Land Use and Transit Connection
Transit Strategy Guiding Perspectives Report
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1. INTRODUCTION

The relationship between transit and land use is complex, with many interdependencies driving planning and engineering decisions and outcomes. This complexity means that there is still a lack of definitive research that points to either land use or transit and transportation decisions as being the primary drivers of land use change and the built form. Temporal and contextual variables must be considered at both the macro (city) level and the micro (station/corridor/community) level in recognition that different opportunities, constraints, and objectives require unique and creative planning and design approaches. When innovation and collaboration are encouraged, it is possible to achieve strong positive outcomes for both the land development and transit operations sides of the equation.

There are generally three ways that transportation and transit investment can influence the built form (Wegner & Furst 1999):

1. By enhancing mobility choice and accessibility
2. By encouraging complementary investments and policies
3. By creating momentum that catalyses changes in existing land uses

In most cases, decisions related to both transit investment and land use policy are part of an iterative cycle with each decision impacting the decisions to follow. This iterative process creates a virtuous cycle where investments in both transit and land improvements mutually support sustainable development over time as shown in Figure 1.

**FIGURE 1: THE VIRTUOUS CYCLE OF TRANSIT AND LAND USE INVESTMENT**

*(ADAPTED FROM WEGNER & FURST 1999)*

- Significant transit investment with high quality service and features is announced or built
- More people and jobs begin to locate around areas with strong LRT or bus service
  - Increased transit ridership supports transit system viability
  - Signals perception of permanent improvement in accessibility to land owners and developers
- Improved access leads to increased interest in the area and land being perceived as more valuable for higher density mixed uses
  - Planning policy may be enacted to encourage higher density development
Current literature in the field is predominantly focused on understanding the relationship between rail investments (subway, light rail transit (LRT), commuter rail) and land use. Increased investments in bus rapid transit (BRT) in North America is leading researchers to begin expanding their work to understand the impacts of high-quality bus investments on land use, but research examining the long term impacts of BRT on land use remains limited with much of the available literature focused on Latin America and Asia.

1.1. What is Transit Oriented Development?

Transit Oriented Development (TOD) is an approach to city building that aims to achieve more compact, sustainable growth by creating more opportunities for people to live, work, and play within easy access of a high-quality transit system, including both bus and rail systems. TOD integrates transportation, land use, and development by concentrating housing, employment, retail, and recreation destinations along a network of walkable and bikeable streets within a five to ten minute walk in any direction of a transit station (approximately 400-800 meters) (City of Edmonton 2012).

The many definitions of TOD in the literature share several common elements, often referred to as the 3Ds of TOD. Density refers to increasing residential and commercial density within the closest 400-800m of the station, Diversity refers to the provision of mixed land uses and extensive housing choices, and Design refers to pedestrian friendly planning solutions (Gilmour et al. 2008).

TOD is aligned with a wide range of benefits that relate to individuals as well as broader citywide impacts.

TOD can benefit individual residents by:

- Providing increased transportation choices
- Encouraging fewer and shorter personal auto trips
- Lowering personal transportation costs
- Providing increased housing choices
- Improving ease of access to daily needs
- Supporting healthy lifestyles through increased physical activity

TOD can transform the city by:

- Supporting transit system sustainability with increased transit ridership and revenue
- Delivering more efficient use of infrastructure, including transit, sewers, and other services
- Reducing air pollution and energy use
- Revitalizing neighbourhoods
- Contributing to urban and regional sustainability

This paper explores many different ways in which transit, transportation, and land use come together, from policy to the practical, in an effort to better understand where opportunities exist to further align policy and implementation to support shared objectives around sustainable city building in The Way Ahead.

First there is a discussion of the link between regional urban growth patterns and transit followed by commentary on compact development in comparison to less dense sprawl. The paper then introduces various development impacts related to property values in connection with growth patterns. The next two sections discuss the need to, and benefit of, serving major destinations at all times of day. This is followed by an overview of demographic and market shifts that are driving new relationships to transportation and housing in cities. The last three sections
discuss specific impacts on land use from transit systems and local transit-supportive infrastructure including modal impacts, parking, and grade separation.

2. Key Discussion Topics

2.1. Generative vs Redistributive Growth

Transit services are associated with both generative and redistributive impacts on land use; however the impacts in each category are not necessarily equal. Generative impacts are associated with new net economic growth and other benefits across a region such as improved environmental quality and increased job accessibility. Redistributive impacts account for locational shifts of growth within a region as land development and employment growth shift to closer proximity of a transit corridor or station rather than being dispersed throughout the region (Higgins et al. 2014).

In most examples studied, it can be difficult to ascertain how much growth was attributed to regional redistribution compared to additional growth that happened only because of the investment in transit infrastructure and service. It is important to recognize that transit service (including rapid transit) is not typically a primary driver of new growth or revitalization but is more clearly seen as a tool which can guide and redistribute growth that would have occurred anyhow (Higgins et al. 2014). Research has also shown that continued investment in non-rapid transit or TOD infrastructure, such as highway investments that attract new employment development but are located far from other transit in a region, can undermine the land use impacts of a parallel transit investment. The impact is undermined because the transit in and of itself does not generate new growth but more effectively serves to redistribute land use patterns, only if other policy levers and infrastructure investments are moving in a similarly supportive direction (Cervero & Kockelman 1997).

2.1.1. Case Study: The Greater Toronto and Hamilton Region

Metrolinx, the regional transit provider in the Greater Toronto and Hamilton Area (GTHA), operates services within the built up urban areas and also connects to communities on the other side of the protected Greenbelt of agricultural and natural areas that borders the GTHA. Greenbelt legislation came into effect in 2005 in an effort to limit sprawl and urban development in environmentally sensitive areas. Following soon after in 2006, Places to Grow: The Grow Plan for the Greater Golden Horseshoe was put into effect. This legislation directs where urban development is most appropriate across the region, laying the bones for a polycentric urbanized metro region (Ontario 2006). In 2008, Metrolinx adopted The Big Move regional transportation master plan, shown in Figure 2 below, which outlines the intermunicipal transportation needs and objectives for the GTHA (Metrolinx 2008). These three pieces of legislation have contributed to supporting greater intensification of urban residential and commercial development while connecting key destinations and urban centres with more transportation and transit choice.

Results to date have been mixed (Ontario 2015; Bascaramurty 2015), but overall intensification near rapid transit is occurring in many communities and a broader spectrum of housing types and densities are appearing in all markets. It is difficult to separate out if the growth in some areas is happening because of transit investments or, more likely, due to the combination of the environmental, planning, and transportation policies. With the GTHA forecast to grow by 2.5 million, or 39.1 percent, in the next 20 years (Ontario 2013), much of the growth may simply be redistribution of growth that was happening anyway. Likely some combination of distributive and generative effects are at play which further points to the need for supportive complementary policies. Transit alone cannot be expected to be the main driver of land use change.
2.1.2. REDISTRIBUTING GROWTH IN EDMONTON

Given there is some opportunity to shape land use, investments in the transit system in Edmonton can give signals to the development industry about high opportunity development sites. The development of the future LRT network plan has already resulted in interested landowners and developers beginning to invest in their sites in anticipation of the high-quality service to come. Higher density residential development opportunities such as Blatchford and Griesbach have been unlocked as future transit is promised in those areas. These opportunities mean that density is being accommodated strategically rather than adding to the greenfield development that continues on the outer edges of the city. Further signals regarding high-quality transit have the potential to continue attracting developers, homebuyers, and employers along transit corridors and in station areas resulting in a redistribution of growth from the new neighbourhoods to existing built up areas.

Given the redistributive function of transit investments on growth, continuing to make investments in high-quality auto access to suburban/urban fringe areas, as well as policy to continue to support reasonable quality of transit in all suburban areas, may be sending mixed signals to the development community in Edmonton about the value of lower intensity suburban greenfield development over infill redevelopment that is proximate to high-quality transit. In recent decades, this policy and investment combination has created the expectation that a reasonable level of transit service is being provided everywhere in Edmonton, and this may have limited the redistribution of population and employment growth towards the high-quality LRT transit investments such as the original 1970s/80s LRT line.
2.2. Compact Development

The benefits of compact development are many, as shown in Figure 3 below, but in relation to transit provision there are primary resource impacts (illustrated in red below) which are particularly important to consider.

**FIGURE 3: SPRAWL RESOURCE IMPACTS (ADAPTED FROM ANALYSIS OF PUBLIC POLICIES THAT UNINTENTIONALLY ENCOURAGE AND SUBSIDIZE URBAN SPRAWL, LITMAN 2015)**

First, families choosing to live in auto-oriented suburbs typically end up with two or more cars in each household at a cost of approximately $7,500 per year (CAA 2013). Factored in over the life of a 30-year mortgage, families are paying an additional $225,000 just to have a second car. This does not factor in less quantifiable costs such as stress associated with long commutes and congestion, increased emissions, higher risk of auto accidents, fatigue, and less time to spend at home with the family, all costs that are often underestimated by homebuyers (Cool Communities 2012). While transit users may also experience long commutes, some workplaces are beginning to allow employees to work during their transit commute as a way to provide flexibility around formal start and end times at the office and help employees reclaim time with families and friends (Immen 2007). Compact development can help people redirect money that would have paid for a car toward housing which may be more costly due to the location premium in a walkable community (Dodge & Kinney 2015).

On top of these personal costs, there is the increased municipal cost of providing infrastructure and maintenance in low-density communities compared to using excess capacity within built up areas to minimize infrastructure capital and operating investments. Additional external costs such as illness related to reduced health from inactivity and pollution from increased personal vehicle travel must also be considered when understanding the impacts of low-density development.

2.2.1. Case Study - Urban Sprawl in the United States

As North American cities age, more information is becoming available about the long term costs of sprawl. Increased land development in the edges of urban areas disperses activity and increases total vehicle miles travelled in the area (Newman & Kenworthy 1999). These changes result in both costs and benefits, however the personal benefits are typically realized by only the residents of the sprawling communities while many of the collective costs are external and imposed on non-residents (Litman 2015). Personal internal and collective external costs of sprawl include increased public infrastructure and servicing costs, increased transport costs such as traffic congestion, consumer costs, accidents, pollution, reduced biodiversity, destruction of habitat, and reduced...
accessibility for non-drivers as well as reduced public health and fitness levels. When all of these costs are calculated across the United States, an estimated $400 billion in external costs and $625 billion in internal costs are accrued annually (Litman 2013). These costs will ultimately be borne through increased public taxes to cover both municipal costs and broader public impacts such as health-related illness and environmental degradation.

2.2.2. BUILDING A MORE COMPACT EDMONTON

Working with the new Capital Region Board policies coming up through the Growth Plan update, the City will further densify in greenfield areas with planned employment areas nearby. The Edmonton region is projected to accommodate another million people in the next 35 years and the City of Edmonton is the best positioned to ensure that those residents live and work in a City that is well planned, maximizes infrastructure, and is as compact as possible. Greenfield development that houses new residents and businesses will be balanced with efforts to infill in low density neighborhoods and concentrate development in the downtown and around transit (Capital Region Board 2015).

With over 85% of new development currently occurring in greenfield development, and plans to annex significant land to the south, consideration is being given to the long term financial, social, environmental, and economic implications of growth. Long term operating and maintenance costs of public infrastructure are expected to far outpace property tax revenues by nearly $4 billion over the next 60 years across the city, meaning future costs will likely require tax increases (Diamond & Thompson 2013). In three new urban growth areas alone, costs are expected to exceed revenues over 50 years by $1.4 billion (City of Edmonton 2016, March 22). With the current coverage policies for bus service within ETS, transit operations will continue to face the same financial challenge as other infrastructure maintenance as new communities expand outward. Options that change the transit system to strengthen efforts to make Edmonton more compact need to be explored.

2.3. DEVELOPMENT IMPACTS & PROPERTY VALUES

As previously discussed, typical TOD areas of influence (in empirical literature and in municipal policy) range from 400 - 800 meters, or a five to ten minute walk (Campbell et al. 2010). Observed data has shown that in the area around high-quality transit station/stops, the parcels within walking distance are generally more likely to convert to more intensive uses relative to parcels outside of this station radius (Cervero & Dok 2011). It has been found that this is also the distance that is most reasonable to expect users of transit to travel from adjacent land uses on foot, although this can vary considerably depending on the quality and characteristics of the pedestrian and land use/development environment within the adjacent precinct. The land value impacts measured vary greatly with some American findings showing high-quality transit improvements will deliver a zero to 45 percent increase in residential real estate values, and that these areas will also retain more value over time, including seeing lesser impacts in times of market contractions than properties with poor or limited transit access (CTOD 2008).

Property value changes generally accompany changes in transportation accessibility, whether that be new roads, expressway interchanges, or significant transit investments. Residential and commercial property value shifts are observed around station areas in most cities. High capacity transit, offering higher travel speeds and ridership capacity, such as rail and BRT, tends to see a higher transit premium added to property values than lower capacity mixed traffic transit services, such as regular bus routes. Research in the US shows that property value premiums

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¹ When property values increase directly as a result of proximity to high quality transit service, the additional value is often referred to as a transit premium (Metrolinx 2013).
can rise to 18 percent for a condominium, 32 percent for a single family home, and up to 45 percent for rental accommodation within walking distance of high-quality transit. Similarly, commercial office and retail property values also see transit premiums from between 9 - 120 percent for office and 1 - 167 percent for retail within walking distance of high-quality transit (CTOD 2008).

It is important to note that the effect of transit on property values is not uniform across all cities and can vary depending on how well the transit system connects people to jobs and other community services, the strength of the overall housing market, distance of development from the station, as well as whether TOD is built in a way that improves or reduces the ability to access the station area via non-vehicular modes (Campbell et al. 2010). Much of the value premium in TOD areas is more closely related to the attractiveness of each specific station area. Transit is one amenity within a district that drives value, but unless the transit system is well-established and comprehensive, such as in New York or Boston, the attractiveness and amenities of the place will drive value more directly than the transit service itself (Curtis et al. 2009).

Speculation on property values can occur long before a transit line opens (Gihring 2009) which can actually discourage TOD as the inflated land costs require higher returns on rent or unit sales to make projects viable (Curtis et al. 2009). This can result in development occurring in areas slightly removed from the station, where land costs are lower, before station-adjacent development happens. This can also result in developers waiting until market or policy conditions favour much higher density development which can leave station areas sterilized by vacant or underutilized land for years or even decades after the transit station is built; this can create a vicious cycle which undermines the potential for a successful overall TOD due to a poor pedestrian environment near the station. The need for higher returns on investment can also make it difficult to situate affordable housing near transit, even though residents of affordable developments could benefit greatly from enhanced mobility access (Reconnecting America 2012). This affordability downside related to property value impacts is often tied to the forces of gentrification. While gentrification is a complex topic with many interlinked variables, the risk of captive transit users being priced out of homes with good access to transit is being witnessed in Canadian urban areas (Jones 2015), is real and there is a need to consider policy or market interventions in tandem with transit investment programs to ensure those who need it most can gain from the benefits direct transit access offers.

Complex mixed-use projects in station areas typically entail higher development costs and higher risks so until the property values and rents are high enough to offset these increased costs and risks, the TOD projects might not be feasible (Curtis et al. 2009). Development risks that are often seen with transit-oriented development include unknowns around infrastructure upgrading requirements and costs (especially water and sewer), environmental remediation requirements, as well as the additional resource-intensive coordination requirements to design, construct, and sell/lease a truly integrated development around public transit assets. Local governments looking to encourage mixed-use, high-density TOD can take steps to help developers manage and limit costs and risks related to these projects such as reducing parking requirements, freezing or lowering development charges, and assisting with land assembly.

Further challenges around compact redevelopment projects can arise when it comes to land ownership. To develop significant density, land assembly of smaller lots is often required to create a large enough parcel to accommodate a larger development footprint. Financing rules for developers can also challenge high density building, when a minimum of 65 percent pre-sale units in a project are required before a lender will finance the development (Dmitrieva 2015). This can mean long lead times as sites are purchased or plans that do not materialize when assembly of sites falls through (Curtis et al. 2009), or if financing takes longer to arrange than
expected. The costs of holding on to land and risks associated with this type of compact development can act as deterrents to developers compared to the relative ease of greenfield projects.

As greenfield projects are typically less costly and risky than TOD for developers/landowners, those savings are passed on to buyers which can soften demand for higher priced TOD properties and reduces potential property value increases in these areas. There is little doubt that high-density TOD projects producing a transit premium are unlikely to occur where low-cost suburban and rural development is dominating the market with low rents and property prices.

This effect is exacerbated where investments in transportation accessibility in low density suburban areas further supports easier, lower cost travel in areas away from high-quality transit. In addition, transit service is costlier to deliver and generally less well-used in low-density communities, so such greenfield development can reallocate limited transit resources to transit-inefficient suburbs at the expense of higher-density areas. If this reallocation results in higher quality transit services being scaled back, then TOD areas will have an even bigger gap to cover when trying to attract development.

The amount of land available for more intensified development, benefiting from the higher property values that may come from good transit access, can also be undermined in cases where land-intensive designs for transit facilities, such as multi-bay bus-rail exchanges, occupy much of the most highly desirable and accessible land. While facilities are necessary to ensure effective connection between transit modes and to allow access by other modes to the station (such as cycle parking, kiss-n-ride drop off, etc.), the use of land for these facilities can be better integrated with developable lands (e.g., through use of alternative designs such as on-street terminals) or using approaches such as sale of air rights over transit facilities to maximize development potential of high value, high access lands.

2.3.1. **Case Study - The Bridges, Calgary**

The Bridges is a redevelopment project on an old hospital site just north of downtown Calgary, adjacent to an LRT station. The plan for the site includes high rise condominium and townhouse units, including a minimum number of affordable units, along with commercial units at grade in each building. When built out the development will have 1,575 multi-family units to accommodate up to 2,500 residents within 600 meters of LRT (CMHC 2009). The final parcels of land for development were scheduled to be released by the city to the market in 2015 (City of Calgary 2016). The City of Calgary decided to act as the developer on this project to ensure site costs were recovered. This redevelopment project has demonstrated strong returns as market demand continues to increase as more portions of the development come online. In 2004, prices ranged from $206,400 to $302,400 with prices increasing to $390,100 to $590,000 in 2006 (CMHC 2009).
Much of the success of this project is demonstrated through the implementation of sound TOD design principles, including:

- Provision of a strong mix of land uses and housing types
- Increased density around the station with strong attention paid to transitions into the surrounding existing development
- Safe, universally-accessible, pedestrian-friendly design
- Features to make the station area a “place” for lingering
- Management of parking, bus, and vehicular traffic with reduced parking standards, goods movement restrictions, and emphasis on pedestrian needs first (CMHC 2009)

To support successful implementation of non-standard TOD components, the City granted approval authority to the Customized Infrastructure Committee (CIC) so decisions could be made to deviate from existing standards where appropriate. This was seen as an essential step in realizing the vision of a different form of urban-suburban development (CMHC 2009). The Bridges is a strong example of what can be achieved with TOD when the City takes an active role in making design decisions, rather than requiring developers to put forward non-standard design ideas and hope that they will be supported by the municipal administration.

2.3.2. THE EVOLVING EDMONTON LAND DEVELOPMENT MARKET

Edmonton-focused research has suggested that transportation improvements, including both LRT and the ring road, will drive higher property values, especially in areas that benefit from better direct access to both high-quality transit and roadway infrastructure (Campbell et al. 2010). Values are expected to be impacted in a positive direction more significantly in mature and established neighbourhoods (Campbell et al. 2010) which also implies that affordability in these communities may be more challenged than in others.

As the Edmonton region continues to develop greenfield areas and moves closer to an annexation application, there is a need to truly understand the long term implications for development including the relationship to property values (and future tax revenue) and the costs associated with providing transit service to new greenfield neighbourhoods. Most recently, it was determined that over the 50 year life of three new growth areas, the cumulative revenue is expected to be $1.4 billion lower than the combined capital, operating, and lifecycle costs the City would expect to spend (City of Edmonton 2016). This tension between the objectives of growing up, in, and out will continue to challenge the development of high-density station areas where there is not currently a strong underlying demand for high-density development due to existing market conditions which favour cheaper greenfield development. As has been documented in other markets, almost no combination of public policies will trigger a shift to a more compact urban structure without a significant change in market demand (Meyer & Gómez-Ibáñez 1981).

2.4. TIME OF DAY AND LOCATION/DIRECTION OF RIDERSHIP

Many North American transit systems document ridership that is predominantly flowing into a main business district in the morning peak and out again in the afternoon with little traffic midday and on the evenings and weekends. This results in trains and buses running significantly under capacity with reduced frequencies outside of these peak hours and all day when running in the opposite direction of the peak travel flows. There is evidence in the United States that only 16 percent of all travel trips are commuting trips, with 30 percent of those taken on transit (AASHTO 2013). This means there is significant opportunity to capture a portion of the other 84 percent of trips that happen outside of the peak commuting hours by providing high quality transit service. If an objective is
to operate a more financially sustainable transit system, increasing off-peak and counter-peak direction ridership by providing higher frequency service could help (Jaffe 2014).

When major travel generators such as post-secondary institutions, hospitals, employment parks (industrial and business-related), and entertainment districts are situated with direct access to high-quality public transportation, transit systems see increased off-peak and counter-peak ridership since these uses attract people at a range of times throughout the day. Changes being observed in North American employment markets include increasing opportunities for telecommuting and working flexible hours and, paired with trends in reduced auto ownership, different demands being placed on transit systems outside of the traditional peak hour, peak direction travel patterns (Jaffe 2014). Additionally, since work commutes are not the majority of travel in cities (AASHTO 2013), it is important that transit services and investment link multiple types of land uses (live/work/play/learn/engage/recreate) together. This helps to reinforce the evolution of local planning, engineering, and land development towards building capacity to deliver more creative mixes of land use types in different parts of the urban area.

By situating TOD at rapid transit stations, regional economic development is encouraged as these polycentric land use patterns provide strong connections that ensure transit infrastructure is utilized in all directions rather than further solidifying and growing peak period, peak direction travel.

2.4.1. Case Studies: GO Transit Lakeshore Line
GO Transit is a commuter rail service that links municipalities across the Greater Toronto and Hamilton Area to downtown Toronto via seven lines comprising of 450 kilometers of rail. Since inception, this service has been primarily focused on serving peak-hour; peak-direction commutes from outlying communities into the Toronto central business district. In 2014, GO Transit began piloting a new model with all-day, 30-minute, two-directional service along the Lakeshore commuter line in response to modest but growing counter-peak and off-peak ridership to suburban destinations along the corridor. The service expansion has accompanied a significant increase in ridership of 30 percent while improving travel options for people who are trying to get to their destinations outside of the Toronto core at times other than peak hours (Freemark 2014). Metrolinx, the GO Transit parent agency, is currently planning to electrify the whole rail system as a precursor to offering all-day, two-way, 15-minute service across the region (Ontario 2014). This is envisioned as a way to greatly increase transit capacity along existing infrastructure which requires less intensive capital investment when building a completely new line. Additional lines will still be required in other areas, but increasing asset use on existing infrastructure is seen as a prudent way to improve access to high-quality service when resources for capital intensive expansion may be relatively constrained.

2.4.2. Connecting Destinations Across Edmonton
Edmonton’s centrally-located central business district and University of Alberta areas are well served by high-quality LRT and bus services. Significant peak direction travel is seen from lower density residential neighbourhoods into this central area during peak commuting hours. There are other major trip generators, such as hospitals, educational institutions, and office/retail commercial nodes that are located outside of the downtown core, but few are currently connected to the transit system via high frequency and high-quality rapid transit. Those
that are, are generally connected with the central core by transit but not well connected to each other or to other parts of the city and region. With the expansion of the LRT network to reach the Grey Nuns hospital in the southeast and the Misericordia hospital in the west there are opportunities to further support counter-peak and all-day travel patterns with high-quality rapid transit. Further opportunities for high frequency transit connecting these non-core hubs of activity with each other to form an integrated high-quality transit network regionally would help to reinforce a multi-nodal urban form and also improve peak spread and directionality of transit travel to make more efficient use of the infrastructure.

2.5. AGGLOMERATION

Agglomeration is simply defined as a mass collection or assemblage of different elements. In the context of land use, agglomeration is when different uses, such as employment, institutional, or industrial lands, are developed in close proximity of each other. Cities form in large part through the development of agglomeration economies where costs of production are typically seen to decline in a geographic area due to better access to the means of production, including both physical and human resources, while productivity outputs typically increase in the same areas (Nelson & Ganning 2015). As congestion levels rise in urban areas, the key to building successful areas of agglomeration becomes more closely linked to the ability for people to access the area as well as easily move between destinations within an area. Public transit has an important role to play in connecting people between origins and destinations. When major destinations are connected, especially via fixed-route transit, ridership numbers grow, and that can result in a more financially sustainable transit system that can help preserve agglomeration economies. Research has shown that agglomeration economy benefits are maximized within 0.25-0.50 miles (~400-800 meters) from fixed-route transit stations (Cervero 2004).

As more people and job opportunities cluster in areas of a city, there is often an overall boost to both wages and productivity observed. This boost is enhanced when public transit is designed in a way that supports job access for the entire labour market. This unlocking of labour potential (by not limiting workers to stay within restricted geographical areas) means that better matching between skills and job vacancies is possible (AECOM & Metrolinx 2013).

In many cities, land use types are already grouped together based on uses defined within the zoning bylaw. Transit service has not always been structured in a way that best connects these clusters of non-residential land uses to ensure service can meet demand, but rather focuses on coverage-based operational designs (ensuring more equitable access to transit service) which may or may not effectively move people to key destinations efficiently. Investments in transit service, especially those involving major capital investments (like rapid transit or corridor infrastructure improvements), should make strong efforts to connect existing higher density employment and residential land uses or be planned to connect areas with high development or redevelopment potential as strong infrastructure can influence where residents and employers choose to locate in future. Such strategic investment decisions can result in stronger asset utilization and ridership revenues over similar investments connecting already lower density or low development potential areas (Thompson 2013). Coverage services can still be employed to act as feeders to higher intensity agglomeration area destinations. However, high frequency and reliable transit service needs to be strategically deployed to build on existing or future high-potential demand patterns within and amongst labour pool areas and agglomerated economic areas in the city for maximum ridership and operational efficiencies.
2.5.1. **Case Studies: Intuit & Coca-Cola**

There are many examples of employers who recognize the value of being located near transit as younger generations of workers are choosing not to drive but travel by public transit and other modes. The Edmonton software company, Intuit, moved its main office away from a campus near Roper Road in the south-central area into the new EPCOR Tower downtown. This move recognized the need for access to strong transportation options and other live-work-play amenities as one key ingredient to attracting and retaining top quality multi-generational talent (MasterMaq 2012).

In the Toronto region, Coca-Cola recently moved its headquarters from a suburban office campus in an East York suburb into the rapidly revitalizing eastern edge of downtown Toronto. The company was looking for the right combination of an active neighbourhood with shops and restaurants, other businesses, and easy access to public transit. The move aligns with the corporate pledge to address obesity by making it easier for employees to choose alternative active modes of travel to get to work (Yew 2013).

2.5.2. **Edmonton’s Employment Clusters**

In Edmonton we have many examples of clustering of employment lands. One obvious example is the downtown employment zone, which is well served by both bus and LRT service. Another example would be the numerous industrial and business employment areas which are typically located toward the outer reaches of the city limits or within easy access of the inner or outer ring road networks, including the NE, SE, and W industrial areas. This second set of land uses is served with limited, weak bus service and few or no direct connections to rapid transit. The isolation of these areas from the rapid transit network means that if employment uses intensify (which may be desirable for business or for policy reasons to get better economic development and tax value from this key land resource), significant investment will be required if there is direction to provide better quality transit service to these areas, especially for serving commuter travelers. Suburban industrial areas are more expansive and low-density in nature due to their land requirements which adds an additional complication in providing high quality transit. This means there could be opportunities to explore alternative service delivery models to improve connections between these currently isolated employment areas and nearby transit destination nodes served by higher quality transit service. In other cases, building future rapid transit stations in locations which can maximize efficient transit access to such business/employment areas and encourage their further growth through intensification of uses on adjacent lands could be encouraged, such as potential redevelopment opportunities at the future Davies LRT station on the Valley Line.

2.6. **Demographic Change & Shifting Market Demand**

The demand for walkable\(^2\) neighbourhoods that support a quality urban lifestyle is increasing across North America.

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\(^2\) *Walkable communities typically share a number of common characteristics. There is a network of complete streets designed for all travel modes, enough population to support businesses and transit, numerous parks and*
Both the millennial population and the baby boomer generation are seen to be driving this demand. Millennials value walkability in both core and suburban neighbourhoods and are demanding diversity of amenities within these areas. They are increasingly making the choice to raise their families in smaller homes in dense and walkable neighbourhoods over moving to larger homes in less walkable suburbs. While many millennials are still obtaining driving licenses, there are an increasing number who are choosing not to drive at all, which increases reliance on transit services and makes walkable communities that much more attractive (Schaper 2016). Boomers are also driving up demand in walkable areas as they downsize from family homes upon retirement. Realtors are increasingly reporting trends of people preferring to live in an attached home where they can walk to amenities and have a short commute over a detached home where they are reliant on a car for commuting and daily needs.

Walkable neighbourhoods need to also provide mobility options for people travelling beyond a reasonable walking distance. Transit services are effective in walkable communities as the grid of streets typically present supports efficient and direct bus and rail routes, compared to curvilinear, indirect bus routings common in more recently developed communities. Walking infrastructure such as sidewalks and small blocks supports station access by providing direct and comfortable routes to reach the transit service (Halcrow et al. 2009). The increasing demand for walkable communities means there is a related need for strong transit service for travel between these communities. This increasing demand for walkability is also good news for the environment as auto emissions will decline while public health benefits that come with increased active lifestyles and cleaner air continue to grow.

The homebuilding industry in much of North America has settled into a pattern of building relatively uniform, inward-facing, auto-oriented subdivisions on fringes of urban areas. This development pattern leads to the curvilinear, indirect streets described above. While this development model is still attractive to some buyers, it is no longer as attractive to the portion of the homebuyer market that is growing (Benfield 2015). Shifting away from this model in response to demographic changes will require changes in a variety of areas including lending practices that favour low-risk greenfield development, updates in zoning to support reduced parking requirements, mixed-uses, and increased diversity in housing stock, and a focus on pedestrian-first design. Shifting to this form of development can lead to more efficient street grids to support an effective and sustainable transit service.

2.6.1. CASE STUDIES: TAKE THE HOME MORTGAGES, BOSTON LOCATION

A concept gaining traction in urban areas is that of location efficiency, or the amount of time, energy, and greenhouse gas emissions spent travelling between home and other frequent destinations. As people are looking to purchase a home, the major hidden cost of transportation is often not considered when determining a budget. The average annual cost of car ownership in Canada is around $7,500 per year (CAA 2013). If a two-car household was able to scale down to a single car, or even no-car, the economic public spaces, pedestrian focused design that places cars away from buildings, and a mix of schools, workplaces, and other destinations people can travel to without a vehicle (WalkScore 2016).
impact can be significant. $7,500 per year over 10 years represents an extra $75,000 that could have been put towards a mortgage in a walkable, transit-friendly neighbourhood that may have seemed out of reach due to higher housing costs in mature neighbourhoods (Dodge & Kinney 2015).

The Take the T Home Mortgage program is a collaborative effort between the affordable housing non-profit organization, MassHousing and the Massachusetts Bay Transportation Authority (MBTA). The program is designed to help low and moderate-income MBTA riders purchase a home that is located near public transportation. Borrowers must demonstrate regular transit ridership through monthly pass purchases as well as meet income and loan limits which can vary between cities within the program area. An assessment of the program from 2001-2004 show an approximate credit increase of $50,000 per loan was enabled and there was only one default and zero foreclosures out of 53 mortgages; suggesting the program is a relatively low risk for lenders (Pembina 2012).

2.6.2. A Changing Edmonton

Edmonton is home to one of the youngest urban populations in Canada (City of Edmonton 2011). The most recent data gathered on transportation mode choices was in 2005. This data shows that central neighbourhoods with mixed land uses within 15-20 minute walk of Downtown or the University show higher rates of walking. Neighbourhoods closer to the city centre also have higher rates of cycling and transit use (City of Edmonton 2014). The growth of Edmonton-based Pogo car sharing service in the central core shows there is interest in participating in alternative auto access models (Pogo 2016). These are the neighbourhoods that typically have a more walkable urban form, with a fine grained street grid and destinations and amenities within easy access of residences.

As Edmonton continues to grow, there is a need to ensure that growth is paired with the real demands and needs of the market. Developers and builders in the region are familiar with greenfield development but have less experience with intensification and infill redevelopment. As the LRT network expands, there is already a growing interest from developers from other cities around certain key locations, such as Stadium Station and Mill Woods, the future terminus of the southeast Valley Line. The Edmonton residential market is currently quite segregated (City of Edmonton 2001), meaning that young families who may be interested in living in a denser, central neighbourhood may have difficulty locating family-friendly housing units and/or amenities. This tends to force these families to purchase in suburban areas that may not be as well-connected to rapid transit. Further strategic investment in high-quality transit may be one way to attract a wider range of development interests to the city who could be well placed to bring experience in transit oriented development and family-supportive infill to the region. Additional opportunities exist within the city to update zoning and growth targets to support growth patterns that are better aligned with sustainable transit provision.

2.7. Modal Impacts of Bus, BRT, and LRT

There is significant literature looking at the impact of rail transit investments on land use but relatively few reports examining the potential of high-quality rapid bus investments to influence land use patterns around stations, especially within the North American context. There is no clear consensus regarding the impacts of various transit types on land use as these relationships are not simple and direct, making causality a challenge to identify definitively. Studies typically point to rail investments linked more closely to high-density and large-scale development with bus investments linked more closely to more modest, small-scale density in station areas and corridors (Currie 2006). In North America, qualitative case study research is beginning to show positive development impacts from BRT when integrated land use and transit strategies work to improve both the aesthetic and experiential environment of the transit system (Stokenberga 2014).
There are indications that the mode being deployed has less of a direct impact on land use than the real or perceived permanence of the investments. For example, a BRT system that invests in significant high-quality station infrastructure will likely attract more significant development than a regular bus route with minimal station infrastructure. The investment in permanent high quality stations and rights of way provides some confidence to developers and homebuyers that the high-quality transit service will be guaranteed over the long term compared to perceptions that a standard bus route alignment or basic bus stop could be changed at any time. Potential impermanence can act as a deterrent to investing in transit-supportive land use developments. There are still questions posed within the literature around what permanence really looks like since there are many examples of busways, and even regular bus routes that have been operating in the same spaces for decades. It is not so simple to determine the power of rail over bus station areas as attractors of development (Dittmar & Ohland 2004).

Frequency and speed of service must also be considered when examining the land use and transit relationships (Currie 2006). High frequency and reliable service can make station areas attractive for TOD, as they influence perception that transit will always be readily available. Frequency and reliability are often associated with dedicated rail and bus infrastructure that is separated from mixed traffic. Transit corridors that are subject to on-street congestion can have a hard time competing to attract density as that transit service is not as strong a ridership attractor due to the variability in travel times and less frequent service than most fixed-route rail or BRT corridors.

One additional consideration is an effect termed “scale dilution.” Bus routes, and to a lesser degree BRT, tend to have many more stations than rail routes which can make it difficult to concentrate development activity (Currie 2006). While rail TOD areas typically absorb more density and mixes of uses than bus TOD areas, the sheer volume of potential bus TOD sites is larger than rail opportunities so the overall effect on shifting mobility patterns can still be significant. The differing scales of opportunity between rail and bus TOD areas can also result in a wider range of housing choices for developers and homebuyers as bus TOD areas may be better suited for more modest forms of density than the towers that are typically built in rail TOD areas. This effect can support somewhat lower intensity, but more continuous, corridor development, in exchange for more widely spaced, intensive, but highly nodal development. In cases where sufficient transit demand can be supported, a widely spaced rapid transit mode can be overlaid with a more frequently-stopping mode.

2.7.1. Case Study: York Region VIVANext Rapidways

York Region, located in the north-central Greater Toronto and Hamilton Region, has been a leader in implementation of high-quality, dedicated BRT infrastructure in Ontario. The first segments of these “rapidways” opened in 2013 and there has been a strong positive response from the development community in locating projects near these new transit corridors. Most of the rapidway corridors are anchored on the edges by urban centres which are often the location of a GO Rail commuter transit station or the Toronto Transit Commission (TTC) subway which provides direct connections between regional and local high-quality transit services. Along the Highway 7 rapidway there was a transit ridership increase of 10 percent between September 2013 and September 2014 (York Region 2015). The BRT rapidway stations have been designed with traveler comfort and convenience in

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3 Fixed route transit is defined as any form of transit that operates on a fixed alignment which cannot deviate onto a different path. Fixed routes typically involve rail infrastructure that is either in a separated corridor or rail infrastructure operating in mixed traffic, however fixed route systems can also include bus systems that provide a separated, fixed facility alignment for buses to operate in.
mind with enclosed, heated, weather protected waiting areas, off-board fare collection, GPS navigation, and real
time travel information along with a range of accessibility features (VivaNEXT 2011).

There are currently 25 multi-story residential buildings under construction within the urban centres and corridors representing approximately 5,600 apartment units. Of all new building permits issued in 2014, 66 percent of new multi-story residential units were located in the centres and corridors. In 2014, 88 percent of residential units in centres and corridors were condo apartments, 9 percent were rental apartments, and 3 percent were townhouses (York Region 2015). On the employment side, 25 percent, or 112,000 jobs, are located in centres and corridors with 38,000 of those jobs located within two business employment nodes serviced by the Highway 7 rapidway (York Region 2015).

While the development along BRT in York Region has been strong, it has required strong communications and marketing efforts both to attract employers to transit-oriented locations while also providing information to residents about the benefits of choosing to live in transit-oriented communities. Additional efforts are underway to bring more flexibility into the development application process to further support TOD, including freezing development charges and exploring tax increment grants to encourage development in centres and corridors and developing tools to inform and streamline high-rise construction projects (York Region 2015).

2.7.2. Strategic Redevelopment Opportunities Around Edmonton’s Nodes and Corridors

Edmonton has the benefit of significant vacant or underutilized land within close proximity of existing or planned LRT stations. Some of these areas are already being considered for significant high-density TOD projects including mixed-use commercial and residential developments such as Mill Woods and Stadium. The bus network, however, has not seen the same level of development interest in most high service corridors, including in areas around Transit Centres. As the LRT network is expanded, there will continue to be opportunities to accommodate increased density in station areas.

Given the prevalence of bus services across the city there is an opportunity to target key bus corridors with high redevelopment potential, especially where there are already major developments to act as anchor destinations along a corridor. Investments in bus infrastructure that enhance stations with passenger shelter, traveler information, and pre-board fare collection systems, along with corridor design/operation such as dedicated right of way and preferential treatment at intersections, and frequent, reliable, regular service (Vuchic 2005) could help attract medium-scale infill redevelopment projects. In some locations, land use planning would be required to support redevelopment, while in others supportive planning has already been done and zoning changes have been enacted. The scale dilution effect is a potential risk to be aware of as there are so many station areas that could accommodate density to choose from. Both bus and rail transit service commitments in key corridors could help direct developers and homebuyers to a more focused set of bus and rail station areas, helping guide strategic redevelopment around these key transit station nodes and high frequency corridors in mature and established neighbourhoods.
2.8. PARKING

At the regional scale, the amount of land devoted to roads and parking can have significant impacts on development patterns and, as a result, the effectiveness of transit service. Practices linked to increased amounts of road and parking space tend to favour urban fringe development, or sprawl, over higher density urban infill. Incremental increases in road and parking capacity tend to create more dispersed land use patterns, increasing the amount of mobility required to achieve a given level of accessibility; resulting in a system that favours private vehicle travel over public transit (Litman 2012).

At the level of individual developments, generous parking requirements increase housing costs, particularly so in urban areas. These costs may be absorbed by middle or upper-income households but affordable housing developments face hurdles when trying to keep costs low but still required to provide significant parking supply. Providing high-quality transit service that can attract developments within walking distance, increases use of non-auto travel modes, including walking and cycling at shorter distances and use of transit for longer distance travel. By supporting walkable station environments and neighbourhoods adjacent to corridors, residents, workers, and others using these areas can make fewer auto trips and own fewer cars. Thus, the transit investments can support a reduction of parking minimums that have been in place in North American cities for decades. Without viable transit as a true option for travel and walkable urban environments that are supported along with it, parking demands and costs will remain high.

From a contrasting position, Park and Ride (P&R) facilities sometimes accompany high-quality transit investments and are connected with supporting transit services by providing an alternative means of access for those more distant to the station. However, they have also been identified as a factor that can limit TOD opportunities (Currie 2006). The immediate concern is the conflict associated with using prime, transit-accessible land closest to stations for large parking lots, and the accompanying use of land for road capacity and volume of car access, which is often only required during a narrow window in the morning and evening peak travel hours. Thus, P&R conflicts with the desire for prime location redevelopment and the need for quality walkable access to the transit service. Rail and BRT systems are more likely to rely on P&R facilities than local bus services but these are also the station areas that are typically identified as most appropriate for increased density, over the largest areas around the transit station. On-street bus services may have a limited reliance on patrons accessing transit by P&R. This need for less parking can support modest bus TOD without the same spatial negotiation that comes with locating P&R within larger rail TOD catchment areas.

More generally, P&R infrastructure facilitates travel for people living beyond the reach of rapid transit systems. This encourages use of transit by people whose only choice otherwise would be travel by car, which is a good thing, but it also has the unintended effect of encouraging more people to live in automobile-oriented, greenfield subdivisions based on the knowledge that transit access is only a convenient car ride away. From this perspective P&R can be viewed as a subsidy for sprawl (Bullard et al. 2000) and careful attention to its costs and benefits is required in planning for it at the station area, transit line, and metropolitan planning levels.

To maximize efficient use of space, structured parking can be explored in high value TOD areas to free up land for development. In these cases, it is important to consider the cost of parking provision, ranging from $26,000-$48,000 USD per underground space and $17,000-$73,000 USD per above ground space (Shoup 2014) -- not to mention ongoing maintenance costs -- when determining if free parking is appropriate when delivering a new structure. It is also sometimes beneficial to locate P&R a distance away from the station so that the most accessible, valuable land can still be used for TOD. A side benefit of this approach is that businesses can benefit from the added foot traffic to the station.
In some instances, it could make sense to use land for temporary P&R until market conditions are favourable to development. Although this approach can trigger public disapproval if parking is later taken away without being replaced. Ensuring there are multi-modal options for station access available is helpful for these transitions. There can be an argument that free P&R helps drive ridership by improving station access, but access can also be enhanced with strong feeder bus services and facilities that support active travel modes. A cost benefit analysis should be completed to understand the implications of providing free parking over other investments supporting access (Coffel 2012). Like most land use and transit relationships, it is not easy to generalize P&R as a positive or a negative influence. Different systems and station areas have different characteristics that must be considered when determining allocation of space for parking and the associated costs and benefits.

2.8.1. Case Study: Portland, Oregon
Portland was ahead of its time and eliminated off-street parking requirements in some parts of the city in the 1980s. The policy was expanded to include areas served by frequent transit service shortly after. Developer interest in eliminating parking completely has been increasing in parallel to improvements in Portland’s transit and active travel transportation networks. Since 2006, roughly 50 percent of total residential units built were planned without parking. As market pressures continued to increase for multi-family housing, pressures on limited parking supply within neighbourhoods caused the City Commissioners to impose very modest parking requirements in 2013. Buildings smaller than 40 units continue to have no parking requirements in an effort to support smaller-scale development while larger projects now require one space for every four units. Parking can be provided off-site within 100 meters of the development and requirements can still be relaxed through provisions for car-sharing spaces (Steuteville 2013).

Portland has demonstrated that market demand for parking-free developments can grow over time if the right transit investments and policy interventions are aligned. Eliminating unnecessary parking costs has a direct impact on housing affordability while simultaneously reinforcing the need to rely on non-auto forms of transportation; this results in increased support for investments in public transit, car sharing, and bicycle infrastructure.

2.8.2. Transforming Edmonton’s Parking Areas
Edmonton already has a park and ride policy (C554) which explains why P&R should be provided, where facilities are to be located, design requirements, and fees. This policy was recently updated to address limitations and inconsistencies with other City policies (City of Edmonton 2016). In Edmonton, LRT TOD areas have a reduced requirement of 0.7 to 1.75 parking spaces per unit built, depending on size of unit⁴, yet it remains to be seen if significant decreases in parking demand for residential units will be realized.

At Century Park, the existing parking is being removed as the landowner wishes to develop on the land that has been used as temporary parking for several years. This means creative interventions are needed to ensure residents can still access the LRT while also recognizing that structured and paid parking may be of value at this station. Exploring different ways of accommodating parking, especially at

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⁴ City of Edmonton. Zoning Bylaw 12800: 54.2 Schedule 1
station areas on the urban fringe, is necessary as the system expands outward and regional travellers begin driving into the city to access the transit service.

Edmonton’s Administration is also reviewing parking requirements around Main Street areas that are strong bus transit corridors. Existing parking minimums can make it very difficult to locate new businesses in these areas. Transit service can help bring visitors to these vibrant mixed-use corridors without relying on off-street parking that can degrade the walkable nature of these streets within neighbourhoods.

2.9. Grade Separation

Transit systems can be designed at-grade, meaning they operate at the same level as traffic, or they can be grade-separated, with the transit operating either below in a tunnel or above on an elevated guideway. These various options have different impacts on surrounding land use/form.

The question of grade separation is typically examined for any major transit project that intersects with the road network. From a transit operations perspective, grade separation tends to allow higher performance and safety due to the dedicated right of way (Bruun 2013) and ability to avoid slowing traffic due to intersections or other road crossings. From a land use and redevelopment perspective, grade separation can often allow for a smaller footprint on the ground for the alignment but can challenge the ability for development to integrate with the station at street level. The disconnect this creates, between the transit infrastructure and the adjacent lands, can make it difficult to design a transit oriented development that provides a quality environment for pedestrians and strong access to the infrastructure (Bruun 2013). Grade separation will also typically cost significantly more than at-grade alignments, which can impact project viability (Bruun 2013). When determining the appropriateness of grade separation it is important to look at both the transit and land use perspectives to understand the long-term costs and benefits when determining project viability. The balance between operational efficiency, monetary benefit and the community impact that can come from significant land development projects should be compared for each project (Bruun 2013).

2.9.1. Case Study - Metropole, Ottawa

Metropole is a residential redevelopment project including a single 32-storey condominium tower and 68 townhouses within 200m of the Westboro grade-separated transitway station offering five-minute peak travel bus frequencies. The site was seen as attractive due to the grade separation which helps mitigate noise from the high frequency bus services running immediately adjacent to the properties (CMHC 2009). Given the close proximity to the transit station, the City of Ottawa was not required to provide additional transportation infrastructure upgrades. Efforts were made to create a direct pedestrian connection to the transitway however unwilling neighbouring landowners forced a less than optimal location of this connection (CMHC 2009). If the transitway was at grade, then it would have been very simple to provide a direct connection to the station, but the grade separation meant that more intensive pedestrian infrastructure was required. This project provides evidence that grade separation infrastructure can provide both positive (separation from traffic) and negative (poor pedestrian connection) impacts and both need to be balanced when examining grade separation opportunities.
2.9.2. **Strategic Grade Separation in Edmonton**

Recent experience with the Metro Line causing delays for cars at intersections has led to increased consideration for grade separation at major intersections for future LRT projects. Currently the conversation appears to be focused on the cost-benefit tradeoff between more expensive separated crossings and faster moving traffic (Tumilty 2016). While it is important to understand traffic network and transit operation impacts, there is also a need to examine the impact of grade separation on the surrounding community and potential redevelopment sites to ensure designs do not sacrifice human scale and accessibility. Grade separation is best employed on a case by case basis and needs to consider both land use and transit impacts to ensure that infrastructure decisions do not harm the long term opportunities for creating well-integrated transit oriented developments with high-quality station access designs that will help drive ridership growth over time.

3. **Conclusion**

In summary, the relationship between land use and transit is complex and layered. There are temporal and contextual variables that are important to consider. For every city, at the macro level, and for every station area and corridor, at the micro level, there needs to be attention given to the unique combination of characteristics, constraints, and objectives in order to determine the most appropriate context-sensitive solutions.

As Edmonton moves forward, key opportunities related to the land use and transit interface include:

- Development of supportive policies and internal procedures that promote greater access to transit service by ensuring development opportunities around significant transit infrastructure, such as LRT stations, are protected and encouraged.
- Exploring ways to create more development and multi-modal transportation options that maximize residents, employees, visitors and other potential transit users to access major transit infrastructure via active travel modes or other transit modes rather than relying on park and ride services.
- Aligning high frequency transit services with key destinations people travel to, including those beyond the downtown core and beyond the peak period, work commute.
- Implementing strong city-wide and regional land use policies to support compact growth and sustainable transit services that can reach the most people, the most cost-effectively. This includes removing barriers to infill, and focusing growth in areas best suited for change. This also includes robust research and informed decision-making related to the costs, benefits and tradeoffs of continuing to pursue ‘up’, ‘in’ and ‘out’ growth objectives, which have resulted in limitations on the ability for transit investments to maximize land use benefits historically, and are resulting in conflicts for transit outcomes.
- Ensure that land use and transit policies are supporting mutually inclusive strategic objectives, at the regional scale, as well as at the scale of individual lines, along corridors, and at nodes (e.g., station areas).

Additionally considerations as part of transit and land use policy development include:

- Resolving conflicting policies that attempt to address one side of the transportation or land use equation while simultaneously hindering a different transportation or land use objective. For example, promoting infill development while simultaneously approving high-quality road infrastructure and coverage-based transit policy that makes greenfield development attractive, or providing development incentives such as reduced parking requirements where there are limited walkable transit access opportunities.
Understanding of the true long-term costs of current land use and transit operations policies in order to fully understand how changes to development and transit service could improve cost-effectiveness of providing mobility choices to Edmontonians.

4. REFERENCES


5. APPENDIX: CASE STUDY SUMMARY TABLE

The following table presents a comparison of transit agencies and urban centres with similarities in scale and type to Edmonton. The intent here is to consider the integration and impacts of land use based on the scale, form, and design of transit present in these centres. Factors considered across these different cases include the: system population and the types/number of modes and stations; this is an indication of potential scale for transit oriented development and for overall land use change/influence from transit in the area.
Many of the systems compared here have more modes, lines and stations of fixed transit than Edmonton, which may relate to their successes with land use change. Mode share and system ridership counts are also shown; this speaks to the level of success of these centres in achieving riderships gains which can have linkages to the land use factors and policy decisions described in this paper. The final columns specifically relate to the experience or implementation with policies or interventions that would help to support land use change from transit investments, such as accompanying TOD policies or development authorities, changes in parking requirements within zoning regulations, and complete streets policies to encourage more walkable communities and multi-modal transit access. The final column speaks to the governance model for transit and how aligned the transit service is with other land use regulatory boundaries within an urbanized area. Experience suggests it is easier to develop and implement macro-level policies for transit-land use integration when transit operator and land use regulatory bodies are aligned.