City of Edmonton – LRT Crossing Assessment Framework

Abstract. Impacts to traffic and the ongoing debate around grade separations are some of the most highly debated issues along planned LRT corridors. Edmonton's 2017 municipal election brought many related issues to the fore, including:

- increased demands for the technical rationale behind decisions;
- a need for a more defined toolkit for decision-making regarding intersection performance; and
- greater clarity around City vision and project trade-offs.

As a result, the City of Edmonton's LRT Delivery group, in conjunction with other key City personnel and a study of industry best practices, developed a process and accompanying evaluation criteria to both clarify its own processes and assist City Council in making these critical decisions.

The framework developed consists of a three phased approach that aims to balance sustainable urban integration principles with impacts to network operations. This framework is being used to guide decisions on both new LRT alignments as well as expansions to the existing network and has recently assisted City Council in making critical decisions along the Valley Line West and Metro Line corridors.

LRT NETWORK PLAN

In 2009, Edmonton City Council adopted a long-term LRT network plan to define the future size, scale and style of Edmonton's LRT system. This expansion consists of over 50 km of new trackway over the six spokes that comprise the LRT network, and is planned to extend to all quadrants of the City by 2040. This expansion was founded on a core philosophy of Urban LRT - infrastructure woven seamlessly into communities, promoting better access, and encouraging a compact, attractive urban form.

Figure 1 - City of Edmonton LRT Network Plan

URBAN LRT

As part of the LRT Network Plan, Edmonton City Council approved the Urban LRT philosophy to guide these expansion plans. In general, Urban LRT consists of:

- Building smaller-scale stops, spaced closer together;
- Providing better links to destinations through integrated connections with direct transit and active modes;
- Respecting communities – safe operation in pedestrian-oriented areas and with fewer barriers;
- Investing in aesthetics – infrastructure woven into the urban fabric of the community; and
- Promoting placemaking, Transit Oriented Development, and densification.

Figure 2 - Urban LRT Vision

The Urban LRT philosophy was approved to guide both the expansion of the existing high-floor system (where applicable) and the establishment of new low-floor lines such as the Valley Line. Urban LRT generally runs at-grade, within the road right-of-way and interacts with the traffic system through Transit Signal Priority (TSP). Suburban LRT, which has guided much of the current City of Edmonton LRT network build out, typically operates within a dedicated right-of-way (historically in old heavy rail corridors or along high-volume arterial roadways), runs at higher speeds, and is given full pre-emption at intersections.

With the push towards Urban LRT, the City had to find an effective way to balance the principles behind Urban LRT (at-grade, minimal infrastructure) with the political and public demands to mitigate traffic impacts (often expressed as a call for grade separation at key intersections). Integrating Urban LRT into a legacy suburban system also carried its own unique challenges. In response, the City developed a framework for evaluating key road crossings that will be applied on all expansions to both its high-floor

and low-floor systems. This framework, called the LRT Crossing Assessment Framework (LRT-CAF), was approved by Edmonton City Council in June 2017.

FRAMEWORK DEVELOPMENT

To develop this framework, a working committee was formed. While led by LRT Delivery, it involved a wide cross-section of administration including Planners, Engineers, Operators, Finance and Communications staff. This group undertook a series of workshops to identify key criteria, establish how criteria would be evaluated, and assign respective weightings. The content produced by the working committee was supplemented with a study of industry best practices of other major cities throughout North America.

The formal process adopted by the City of Edmonton consists of a three-phased approach. Phase One relies on an industry-accepted Institute of Transportation Engineers (ITE) nomograph which evaluates traffic impacts (number of trains/hr versus peak traffic movement volume/hr). This phase is used to determine which locations may require a crossing assessment based on traffic impacts alone, as traffic was determined to be the primary driver to trigger an evaluation. Administration overlaid the City's existing and planned Metro Line and Capital Line crossings on the ITE graph under the following parameters:

- to the left of the green line should remain at-grade;
- to the right of the yellow and red lines be grade-separated; and
- on or between the green and yellow lines require site-specific assessment.

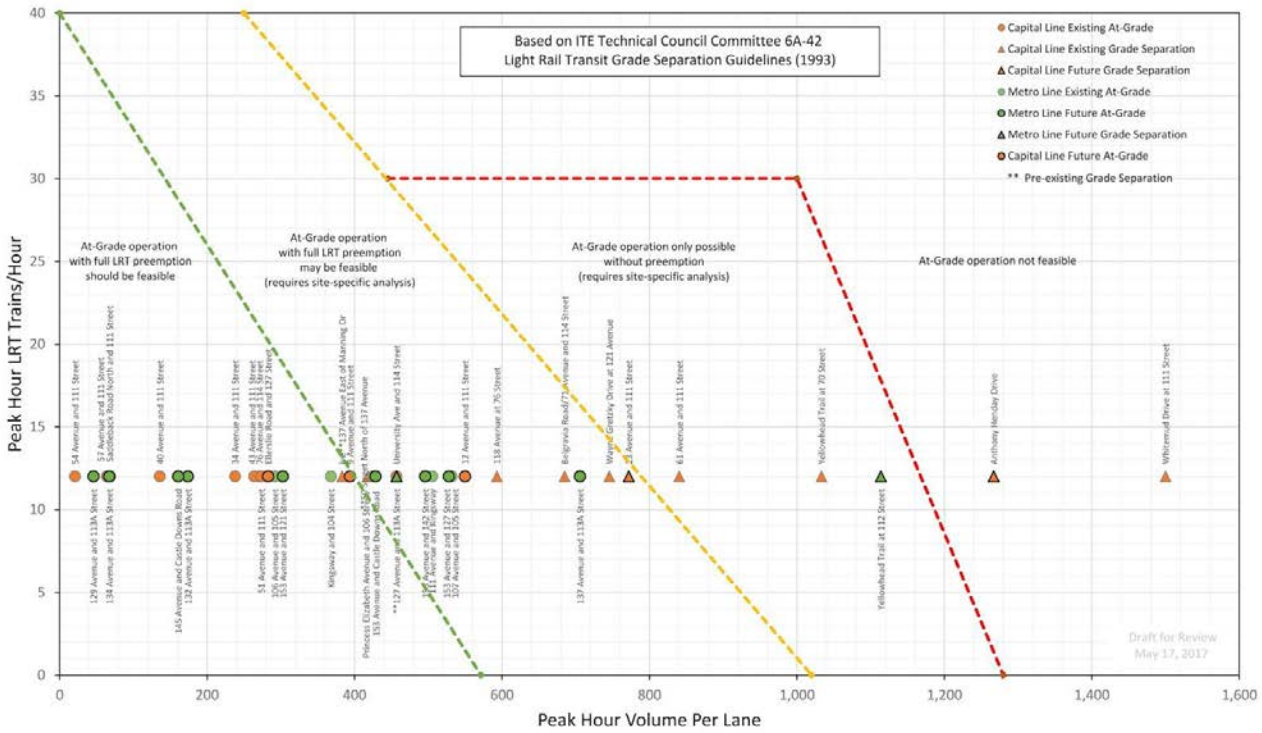

Figure 3 - ITE Nomograph

The Phase One analysis is used for screening. If an analysis passes through the Phase One gate, the evaluation moves to Phase Two. Once a specific location is identified for assessment through the screening phase, LRT crossing options are developed to explore, at minimum:

- At-grade crossing with maximized roadway/intersection capacity;
- Grade separation of LRT and/or roadway for both over and under scenarios; and
- Off-corridor improvements that may mitigate traffic delays at the crossing in question.

Option development would also include assessment of impacts on any adjacent LRT stops/stations (i.e. does the option create the need to elevate, bury or relocate the station) and the identification of any fatal flaws.

Figure 4 - Crossing Assessment Options

Once all options are developed and those with fatal flaws eliminated, the process moves into Phase Three where a comparative analysis of the options is completed using weighted analysis of a four-criteria framework with approximately 30 sub-criteria. The key criteria selected were Accessibility, Network Integration, Urban Design and Social Environment, and Constructability and Feasibility.

Accessibility – This criteria evaluates how the various transportation modes link between one another and with adjacent developments. This includes assessing the impacts to pedestrian connectivity and active mode linkages, as well as potential accessibility issues for citizens with mobility challenges. Ease of transfers between transit centres and other modes of transit (e.g. bus service) are also assessed. This

category generally did not favour elevated or below-grade stations as transfer times were generally impacted through the introduction of stairs, elevators and/or escalators.

Network Operations – This criteria evaluates how the surrounding and broader transportation network is impacted. This category rewards options that improve network efficiency by minimizing travel delays for active modes (pedestrian, bike, etc.), transit, and vehicular traffic on both opening day and long-term horizons. Detailed assessment for this category requires both macro and micro simulation modelling of the traffic network, as well as LRT operation simulations. This category generally favours grade separations as they reduce conflicting interactions between the transit and traffic networks, reducing travel delays.

Figure 5 - Trenched Grade Separation

Urban Design and Social Environment – This criteria evaluates how the surrounding community and stakeholders are impacted. The first part of this category assesses how options impact or promote development opportunities (Transit Oriented Development), marketability of lands, property value uplift and promotion of City goals to achieve urban compact form. The second part of this category assesses the impact to the community itself by analyzing visual and aesthetic impacts, impacts to parkland and open spaces, and connectivity between adjacent communities. Scoring for this category was highly dependent on the context of the location. For example, an elevated guideway may be suitable in an industrial area, but may introduce concerns in a downtown urban setting related to visual obtrusiveness, noise/vibration and privacy. Therefore, a below-grade separation and station may be preferable in the urban context.

Figure 6 - Trenched Grade Separation with Station

Feasibility and Construction – This criteria evaluates impacts to feasibility, constructability, cost, schedule and risk. Options that include the construction of complex infrastructure that increase cost, schedule and risk score lower in this category than more simple solutions. For example, an option that recommends the addition of a simple turning lane to help alleviate traffic congestion would score higher than a complex grade separation that may cost hundreds of millions of dollars.

Public Engagement - The fifth criteria that needs to be completed prior to bringing a recommendation forward is public engagement. It is important to understand the local community's vision and what factors are most important to them, while remembering that communities are not uniform in their concerns and opinions, and often disagree on who can or should be expressing those concerns on their behalf. In some communities, traffic impacts are very important and the support for grade separation is high, while other communities may see an elevated structure or tunnel portal as aesthetically undesirable infrastructure that may physically divide their community. Other corridor users, such as car drivers, bus transit passengers, and private-sector goods movement stakeholders, must also be considered. Public engagement helps to identify challenges, opportunities and concerns specific to the surrounding community.

In order to effectively balance these criteria, the first three criteria – Accessibility, Network Operations, and Urban Design and Social Environment were all given a weighting of four (4). City Council has informed administration that critical decisions with long-reaching impacts (i.e. LRT is considered 75-100 year infrastructure) should not be based on cost alone. As a result, the Construction and Feasibility category was given a weighting of two (2). The public engagement section was not given a formal weighting, but is a core policy-based requirement for bringing any proposed recommendations and changes to Council.

City of Edmonton – LRT Crossing Assessment Framework

The framework is not a formula, but rather a starting point to assess options for specific crossing locations.

FRAMEWORK APPLICATION

This framework is currently being applied to 15 key road crossings on the preliminary engineering assignments for three future LRT extensions (Metro Line North West, Capital Line South, Valley Line West), and will also be applied to future lines and extensions (including the Centre LRT route). The openness of the criteria encourages a wide array of options for analysis including: modification of road network (e.g. addition of turning lane), off-corridor improvements, LRT grade separations (over / under), road grade separations (over / under), and even intersection optimization through Intelligent Transportation Systems (ITS). It is important to the City to maintain this openness to different solutions, instead of only analyzing whether to grade separate or not.

RECENT OUTCOMES AND LEARNINGS

LRT Delivery brought the first series of recommendations resulting from application of the LRT Crossing Assessment Framework to City Council in March 2018, as part of Council reports outlining crossing assessments and concept amendments for the Metro NW LRT and Valley Line West LRT projects. These two reports reviewed six crossing locations along the future Valley Line West corridor and the existing Metro Line. The assessment process should also be supplemented with a network-level overview to validate the analysis of specific locations. The Valley Line West crossing along Stony Plain Road at 149 Street is an example that reflects this added complexity.

Based on a location-specific assessment for Stony Plain Road and 149 Street, community impacts and urban integration challenges associated with grade separation favoured an at-grade crossing. However, upon review of the broader transportation network in this quadrant of the city, it was determined that the overarching network would benefit from the addition of a grade separation somewhere along the LRT corridor to provide a “relief valve” for automobile traffic. With 149 Street being a major north-south corridor, connecting Whitemud Drive to Yellowhead Trail and serving various industrial neighbourhoods, a grade separation of 149 Street from Stony Plain Road and the Valley Line was recommended.

Figure 7 - Urban Interchange

Public engagement was undertaken to determine the level of support for this recommendation. It became clear during that process that there were two contradicting themes with respect to public opinion. On one side, the local stakeholders (surrounding residents, businesses, community leagues) largely supported the at-grade option as it provided the best solution from an urban integration perspective while mitigating community impacts. On the other side was commuter vehicle traffic, being those members of the public who do not live, work and play in the surrounding community but rather commute through the area. These users supported the grade separated option as a way to minimize potential impacts on traffic flow.

At the March 2018 public hearing regarding the six crossing assessments, all but one of the recommendations that Administration brought to City Council were approved. The recommendation to grade separate 149 Street to the benefit of the broader transportation network was rejected in favour of the less obtrusive and community-friendly at-grade solution.

Figure 8 - At-Grade Crossing

It was Administration's goal to adopt a framework that considers all elements of impact. Although, it was found that options that score well in Network Operations would be offset by a low score in Urban Form, and vice versa. For example, at-grade LRT has a tendency to provide superior integration with the urban realm, as it maximizes accessibility for pedestrians, bus connections and from surrounding developments. However, at-grade LRT (depending on how it is operated) may have a potential negative impact to other transportation modes. Conversely, grade separations tend to create physical barriers to local communities, while benefiting commuter traffic.

Lastly, due to the nature of the sub-criteria, some results are easily quantified (e.g. LRT delay time), while others are more qualitative in nature (e.g. alignment with City vision and urban fit). Establishing metrics to quantify as many sub-criteria as possible helped to promote consistency across several project teams.

Ultimately, a perfect solution may not exist. It is up to LRT planning teams to assess all options, consult with the public to understand site-specific considerations, and advance recommendations that best balance the competing themes. As stated previously, the LRT Crossing Assessment Framework should not be used as a definitive decision-making tool, rather it is a starting point to guide and support the analysis and development of recommendations for City Council's consideration.

CONCLUSION

By evaluating each location consistently and in alignment with a City Council-approved set of criteria and weightings the LRT Crossing Assessment Framework assisted City Administration in the development of recommendations for City Council's consideration. The framework also assisted the LRT project teams

in conducting their evaluations in alignment with City Council's approved policies related to transportation mode-shift and compact urban form while balancing public opinion. While there are a multitude of variables and criteria that need to be considered, the LRT Crossing Assessment Framework is a beneficial addition to the City's LRT planning toolkit.

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