



## MEMO / NOTE DE SERVICE

To / Destinataire	Mayor and Members of Council	File/N° de fichier: 66-2021
From / Expéditeur	Director, Rail Construction Program Transit Services Department	
Subject / Objet	O-Train Light Rail Transit Line 1 and Line 2 Comparison	Date: December 16, 2021

The purpose of this memo is to provide the Mayor and Members of Council with a detailed, side-by-side comparison of the technical design and construction of the Stage 1 Confederation Line and Stage 2 Trillium Line projects. This memo also provides additional background information on the Trillium Line design and construction, including an outline of the quality assurance mechanisms in place and an analysis and recommendation regarding the engagement of a peer review of the project. This memo was developed as per the motion which was referred to the Finance and Economic Development Committee (FEDCO) by Council on October 27, 2021 (MOTION NO 62/18 and referral MOTION 62/19).

### *O-Train Line 1 and Line 2 System Comparison*

O-Train Stage 1 Line 1 is a 12.5 KM fully electric Light Rail Transit (LRT) system that provides passenger service to 13 stations between Tunney's Pasture Station in the west and Blair Station in the east. Line 1 operates using a Thales communication-based train control (CBTC) system and provides 5-minute headway frequencies during the peak period.

The original O-Train Line 2 system originally began operations in October 2001 as an eight-kilometre diesel light-rail service. It was constructed as a \$20 million pilot project to provide an alternative to the north-south bus rapid transit in Ottawa. The original O-Train Line 2 alignment ran from north to south serving five stations: Bayview, Dow's Lake, Carleton University, Mooney's Bay and Greenboro. The maintenance and storage facility is located at Walkley Yard. From 2001 to 2015, Line 2 operated three Bombardier Talent diesel multiple-unit (DMU) vehicles and provided service every 15 minutes with two trains in service.

In March 2015, the City opened an expanded and upgraded O-Train Line 2 service, costing \$65 million. Improvements included the construction of new rail sidings and platforms, track and signal upgrades, and six Alstom LINT DMU vehicles. The project coincided with an upgrade to the centralized traffic control to help facilitate the passing movements through the new sidings. In May 2020, Line 2 closed to customers for construction of the Stage 2 project south extension, approved by Council on March 6, 2019.

The Stage 2 Project south extension is a 12 KM extension to the existing single-track, diesel-powered north-south passenger service line from its present southern terminus at Greenboro Station to Limebank Station, and a new 4 KM passenger service line connecting a new South Keys Station to the Ottawa Macdonald-Cartier International Airport. The system will continue to use a strategy of passing sidings and coordinated passing movements.

**Table 1: Systems Comparison**

<b>Function</b>	<b>Line 1 O-Train Confederation (Stage 1)</b>	<b>Line 2 O-Train Trillium Line (Stage 2)</b>
<b>System Power</b>	Electric light rail	Diesel light rail
<b>Track</b>	12.5 km Tunney’s Pasture to Blair	19 km Limebank to Bayview 4 km Airport Link
<b>Fleet</b>	34 Alstom Citadis Spirit vehicles	6 x 40 m Alstom LINT vehicles 7 x 80 m Stadler FLIRT vehicles
<b>Signals</b>	Communication-Based Train Control (CBTC) System	Centralized Traffic Control System with Speed Supervision
<b>Service Frequency</b>	Approximately 5-minute headway	12-minute headway
<b>Yard</b>	Belfast Yard	New Walkley Yard
<b>Stations</b>	13 Stations	11 Stations (80m Platforms) 2 Stations (40m Platforms)

The following table compares the technical elements of O-Train Line 1 and the technical design improvements that will be implemented on the Stage 2 system.

**Table 2: Comparison of Line 1 Technical Issues with Line 2 Design/Experience**

<b>Technical Areas</b>	<b>Line 1 Current Status</b>	<b>Stage 2 Line 2 Trillium Line</b>
<b>Fleet Overview</b>	Fleet manufactured in Ottawa based on Alstom TTNG and Alstom Citadis platform.	Existing Alstom LINT vehicles in service since 2015. New Stadler FLIRT vehicles based on proven platform used in many European countries.

Technical Areas	Line 1 Current Status	Stage 2 Line 2 Trillium Line
<p><b>Switch Heaters</b></p>	<p>Electric switch heaters on the eastern portion of the alignment were replaced with gas heaters to improve performance.</p>	<p>Gas switch heaters will be used throughout the Line 2 alignment.</p>
<p><b>Overhead Catenary System (OCS)</b></p>	<p>Reliability issues that occurred during the first 6 months of service have been resolved.</p>	<p>Not applicable.</p>
<p><b>Mainline Track Design: Curves</b> <i>Can contribute to noise issues if not properly managed</i></p>	<p>The sharpest (smallest radius) curve on the Confederation Line is located east of Hurdman Station with a radius of 110m.</p>	<p>The sharpest (smallest radius) curve on the Trillium Line will be located north of Bowesville Station with a radius of 290m.</p>
<p><b>Mainline Track Design: Wheel-Rail Interface</b> <i>Affects external noise, vibration and overall ride quality</i></p>	<p>Specialized grinding was undertaken to help reduce noise and vibration. A detailed technical review is underway to assess opportunities for improvement.</p>	<p>Line 2 uses the same wheel type and rail profile as the original Trillium Line system (APTA 220 wheels and 115 RE rail).  The interaction between the wheel and rail profile has not resulted in past issues.</p>
<p><b>Mainline Track Design: Rail Neutral Temperature</b> <i>Affects trackwork performance during high temperatures</i></p>	<p>The rail is stressed to 15C (10C to 20C) to balance tensile and compressive forces during the temperature extremes are generally alike. A plan to adjust and increase the rail neutral temperature is under review.</p>	<p>The ballasted track rail will be stressed to 32C (29C to 35C) such that the rail will be in tension for most of the year. This is in line with practices adopted by VIA Rail and Metrolinx given the similar climatic conditions.</p>
<p><b>Yard Track Design: Curves</b> <i>Sharp yard curves have greater risk of derailment due to wheel climb</i></p>	<p>The sharpest curve in the lead tracks (West Connector and East Connector) is 55m in radius. The sharpest curve in the yard is 35m in radius.</p>	<p>The sharpest curves in the lead tracks (the North Connecting and South Connecting Tracks) are 158m in radius. The sharpest curve in the yard is 150m in radius.</p>

<b>Technical Areas</b>	<b>Line 1 Current Status</b>	<b>Stage 2 Line 2 Trillium Line</b>
<b>Vehicle HVAC</b> <i>Affects general comfort for Operator and customers</i>	Alstom will continue to monitor, fine tune, and make seasonal adjustments to the vehicle cabin HVAC system to improve the comfort for operators and to ensure the desired performance results are achieved.	<p>The Stadler vehicle has a dedicated HVAC system for the Driver's Cab which should address any cab concerns.</p> <p>Issues have not been previously identified with the existing Alstom LINT fleet.</p>
<b>Vehicle Braking</b> <i>Excessive braking results in wheel flats and poor ride quality; commonly linked to integration issues</i>	High incidence of wheel flats during first 6 months of service.	The Alstom LINT trains did not suffer from excessive braking and wheel flats from 2015 – 2020 and this is not expected to occur on the Stadler vehicles.
<b>Vehicle Doors</b>	RTG installed updated door software, which has improved the overall operation of the vehicle doors.	The door system on the existing Line 2 Alstom LINT vehicles operated without issue and this specific issue is not expected to occur on the Stadler vehicles.
<b>Vehicle Onboard Systems</b>	Various challenges with train control monitoring software and passenger information software. RTG installed software upgrades, which has improved overall system performance.	The Alstom LINT passenger information system was reliable. New systems on the Stadler vehicles will need to go through a commissioning process.
<b>Vehicle Traction Power: Inductors</b>	All vehicle inductor replacement work has been completed.	Not applicable.
<b>Traction Power Substations</b>	Some power integration issues were experienced but have since been resolved.	Not applicable.

### *Stage 2 City Oversight*

The City of Ottawa Rail Construction Program office is comprised of an integrated team of project management, design, engineering and construction professionals who monitor, oversee and work diligently to ensure that the Stage 2 extensions are executed in full compliance with the requirements of the respective Project Agreements. The City's construction oversight team is co-

located with the construction project teams at each of the Stage 2 construction sites to ensure that there is active City presence overseeing the work and the City is aware of and can assist in resolving issues in real-time and provide escalated reporting on the progress.

### *Stage 2 TransitNEXT Quality Assurance*

As required by the Project Agreement, TransitNEXT must develop and implement a detailed Integrated Management System (IMS) that outlines the overall system and management oversight processes that they will follow to ensure compliance with the contract.

The Stage 2 Line 2 Project Agreement also requires that TransitNEXT undertake a system engineering and safety assurance process to certify that all elements of the new expanded system are safe prior to the start of operations. As part of this process, TransitNEXT has appointed an internal Safety Assessor to carry out audits and assessments of the safety and assurance of the works at key stages of the project lifecycle and provide a Safety Assessment Report prior to Substantial Completion.

### *Stage 2 Project Agreement Roles*

As is the standard model for this type of project, an Independent Certifier (IC) actively reviews the progress of works on site and authorizes payments for works completed.

In addition to the Independent Certifier role, the Stage 2 Trillium Line Project Agreement includes the requirement for a System Integration Verifier who will assist in confirming system integration requirements at Substantial Completion.

Lastly, the City has hired a Safety Auditor to provide safety expertise and review and audit the TransitNEXT safety program to provide advice to the City on the readiness of the integrated system from a safety perspective.

### *Stage 2 Independent Oversight*

In addition to the Project Agreement requirements, the independent expert reviews the City's oversight and a variety of independent regulatory bodies including, Building Code Services, Technical Standards & Safety Authority and Ottawa Fire Services play an important role in ensuring that station and systems elements meet pertinent code requirements. As the Trillium Line is a federally regulated railroad, and the City is actively engaged with Transport Canada and the Canadian Transportation Agency to obtain the necessary regulatory approvals, an amended Railway Operating Certificate and an updated Certificate of Fitness respectively, to enable the resumption of service for the expanded Trillium Line.

### *Stage 2 Quality Assurance Lookahead*

The oversight functions completed to date have focused on the functional designs for the infrastructure and verification that all requirements of the Project Agreement have been met.

Looking ahead to the handover process, the next phase of oversight will transition to the review of the ongoing safety certification process, critical vehicle and signal system testing, trial running, and maintenance readiness. The incremental testing program combined with staff training culminates in a three-week trial running period, as defined in the Stage 2 Trillium Line Project Agreement. This trial running period will be used to validate that the system performs as expected. The longer trial running periods defined under the Stage 2 Project Agreements combined with the City's operational experience on the Trillium Line will provide additional assurance of system performance.

#### *Trillium Line Project Peer Review*

As outlined above, the Line 1 and Line 2 systems have many technical differences. However, in designing the new Line 2 system, the City has ensured that lessons learned from the Line 1 experience are implemented ahead of the start of operations to ensure a successful delivery of the Project for customers and residents alike.

In order to assess further opportunities for improvement and to meet the direction of Council, staff will initiate a peer review of the Stage 2 Trillium Line extension project in order to assess:

- 1) infrastructure design and construction;
- 2) commissioning and training strategy; and,
- 3) organizational readiness.

The City is currently exploring opportunities to have either an experienced rail construction firm or an experienced rail agency undertake this review. This process is expected to take three to four months to complete and will be completed with sufficient time to influence the final outcomes of the project. Staff will provide an update to the Mayor and Members of Council on the outcomes of this review once it is complete.

Should you have any questions about the information provided in this memo, please do not hesitate to contact me at extension 52718.

*Original signed by  
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