

Converting BRT to LRT in the Nation's Capital Ottawa, Canada

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The Challenge



*Mackenzie King Bridge – Ottawa, AM peak period

The Challenge

- Ottawa's population is projected to grow 30 per cent by 2031
- The Transitway in the downtown core can only accommodate a maximum of 180 buses in the peak hour
- Despite transit priority measures, we are constrained in the downtown core and limited by signal timings
- Adding additional buses slows down existing service
 - Customer frustration
 - Operational impacts
- Downtown, the Transitway is susceptible to delay caused by traffic congestion, accidents, weather, and major events

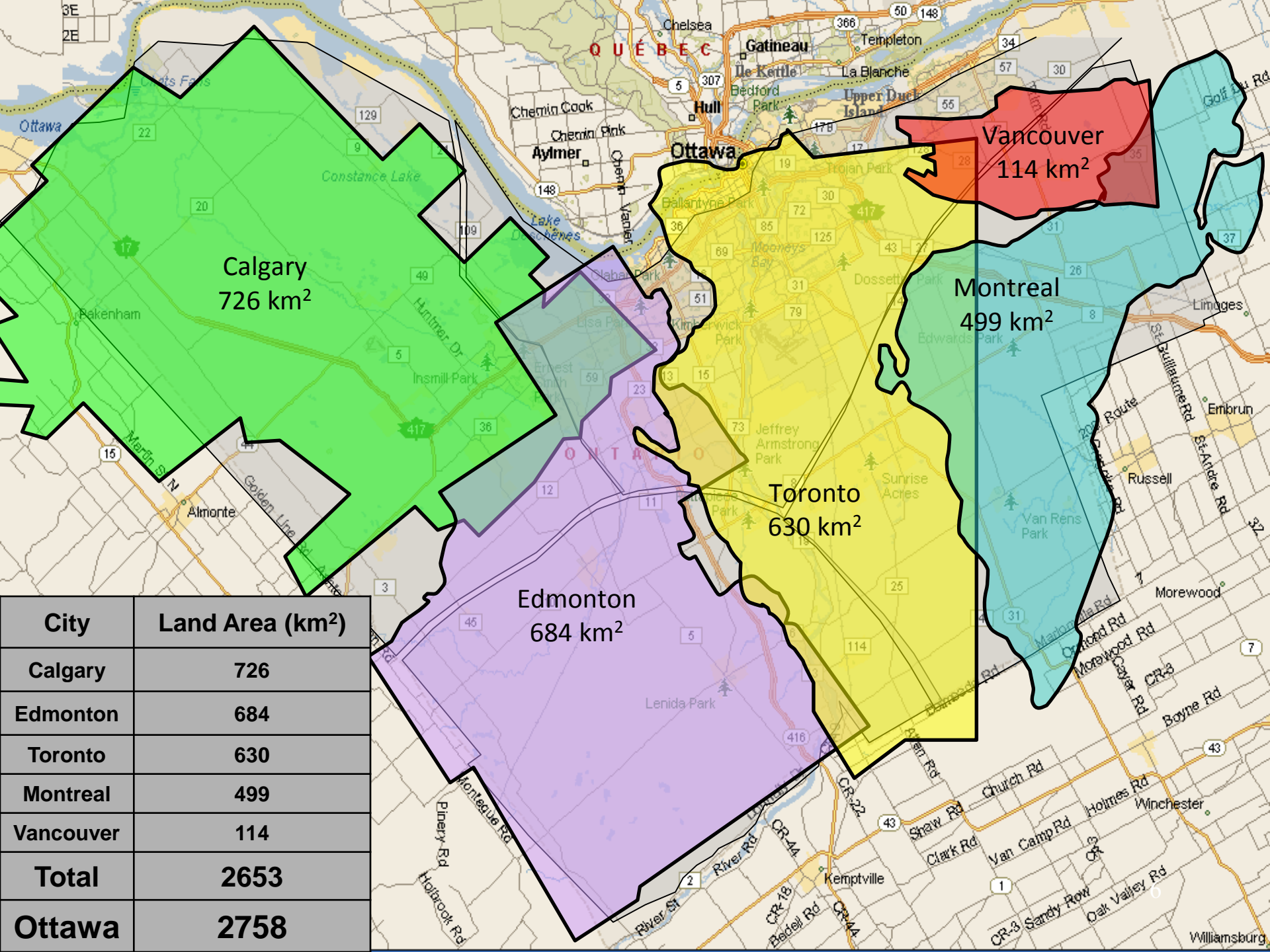
Key Take-Aways

- BRT to LRT conversion is possible
- Conversion is complex requiring careful planning
- P3s work when you have a well thought-out plan and a great partner

Ottawa

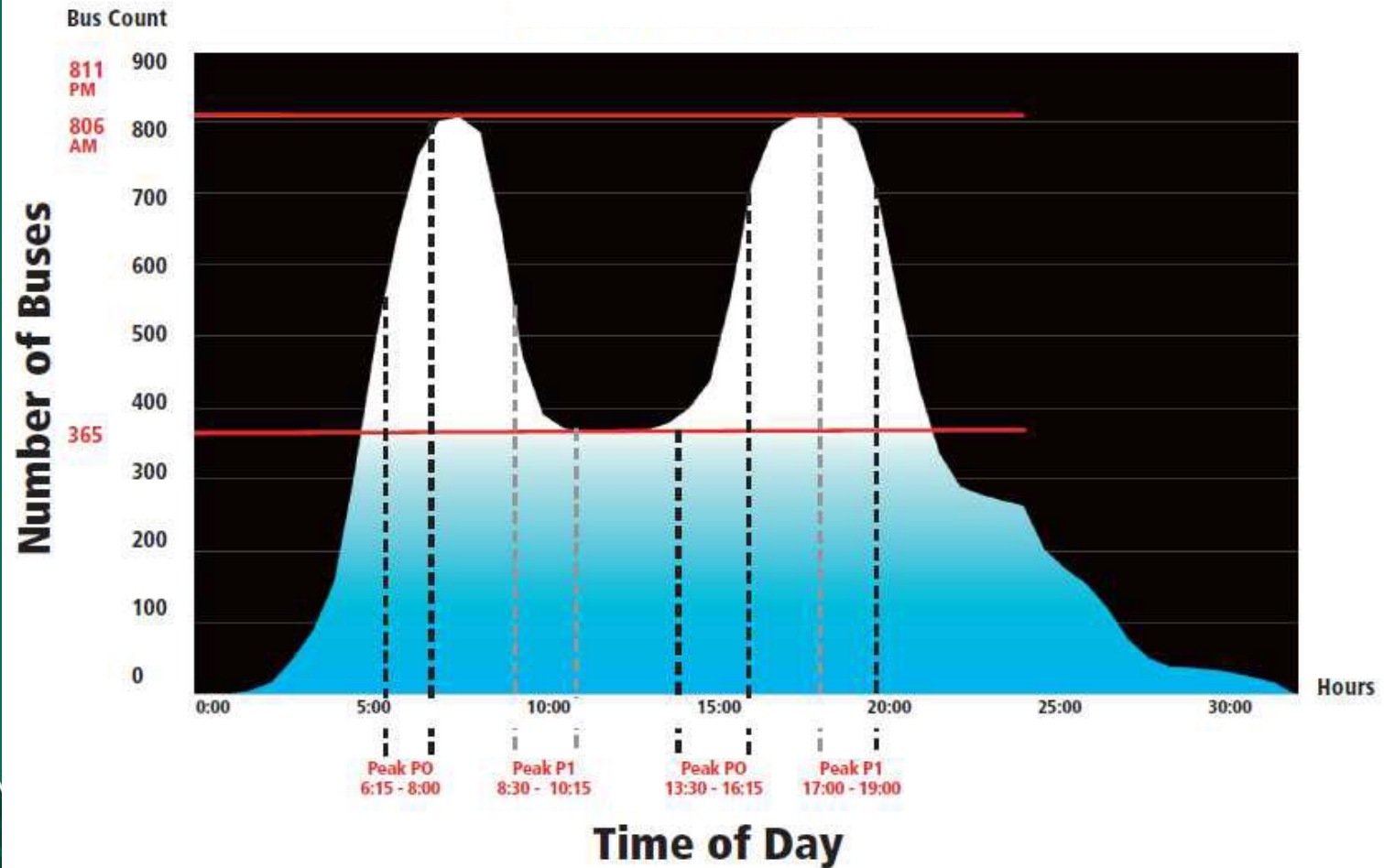
- Our Nation's Capital
- Population of approx. 1 million
- Canada's 4th largest city
- Several post secondary institutions
- More than 100,000 federal government employees
- The City occupies approximately 2,758km² of land





City	Land Area (km ²)
Calgary	726
Edmonton	684
Toronto	630
Montreal	499
Vancouver	114
Total	2653
Ottawa	2758

Service Curve



Key Metrics

- 96,500,000 riders per year (2016)
- 2.56 million service hrs per year (2015)
- 1,000 active buses
- 8 km DMU Rail Line



OC Transpo Key Metrics

Bus Operations

- **330,000** customer trips/day
- **8,600** bus trips daily

Para Operations

- **3,200** daily Para trips scheduled
- Annual passengers **884,000**

Trillium Line (DMU Rail Line)

- **14,800** daily customer trips
- **2.6 million** passengers annually

O-Train Confederation Line

- Will be the **highest ridership light-rail line in North America**
- **10,700** passenger capacity/hour/direction on opening day

The Transitway

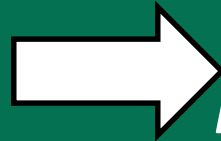
- Has served Ottawa well since 1983
- 34 km of segregated busway
- 22 km of on-street transit only lanes
- 22.1 km of highway transit only lanes
- 57 Stations
- 17 urban Park and Ride Lots, over 7,700 spaces available
- 10 rural Park and Ride Lots
- Continues to be expanded

The Solution

- Convert part of the central Transitway, running east-west through the downtown core between Blair Station and Tunney's Pasture Station, to light rail (approx. 12 km), with 13 stations
- Have buses feed three major transfer stations, where customers will transfer to the Confederation Line to complete their journey
- Downtown, trains will operate in a 2.5 km tunnel, and serve three new underground stations

The Transformation

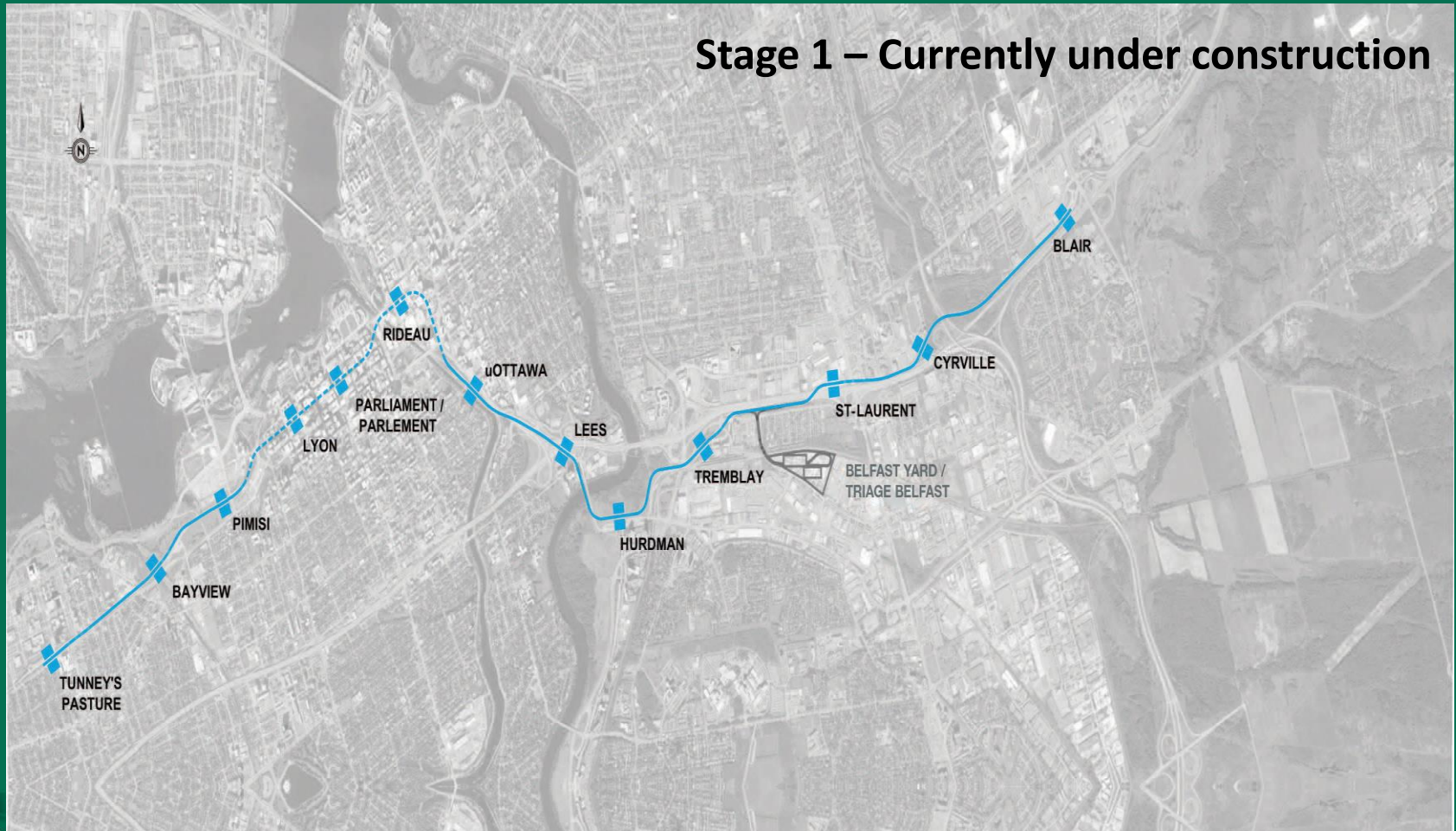
Current
Bus-Oriented System
*Bus, Para Transpo &
O-Train Trillium Line*



2018
Multi-Modal System
*Bus, Para Transpo, O-Train Trillium
& Confederation Lines*



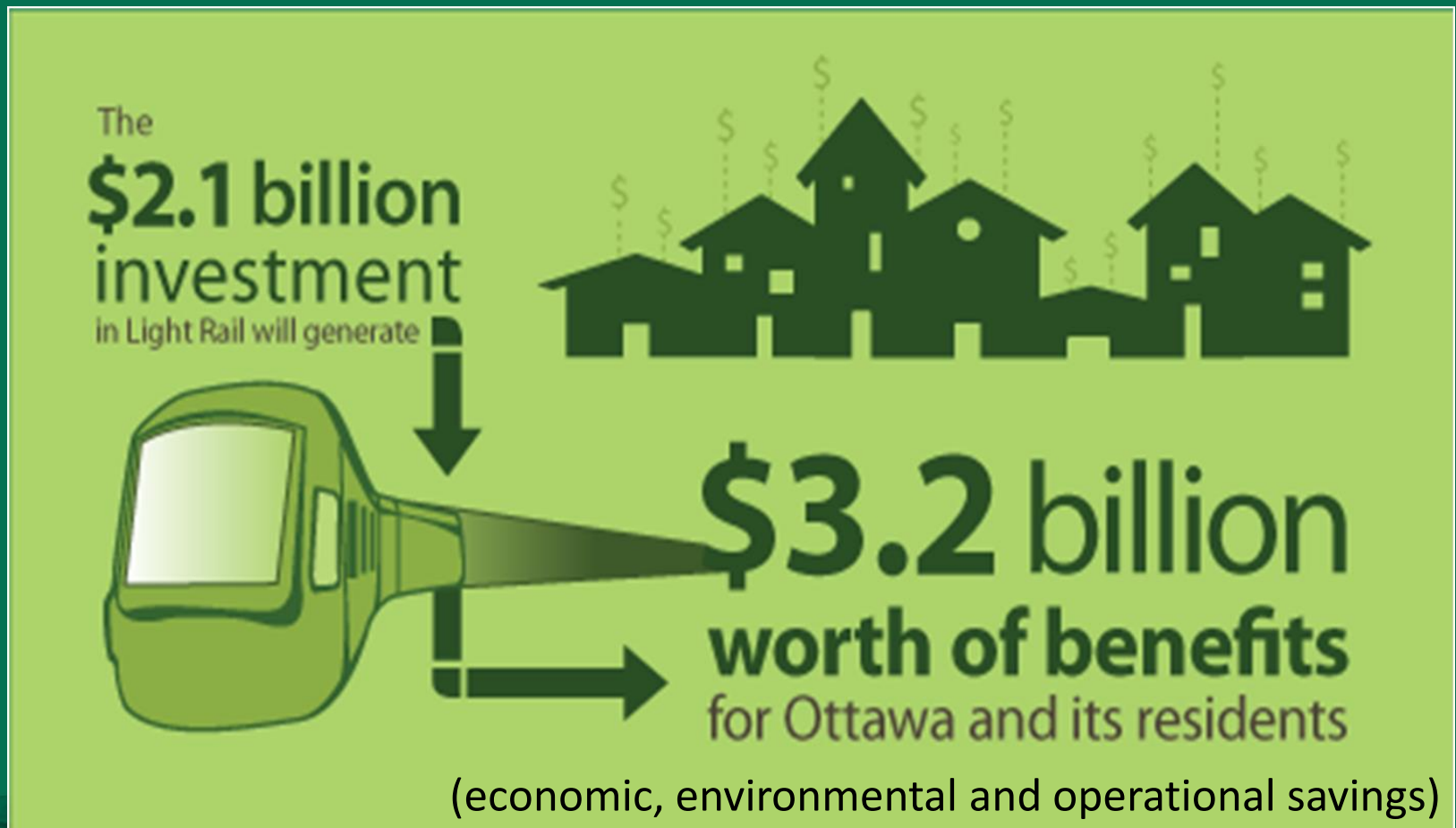
Project Overview Alignment



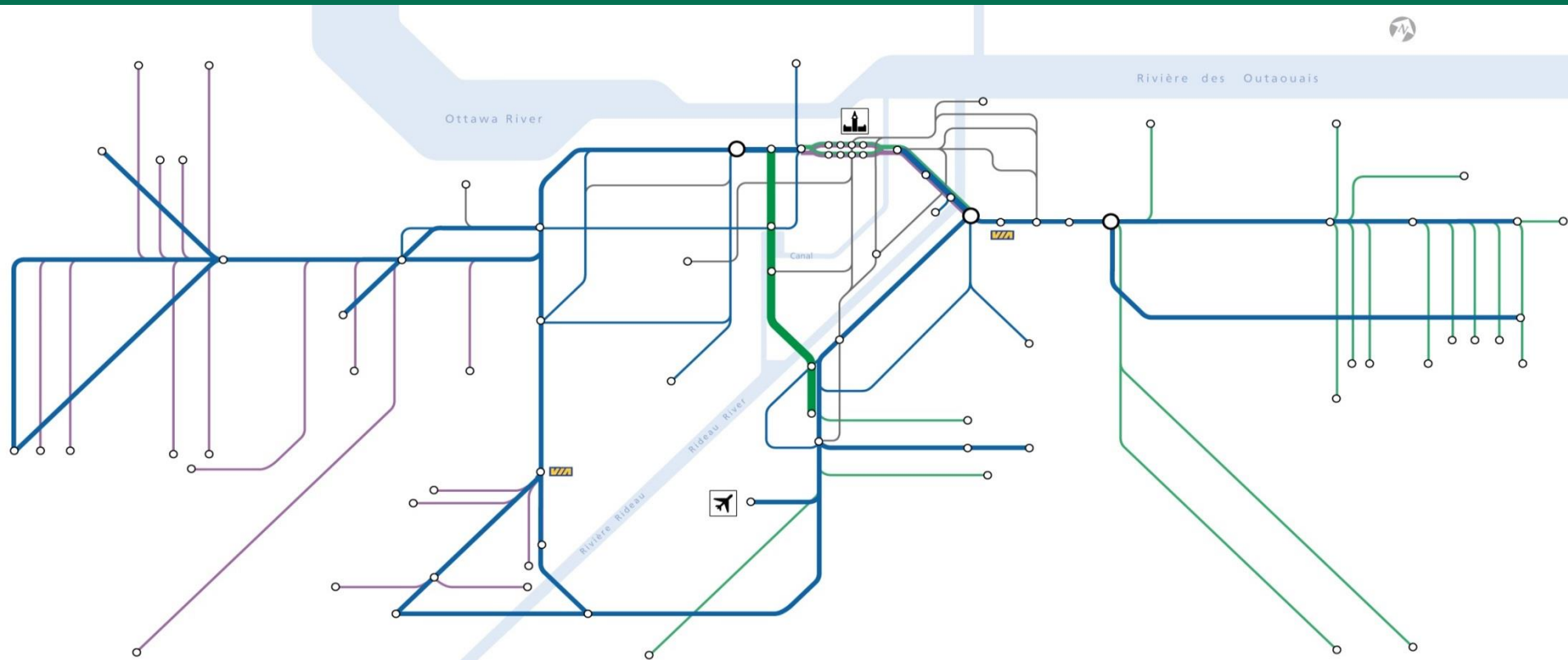
Benefits

- Increased Capacity
 - The Confederation Line will launch with a planned peak capacity of 10,700 passengers per hour in each direction, with potential to grow to over 18,000 passengers per hour in each direction by 2031
- Reliable Commuting
 - Consistent journey time, 24 minutes end to end at all times of day
 - Totally segregated, not susceptible to delay caused by traffic congestion
 - Train every 3:15 (designed to move to every 90 seconds)
- Operational Savings
 - Estimated to be at \$14 million per year
 - 10 million litre diesel reduction per year
- Opportunity to reshape Ottawa's downtown
- 3.2 billion in economic activity and 20,000 person years of employment during construction

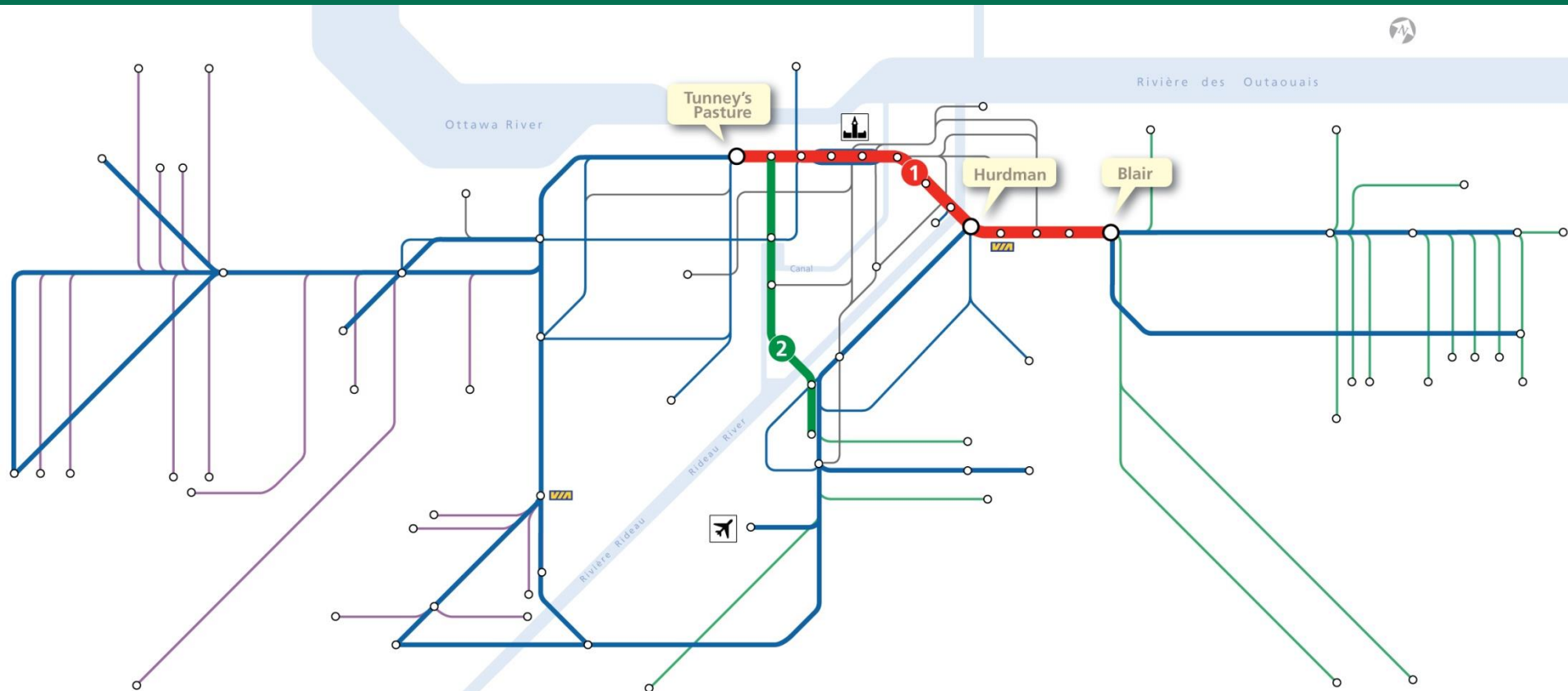
Project Benefits



Before Transformation



After Transformation



**2018 - Bus lines connect to O-Train
Confederation Line Stations**

Project Challenges

- City Council objectives:
“On time, on budget, fixed price”
(Mayor)
- Full risk transfer for geotechnical /
tunnel risks
- Direct staff to shorten procurement
process by 12 months
- Protect existing transit
operations/OC operating budget



Project Challenges

City Council Objectives:

- “Service proven” vehicle capable of operating in Ottawa climate
- High-quality architectural design in keeping with Nation’s Capital
- OC to operate, proponent to design, build, finance, maintain for 30-yr concession period



Procurement Process

DBFM

DESIGN

BUILD

FINANCE

MAINTAIN



Benefits of DBFM for Ottawa

- The model ensured a high quality of design and construction by bringing the bidders into the design phase of the project and providing detailed data for the tunnel section
- Have been able to achieve a fixed price contract and schedule acceleration for the construction of the project
- The winning consortia is responsible for a 30 year maintenance term, which will also help ensure the quality of construction
- Performance is ensured by the finance portion of the procurement model, totalling approximately \$300 million
- Steps were taken throughout the procurement to further incentivize performance and transfer as much risk as possible to the winner consortium such as, 'mobility matters' and energy matters' clauses

The Project

- Approved by Council in December, 2012
- \$2.1 billion price tag
- Public-Private Partnership
 - The Project Co, Rideau Transit Group (RTG) will construct the line and maintain it until 2038
 - RTG is a consortium of Canadian and international companies, with a track record of delivering major transportation projects on time, and on budget

Design-Build-Maintain-Operate Team Rideau Transit Group



Design Challenges

- Rideau Canal a UNESCO World Heritage Site
- Major sewers on either side of the Canal
- Ottawa road network very narrow for tunnelling / station construction
- Station entrances in street ROW limits pedestrian capacity



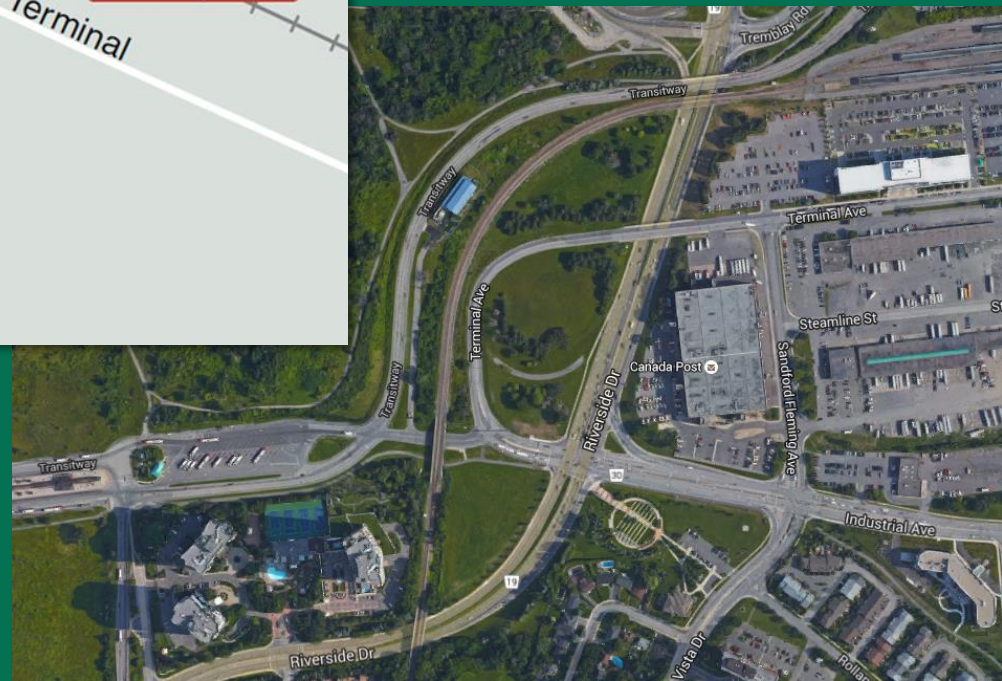
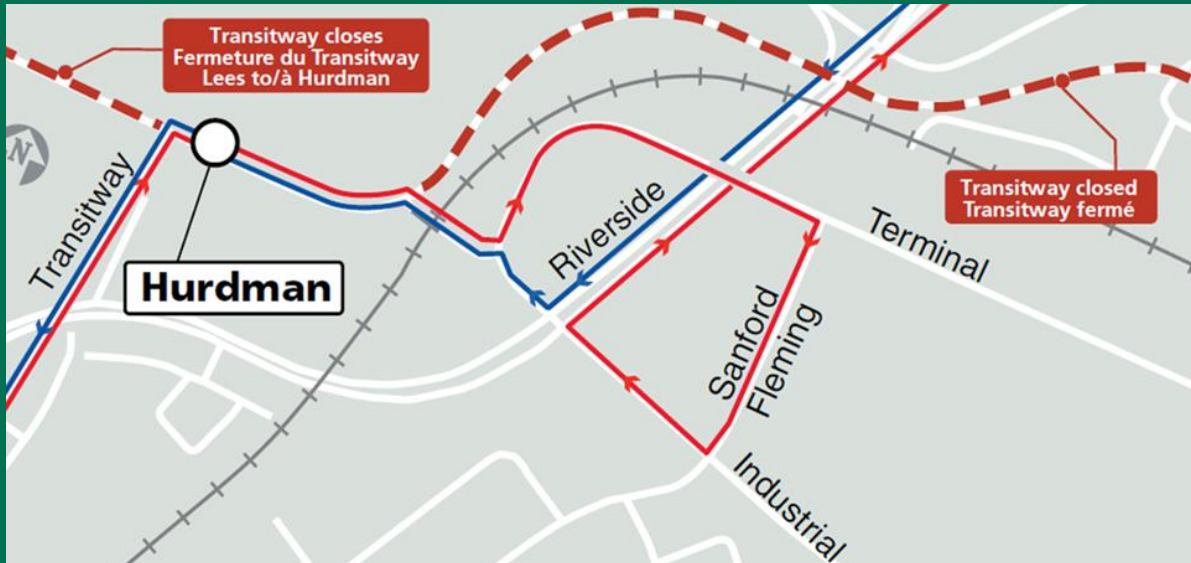
Design Challenges

- For passenger convenience / cost reasons, a shallow tunnel desired
- Full accessibility, integrated art, address Federal “capital” interests, cycling / pedestrian connections
- Vehicle / systems design had to address long-term capacity needs:
 - 18,000 pphpd by 2031
 - Ultimate ridership 24,000 pphpd
 - 75% of property in public ownership

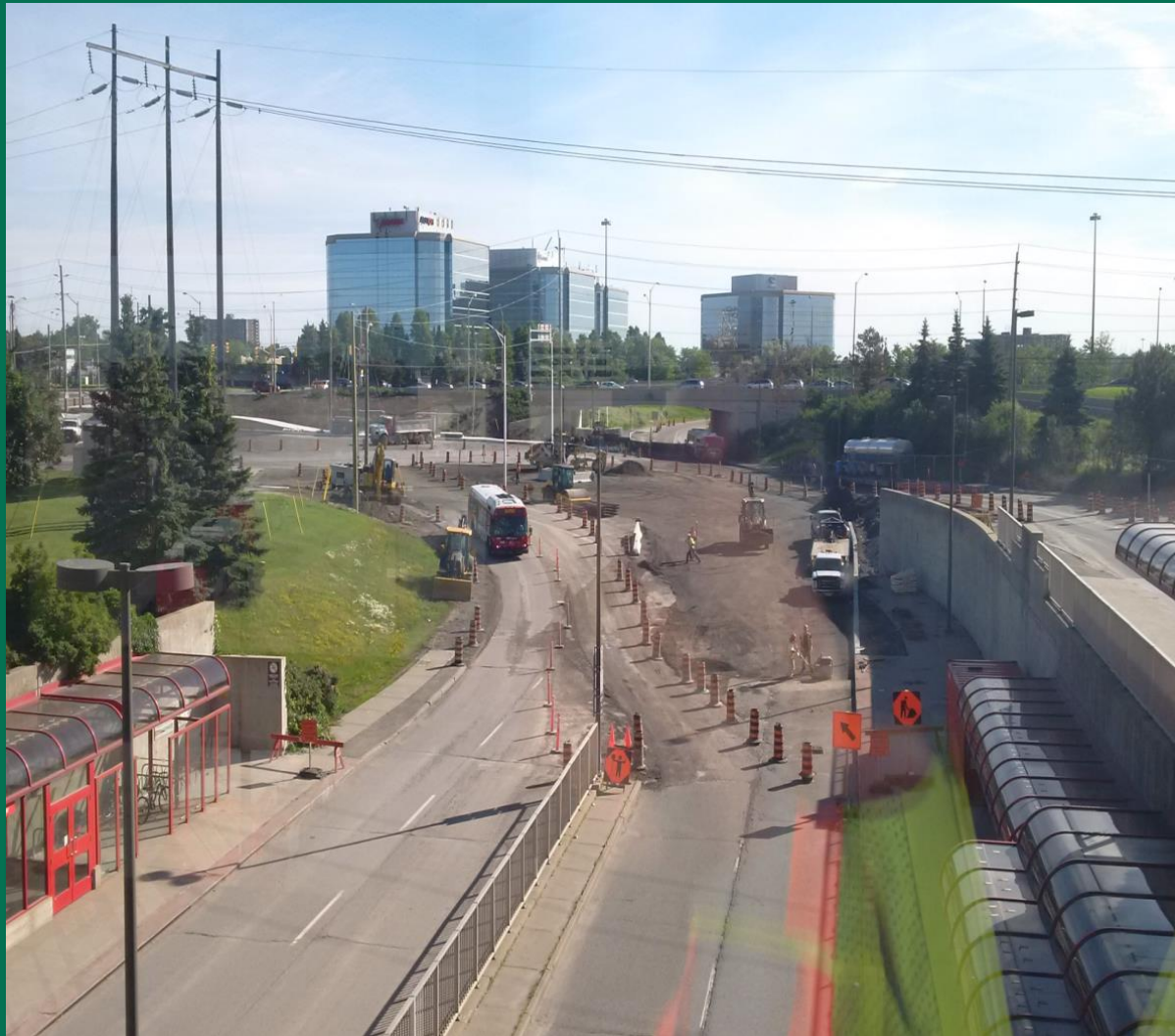
BRT Operations During Conversion Traffic and Transit Management

- Effective management of traffic and transit, throughout LRT construction, was a key criteria that the Project Co. was assessed on during the RFP process
- The successful proposal minimised the impact to transit operations, by closing the Transitway in several parts
- This enabled segregated bus operations to continue, in part, for as long as possible – ensuring good journey times, reliability, and reduced operating costs
- Through the Project Agreement, strong financial incentives have been placed on the Project Co. to manage construction impacts on traffic

Hurdman Station



Temporary Facilities and Conditions



Challenges During Construction



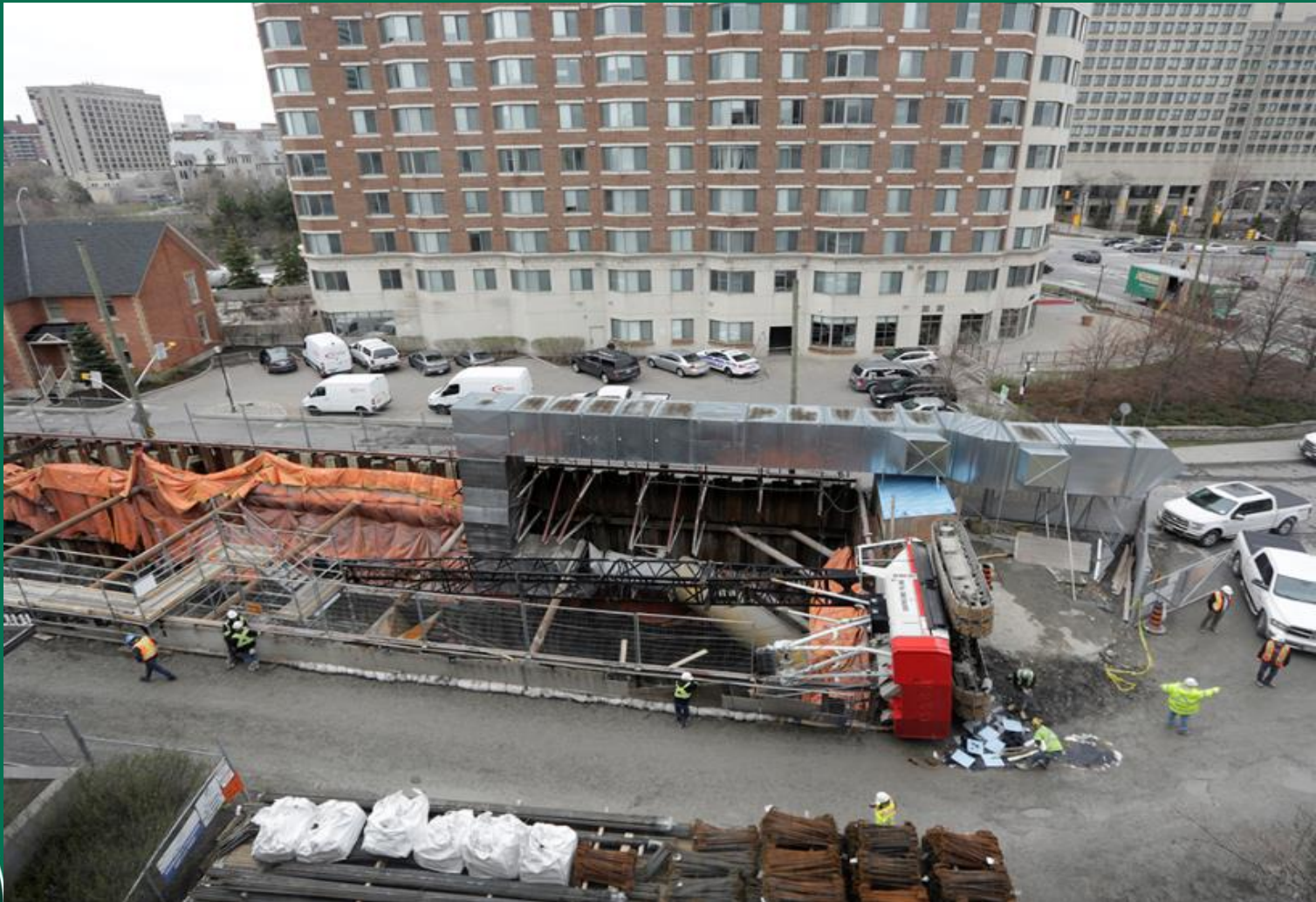
Sink hole Laurier and Waller Street. Sink hole Laurier and Waller Street. Bruno Schlumberger / Ottawa Citizen

Challenges During Construction (Cont'd)



Ottawa sinkhole: Rideau Street sinkhole swallows van, forces evacuations in Ottawa | Ottawa Citizen

Challenges During Construction (Cont'd)



Crane operator escapes injury after heavy machine tips over near LRT tunnel | Ottawa Citizen

Tunnel Sequential Excavation method (SEM)



Cavern Drift Excavation



Mining in drifts in
Rideau Station Cavern

Tunnel



Light Rail Vehicles





Blair Station 2018



Hurdman Station



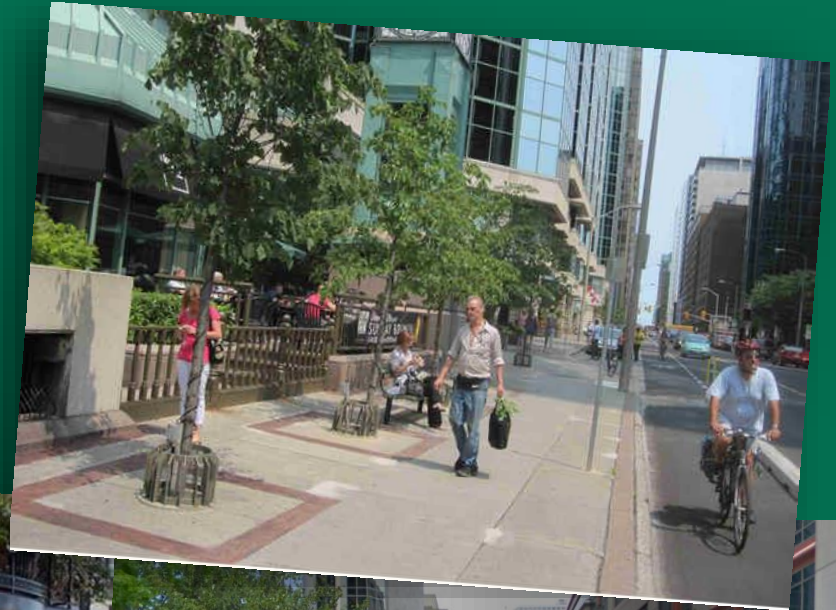
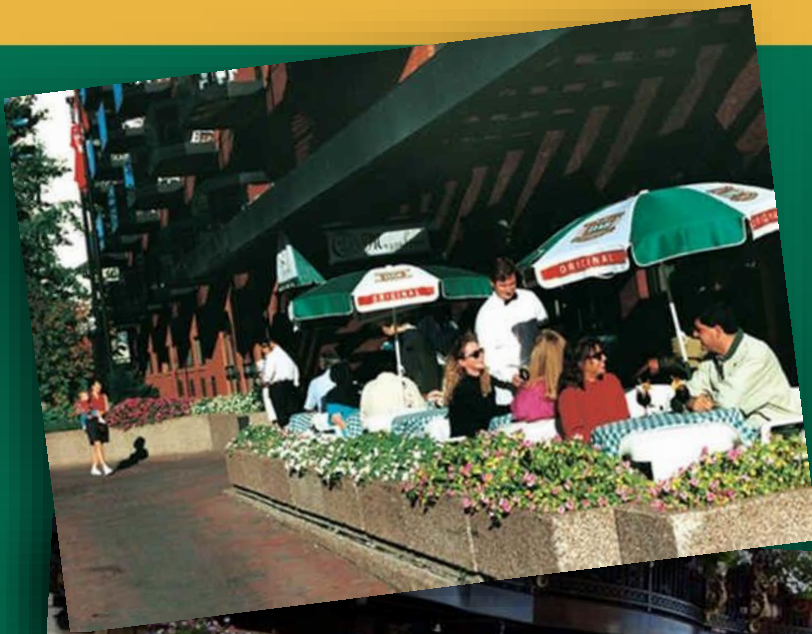
Belfast Yard and Maintenance & Storage Facility



Changing Centretown Streets from this...



...to this!



From this...



(Mackenzie King Bridge- Ottawa) 43

...to this!






Stage 2 LRT Project

Confederation Line **WEST**






Trillium Line **SOUTH**

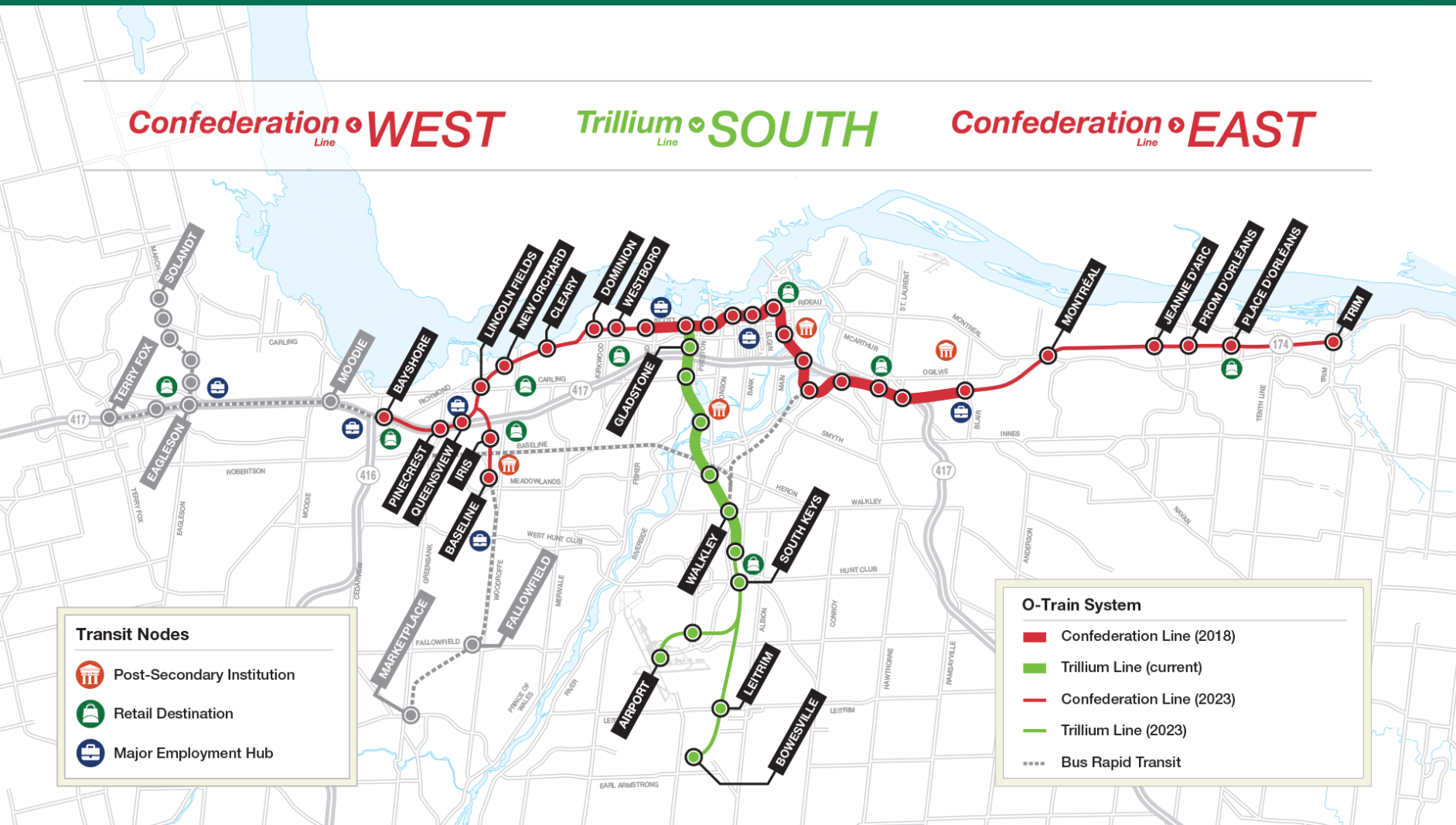
Confederation Line **EAST**

Transit Nodes

-  Post-Secondary Institution
-  Retail Destination
-  Major Employment Hub

O-Train System

-  Confederation Line (2018)
-  Trillium Line (current)
-  Confederation Line (2023)
-  Trillium Line (2023)
-  Bus Rapid Transit



Project Scope

- Budget: \$3 billion
- Schedule:
 - Construction begins in 2018
 - Service operation begins in 2023
- Scope:
 - 36 kms of new track and 22 new stations, including:
 - Trim Extension (\$165M)
 - Airport Rail Link (\$155M)
 - Maintenance and Storage Facilities
 - Vehicles

Benefits



14,000 less vehicles



GHG Reductions:
155,000 tonnes



\$10.8B less in commuting costs



\$3.8B Economic Impact
24,000 person-years of employment



70% of City's population within 5 km of rail

Lessons Learned / Conclusions

1. BRT to LRT is feasible;
2. Plan for the conversion even though it may be 20-30 years out;
3. Plan for the bus detours;
4. Plan for challenges during construction; and,
5. P3s – excellent procurement for the right type of project.