West Edmonton Valley Line Estimates

Recommendation

That the March 21, 2018, Integrated Infrastructure Services report CR_5610, be received for information.

Previous Council/Committee Action

At the January 23, 2018, City Council meeting, the following motion was passed:

That Administration provide a report on the Valley Line LRT extension to West Edmonton summarizing comparative capital cost estimates for mass transit, expressed as present value equivalents, as follows:

1. Order of magnitude capital cost estimates for Bus Rapid Transit service from downtown to Lewis Farms, assuming a dedicated right of way along the same route as current LRT planning, and identify the cost differentials among key components,

2. Comparative capital cost estimates, for LRT and BRT (order of magnitude), broken down by current alignment segments as follows:
    a. Downtown to 142 Street
    b. 142 Street to 156 Street
    c. 156 Street to West Edmonton Mall
    d. West Edmonton Mall to Lewis Farms

3. A summary of system operating costs for each methodology, including maintenance and life cycle costs,

4. System comparisons for each methodology (passenger capacity per hour per vehicle, travel times, travel speeds, etc.),

5. Summary of known experiences of other cities that have employed BRT (eg. Ottawa's rationale for moving from BRT to LRT),

6. Estimate of property tax revenue increases and an outline of the development scenarios and possible tax benefits of Transit Oriented Development along the West Valley Line route for both LRT and BRT,

Due: Return at the same time as report CR_5426_Automated Vehicles

Note: At the February 13, 2018, City Council meeting, the above motion was amended by replacing the last part of the motion with the following:

> Due: March 21, 2018, along with a status update, if possible, for CR_5435 - Emerging Mass Transportation Technology.

Executive Summary

The LRT Network Plan was approved by Council in 2009. This plan called for LRT connecting all parts of the city as the backbone of a sustainable transportation system, with strong linkage to land use planning. The Valley Line was identified as part of the LRT Network Plan, to serve southeast and west Edmonton with a low-floor, urban style LRT line connecting through the downtown core.

The 2017 Council-approved Transit Strategy notes that Edmonton's bus network will be structured around a Primary Transit Network, consisting of both LRT and precursor Bus Rapid Transit (BRT) Routes which are complemented with rapid bus and crosstown routes. The Transit Strategy recognizes that Edmonton's public transportation system is best served by multiple forms of transportation service, with each component serving a specific and intentional purpose within the larger network.

Well established bus service, including express bus routes, already exists along the Valley Line West Corridor. Valley Line West LRT is expected to provide enhanced ridership capacity in comparison to Bus Rapid Transit (BRT), a different passenger experience, and is also anticipated (due in large part to the permanency of the infrastructure) to provide a greater draw for transit oriented development, densification, and urban shift.

This report highlights some of the differences between LRT and BRT, specifically related to the Valley Line West corridor. The report provides a high-level, primarily qualitative assessment. A concept planning study would be required at a minimum to fully test a BRT option including development of capital and operating cost estimates.

Report

Project Overview

Once complete, the Valley Line is a 27 kilometre low-floor urban LRT line that will operate between Mill Woods Town Centre and Lewis Farms, with a 2047 projected ridership of 128,900 boardings per day. Related Council approval and implementation history is as follows:

- In 2009, the LRT Network Plan was approved;
- In 2009, the Valley Line corridor was approved;
- In 2011 and 2012, the concept plans for the Valley Line were approved;
- In 2013, preliminary engineering for the Valley Line was completed; and
- In February 2016, procurement of the Public Private Partnership for the Valley Line Southeast was completed.

A summary of the project and public engagement process is provided in Attachment 1, along with a fact sheet on the LRT Crossing Assessment process in Attachment 2 and a fact sheet on LRT Route Planning and Evaluation Criteria in Attachment 3.

City Council designated Valley Line West as one of the top two priorities for LRT expansion, along with the Metro Line running from NAIT to Blatchford, for LRT delivery funding based on the information provided in the Integrated Infrastructure Services report CR_3314 *(Long Term Funding Plan for the LRT - Strategic Options, Extension Planning and Proposed Stages of Construction)* on May 3, 2016.

In September 2016, the City of Edmonton received funding to update preliminary design for the Valley Line West through the Government of Canada's Public Transit Infrastructure Fund, and to get the project ready for procurement.

Responses to the January 22, 2018 Motion

1. Order of magnitude capital cost estimates for Bus Rapid Transit service from downtown to Lewis Farms, assuming a dedicated right of way along the same route as current LRT planning, and identify the cost differentials among key components;

There are multiple methods of providing Bus Rapid Transit, an overview of which is provided in Attachment 4. For the purpose of this report, the estimates are based on premium service as described in the table below, assuming that BRT is implemented as a precursor to LRT in the future.

	Regular Service	Enhanced Service	Premium Service
Characteristics	Transit queue jumps with mixed traffic	Blend of options	Dedicated busway Transit signal priority
Travel Time	Slowest	Medium	Fastest
Reliability of Service	Lowest - traffic dependent	Medium	Highest - mostly independent of traffic
Capacity	Low	Low	Medium
Cost	Lowest	Medium	Highest
Time to Implement	Fastest	Medium	Slowest

The capital cost to build BRT as a precursor to LRT is estimated to be approximately 75% of the capital cost to build LRT. The current capital cost estimate for the Valley Line West is $2.24 billion in 2019 dollars, assuming that recommendations identified in CR_5165 Valley Line West LRT - Crossing Assessments and Concept Plan Amendments are approved by City Council on March 21, 2018. The comparative cost to build BRT is approximately $1.68 billion.

The cost differential of major components between LRT and BRT is noted in the table below:

Component	LRT cost ($million)	BRT cost ($million)	Cost Difference ($million)
Civil & Structures	$1,120	$1,120	-
Systems & Electrical	$420	$120	$300
Vehicles, Storage and Maintenance Facilities	$550	$290	$260
Land	$150	$150	-
Total	**$2,240**	**$1,680**	**$560**

With BRT as a precursor to LRT, measures could be taken during the initial BRT construction to enable conversion to LRT. These measures may include installation

of duct banks, conduits, drainage systems, and foundations for overhead catenary supports. Other elements would be deferred until LRT conversion, such as trackwork, overhead catenary lines and train power and control systems.

2. Comparative capital cost estimates, for LRT and BRT (order of magnitude), broken down by current alignment segments as follows:

a. Downtown to 142 Street;
LRT: $800 million
BRT: $620 million
b. 142 Street to 156 Street;
LRT: $280 million
BRT: $220 million
c. 156 Street to West Edmonton Mall;
LRT: $670 million
BRT: $520 million
d. West Edmonton Mall to Lewis Farms.
LRT: $490 million
BRT: $320 million

These costs are based on general items such as land, maintenance facilities, and vehicles being distributed evenly across all the segments.

3. A summary of system operating costs for each methodology, including maintenance and life cycle costs;

A BRT scenario was evaluated with the assumption that articulated buses would be used, which can each accommodate 70-85 people. For this exercise, the Valley Line LRT is assumed to operate with two 40-meter low-floor vehicles during peak hours, which can accommodate 275 passenger per vehicle, or 550 passengers per train. Therefore, seven articulated buses are required to provide the same capacity as a two-car train.

The typical lifespan of an articulated bus is 12 years, whereas a light rail vehicle has a life expectancy of 35 years. Therefore, to move the same number of riders by bus over the life expectancy of a single two-car low-floor train, a total of approximately 21 buses is required. This also results in a corresponding increase in staff time to operate and maintain the fleet of buses compared to LRT.

Generally, LRT vehicles are less expensive to operate on a per-rider basis compared to buses, as the cost to maintain, operate and power a single two-car LRT train is less than that for seven articulated buses.

As a result of these factors, the total life cycle cost of a BRT system over a 35-year period could be 20-30% more than that of an LRT system.

As LRT and BRT technology evolves, there may be new vehicle types such as double articulated buses or rubber-tire mounted trains, which may increase the capacity of BRT and make it more competitive with LRT.

4. System comparisons for each methodology (passenger capacity per hour per vehicle, travel times, travel speeds, etc);

As noted in response to item 3 of the motion, a single two-car, low-floor LRT train can accommodate 550 people. Seven articulated buses would be required to carry the same ridership.

LRT can accommodate the anticipated opening day peak ridership demand of 40,100 passengers per day at five-minute frequency. It is estimated that BRT service would require approximately one-minute frequency to handle the same ridership. This would significantly impact intersection performance.

Travel speeds for BRT and Valley Line LRT will be comparable. Low-floor LRT is planned to operate at the same speeds as adjacent traffic. If BRT is provided as a pre-cursor to LRT, it would require a transfer at the 102 Street Stop on 102 Avenue. This transfer could add 5-10 minutes to a normal trip during peak periods. A continuous LRT trip eliminates any transfers and decreases overall travel time.

5. Summary of known experiences of other cities that have employed BRT (eg. Ottawa's rationale for moving from BRT to LRT);

Discussion with City of Ottawa Administration indicates that the primary reason for switching from BRT to LRT was due to capacity constraints.The 2011 Business Case for the Confederation Line indicates the following rationale for converting from BRT to LRT:

- The average speed of the LRT system will be higher than the current BRT system primarily because of the downtown tunnel.
- Customers will use off-board fare payment, allowing for more efficient train boarding (as all doors to all trains can be used).
- More comfortable ride for customers on LRT – better customer experience.
- Easier navigation of the transit system with increased technology for sign displays, station design, etc.
- Increased transit ridership.
- Reduced emissions and greenhouse gases, reduction in salt use for bus-only roads that will become LRT.

- Far fewer buses required means savings for vehicle operations and maintenance.

Research has demonstrated that investment in premium rapid transit (LRT and BRT) provides a positive impact on land values along the corridor. When combined with municipal planning initiatives, rapid transit can positively support and influence redevelopment or infill near transit stations.

Research suggests that specific rapid transit technology is also a contributing factor in which the degree of increase in land value and development is captured. More permanent or fixed technology, such as LRT, typically generates higher land value and increases the return on development. Typically, at-grade LRT will capture a catchment area of 500-800 meters surrounding stations influencing the land value as compared to 400-500 meters for BRT.

The Hamilton King-Main LRT Business Case referenced a 2002 comprehensive review of land value and public transport illustrating how technology does have an influence on land value. This review is supported in other business cases, such as Metrolinx's Hurontario / Main Street and Queen Street LRT.

An example of redevelopment can be demonstrated with Vancouver's 98B line, a BRT or rapid bus line with dedicated right-of-way during peak hours in service from 1998 to 2009. The 98B line operated primarily along the Granville corridor and generated very little redevelopment during service years. The 98B line was replaced in 2009 by the Canada Line, rail transit which operates along the Cambie corridor. Since 2009, substantial redevelopment has occurred along the corridor and primarily near stations. Please see below in response to Question 6 for a list of other factors that influence development along transit corridors.

6. Estimate of property tax revenue increases and an outline of the development scenarios and possible tax benefits of Transit Oriented Development along the West Valley Line route for both LRT and BRT.

Property taxes are collected to provide services to the citizens of Edmonton as prioritized by Council. As part of the budget setting process, the City first establishes the required total property tax to enable a balanced budget. The distribution of this taxation burden is then applied to all taxable property owners in the City based on their respective proportion of ownership of the total City taxable property value (the proportion of the value of their property versus the total taxable property value in the entire City). The effect of this approach to property tax is that market value changes to existing properties results in no tax uplift for the City of Edmonton. New construction, however, does result in growth revenue.

The Valley Line West project alignment has the potential to drive multiple and significant Transit Oriented Development scenarios. These scenarios and the resulting potential uplift in the number and value of taxable properties, are driven by the desirability of Edmontonians to work, live and play in the areas serviced by the project. This in turn will result in real estate development companies and employers rising to meet the demands of the people, through offerings of mixed residential, commercial and industrial property development. Thus the project creates a virtuous circle of development, feeding ridership and transit use - and vice versa.

While the project is likely to generate development using either BRT or LRT, maximizing the benefits to the City, such as encouraging Transit Oriented Development and increasing taxable properties and values and increasing the overall ridership, will depend on a number of project characteristics, including: 1) the perceived permanency of transit service; 2) volume of passengers that can be carried; 3) comfort and accessibility of the system. 4) the type of property mix along the alignment (vacant, occupied, residential, commercial, industrial etc);

1) *Perceived permanency of transit system*
   LRT is a fixed transit system. The alignment is considered to be permanent, therefore the passenger movement can only be deployed along that alignment. BRT can be considered to be a semi-fixed system. While infrastructure can still be created to create a permanent transit corridor, the buses themselves can be deployed elsewhere if necessary to meet other perceived needs. This inherent flexibility leads to a perceived lack of permanency for the BRT system.

2) *Volume of passengers that can be carried*
   Businesses and developers will consider the passenger volume of the transit system when determining the scale of the development they wish to undertake - as it will speak to the level of achievable demand. LRT is more conducive to higher ridership volumes than BRT. Coupled with the permanency of the system, this allows the development community to consider higher density developments and large employers to consider the LRT system as valuable service for its employees.

3) *Comfort and accessibility of the system*
   Major mixed residential developments need to attract a mixed income band of residents to purchase homes. The LRT system can carry high volumes of passengers in a high degree of comfort when compared to BRT. As such, LRT is perceived to be an attractive transit alternative. When the transit system is attractive to a range of demographic cohorts, developers, employers and businesses can seek to build more density, high value mixed residential and commercial developments.

4) *Type of land use along the alignment*
Property value uplift is a function of a number of factors in and of itself (the real estate market is influenced by much more than just the transit service for example). Among the other external factors, the potential impact of BRT versus LRT on the Valley Line West is a function of the property type mix or land use along the alignment. The following table summarizes the potential difference in property value uplift between BRT and at-grade LRT for various land uses. If factors 1-3 from above are in place, this would tend to result in the ranges in the LRT column rather than the BRT column.

Land Use	BRT	LRT
Residential	2-4%	10-25%
Office	2-4%	10-50%
Retail	1-2%	10-50%

The potential property value uplift factors summarized here are based on a 2009 business case for a Canadian transit project, which used data from a comprehensive review of land value and public transport literature that references approximately 150 studies. This business case reviewed various case studies and data sources regarding uplift factors for BRT, LRT and other transit technology. It is important to emphasize, however, that an increase to existing assessment values does not result in incremental property taxes revenue (as the overall tax is determined by the City budget).

When these factors combine - LRT is shown to attract higher levels of transit oriented development and higher system ridership volumes, resulting in an increase in assessable properties and higher assessable property values.

Corporate Outcomes and Performance Management

Corporate Outcome(s): Edmontonians use public transit and active modes of transportation			
Outcome(s)	**Measure(s)**	**Result(s)**	**Target(s)**
Edmontonians use public transit and active modes of transportation	Transit ridership	96.9 rides/capita (2016)	105 rides/capita (2018)
	Journey to work mode	24.7% (2016)	25.9% (2018)

Corporate Outcome(s): The City of Edmonton has sustainable and accessible infrastructure			
Outcome(s)	**Measure(s)**	**Result(s)**	**Target(s)**
Increased stakeholder (operator and community) satisfaction as LRT development meets their needs (during and post project)	Citizen Satisfaction Survey (Valley Line) -TBD	TBD 2026	TBD 2026

Corporate Outcome(s): The City of Edmonton has sustainable and accessible infrastructure			
Outcome(s)	**Measure(s)**	**Result(s)**	**Target(s)**
Valley Line West Catchment Area	Valley Line West residential density (dwelling units per net residential hectare)	51.40	30 - 45 +
	Valley Line West population density (people per net residential hectare)	86.72	Increasing trend

Attachments

1. Valley Line LRT Backgrounder
2. LRT Crossing Assessment Framework Fact Sheet
3. LRT Route Planning and Evaluation Criteria Fact Sheet
4. Bus Rapid Transit Information Sheet

Others Reviewing this Report

- T. Burge, Chief Financial Officer and Deputy City Manager, Financial and Corporate Services
- C. Campbell, Deputy City Manager, Communications and Engagement
- D. Jones, Deputy City Manager, City Operations
- L. McCarthy, Deputy City Manager, Urban Form and Corporate Strategic Development