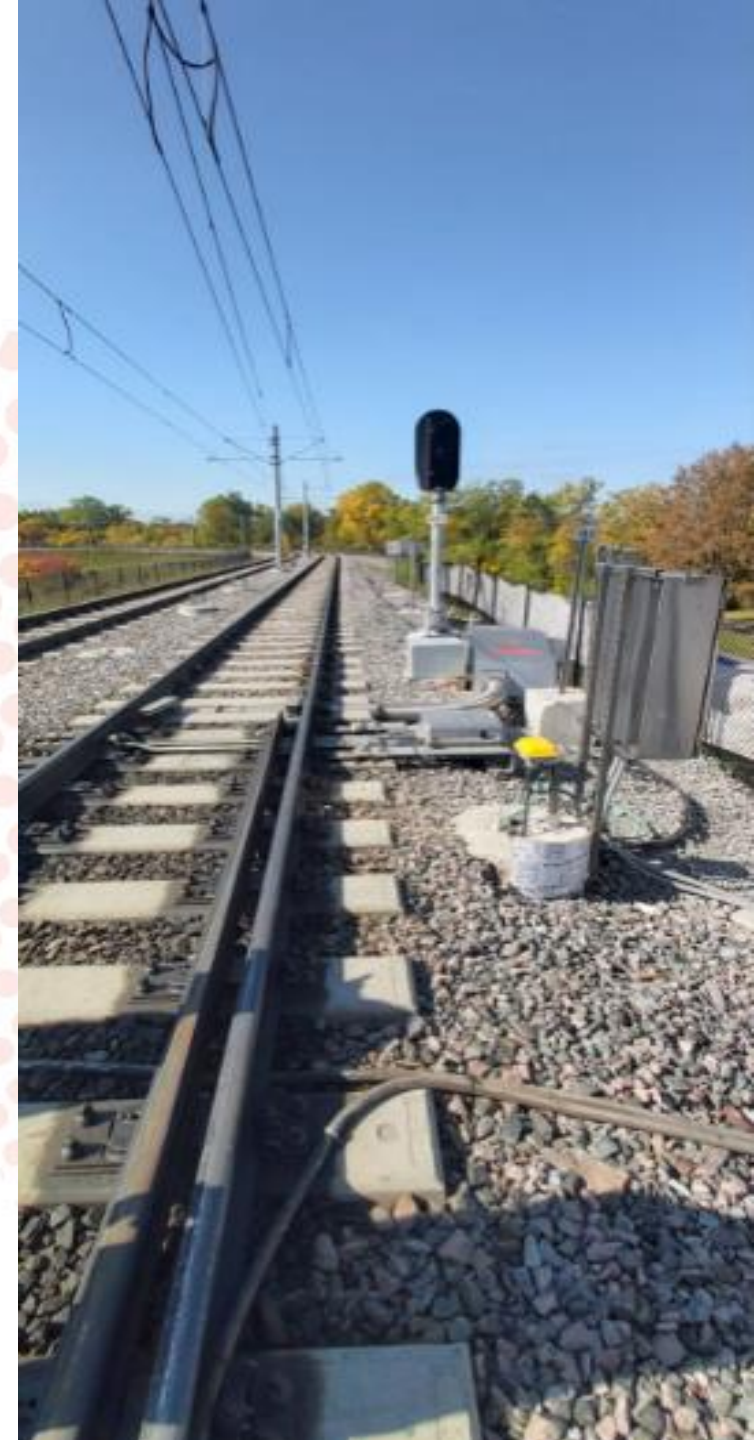
- Switch machine and switch heater damaged.
- Signal post and concrete pad damaged.
- Broken and chipped concrete ties, rails clips and clamps, track bolts and ballast were damaged and required replacement.

Vehicle:

- Gearbox and related components:
- Traction motor and components.
- Wheels, train door, side body and glass panels.
- Maintenance, corrective repairs and fleet checks continue on all LRVs.

Repairs to Date

- All track and infrastructure repairs were effectively completed by October 18. All systems will undergo verification testing prior to confirming their release for service.
- Test trains will be required for additional measurements and validation of the infrastructure.
- An intensive fleetwide inspection is required to assess and validate the integrity of all the trains.



Root Cause Investigation

- The root cause investigation into the September 19 derailment continues.
- The derailed LRV had recently undergone axle repairs to replace the axle bearing assembly from the August 8 derailment.
- Initially believed to be an issue with the sanding bracket, subject to the ongoing investigation, RTG and Alstom have confirmed that the improperly torqued bolts on the gearbox is the primary cause of the derailment.
- The gearbox appears to have dropped down and impacted the rail and track infrastructure.



Gearbox

Background: Vehicle Bogies

- LRVs have five bogies per car (3 motor bogies + 2 trailer bogies).
- Motor bogies are comprised of many components including axles, wheels, bearings, frames, brakes, motors and gearboxes.
- The gearbox is the mechanism that couples the motor to the axles.
- The gearbox facilitates the energy transfer from the motor to the wheels, which is required to propel them forward.

Background: Vehicle Bogies



Bogie installed on a LRV

Background: Vehicle Bogies (Cont'd)



Bogies at Belfast Yard

Background: Vehicle Bogies (Cont'd)



Bogie with gearbox removed (undamaged)

Safe Return-to-Service

- The final timing for service resumption will be confirmed following
 - 1) TRA's acceptance of RTG's safety plan, and
 - 2) TRA's acceptance of RTG's evidence detailing the execution of the plan.
 - 3) Confirmation by the City that stations, infrastructure, and systems are ready.
- RTG is responsible for implementing the return-to-service plan.
- The final return-to-service date will be determined once all due diligence has been taken.
- One to two days of testing will be required to validate and verify service can resume.
- The final date for return-to-service will be determined once the City is satisfied it is safe to do so.
- A technical briefing by the TRA team will be provided in advance of Line 1's return to service.

R1 Replacement Bus Service

R1 Replacement Bus Service

- While train service is not operating on O-Train Line 1, replacement bus service is operating between all stations.
- R1 buses operate every few minutes, as required by customer volumes, over the same hours as O-Train service.
- Replacement buses operate in mixed traffic on streets and highways.
- Replacement buses can never be as fast, as reliable, or have as much capacity as regular train service.

R1 Replacement Bus Service – Improvements

- High-capacity buses reassigned from other routes to R1 service to provide more capacity and reduce crowding (started September 21).
- Express trips from Blair to downtown in the morning, operating on the highway and bypassing intermediate stations, to make trips faster (started September 21).
- Express trips from downtown to Blair in the afternoon (started September 24).
- All R1 trips bypass Cyrville Station to make trips faster; special shuttle service St-Laurent to Cyrville (started September 27).

R1 Replacement Bus Service – Improvements *(Cont'd)*

- Additional trips between Tunney's Pasture and downtown in the morning and afternoon to increase capacity (started September 29).
- R1 bus service schedules available in customer information systems (started September 21).

R1 Replacement Bus Service – Resource Availability

- Operators, maintenance staff, supervisors and others are working as much overtime as they can to sustain service across the whole system.
- Staff who would normally be standing by to back up regular service are working on R1 service and additional school trips.
- Some operators have been made available by delaying training for their transfer to rail operations for Line 2 reopening.
- Additional buses and operators were made available by reducing service on other routes across the system.
- Rail operators are assisting customers at key locations along the R1 service.

R1 Replacement Bus Service - Cancellations on Other Routes

Route	Number of trips cancelled	Trip times
Line 2 Bus	38	07:28, 08:37, 09:48, 10:57, 12:07, 13:19, 14:21, 15:14, 15:48, 16:27, 17:00, 17:27, 17:49, 18:26, 19:38, 20:50, 22:02, 23:14 • 08:00, 09:09, 10:17, 11:27, 12:38, 13:48, 14:02, 14:26, 14:53, 15:10, 15:49, 16:21, 16:58, 17:27, 17:47, 18:56, 20:07, 21:19, 22:31, 23:43
7	17	07:08, 08:07, 10:39, 13:40, 14:56, 15:25, 16:10, 17:40, 18:10 • 08:21, 09:24, 12:09, 14:53, 16:20, 16:52, 17:36, 19:24
10	2	17:01 • 17:43
12	7	08:15, 14:30, 15:00, 15:59 • 15:08, 15:38, 16:38
14	6	06:31, 15:44, 16:59 • 07:54, 14:39, 15:40
15	11	06:12, 08:19, 16:19, 19:24, 21:26 • 07:23, 09:26, 15:11, 17:37, 20:21, 22:16
24	10	06:25, 06:55, 07:23, 07:55, 08:25, 15:19, 16:23, 16:53, 17:23, 17:53
25	2	16:25 • 15:32
30	3	15:55 • 16:26, 17:36
39	3	14:43 • 15:12, 17:34
40	3	06:39, 10:25 • 07:13
42	1	08:07
44	5	06:14, 07:29, 18:23 • 06:55, 08:12
46	3	15:26, 17:10 • 16:09
55	8	07:20, 08:49, 09:35, 16:10 • 06:35, 07:50, 08:20, 15:16
64	2	06:57 • 07:34
74	2	13:03 • 13:53
80	1	06:00
88	2	17:35 • 15:56
90	9	06:23, 08:09, 09:38, 16:24 • 07:05, 08:49, 10:19, 15:04, 15:31
93	1	07:23
98	1	08:09
257	1	08:05

R1 Replacement Bus Service – Effects on Other Customers

- Removing buses from other routes to reassign to R1 service has caused inconvenience to customers on other parts of the system.
- Removing high-capacity buses from other routes to reassign to R1 service has made buses on other routes more crowded.
- Staff have worked to minimize the negative effect by avoiding first trips, last trips, school trips, and consecutive trips.
- Customers have longer waits and less reliable service.
- Bus trips reduced to RedBlacks and Senators games to match lower attendance and ridership.

R1 Replacement Bus Service – Management

- Maintaining R1 bus service is the highest priority.
- Sustaining the rest of the system remains very important, especially after reductions have increased waiting times.
- Sustaining the school services added this year because of the workforce shortages at school bus companies remains very important.
- The Transit Operations Control Centre is working at an enhanced level with its Service Command Centre activated.
- The Service Command Centre has a special R1 task force with staff from all parts of OC Transpo, plus Traffic Services.
- On-street supervisors and customer support staff are managing and assisting service on the street and at stations.

R1 Replacement Bus Service – Transition as O-Train Service Returns

- As O-Train Line 1 returns to service, it will resume its place as the core of the OC Transpo system.
- Trains will provide faster service between stations and across the line.
- Trains will not be affected by on-street traffic conditions.
- Trains will have more capacity.
- This will allow the replacement bus service to be gradually reduced.
- Buses may need to continue to provide a supplementary service until full train service has resumed.
- As replacement and supplementary bus service is reduced, more of the cancelled service can be restored across the system.

Next Steps

- TRA to undertake independent review of RTG's return-to-service plan.
- The City will verify RTG's ability to safely and reliably relaunch O-Train Line 1.
- Once testing is complete and satisfactory, final return-to-service date will be announced.
- Technical Briefing with TRA officials prior to the relaunch of service.
- Continue to support ongoing TSB investigation.
- Regular updates will continue to be provided as they become available.

Questions?

