

A Case for Edmonton to Explore Bus Rapid Transit

Edmonton Transit Service Advisory Board
August 2015



Executive Summary 1

A Case for Edmonton to Explore Bus Rapid Transit	1
BRT Strategic Impact Map	4

Research Report 5

Background	5
a) What is Bus Rapid Transit (BRT)?	
b) Previous BRT Studies in Edmonton - What has changed?	
Costs and benefits of BRT	10
a) Capital and Operating Costs	
b) TOD Opportunities	
c) Strengths, Weaknesses, Opportunities and Challenges	
BRT Examples in cities similar to Edmonton	17
a) Winnipeg	
b) Calgary	
c) Ottawa	
d) York	
e) Vancouver	

Appendixes 31

Appendix A: BRT Best Practice Guides	31
Appendix B: A Brief History of Transportation in the City of Edmonton	32

Executive Summary

A Case for Edmonton to Explore Bus Rapid Transit (BRT)

The Board recommends that Council investigate in further detail the potential of adopting Bus Rapid Transit (BRT) in Edmonton as both an interim method of servicing routes earmarked for future LRT expansion (LRT Network Plan), as well as other high-traffic corridors that are suitable for high-speed, high-frequency transit services.

Bus rapid transit (BRT) is a high-speed, high frequency bus-based mode of transit that delivers fast, high-capacity, and cost-effective transit services in urban areas. The Edmonton Transit System Advisory Board believes there is tremendous value in the City of Edmonton exploring BRT as an alternate mode of transit to complement LRT and regular bus service, and better meet the needs and expectations of Edmontonians now and in the future.

BRT is a feasible option both as a pre-cursor to LRT where funding and construction is decades away, as well as in high-traffic corridors where there are no LRT plans proposed in the long-term. BRT could also be an effective and efficient mode of transit in high-density areas where it is not feasible or cost-prohibitive to build LRT, such as suburban developments far from the downtown core.

The current LRT Network Plan is ambitious and costly, and some of the lines are not expected to begin construction until 2040 or later. BRT provides the ability to deliver mass transit, comparable to LRT in both speed and capacity, at a fraction of the cost, infrastructure, time and operating costs necessary to build LRT. Bus Rapid Transit can be developed much quicker than LRT, and would be able to serve the transit needs of citizens today.

Investing in BRT will demonstrate a commitment to sustainable and quality public transit, and, along with other government interventions, serve as an incentive for Transit Oriented Development (TOD) with the private sector. BRT has the potential to significantly increase transit ridership, and help induce a transit mode shift towards both public and active modes of transportation.

Bus Rapid Transit as a mode of transit is closely aligned with the City's Vision, and supports each of the 10-year strategic goals outlined in *The Way Ahead*. The use of BRT would better position Edmonton to excel in each of the 10 corporate outcomes that support the overall strategic goals outlined the City's strategic plan.

The attached Strategic Impact Map shows the linkages and relationships between BRT and the City's targeted short, medium, and long-term outcomes. The capabilities offered by BRT are also fully aligned with the City's Transportation Master Plan (*The Way We Move*), and for this reason make a strong business case for the City to study in further detail and consider BRT as an integral component of the future transit network.

Given the Strategic Transit Review that the City will be undertaking, it is a very opportune time to consider BRT as an integral feature of Edmonton's transit system. The public engagement campaign that's already underway (*Let's Talk Transit*) offers an excellent forum and mechanism for Edmontonians to share their input, feedback and perceptions of BRT.

Characteristics and Benefits of BRT

Compared to a regular bus service, BRT is faster, has a higher ridership capacity, runs more frequently, and offers greater reliability and convenience. Bus Rapid Transit differs from regular bus service based on several key characteristics:

- The use of dedicated busways lanes (exclusive street-level lanes, often fully segregated from mixed traffic)
- Off-board fare collection for less idle time at stations (simultaneous boarding at all doors)
- Platform-level boarding for improved accessibility
- High frequency (focus is on ridership, not coverage; service is based on a pre-determined frequency rather than a schedule)
- High capacity; BRT often uses articulated buses capable of transporting 80+ passengers
- High quality stations

Compared to LRT, BRT has significantly less costly infrastructure and capital costs, can be developed faster, and is less expensive to operate on a per-kilometer basis¹. BRT is also more flexible and scalable, and offers the benefit of being able to operate before the entire line is fully constructed. BRT also has the potential to yield a higher return on investment with regards to Transit Oriented Development².

In the short to medium term, BRT has the potential to vastly increase transit capacity and ridership, shorten travel times for commuters, reduce traffic congestion on high-traffic corridors, and better integrate public transit with urban development.

In the long run, incorporating BRT into the public transit system would improve the sustainability of our public transit system, the financial resilience of the City, and ultimately Edmonton's livability.

¹ "Bus Rapid Transit Shows Promise" – United States General Accounting Office Report to Congressional Requesters (<http://www.gao.gov/new.items/d01984.pdf>)

² "More Development For Your Transit Dollar – An Analysis of 21 North American Transit Corridors" – The Institute for Transportation and Development Policy (https://www.itdp.org/wp-content/uploads/2013/11/More-Development-For-Your-Transit-Dollar_ITDP.pdf)

The Need to Revisit BRT

The City of Edmonton has previously undertaken several studies on BRT following the 1999 Transportation Master Plan, but opted not to proceed due to concerns it would take focus away from LRT development. Since then, much has changed warranting a renewed interest in BRT. Some of these changes include:

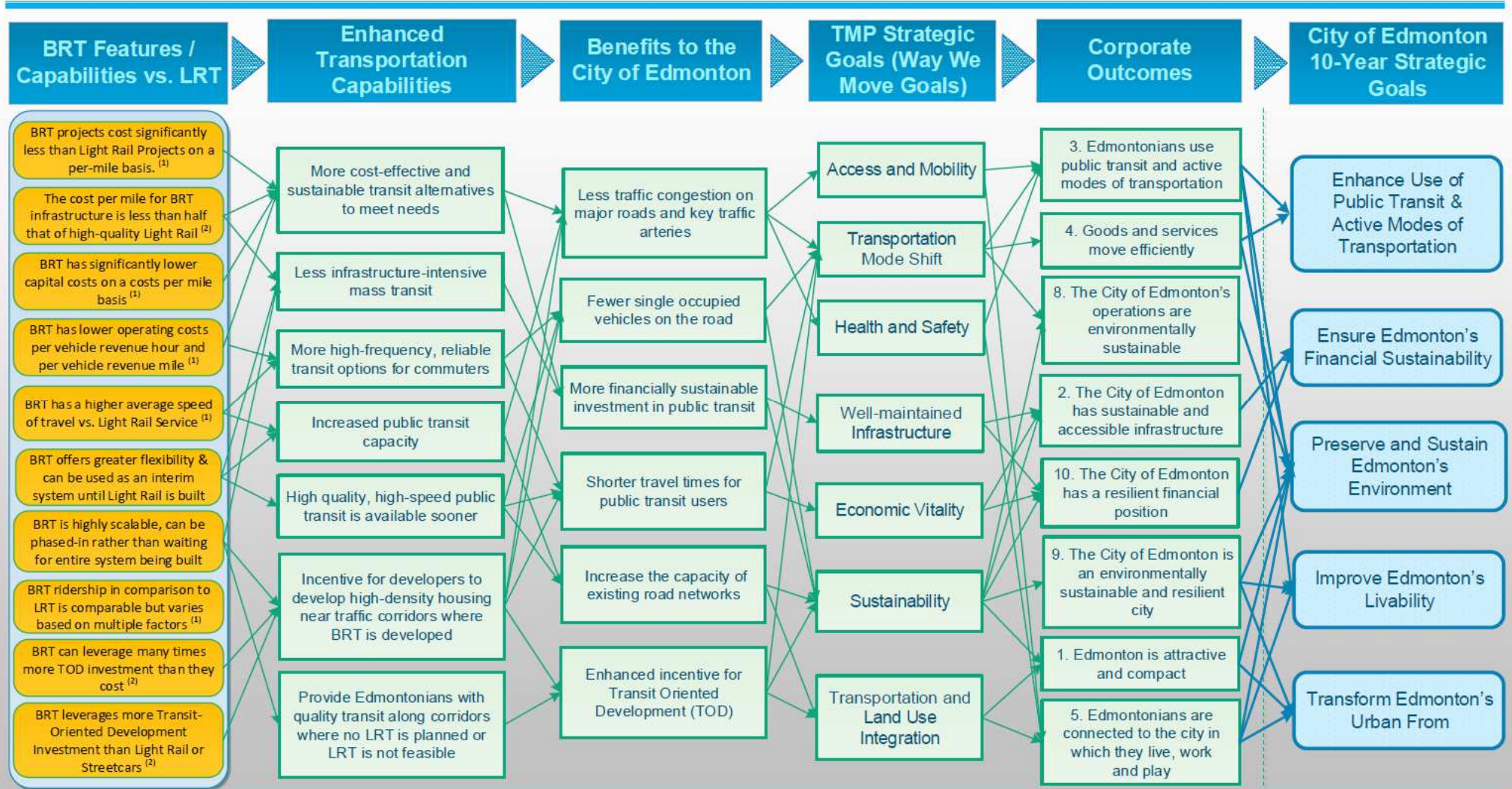
- High growth in outlying communities is unlikely to be sufficient to support LRT
- Rapid population growth; from 2011 to 2014 the City of Edmonton added more than 65,700 new residents, and that figure is projected to grow another 17,000 during 2015³
- Provincial and federal funding constraints have limited the ability to expand LRT in line with population growth and expectations
- Increased adoption in comparable Canadian jurisdictions; Winnipeg, Calgary, Ottawa, York and Vancouver utilize BRT and new data is available to demonstrate its value
- Downtown density increased at a more rapid pace (27% increase from 2008 to 2014)
- Downtown parking rates increased to an average of \$306 per month

The Edmonton Transit System Advisory Board has spent months researching, discussing and evaluating the suitability of BRT as a mode of transit in Edmonton. We have prepared a supporting research report that goes into more detail describing the opportunities and benefits BRT could deliver. The research report discusses financial and business considerations, implementation best practices, property development/TOD impact, as well as a closer look at how Calgary, Ottawa, Winnipeg, York and Vancouver have adopted BRT. In addition to the research report, a strategic impact map was developed to visually depict the linkage between BRT and Edmonton's 10-year strategic goals.

The Board wishes to thank Council members for their consideration on this very consequential topic.

³ The City of Edmonton. Population Forecasts (2014)
http://www.edmonton.ca/business_economy/demographics_profiles/population-forecasts.aspx

Bus Rapid Transit (BRT) – Strategic Impact Map



¹ "Bus Rapid Transit Shows Promise" – United States General Accounting Office Report to Congressional Requesters

² "More Development For Your Transit Dollar – An Analysis of 21 North American Transit Corridors" – The Institute for Transportation and Development Policy (ITDP)

Research Report

Background

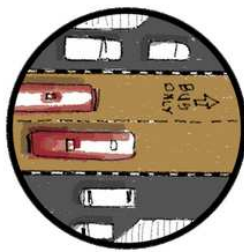
What is Bus Rapid Transit?

For the purposes of this report we assume that when referring to Bus Rapid Transit (or BRT) we are advocating for a system which meets the main criteria of “The BRT Standard”. The BRT Standard is an evaluation tool for Bus Rapid Transit corridors around the world, based on international best practices. The BRT Standard creates a concrete minimum standard, identifying several critical design elements that must be present for a corridors to qualify as BRT. The Institute for Transportation and Development Policy (ITDP) conceived of and uses these criteria to evaluate systems around the world. For each element, a best practice is identified, along with benchmarks for partial achievement of the feature.

Basic Characteristics



Dedicated Right-of-Way
Bus-only lanes fully segregated from mixed traffic



Busway Alignment
Bus-only lanes aligned to the middle, not the curb, of a road



Off-Board Fare Collection
Turnstile-controlled or proof-of-payment fare collection system



Intersection Treatments
Mixed-traffic is prohibited from making turns across the busway



Platform-Level Boarding
Station platforms level with bus floors when boarding and alighting

There are five essential characteristics of a BRT corridor⁴:

1. **Dedicated right-of-way**
An exclusive right-of-way is vital to ensuring that buses can move quickly and unimpeded by congestion. Enforcement of the dedicated lane can be handled in different ways, such as delineators, bollards, or colored pavement.
2. **Busway alignment**
Defines where a busway's dedicated lane is located on the road (e.g. center aligned, exclusive road, or along one side of the street). The busway is best located where conflicts with other traffic can be minimized. In most cases, the central verge (or

⁴ The Institute for Transportation and Development Policy. What is BRT?

<https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/what-is-brt/>

- median strip) of a roadway encounters fewer conflicts with turning vehicles than those closer to the curb.
3. Off-board fare collection
Collecting fares before boarding, is one of the most important factors in reducing station dwell time and therefore total travel time, thus improving the customer experience.
 4. Intersection treatments
There are several ways to increase bus speeds at intersections, all of which are aimed at increasing the green signal time for the bus lane. Forbidding turns across the bus lane and minimizing the number of traffic-signal phases where possible are the most important. Traffic-signal priority when activated by an approaching BRT vehicle is useful in lower-frequency corridors.
 5. Platform-level boarding
Having the bus-station platform level with the bus floor is a crucial factor in reducing boarding and alighting times per passenger. The reduction or elimination of the vehicle-to-platform gap is also key to customer safety and comfort. A range of measures can be used to achieve platform gaps of less than 5 cm (2.0 in), including guided busways at stations, alignment markers, Kassel curbs, and boarding bridges.

Best Practices

In addition to BRT basics, the Standard identifies several categories of BRT elements and characteristics which contribute to superior BRT corridors⁵:

1. Service Planning
Multiple routes, peak frequency buses, and hours of operation
2. Infrastructure
Passing lanes at stations, minimizing vehicle exhaust emissions, and improved pavement quality
3. Station Design and Station-Bus Interface
Safe and comfortable stations, number of doors on bus, and reasonable distances between stations
4. Quality of Service and Passenger Information Systems
Branding and passenger information
5. Integration and Access
Integration with other transportation, secure bicycle parking, and universal access

Potential for Scope Creep

⁵ The Institute for Transportation and Development Policy. What is BRT?
<https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/what-is-brt/>

The Bus Rapid Transit being described in this report is assumed to be one where all elements of the BRT Standard are met. BRT aims to combine the capacity and speed of a light rail or metro system with the flexibility, cost and simplicity of a bus system. BRT creep occurs when a system that promises these features instead acts more like a standard, non-rapid bus system.

Scope creep needs to be highlighted because BRT is, in itself, an accommodation (between regular bus service and LRT). BRT can work well in theory, but difficult decisions must be made. For example, the largest time savings would be gained when BRT uses exclusive lanes on the most traffic congested roads. However, closing lanes to car traffic on roads that are already congested can be difficult to justify (though in the long term will lead to a lower induced demand for automobile traffic).

According to Dan Malouff, a transit planner who may have coined the phrase “bus rapid transit creep”, the erosions of service vary widely from system to system. Major compromises in service are highlighted by one or more common symptoms⁶:

- The bus runs in shared HOV lanes or general purpose lanes rather than true dedicated lanes
- True "stations" instead become "stops"
- Pre-pay is done away with, slowing passenger boarding
- The bus does not receive priority at traffic lights

⁶ Dan Malouff. "BRT creep" makes bus rapid transit inferior to rail (2011).
<http://greatergreaterwashington.org/post/9600/brt-creep-makes-bus-rapid-transit-inferior-to-rail/>

Previous BRT Studies in Edmonton

After the 1999 Transportation Master Plan, three major reports concerning BRT were published by the City of Edmonton.

- **High Speed Transit Study** (Stantec) - A general city-wide study that came out of the 1999 TMP.
- **Southeast BRT** (Bunt & Associates) - Looked at a priority BRT route to Mill Woods Town Centre.
- **West BRT** (ISL Engineering) - Looked at a priority BRT corridor from West Edmonton Mall to downtown in 2007. This study had a generous amount of public engagement and some controversy.

These studies occurred in mid-late 2000's. They did not lead to the implementation of BRT because of Council decision, administration's concerns and public input. The major factors influencing the decisions at that time were that BRT would distract from the focus of LRT, that it was difficult to implement without upsetting some element of the public (in terms of the right of way needed to increase the level of service), and that, if positioned against LRT, it was seen to be less desirable.

What has Changed?

After the last Bus Rapid Transit study, Edmonton City Council adopted a long-term LRT Network Plan. It sets ambitious targets for where LRT should go. It also recommends that future LRT be built to a low floor urban system design. This means that future LRT lines will be slower, and more integrated into the street, with stations closer together. Meanwhile from 2009-today Edmonton has grown significantly in the center of the city and outwards in the suburbs and region. Provincial and federal LRT funding have not kept up. This is common to many Canadian mid-size cities, and we have more evidence today than we did in the mid-2000's about how well those cities are doing with BRT.

Five major changes have happened to warrant another look at BRT. In order of importance they are:

1. The 2009 Long-Term LRT Network Plan was adopted
This plan defines the future size, scale and operation of Edmonton's LRT system.

Key directions within the plan include⁷:

⁷ City of Edmonton. Long Term LRT Network Plan (2012).
http://www.edmonton.ca/transportation/PDF/Long_Term_LRT_Network_Plan_March_2012.pdf

- Growth in outlying communities is unlikely to be sufficient to support LRT. Transit service to regional areas, where demand warrants, would be best provided in a different form such as bus rapid transit.
 - New LRT lines will feature surface (street-level) operation. These lines won't tie into the existing LRT system, but will provide convenient connections to the existing LRT system in multiple locations.
 - An urban-system design will be pursued for any new LRT lines. [This means smaller stations, closer together, with slower LRT more integrated into the street].
 - Low-floor LRT technology should be adopted for any new LRT line that does not physically tie into the existing LRT system.
 - Some sectors such as the West will require premium bus service to supplement LRT service.
2. Rapid Population Growth – from 2009 to 2014, Edmonton added 36,006 new dwellings within its boundaries. In addition, the region's share of population growth averaged about 35% leading to larger, but more dispersed population overall.
 3. Downtown density increased at a more rapid pace – The Downtown neighbourhood increased its population by 27% from 2008 to 2014, compared to a city-wide growth rate of 17%.
 - In addition parking rates in the downtown increased to an average of \$306 per month. After publishing the report, Bob MacDougall, senior managing director for Cushman & Wakefield Ltd. stated, "It will be interesting to see what that sort of threshold point is where parking users say enough is enough. Now that starts to get a little complicated because not only does it bring parking policy into play but it also brings public transportation into play. I think we've already seen some evidence that major corporations are very prepared to move out to the suburbs."⁸
 4. Provincial and Federal funding constraints have limited the speed at which LRT can be built.
 5. Increased data from other Canadian mid-sized and cold weather municipalities – See next section for details on how other Canadian mid-sized municipalities are using BRT.

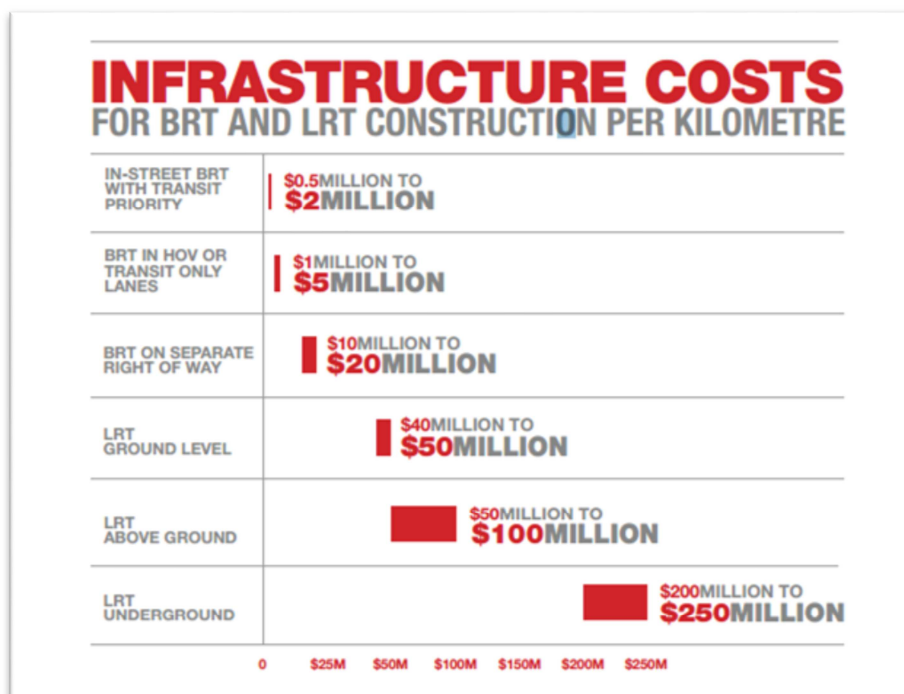
⁸ Calgary Herald. Only New York tops Calgary in downtown parking rates (2014). <http://www.calgaryherald.com/business/Only+York+tops+Calgary+downtown+parking+rates/9690733/story.html>

Costs and Benefits of BRT

Capital and Operating Costs

The capital costs of implementing BRT are generally lower than for LRT. However, the total investment varies considerably due to factors such as cost of the roadway, amount of grade separation, station structures, traffic signal systems and vehicles. A study by the United States Government Accountability Office from 2000 found that the average capital cost per mile for busways was \$13.5 million while light rail average costs were \$34.8 million. Calgary's comparison of the construction costs per kilometre (below) led them to adopt BRT in some situations.

9



With respect to operating costs the exact comparison again varies significantly. Generally while the capital cost to build BRT is cheaper, LRT is cheaper to operate and maintain. Of course, cost is just one factor in considering what type of transit expansion is best suited to a particular situation.

⁹ City of Calgary. RouteAhead (2012).

<http://www.routeahead.ca/wp-content/uploads/2013/02/2013-0118StrategyAheadWeb1.pdf>

Transit Oriented Development Opportunities

The difficulty is discerning to what extent a particular variable- such as the introduction of a BRT system- produces an impact, among the many other factors influencing individual location decisions; the “total activity system”

Given this phenomenon, we may expect that individual decisions on where to locate, and the market response, will be affected by congested roads- and by new mass rapid transit options. Individuals seek to live closer to concentrations of employment opportunities or amenities and services for their needs, while firms may also have to relocate to tap competitive labour markets. Development then may concentrate at areas where accessibility is best provided, or around already developed areas that have a gravity of attraction.

A new or improved mass rapid transit system, such as BRT, has the potential to adjust the accessibility of locations within a region. BRT providing comparable or faster travel times than car to major destinations may effectively increase the accessibility of these places. In turn, high accessibility may increase demands for firms or services to locate at these nodes, and so greater numbers of developments and development intensity would be expected. Likewise, the opportunity for a modal shift could be realized. Locations with regularity in origin/destination and time, are potentially well served by such additions to the public transit infrastructure.

BRT and Property Development Impacts

As several authors point out, major capital improvements to transit systems (of all kinds) often match areas undergoing redevelopment or those for which there exists a desire to redevelop, while the routing of BRT often follows transportation corridors with large established transport demands¹⁰. For BRT to support redevelopment or intensification at stations and along corridors there must already be latent demand for the products and market segments which are compatible or likely to arise¹¹. Good transportation links and accessibility are known to be important conditions for development, but the underlying strength of the regional and local economies ultimately determine whether a shift in development patterns occurs¹⁰.

Evidence that BRT has a positive impact on parcel values is important to the question of whether BRT impacts development decisions, as higher land values or asking prices may translate in to higher density development or new types of development which did not occur in a

¹⁰ Federal Transit Administration. (2009a). Bus Rapid Transit and Development: Policies and Practices that Affect Development Around Transit.

Deng, T., & Nelson, J. D. (2011). Recent developments in bus rapid transit: a review of the literature. *Transport Reviews*, 31(1), 69-96.

Rodríguez, D. A., & Mojica, C. H. (2009). Capitalization of BRT network expansions effects into prices. *Transportation Research Part A*, 560-571.

¹¹ Blume, K. (2008). Past president's award for merit in transportation: bus rapid transit land development guidelines. *Institute of Transportation Engineers Journal*, 78(11), 22-31.

particular market, prior to the introduction of the BRT. It may signal a shift in consumer preference or demand, which ought to translate in to different development products.

A few studies have undertaken to quantify the impacts of BRT on property prices or redevelopment. A recent Seoul, South Korea BRT system and corridors analysis found appreciable property value uplift of 5-10% for residential, and 3-26% for commercial properties. Though such substantial findings may be underscored by the scarcity of developable land in the area¹². A similar study testing the impacts of the Bogota Transmilenio found the perceived benefits of BRT accessibility capitalized as 6.8% to 9.3% premiums in residential multi-family rents¹³. Similar study of Transmilenio expansion areas found higher property price premiums of 13-14%¹⁴, which may indicate that the proven performance of an operating BRT is even more influential than the initial deployment. Case studies from the Los Angeles Metro Rapid and Orange Line found no appreciable uplift in residential property values which might indicate demand for BRT access or lead to denser development, though some commercial areas saw increases¹⁵.

A 2013 report by the Institute for Transportation and Development Policy “More development for your Transit Dollar – An Analysis of 21 North American Transit Corridors” evaluated 21 LRT, BRT, and streetcar corridors in 13 cities across the US and Canada, to see their effect on Transit Oriented Development.

“A growing number of American cities are promoting transit-oriented development (TOD) in order to combat congestion and other problems associated with sprawling, car-dominated suburban growth. Many are planning rail-based mass transit investments like light rail transit (LRT) and streetcars, hoping they will stimulate transit-oriented development, but are finding the costs to be crippling.”

¹² Cervero, R., & Kang, C. D. (2011). Bus rapid transit impacts on land uses and land values in Seoul, Korea. *Transport Policy*, 18, 102-116.

¹³ Rodriguez, D. A., & Targa, F. (2004). Value of Accessibility to Bogota’s Bus Rapid Transit System. *Transport Reviews*, 24(5), 587-610.

¹⁴ Rodríguez, D. A., & Mojica, C. H. (2009). Capitalization of BRT network expansions effects into prices. *Transportation Research Part A*, 560-571.

¹⁵ Federal Transit Administration. (2009a). *Bus Rapid Transit and Development: Policies and Practices that Affect Development Around Transit*. Washington, D.C.: Federal Transit Administration.

The report found¹⁶:

1. Per dollar of transit investment, and under similar conditions, Bus Rapid Transit leverages more transit-oriented development investment than Light Rail Transit or streetcars.

2. Both BRT and LRT can leverage many times more TOD investment than they cost.

Of the 21 corridors studied, 14 leveraged greater than \$1 of TOD investment per \$1 of transit spent. Five of them were BRT, four of them were LRT, two were streetcars, and three were improved bus (non-BRT) corridors.

3. Government support for TOD is the strongest predictor of success.

A government that sees potential in a site for development can provide a range of support from regulatory changes to financing to marketing of the area. There is nearly a direct correlation between the level of TOD investment and the strength of government support. If a government does nothing to support TOD along the transit corridor, there will be no TOD impact.

4. The strength of the land market around the transit corridor is the secondary indicator of success.

Where governments provide moderate support for TOD, the existing market strength of the land determines the level of TOD investment. Today, downtowns tend to be strong land markets, so having the transit investment pass through downtown leads to better TOD impacts.

5. The quality of the transit investment – how well it meets the best-practices detailed in the BRT Standard - is the tertiary indicator of success.

Holding constant for level of government support and potential of the land to develop, the quality of the transit investment is generally the final indicator of the level of TOD investment.

¹⁶ The Institute for Transportation and Development Policy. More Development For Your Transit Dollar – An Analysis of 21 North American Transit Corridors (2009). https://www.itdp.org/wp-content/uploads/2013/11/More-Development-For-Your-Transit-Dollar_ITDP.pdf

Strengths, Weaknesses, Opportunities and Challenges of BRT

Strengths

- Lower capital costs than LRT
- Faster than regular bus service (off board fare collection, priority signalling, dedicated lanes, less frequent stops)
- Demonstrated better adherence to scheduling (due to dedicated Right of Way)
- Improved safety for driver due to less fare alterations (off-board fare collection)
- BRT routes can be reconfigured to reflect changing needs (for example: special events, or emergencies)
- Frequent service
- High capacity transit service (compared to busses)
- Easier to monitor and police (less frequent stops)
- Improved universal access and accessibility (platform at same level as station)

Weaknesses

- Higher capital costs than standard bus transit service
- Less frequent stops
- Less driver interaction with passengers as fare collection component removed
- Suitable only on high occupancy routes

Opportunities

- Construction of BRT system can be staged, and to add one stop at a time
- Opportunities to improve public perception taking the bus
- Can be used by regular busses in high congestion areas
- Improved service for higher density communities
- Reduces reliance on automobile (due to BRT convenience and reduced “induced car demand” when lanes are removed)
- Increased opportunities for Transit Oriented Development

Challenges

- Research on operating costs vary
- Environmental impacts are difficult to quantify (based on comparison source and specifications of alternative systems)
- Dedicated lanes reduce capacity for auto-oriented traffic (where a new lane is not constructed)

BRT Examples in Cities Similar to Edmonton

	Winnipeg	Calgary	Ottawa	York	Vancouver	Edmonton
<i>Population</i>	663,617 (2014)	1,195,194 (2014)	870,250 (2014)	1,032,524 (2012)	603,502 (2011)	877,926 (2014)
<i>Metro Area Population (CMA) 2014</i>	730,018	1,406,700	Ottawa-Gatineau 1,318,100	Toronto 6,055,700	2,470,300	1,328,300
<i>Length of BRT line(s) (km)</i>	3.6 km (Phase 1) 7.6 km (Phase 2)	47 km	30 km	37 km	27.0 km	NA
<i>Number of stages or routes</i>	13 (Stage 1)	3 routes (Airport/City Centre, North, SE)	9 (others routes use only a portion of the dedicated lanes)	6	3 routes (TransLink: 97 B-Line, 99 B-Line. Metro Vancouver: Highway 1 Rapid Bus)	NA
<i>Ridership</i>	Unknown (new)	Unknown	244,000²	2,359,000 (2014)	97-B Annual: 3,558,000 Avg. Mon-Fri Daily Boarding: 11,250 99-B Annual: 17,054,000 Avg. Mon-Fri Daily Boarding: 55,000	0
<i>Cost/km</i>	\$38.33 million/km (Phase 1) \$47.63 million/km (Phase 2)	\$32.1 million/km (Green Line BRT) 3	Unknown	\$37.8 million/km	Unknown	\$0

	Winnipeg	Calgary	Ottawa	York	Vancouver	Edmonton
<i>Busway alignment (segregated from traffic)</i>	Yes	No	Yes	Yes	No	
<i>Dedicated right-of-way (Bus-only lanes aligned to the middle, not the curb, of a road)</i>	Yes	No	Yes	Yes	No	
<i>Off-board fare collection (proof of payment system)</i>	Yes	No	No	Yes	Yes	
<i>Intersection treatments</i>	Yes	Somewhat	Yes	Yes	No	
<i>Platform-level boarding</i>	Yes	No	No	Yes	No	

¹ The Institute for Transportation and Development Policy. BRT Standard Scores (2013). <https://www.itdp.org/brt-standard-scores/>

² Statistics Canada. Population of census metropolitan areas (2014). <http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/demo05a-eng.htm>

³ BRTDATA.ORG. Global BRT Data - Key Indicators per City (2015). http://brtdata.org/location/northern_america/canada

Winnipeg Bus Rapid Transit

Opened in April 2012, Winnipeg's Rapid Transit consists of a 3.6 km system, which includes both a separated track (Transitway) and dedicated lines within the downtown core. The BRT is a result of significant study and planning that has investigated Rapid Transit opportunities within Winnipeg since 1968. Progress of implementing a rapid transit system over that period has been constrained by both need and funding. Based on commonly agreed upon studies (indicating that BRT has lower costs than LRT for ridership up to 6,000 passengers each way), Winnipeg determined the BRT was a better option based upon ridership/demand and the low density built form.

Rationale:

- Flexible and eliminate transfers
- More affordable to build – costing significantly less than an equivalent LRT line
- Operating costs are lower than those for a comparable LRT system in low-density corridors
- Easier to stage, as funding becomes available, a stage can be built and put into service quickly
- Provide the flexibility to transition to higher capacity systems (LRT) if demand increases

Current Rapid Bus System (Phase 1):

Southwest Transitway is a 3.6 km system

Grade-separated Transitway

Bus only lanes off Transitway

Includes priority signals in the downtown

Total Cost: \$138 million dollars

Passenger Stations – Harkness, Osborne and Fort Rouge

13 Routes - Used by 100 Winnipeg Transit buses daily

350 metre tunnel under the CNR mainline tracks

Speeds: 80km/hr on Transitway, 70km/hr in tunnel, 30km/hr through stations

No change in fare between Rapid Transit and standard bus service

Active transportation facilities and infrastructure:

New bicycle and pedestrian paths

Connection to existing paths

Covered bike racks and lockers at the stations

Rapid Transit – Moving forward:

Rapid transit is envisioned on four corridors in Winnipeg by 2031, with an additional two corridors beyond 2031. The rapid transit network will serve high-demand corridors with high-speed routes that use exclusive rights-of-way to bypass traffic congestion on the street system. Transit stations will become multi-modal transportation hubs, where bicycle parking and park and ride facilities are fully integrated with rapid transit service. Stations will be supported by land use policies to encourage creation of mixed-use transit villages and transit-oriented developments (TMP2012).

Southwest Corridor (Phase Two) – Approved February 2015

SW Transitway Corridor from Jubilee Ave to the University of Manitoba

Construction beginning in 2016 , completion scheduled for 2020

Extend service by 7.6 km; includes 10 Transit Stations, 2 Park and Ride Facilities

Will required 2 transit-way bridges, an overpass, an underpass and a tunnel

Total Cost: \$362.3 Million Dollars (\$137.3 Federal Funds,\$225 million Provincial and City Funds)

WINNIPEG TRANSIT STATISTICS (TMP 2011 DATA)

Census Population- City of Winnipeg 663,617 people, Region 730, 018

545 buses

5,170 bus stops

43,870,050 transit trips

89 routes

Transit Ridership Per Capita – 68.3 rides / capita

All day transit mode share- 14% (one of the highest in Canada: Edmonton 9%; Calgary 8%; Ottawa 14%)

Revenue / Cost ratio: 60% - The highest revenue / cost ratio is attributed in part to the efficiency of the operation, but also be attributed to the lack of investment in off-peak services.

Future Estimated Costs and Comparisons to LRT

Indicator	Future Estimated Costs and Comparisons to LRT					
	RAPID TRANSIT CORRIDOR					
	Southwest	West	East	North	Southeast	Northeast
	Graham Mall to U of M	Portage & Main to Century	Graham Mall to Lagimodiere	Graham Mall to burrows	Nairn to Bishop Grandin	Nairn to Perimeter Hwy
Length (km)	13.5	4.9	5.8	2.5	7.3	7.3
2031 Peak Point Ridership. (Peak hour)	1800	2050	1600	3200	250	500
2031 Average Residential & Employment Density within 500m of Corridor (total residents + jobs per ha)	76	151	90	187	23	35
Number of Regional Mixed-Use Centres within 1 km.	0	1	1	0	0	0
Number of Major Redevelopment sites within 1 km.	5	0	1	1	1	1
Estimated capital cost \$millions (LRT).	\$700	\$340	\$405	\$177	-	-
Estimated capital cost \$millions (BRT).	\$275 for stage 2	\$146	\$174	\$76		
Recommendation on Phasing	By 2016	Before 2031	By 2021	Before 2031	Beyond 2031	Beyond 2031

Winnipeg Transportation Master Plan 2011

Rapid Transit Backgrounder

Stage 2 - Southwest Rapid Transit Corridor Project P3 - Business Case - Deloitte April 4 2014

Rapid Transit Finally Arrives - Winnipeg Sun, James Turner - April 5 2012

www.winnipegtransit.com

<http://www.cbc.ca/news/canada/manitoba/rapid-transit-route-approved-by-winnipeg-epc-1.1386490>

Calgary Bus Rapid Transit

Canadian cities have had very divergent paths in their approach to rapid transit. According to a 2014 report by the Pembina Institute, Toronto and Montreal had a major head-start in terms of construction, as they chose to build subways, while other major cities, chose more affordable and 'quicker-to-deploy' technologies such as light rail transit and bus rapid transit. As a result, the report says, cities such as Calgary and Vancouver were able to build infrastructure more rapidly and at a lower cost¹⁷.

Prior to 2004, Calgary was using a frequent, limited-stop commuter service called Blue Arrow. The Blue Arrow network was used along routes proposed for future LRT development. However, in 2004, Calgary Transit, under Director John Hubbell, introduced the BRT network. Transit ridership increased consistently during Hubbell's administration, with the sole exception of the 49-day strike. Under his successor, Fred Wong, the BRT network acquired advanced bus technologies including traffic signal priority devices and the articulated vehicles¹⁸.

The motivation to increase BRT accessibility to more residents continued through the decade when it was announced that there were plans to launch a new southeast Bus Rapid Transit line. For the new line, Transit would work with the City's Transportation department to speed up service using dedicated travel lanes and traffic signal priority – a feature that was expected to be adapted by the city's other BRT routes.

In 2011, Council signaled that a new long-term for Calgary Transit was needed. The outcome of this was the RouteAhead plan, which provides a strategic direction for Transit in Calgary for the next 30 years. Along with improvements to the LRT network, the plan aims to offer Calgarians enhanced BRT facilities, transit-only lanes or busways, real-time arrival information displays, off-board payment, and other customer service technologies².

Although RouteAhead has called for significant improvements to the BRT network in Calgary, the plan has faced challenges. In early 2012, BRT service was compromised on some lines due to low ridership. The southeast (South Health Campus) line now only ran a shuttle bus (rather than articulated bus) during off-peak hours and weekends, and the Canada Olympic Park to City Centre line stopped running on weekends. In the midst of these cutbacks, however, an Airport-City Centre line was introduced, as well as a line servicing the centre-west area of Calgary. The Airport-City Centre line was supported by Mayor Naheed Nenshi, in making Calgary's Airport more accessible through public transit.

¹⁷<http://www.cbc.ca/news/canada/calgary/rapid-transit-expansion-led-by-calgary-vancouver-says-pembina-1.2756613>

¹⁸ Sanders, Harry Max, *Calgary Transit: A Centennial History*, Calgary: City of Calgary, 2009

There have been even greater challenges for BRT in Calgary in recent years. Some in Council have stated that BRT service is a more-primitive form of rapid transit and that it should only precede the eventual construction of an LRT line¹⁹. In 2015, Council agreed with Councilor Shane Keating's motion to review the feasibility of building a \$5.2 billion LRT line to the southeast, rather than building the previously proposed BRT line³. Mayor Naheed Nenshi, however, questioned the large price tag of the LRT extension and argued that "a bus way would deliver 70 per cent of the time savings of a full train at 30 per cent of the cost"³. Calgary's current BRT network consists of six routes.

BRT in Calgary has seen both, challenges and successes, over the course of the last 11 years. However, supporting it has been recognized as a priority by the City. Of the upcoming capital projects that the City has identified, transportation is the costliest, requiring a total of \$651 million in additional grant money. At the top of the transportation priorities are four proposed BRT corridors (which require \$139 million in grant money) including a 'south cross-town' route, a 'north cross-town' route, and a southwest route²⁰.

¹⁹ <http://www.calgarysun.com/2015/05/25/council-gives-go-ahead-for-southeast-calgary-lrt-study>

²⁰ <http://metronews.ca/news/calgary/1289993/bus-rapid-transit-tops-calgarys-wish-list-of-projects-for-which-grant-money-is-still-needed/>

Ottawa Bus Rapid Transit

The Ottawa Transitway system — perhaps the most comprehensive system in North America — is an outgrowth of the 1974 official transit plan. The 60-km Transitway system includes over 26 km of bus-only roadway, with most of the remaining distance on reserved freeway or arterial lanes²¹.

In 1983 the first sections of the west Transitway opened from just south of Baseline Road to Carling Avenue, and in the east across the Rideau River, with seven new stations at Baseline, Iris, Queensway, Lincoln Fields, LeBreton, Lees and Hurdman. Growth continued through the 90's and 2000's with the addition of stations, new transitways, and many park and ride facilities²².

Canada's capital has become a gold standard for bus advocates, who point to the region's 240,000 daily bus riders and 23% transit share as proof that buses can work just as well as rail in encouraging people to choose public transportation to get to and from work. Most rush-hour routes use the Transitway to downtown in the morning and from downtown in the afternoon. Other rush-hour routes operate on the Transitway to employment centres outside the downtown core, such as business parks in urban areas.

Many other bus routes use parts of the Transitway or connect to a Transitway Station, which are convenient transfer points and often located next to a major shopping centre or employment area. The Transitway also connects with the O-Train Trillium Line at Bayview and Greenboro Stations²³.

Ottawa's several busways transport passengers quickly and relatively comfortably. Unlike most "BRT" lines in North America, this city's are mostly grade-separated, producing actually high-speed buses. Many of the Transitway roads are above or below the grade of normal streets in Ottawa, by the use of overpasses, bridges, and trench highways. Thus, they rarely intersect directly with the regular traffic, and make it possible for the buses (and emergency vehicles) to continue at full speed even during rush hour. Buses that travel on the Transitway can cross very long distances (especially outside the downtown area) without stopping for a single traffic light. Most sections of the Transitway have a speed limit of 70–90 km/h (43–56 mph) between stations, and 50 km/h (31 mph) in the station areas.

Ottawa's system has eventually become a victim of its own success as BRT operates near capacity, leading to LRT expansion plans²⁴.

York Region Bus Rapid Transit

²¹ Transportation Research Board. OTTAWA, ONTARIO BRT CASE STUDY (2001) http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp90v1_cs/Ottawa.pdf

²² Forum Comments. North America's largest and busiest busway turns 25 - Ottawa Transitway (2008). <http://forum.skyscraperpage.com/showthread.php?t=161508>

²³ OC Transpo. Transitway Stations (2015). <http://www.octranspo1.com/routes/transitway>

²⁴ The Transport Politic. Ottawa Closer Than Ever To Replacing Bus Rapid Transit With Light Rail (2010). <http://www.thetransportpolitic.com/2010/05/17/ottawa-closer-than-ever-to-replacing-bus-rapid-transit-with-light-rail/>

VivaNext Capital Expansion Programme

Viva Phase 1

The original Viva system, currently in operation, was a fast-track approach to provide a higher level of express bus service in York Region. Improvements to four corridors, serving six bus routes were carried out in a three-year window from conception to operation. Costing \$164 million, the program was considered to be a lead-up to Phase 2, the current VivaNext program (Transport Canada, 2012). Current Viva service might be considered 'BRT-light', but is not perceived by the development community or most observers as a full-function BRT system. The VivaNext project is designed to significantly improve the first generation system (Metrolinx, n.d.).

The Viva service has proven popular, registering ridership increases of 16% in 2006-07 over 2005-06, and 14% in the period 2007-08 (Steer Davies Gleave, 2008). Service is currently provided by a fleet of 101 busses, many of which are extended articulated models with high passenger capacity. The Viva routes are primarily based on the Yonge Street and Highway 7 corridors, with connections to York University, Finch TTC station, and Brampton's Zum bus system.

VivaNext (Viva Phase 2)

System Characteristics

'VivaNext' is the capital infrastructure programme currently under way in York Region, designed to introduce true BRT capability to the Viva system (Steer Davies Gleave, 2008). The second generation Viva system is demarcated by the introduction of "Rapidways" (YRRTC, 2013), separated travel lanes at grade along the centerline medians of Highway 7 and Yonge Streets. These separated lanes include highly developed station infrastructure termed 'Vivastations', including high standard shelters, hallmark design, and pre-payment terminals. Along with Intelligent Transportation Systems (ITS) such as signal priority and real-time arrival information, the system is designed to improve service reliability, travel times, and passenger capacities.

The full build-out of the system will occur to the 2018 timeframe, with significant portions in place by 2015 (YRRTC, 2013). Currently, four VivaNext projects are underway: lane separation and stations along the Highway 7 segment at Vaughan Metropolitan Centre; lane separation and stations along Highway 7 from Yonge Street to Warden; lane separation and stations along Yonge Street from Highway 7 to Major Mackenzie Drive; and lane separation and stations along Davis Drive in Newmarket onto Yonge Street and slightly south.

Relevant Factors to Development

Over the past decade, attitudes in York Region have shifted from eschewing transit service

to desiring the expansion of higher order transit as a necessary service for economic growth and mobility. Along with rising rates of transit ridership (DMG, 2007c) one might speculate that transit has become substantially more important to the decisions driving the development of residential, commercial, or other mix of uses.

The reality is that the Viva BRT is a lesser consideration than other more desirable forms of rapid transit. In the hierarchy of factors influencing development decisions- including location, product, and timing or staging- BRT in this instance does not emerge as a primary factor, especially with the system still under construction, BRT is a subsidiary consideration affecting the standard elements which must be considered in land development such as ownership, access to amenities, ability to upzone, parking relaxations, and the capacity of infrastructure (as well as the ease of proving that infrastructure has capacity for development) .

Vancouver Bus Rapid Transit

Translink is Metro Vancouver's regional transportation authority responsible for planning, financing and managing public transit and other transport modes in the greater Vancouver region.

Vancouver's growing SkyTrain network is complemented by a series of express bus routes. While not operating in a separated lane, these B-Line buses run frequently at all times of day and stop only at major arterials, making them fast and efficient. Large articulated buses are also used on certain routes to increase capacity.

In Vancouver, TransLink operates two Bus Rapid Transit (BRT) lines, the 97 B-Line and 99 B-Line. Both have been successful. One former BRT route, 98 B-Line, connecting Richmond to downtown Vancouver, operated from 2001 to 2009, was replaced in 2009 by a rapid transit service, the Canada Line.

The 97 B-Line is a bus rapid transit line which connects Coquitlam Central Station on the West Coast Express system to Lougheed Town Centre Station in the SkyTrain system. It is operated by Coast Mountain Bus Company and funded by TransLink. This route serves Burnaby, Port Moody, and Coquitlam.

Although this service is operated by Coast Mountain Bus Company but it is funded by TransLink. Unlike the other B-Line services, this route mainly uses conventional 40-foot buses. It takes 45 minutes to complete during rush hour, and about 30 minutes off-peak.

Going forward, the 97 B-Line is expected to be phased out in 2016 when the Evergreen Line to Coquitlam opens.

Performance review of route 97-B from 2011 to 2013 is as follows:

KEY CHARACTERISTICS

Sub region of Primary Service	North East Sector
Predominant Vehicle Type	Standard Bus
Population (People, 400 m Buffer)	33,500
Employment (People, 400 m Buffer)	18,500
Walkability (intersection density)	High (0.28 int/hect.)
Contributes to FTN (Y/N)	Yes

COST AND PERFORMANCE

	2011	2012	2013	Rank (2013)

Annual Boarding	3,409,000	3,579,000	3,558,000	19/ 206
Annual Service Cost	\$3,900,000	\$4,140,000	\$4,188,000	25/ 217
Annual Revenue Hours	39,800	42,200	42,700	25/ 217
Cost / Boarded Passenger	\$1.14	\$1.16	\$1.18	26/ 206
Avg. Boarding / Rev. Hour	86	85	83	25/ 206
Avg. Daily Boarding (Mon-Fri)	10,750	11,200	11,250	20/ 204
Avg. Daily Boarding (Sat)	7,300	7,750	7,500	19/ 172
Avg. Daily Boarding (Sun & Holidays)	5,250	5,600	5,550	24/ 163
Peak Passenger Load (Bi-Directional Avg.)	35	35	35	21/ 204
Peak Factor Load (Vehicle Occupancy)		0.62	0.60	31/ 204
Avg. Capacity Utilization (Passenger Turnover)	68%	90%	85%	45/ 204

Source: Tranlink- 2013 Bus Service Performance Review: Appendix C- 2013 Route Summaries

The 99 B-Line is another bus rapid transit line in Metro Vancouver. It travels along Broadway, a major east-west thoroughfare, and connects the University of British Columbia (UBC) to Commercial–Broadway Station on the SkyTrain system. It is the first and the most popular of the B-Line routes in the regional system. The other B-Lines that followed are based on the 99 B-Line in terms of the use of articulated buses and frequent arrivals for buses.

The waiting time for a bus during peak hours on a weekday is 1.5–3 minutes. On average it takes 42 minutes to complete the entire route, while at night the time decreases to 30 minutes as compared to 45 minutes in the day.

TransLink and the provincial government have also been leading a study in recent years to examine replacing the 99 B-Line with a full rapid transit solution, given its high ridership levels, it is one of the busiest bus route in North America, with a 2011 average weekday ridership of 53,750 passengers. This number is up from approximately 45,000 passengers per day in 2007.

Performance review of route 99-B from 2011 to 2013 is as follows:

KEY CHARACTERISTICS

Sub region of Primary Service	Vancouver/ UBC
Predominant Vehicle Type	Artic. Bus
Population (People, 400 m Buffer)	68,000
Employment (People, 400 m Buffer)	58,000
Walkability (intersection density)	High (0.5 int/hect.)
Contributes to FTN (Y/N)	Yes

COST AND PERFORMANCE

	2011	2012	2013	Rank (2013)
Annual Boarding	16,384,000	16,879,000	17,054,000	1/ 206
Annual Service Cost	\$8,578,000	\$9,412,000	\$9,435,000	1/ 217
Annual Revenue Hours	87,500	96,000	96,300	1/ 217
Cost / Boarded Passenger	\$0.52	\$0.56	\$0.55	1/ 206
Avg. Boarding / Rev. Hour	187	176	177	1/ 206
Avg. Daily Boarding (Mon-Fri)	53,750	54,100	55,000	1/ 204
Avg. Daily Boarding (Sat)	29,700	33,400	33,350	1/ 172
Avg. Daily Boarding (Sun & Holidays)	21,200	23,900	25,000	1/ 163
Peak Passenger Load (Bi-Directional Avg.)	68	64	63	1/ 204
Peak Factor Load (Vehicle Occupancy)		0.86	0.84	2/ 204
Avg. Capacity Utilization (Passenger Turnover)	179%	167%	168%	6/ 204

Source: Tranlink- 2013 Bus Service Performance Review: Appendix C- 2013 Route

Summaries

Another BRT service in Metro Vancouver region is the Highway 1 Rapid Bus (route 555), connecting Carvolth Exchange and Braid SkyTrain Station over the new Port Mann Bridge, the service began operating in December 2012.

Route 555 BRT is planned to operate seven days a week, and will run every 10 minutes in each direction during peak hours and every half hour the rest of the time during the week. It is expected to generate 3,000 to 4,000 boardings per day. In 2016, service will commence on the Skytrain Evergreen Line, connecting Lougheed Town Centre to Coquitlam.

By April 2013, monthly ridership on the 555 bus from Carvolth Exchange to Braid SkyTrain Station has grown from 23,000 to more than 38,000 within few months of the route launch.

Bus rapid transit provides important service in Vancouver. Designed to be frequent, reliable, and easy to use, BRT has improved service for existing bus customers while attracting new riders from single occupant vehicles. Capital costs are low compared to rail-based systems. BRT is being used in corridors proposed for Intermediate Capacity Transit System (ICTS) or in medium density corridors where ICTS may not be justified.

Investment in BRT allows the establishment of patterns of movement and ridership for conversion to ICTS in the future. The success of the BRT has helped to revitalize bus services and has fostered improved customer loyalty for public transit.

The “B” lines represent cost-effective, environmentally responsive, early action approaches to improved transit services in heavily travelled corridors.

Appendixes

Appendix A: BRT Best Practice Guides

Many organizations have commented on the best practices for BRT. Some prominent best practice guides are listed below.

The Institute for Transportation and Development Policy. The BRT Standard (2014).

<https://www.itdp.org/wp-content/uploads/2014/07/BRT-Standard-2014.pdf>

The Institute for Transportation and Development Policy. Bus Rapid Transit – The Complete Planning Guide (2007). <https://www.itdp.org/wp-content/uploads/2014/07/Bus-Rapid-Transit-Guide-Complete-Guide.pdf>

National BRT Institute. <http://www.nbrti.org/learn.html>

United States Department of Transportation. Characteristics of Bus Rapid Transit for Decision-Making (2009). <http://www.nbrti.org/docs/pdf/High%20Res%20CBRT%202009%20Update.pdf>

Appendix B: A Brief History of Transportation in the City of Edmonton

In the late 1800s the ox cart and horse drawn carriages, wagons and coaches, in all their varied forms, served as the most popular modes of public transportation.

In 1903 the first automobile made its appearance in its open-air/uncovered style.

Two years later, in 1905, Alberta was declared a province and Edmonton its capital.

In 1908 the Edmonton Radial Railway introduced the first streetcar that offered an 'out and back' service that saw the city join the ranks of North American Metropolitan Centres of a thoroughly modern public transportation system.

By 1917 we see the city making its *first* appeal to the public to choose the streetcar over cars; there were ads that *urged* the public to choose.

When motor buses appeared on the streets of Edmonton in 1932 they proved to be successful for the expansion into the outlying areas while the streetcar was reserved for the central areas.

An electric trolley coach system was introduced in 1937 and diesel-powered buses came on board in 1945. However these smelly buses were soon converted to gasoline engines only to be converted again to a propane system in 1949.

The 60's brought urban sprawl to a new level and the City's unusual mixed fleet approach to the challenge bucked the trend in urban transportation. In concert with Centennial Year in 1967 City Council approved a high capacity rail rapid transit that came to fruition 1978 when the City hosted the Commonwealth Games and introduced LRT, the first of its kind in Canada.

The 70s were a busy time: 1973 brought dedicated bus lanes to the City; DATS was introduced in 1975; and 1977 welcomed the first articulated bus that didn't come into regular service until 2001.

Jump forward to the 1990s when low floor buses with ramps were added to the fleet. 1999 was the first year a proposal to introduce BRT was rejected in favour of 12-passenger buses for small population areas that would be upgraded to 30-passenger buses when their population increased. And Council voted to commit \$550 million in the coming decade to LRT and the Anthony Henday Ring Road.

Into the 2000s and the City has a well-established model of an integrated light rail and bus system. In the early 2000's BRT had emerged as a transitional concept that could meet the immediate strains on the system and provide a bridge between LRT and buses, an idea that was fiercely debated for several years before being rejected twice by the end of the first decade of the 2000s.

Entering into the New Millennium the City was looking forward to renewing the spirit of innovation that had sustained public transportation through the years. (Ride of the Century: the story of the ETS by Ken Tingley.)

We're now well into the 2010s where it could be said that "the more things change the more they stay the same." The City continues to expand into the suburbs and to experience rapid population growth, financial restraints, realities and sources of funding still add to the challenges facing transit services, we ride through boom and bust, and The Car remains King.

And BRT remains a viable transitional opportunity to bridge the gap between LRT and buses when "the only thing constant is change." It took two decades for LRT to go from an idea worth consideration in 1960 to 1979 before it rode the rails. Can we afford to wait another two decades for BRT to bring its benefits to ETS, its clients and the citizens of Edmonton?