Report

Mass Transit Backgrounder

Edmonton's Transit System in Context

Prepared for City of Edmonton
by IBI Group
February 7, 2019

Prepared for City of Edmonton

This technical study was initiated to inform the development of The City Plan. The technical studies were considered alongside public engagement, modelling and professional judgment to determine overall outcomes for The City Plan.

February 6, 2019

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1 Introduction

1.1 Edmonton at a Glance

The City of Edmonton stands out among North American cities. Straddling the North Saskatchewan River at the centre of the continent's northernmost large metropolitan area, Edmonton has grown from a 9 km^2 town of 148 people to become a centre of government, economy, and culture in Western Canada. Today, after 33 annexations the Alberta capital spans 768 km^2 and is home to 930,000 people (Statistics Canada, 2017a). It is the largest municipality in the Edmonton Metropolitan Region and is integral to Canada's oil and gas industry.

Exhibit 1.1 shows a map of Edmonton and neighbouring communities. The traffic districts identified on the map are those used in transportation and land use modelling in the City and align with the traffic zone system. These include the following:

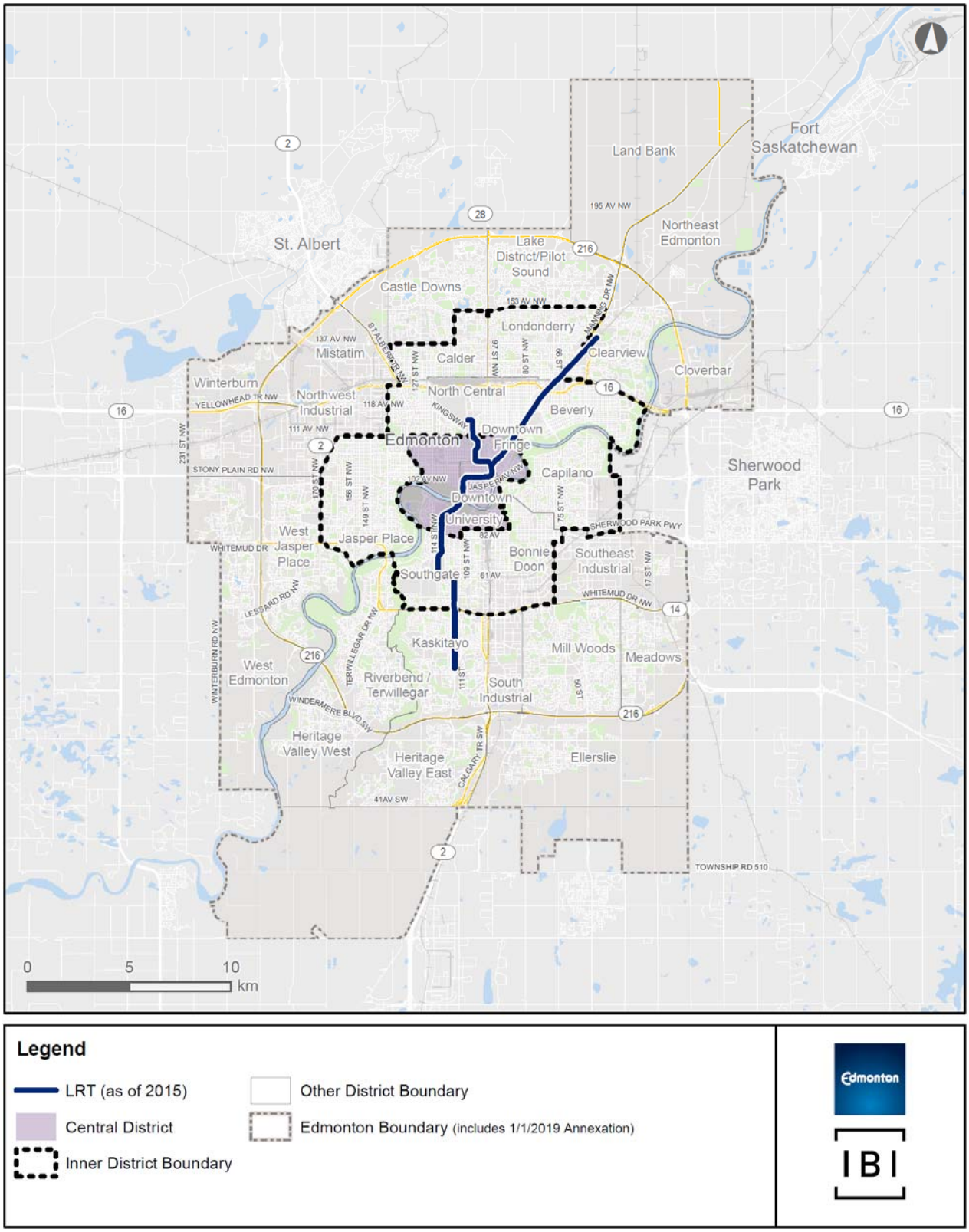
- Central Edmonton including the Downtown, Downtown Fringe and University of Alberta traffic districts;
- Inner Edmonton including the traffic districts outside the centre that fall within the inner ring road; and
- Outer Edmonton includes the traffic districts outside the inner ring road, including those inside and outside of Anthony Henday Drive.

The 2015 *Edmonton and Region Household Travel Survey* showed that Edmonton area residents made 3.14 million trips on an average weekday, of which 77.6% were by car and 8.6% by transit. While transit has a long history in Edmonton—the city pioneered modern urban light rail transit (LRT) in the 1970s—transit mode share has not changed meaningfully since 1994. Recent development trends have seen population and employment growth in the outer suburbs outpace that of central Edmonton where much of the city's transit network is focused.

As the City Plan is developed to describe a vision and policy support for a future of 2 million people, the City of Edmonton will be looking to maintain or increase the 8.6% transit mode share in the future, by doing some of the following:

- Serve growing demand while recognizing the capacity limitations of the existing system;
- Connect communities within the expanded physical footprint of the city in the future;
- Encourage development of mixed-use housing, shopping, and employment areas along a network of walkable streets served by high-quality transit using Transit-Oriented Development principles;
- Consider opportunities related to employment areas and residential districts that are currently more challenging to serve; and
- Build on connections to the rest of the Region.

Exhibit 1.1: Map - City of Edmonton Traffic Districts and Neighbouring Communities



1.2 Purpose and Report Structure

The Mass Transit Study is being conducted by the City of Edmonton as one of the supporting technical initiatives related to the broader City Plan exercise, which is looking ahead strategically to what Edmonton could be like in a future with two million residents.

1.2.1 The City Plan

The City of Edmonton is undertaking an exercise to develop a long-term plan for a city of 2 million residents, double what it is today. This plan will outline future transportation needs, and the form the infrastructure will take. As the city physically grows, this increases the needs for community connections, jobs, housing, amenities and services. The Plan will broadly define built physical spaces, options for how to get around, new connections to support businesses, and more lifestyle choice.

The Mass Rapid Transit Study will be one of several studies looking ahead at the “2 million people” horizon, and working towards building a vision of what that future could be. At several times in this report, a 2065 horizon is referred to, as this is the presumptive timing of the “2 million” horizon. The strategic outcomes of the City Plan and of this study are more important the exact year of that future horizon.

While disruptive technologies may change the way people travel short distances, or in areas that are more difficult to serve with frequent transit, it is expected that mass transit will continue to be one of the most efficient ways for people to move quickly, comfortably and efficiently within and between communities into the future. Consequently, the intensification of land uses, creation of walkable communities, and concentration around nodes and along corridors will lead to increased demands in the existing mass transit corridors, and cause other travel markets to grow, to the point where additional services are desirable to connect places together.

A Municipal Development Plan (MDP) defines the Density; Transportation; Land Use; and Open space networks. These are supported by implementation policies and strategies. The overall plan is expected to address these and other issues:

- Periodic annexations – one is underway. It is recognized that future annexations will not absorb all of the future growth, so a shift to make better use of existing land is anticipated.
- Newcomers – need for connectivity, amenities
- Climate Change – energy consumption and emissions targets
- Supporting business growth, especially small local/regional businesses
- Moving Around – longer daily travel distances, especially for work and school, resulting in mode choice remaining much the same (77.6 auto driver/passenger) despite investments in transit and active modes networks
- Health and Beauty – new housing, new streets, and new parks/open space, but also initiatives to support and make densification livable and appealing. Trend for increased number of people in core and mature areas

The Council’s ***Strategic Plan*** includes four themes: Healthy City, Urban Places, Regional Prosperity and Climate Resilience. These are broad policy statements that will govern how the City Plan options are **defined and evaluated**, including the Transportation Plan, of which the Mass Transit Strategy is a significant component.

The Mass Transit Strategy ties directly into transportation, providing connections and supporting growth, and through Transit-Oriented Development around nodes and corridors, into how

annexations, new residents, and the desire for 'Health and Beauty' in communities can be supported.

The City Plan will bring all this thinking together, into one document, with the Mass Transit Strategy summarized and key directions noted. As indicated in the briefing book for the City Plan:

> *"It will be the Municipal Development Plan that defines how the city grows and develops (currently The Way We Grow), the Transportation Master Plan that defines how mobility systems work (currently The Way We Move), and it will incorporate, modernize and adapt key directions from The Way We Prosper, The Way We Green and The Way We Live."*

The City Plan process has five phases, which include technical analysis, public consultation, synthesis and development of recommendations. The second phase of the plan, Foundations, aligns with the intent of this Mass Transit Backgrounder. The third phase, Framing the Plan, will develop the growth scenarios important to all the streams of technical work, including the evaluation of mass transit options in this study. The initial findings and conclusions from this transit study will be completed by mid-2019, followed by expert advisory services during the fourth phase of City Plan, called Building Up, which will develop a recommended Growth Strategy and draft City Plan, including selection of a Mass Transit Strategy. The fifth phase relates to public hearings and Plan Approval.

1.2.2 Mass Transit Study

The primary objective of this study is to assess the current state of Edmonton's mass transit network, and provide a policy framework to guide the development and expansion of the network as the City grows from approximately 1 million to 2 million residents. This report analyzes foundational issues to identify the transit needs and opportunities to help the City execute its strategic vision.

This report consists of six chapters as follows:

- Chapter 2 describes the current transportation and land use context in the City of Edmonton, and outlines areas of transit success to-date, opportunities for improvements going forward, and key travel markets to consider;
- Chapter 3 sets the stage for Edmonton's transit future, including bus network changes to be implemented by 2020, future LRT network plans, and long-range travel demand forecasts. This sets the stage for the future opportunities and challenges to be met by the mass transit system;
- Chapter 4 presents transit successes in peer cities, laying out possible lessons that Edmonton may want to consider in crafting its own Mass Transit Strategy;
- Chapter 5 reviews the suite of transit modes in use globally, including the conditions under which they are most useful, and how some of these modes fit Edmonton's existing and future transit landscapes; and
- Chapter 6 summarizes the findings of this report, and identifies high-level needs and opportunities that will be used to inform the development of long-term mass transit scenarios.

2 Edmonton Transportation Context

This chapter describes the urban structure of the City of Edmonton and surrounding communities, as well as the housing, employment, and socio-economic factors at play in the Region. The travel patterns and trends emerging from the recent 2015 Household Travel Survey are also discussed, to help pinpoint where the transit system is currently most and least successful in attracting riders. Assuming that some of the existing patterns are likely to continue even when influenced by the coming of new mobility and disruptive technology, then the same types of strengths and weaknesses would apply in the future.

Much of the analysis in this chapter is at the level of the "traffic districts" that were indicated by Exhibit 1.1, which are used in transportation modelling by the City and align with the traffic zone system. The boundaries of these districts do not completely align with those of the "Planning Districts" used in other analyses done by the City of Edmonton.

2.1 Urban Structure and Land Use

The Edmonton Metropolitan Region, whose boundaries coincide with those of Statistics Canada's Edmonton Census Metropolitan Area (CMA), covers an area of 9,439 km^2 centred on the City of Edmonton. In 2015, the Region was home to just under 1.3 million residents, and Exhibit 2.1 shows the population and employment in the communities with 20,000 residents or more. In addition to these communities, the Region also includes 30 other towns, villages, and hamlets that are home to about 140,000 residents

Exhibit 2.1: Major centres in the Edmonton Region, population and employment in 2015

Community	Population	Jobs
Edmonton	894,300	566,000
Sherwood Park*	68,100	28,500
St. Albert	64,300	21,500
Parkland County	34,600	10,100
Spruce Grove	29,400	11,000
Leduc	30,000	19,000
Fort Saskatchewan	24,000	12,300
Other Communities	139,700	55,100
Edmonton Region	**1,284,300**	**723,600**

*Sherwood Park is classified as a Hamlet within Strathcona County, but is larger than every other city besides Edmonton. Source: (City of Edmonton, 2018a)

The regional setting of Edmonton and the surrounding counties and communities is shown by Exhibit 2.2. The counties surrounding Edmonton extend a fair distance outside the city, especially in the east-west direction.

City of Edmonton

Exhibit 2.2: Map of Edmonton, Neighbouring Counties and Communities

Exhibit 2.3 shows how the population and employment are distributed across Edmonton and neighbouring communities as of 2015, and how the urban density (population plus employment per hectare) has changed since 2006. The exhibit highlights a small, densely built up urban core in Downtown Edmonton, with major employment lands located west and south-east of the core.

Exhibit 2.2: Map of Edmonton, Neighbouring Counties and Communities

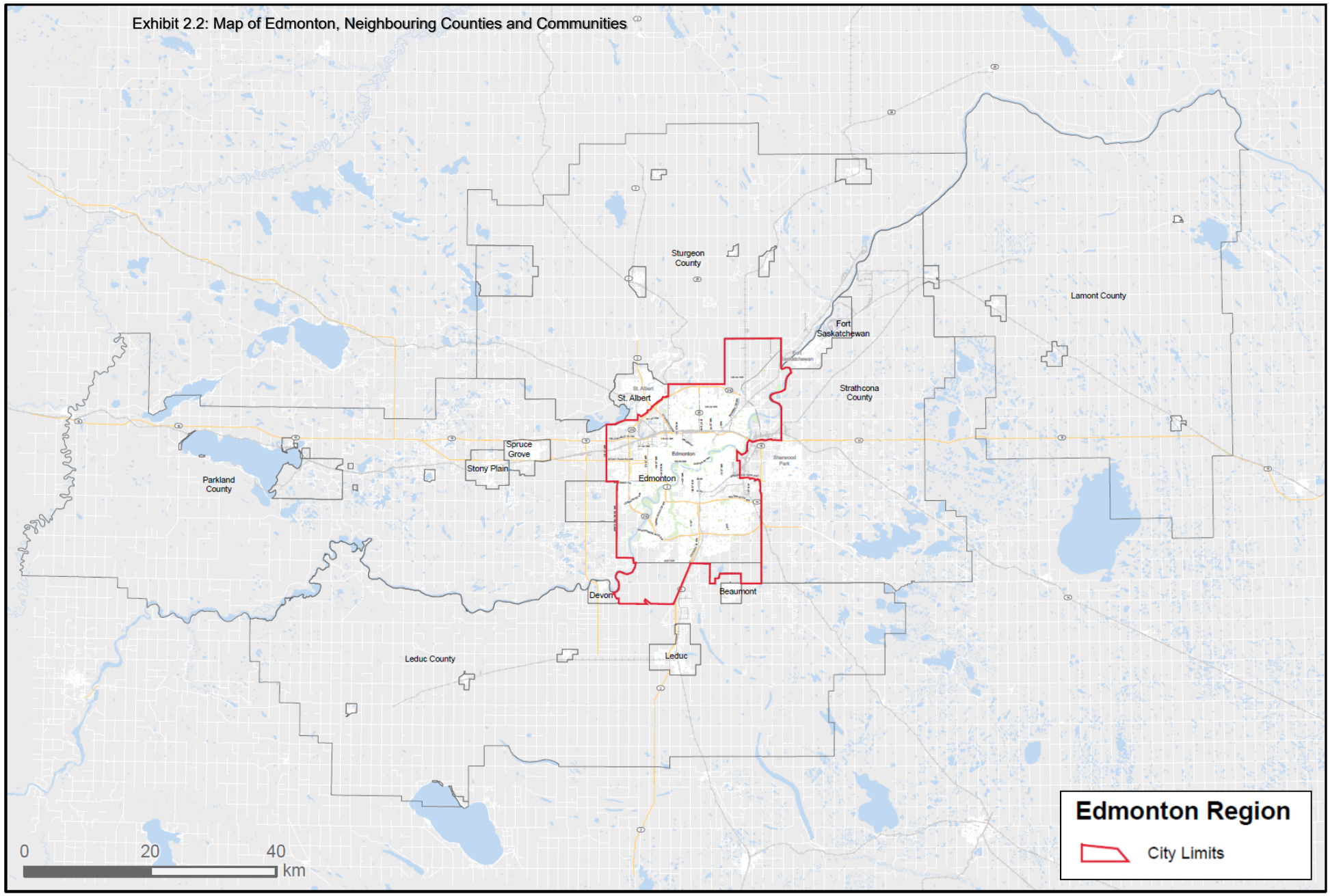
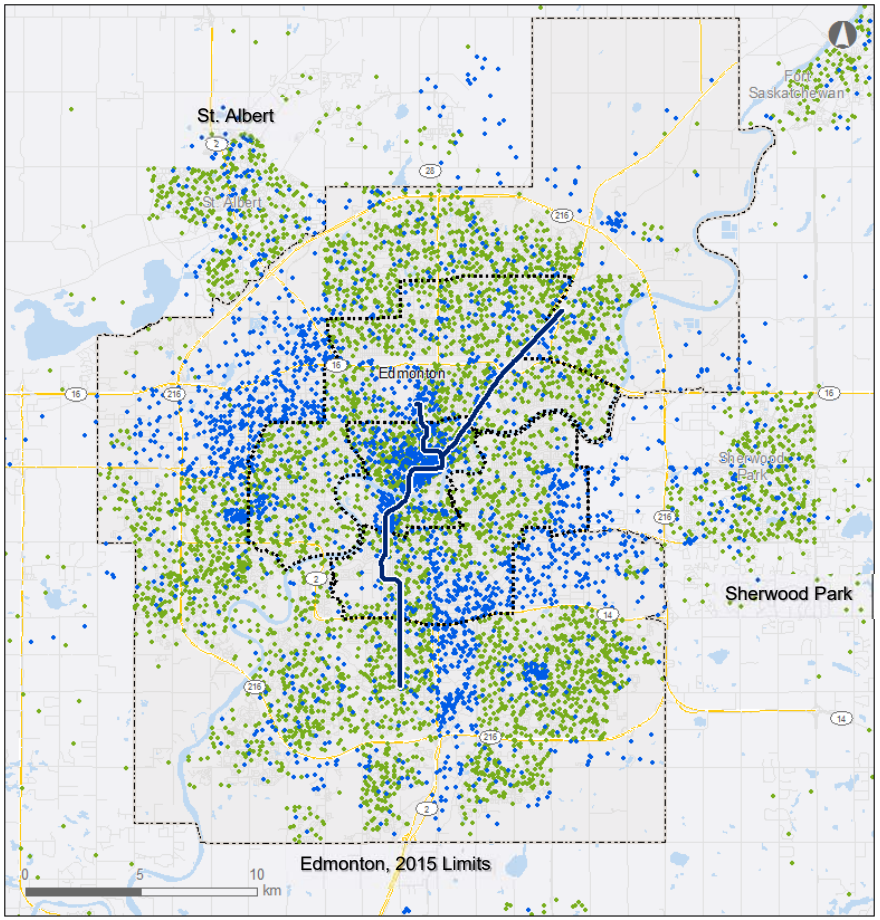
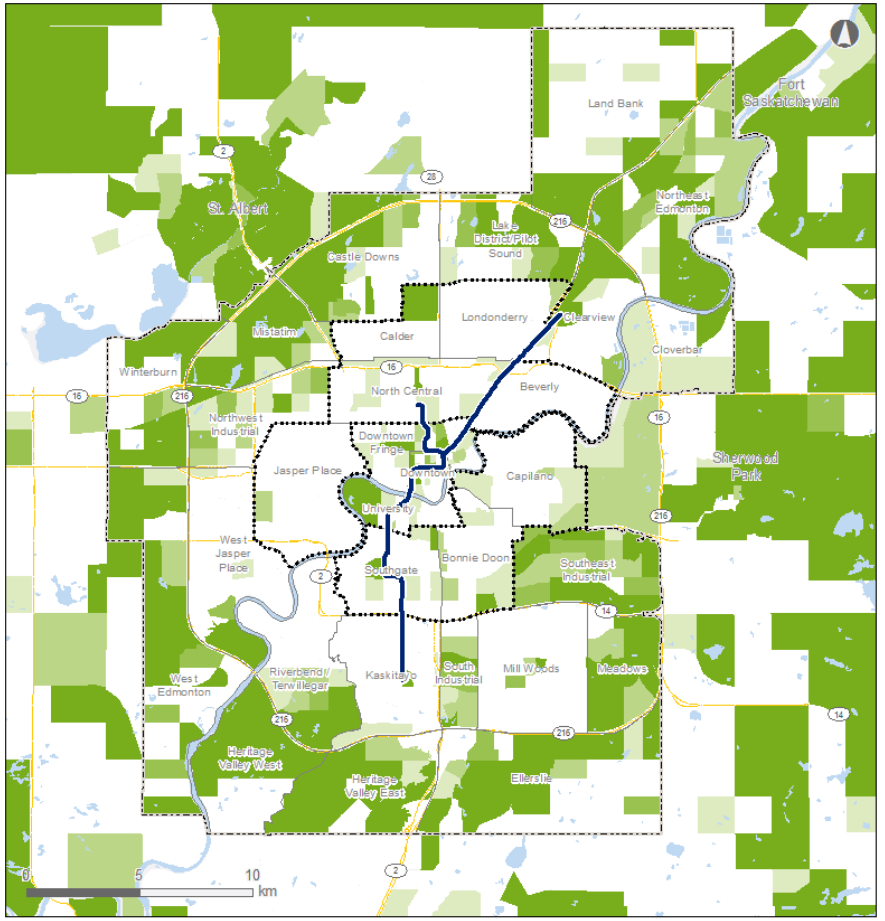


Exhibit 2.3: Population and employment density in Edmonton and neighbouring communities in 2015 (left) and change in density between 2006 and 2015 (right)





Legend
- LRT
- Residents
  - 1 dot = 200 residents
- Jobs
  - 1 dot = 200 jobs
- Inner Edmonton Boundary
- Edmonton City Boundary
- Expressway / Highway
- Arterial; Collector; Local / Street; Ramp

Legend
- Change in Urban Density
  - 20% or less
  - 21% - 40%
  - 41% - 60%
  - 61% - 80%
  - Over 80%
- LRT
- Expressway / Highway
- District Boundary
- Inner Edmonton Boundary
- Edmonton City Boundary

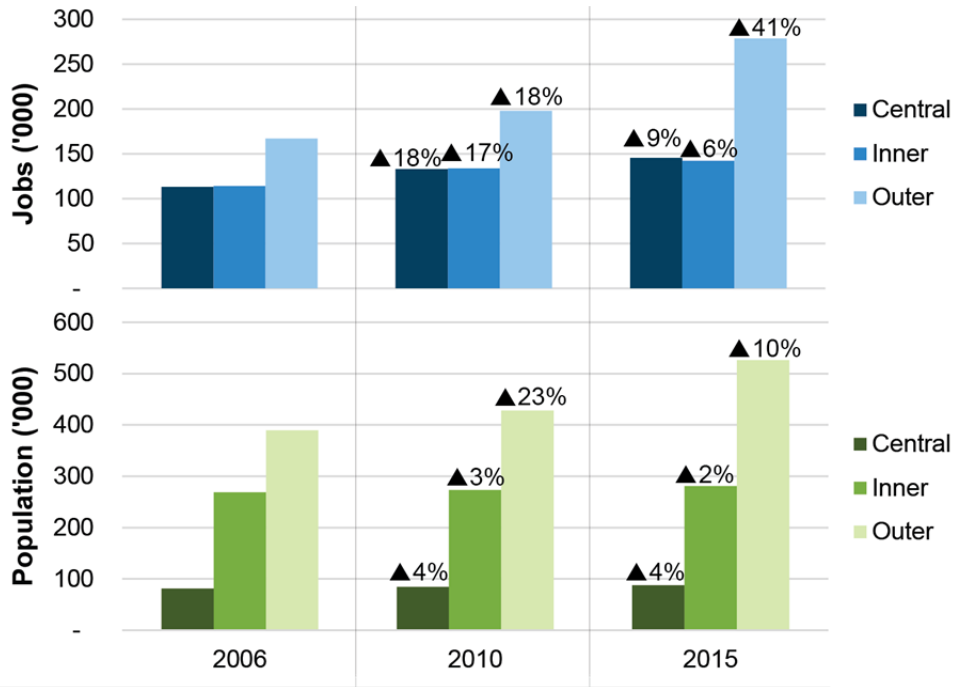
Source: (City of Edmonton, 2018a)

Central Edmonton remains strong, but Outer Edmonton is a growing employment destination

Central Edmonton has long been a key employment centre, and is the focus of the city's LRT system. The ratio of jobs to residents is a good way to assess how decentralized employment is in an area, and gives an indication of the potential travel demand. Areas with lower ratios (i.e. a lot more residents than jobs) tend to generate more and longer car trips (but also some potential for long-distance transit trips) since people may need to travel further to access work, education, healthcare, shopping, and other activities.

Exhibit 2.4 shows the changes in population and job-resident ratios from 2006 to 2015, and highlights that the growth in employment downtown has outpaced population growth. It is notable that despite the strong 35% population growth in Outer Edmonton, employment grew even faster and the job-resident ratio has eclipsed Inner Edmonton to reach 0.53. Almost half of the city's jobs are now located in this area while Central Edmonton's share fell from 29% to 26%.

Exhibit 2.4: Population and job-resident ratios in Central, Inner and Outer Edmonton, 2006 - 2015



Job-Resident Ratio			
Central	1.40	1.58	1.66
Inner	0.42	0.49	0.51
Outer	0.43	0.46	0.53

Source: (City of Edmonton, 2018a)

The established neighbourhoods of Inner Edmonton were largely unchanged in this period. While there has been some densification downtown, most of the city's growth has been driven by greenfield development on the fringe. This in line with the city's previous growth plans, which designated large tracts of greenfield land outside Anthony Henday Drive, the outer ring road.

A clear pattern of intensification along the LRT corridors has yet to emerge, but the city's developing *Nodes and Corridors* plan in the anticipated 2020 City Plan seeks to encourage density, mixed use, and transit oriented development at strategic stations and along priority corridors.

Surrounding Region

St. Albert and Sherwood Park together have 135,000 residents and are both less than 15 km from downtown Edmonton. Job-resident ratios in these communities stood at just 0.33 and 0.42 respectively in 2015, highlighting the significant employment ties to the City of Edmonton. Smaller communities like the City of Leduc, Spruce Grove, and Fort Saskatchewan dot the landscape around Edmonton, but these are more self-contained than St. Albert and Sherwood Park.

The populations of St. Albert and Sherwood Park have grown by 10% and 20% respectively between 2006 and 2015, but the three other cities in the region have grown much quicker. Spruce Grove is up 51%, Fort Saskatchewan up 60%, and Leduc is up 77%.

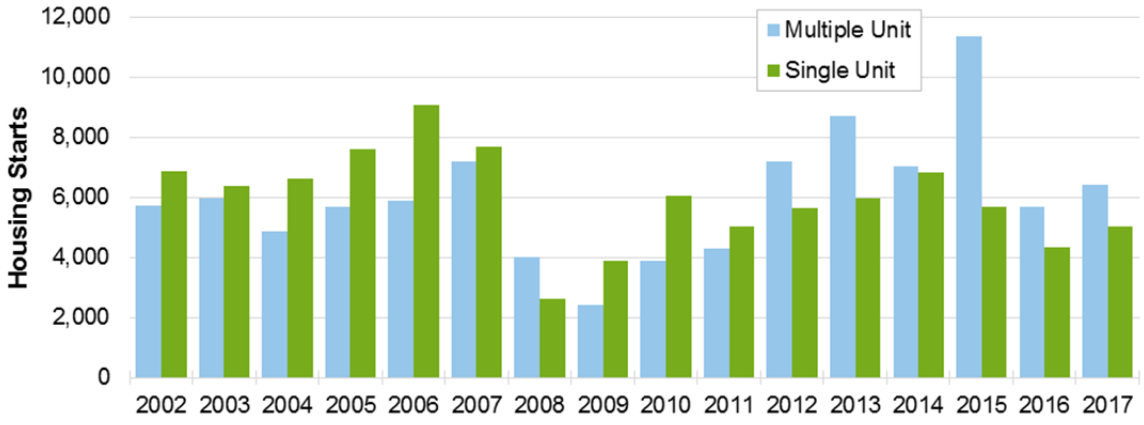
Housing Types

Single-family detached homes remain popular, but multi-unit housing starts are increasing

Edmonton is dominated by single-family dwellings, giving it a suburban character that is less common than in Canada's other large urban regions (except Calgary, which shares Edmonton's urban form). Among the six largest Census Metropolitan Areas (CMAs), single-family detached homes were the dominant form only in the Edmonton (57.3%) and Calgary (58.3%) regions (Statistics Canada, 2017b). Ottawa-Gatineau was the closest at 44.8%, but in Toronto, Montreal, and Vancouver apartments dominate. The 2006 Census showed that 58.6% of Edmonton Region dwellings were single-family detached, indicating that little has changed in the last decade.

It is notable, however, that multi-unit housing starts showed strong growth between 2009 and 2015, as shown in Exhibit 2.5, although that trend has tapered recently.

Exhibit 2.5: Number and type of housing starts in Edmonton CMA, 2002 - 2017



Source: (City of Edmonton, 2018b)

The recent increase in multi-unit starts is unusual for Edmonton, given that single-unit starts dominated every year from 1983 – 2011. It is too early to predict where this will lead, especially given the current economic challenges in Alberta, but denser housing could help attract better transit to neighbourhoods that were previously too sparsely developed for fast, frequent service.

2.2 Socio-Economic and Demographic Conditions

Population Age

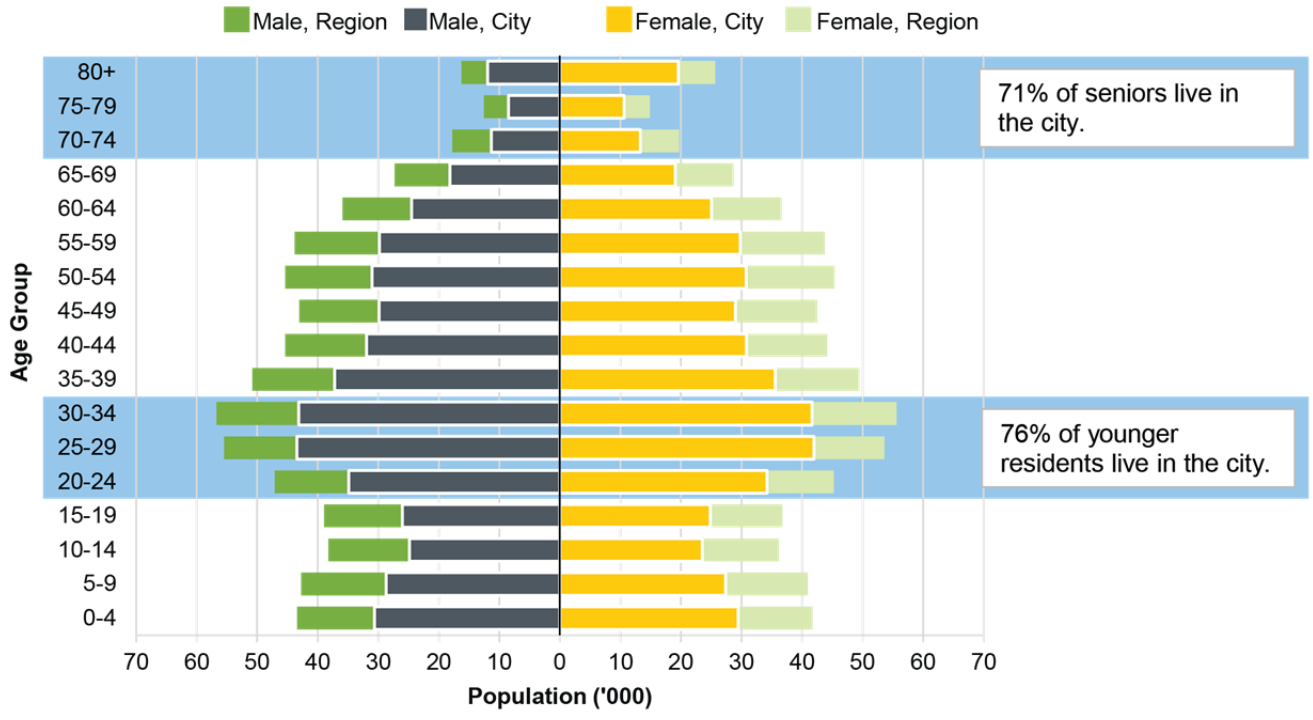
Edmonton remains a youthful city, but seniors also prefer urban living

With a median age of just 36.3 years in 2016, the Edmonton region is the most youthful of Canada's six largest CMAs. Like many places in Canada, the region is aging (the median age was just 33.7 years in 1996), but Edmonton has long had a relatively youthful population. Exhibit 2.6 shows an age pyramid of the City of Edmonton and the Region, and highlights some interesting characteristics:

- The City of Edmonton is home to over 76% of the Region's younger workers aged 20 – 34 years. This proportion falls to a low of 68% among 45 – 60 year olds as families shift to suburban living; and
- 71% of seniors 70 years and older live in the City, potentially indicating that older Edmonton residents prefer city living to rural or outer-suburban living.

In addition to seniors choosing to live in the City of Edmonton rather than the surrounding region, the 50 – 64 year age cohort was the fastest growing one between 1993 and 2015. These indicators suggest the transit network will need to not only cater to traditional peak-period commuters, but there is also a market of retirees, who tend to make more off-peak discretionary trips.

Exhibit 2.6: Age pyramid of Edmonton Region and City populations in 2016



Source: (Statistics Canada, 2017c)

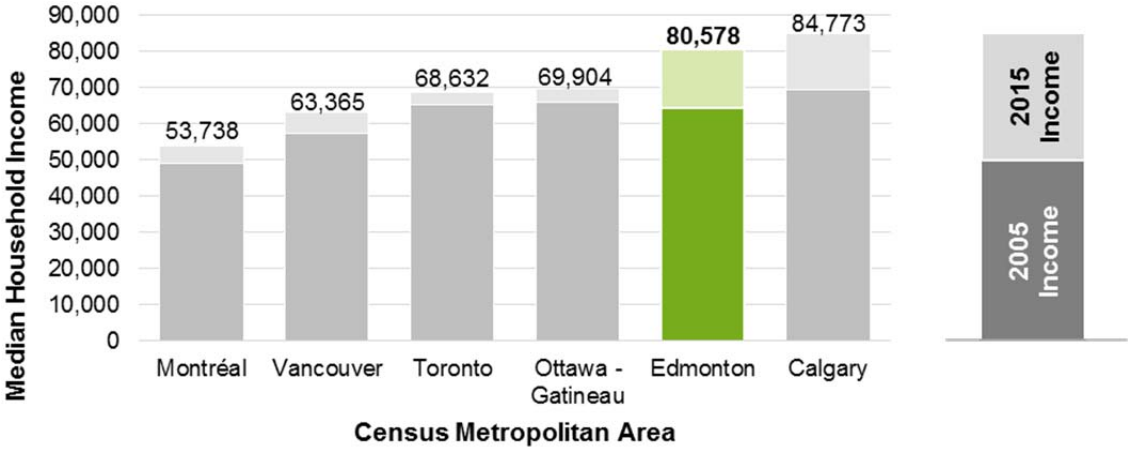
Income and Auto Ownership

High incomes and increasing car ownership are challenges to boosting transit use

Car ownership in the Edmonton Region was relatively stable from 1987 and 2005, ranging between 0.68 and 0.72 cars per resident as the change in the number of cars largely matched the change in population. That trend has since changed and by 2015, there were 0.78 cars per resident. This is not unexpected—much of the region's growth occurred in new areas less well served by transit, so reliance on cars has also increased in the region.

Rising car ownership in Edmonton correlates with the Region's high and rising household incomes. At $80,600 median after-tax income in 2015, it was second only to Calgary among Canada's six largest CMAs, and is over 15% higher than Ottawa-Gatineau as shown in Exhibit 2.7. Moreover, households in Edmonton experienced the largest increase in median after-tax income between 2005 and 2015, rising by over 25%.

Exhibit 2.7: Median after-tax household incomes in Canada's six largest CMAs, 2005-2015



Source: (Statistics Canada, 2017d)

With 66% of the Region's households making over $60,000 in after-tax income in 2015, and 37% of households making six figure incomes, Exhibit 2.8 shows that the region has a large proportion of high income households compared to other large CMAs.

Exhibit 2.8: Distribution of 2015 household after-tax incomes in Canada's largest CMAs

Source: (Statistics Canada, 2017d)

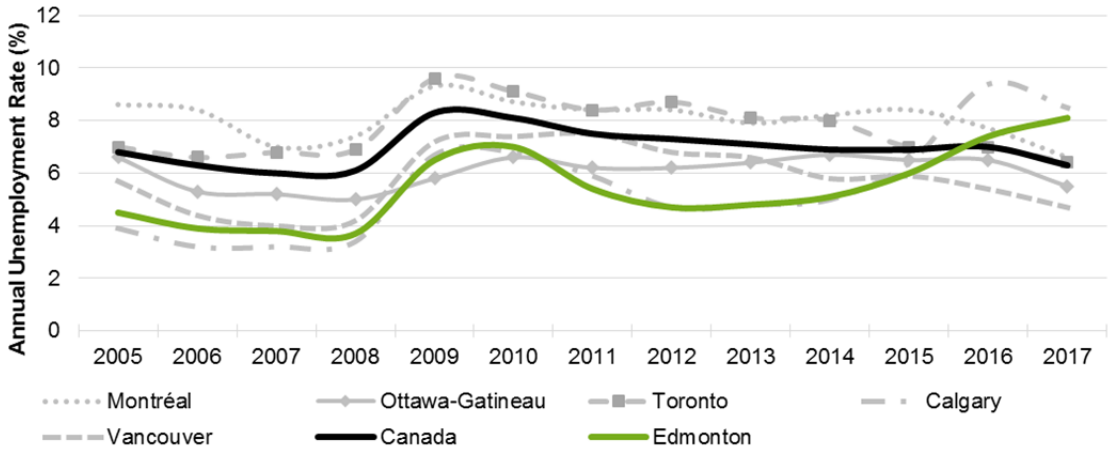
These factors suggest that a large share of the region's households can afford at least one car and are not dependent on transit for the majority of their trips. Combined with the large proportion of single-family detached housing in the area, the task of increasing transit patronage in Edmonton faces significant challenges of unfavourable land use patterns, high incomes, and high auto ownership.

Employment

Edmonton is still struggling with the downturn in Alberta's Oil & Gas industry

Unemployment rates in Edmonton largely follow the fortunes of the oil & gas industry, despite the Edmonton's large number of public sector workers. Almost 52,200, or 8% of workers in the CMA, work in the public sector, a proportion that is second only to Ottawa-Gatineau's 22% among the six largest CMAs in the country (Statistics Canada, 2018). Exhibit 2.9 shows distinct upswings following the 2008 financial crisis, and again after the 2014-2015 oil price crash. The rise in joblessness in Alberta that started in 2014 has pushed unemployment in both Edmonton and Calgary above the national average for the first time in recent years.

Exhibit 2.9: Change in unemployment rate in Canada's largest CMAs, 2005 - 2017



Source: (Statistics Canada, n.d.)

The rising unemployment rate is also evident in the City of Edmonton's relatively high office vacancy rate, which stood at 15.6% in Q3 of 2018 (downtown vacancies are slightly lower at 14.4%) (Avison Young, 2018). While not as high as vacancies seen in Calgary, which exceed 20%, these indicators highlight that Edmonton's economy is undergoing an adjustment to sustained low oil prices.

2.3 Travel Behaviour and Trends

2.3.1 Origin-Destination Patterns

The 2015 *Edmonton and Region Household Travel Survey* highlighted that in 2005, 29% of all trips within the city were either to or from Central Edmonton. By 2015, that statistic fell to 25% due to the rapid growth in population and employment in Outer Edmonton. Trip-making within Outer Edmonton grew by 64% in the decade and now accounts for more than a third of all trips in the city, equivalent to over 1 million daily trips.

Exhibit 2.10 shows an origin-destination matrix for morning peak period commute trips across the region in 2015 while Exhibit 2.11 shows a similar matrix for all trip purposes.

Exhibit 2.10: Origin-Destination matrix of work and school trips starting between 7 AM and 9 AM in the region in 2015

Destinations / Origins	Central Edmonton	Inner Edmonton	Outer Edmonton	Edmonton Total	City of Leduc	Fort Sask.	Sherwood Park	Spruce Grove	St. Albert	Other	Total	% to Edmonton
Central Edmonton	21,100	9,300	4,900	**35,300**	-	100	600	100	600	600	**36,700**	96%
Inner Edmonton	26,700	53,600	21,800	**102,100**	400	100	2,400	200	1,200	2,400	**106,400**	96%
Outer Edmonton	41,200	55,400	111,200	**207,800**	1,400	400	3,700	500	2,200	6,900	**216,100**	96%
Edmonton Total	**89,000**	**118,200**	**137,900**	**345,200**	**1,900**	**600**	**6,700**	**800**	**4,000**	**9,900**	**359,300**	**96%**
City of Leduc	400	400	900	**1,700**	6,900	-	100	-	-	1,800	**8,700**	20%
Fort Saskatchewan	500	600	700	**1,800**	-	6,000	800	-	-	1,000	**8,600**	21%
Sherwood Park	4,600	2,700	3,700	**11,000**	100	300	16,200	-	-	2,500	**27,600**	40%
Spruce Grove	800	500	2,100	**3,400**	100	-	100	6,600	200	1,900	**10,300**	33%
St. Albert	3,100	1,600	4,000	**8,600**	-	100	100	200	14,800	900	**23,800**	36%
Other	3,200	5,200	7,700	**16,100**	1,500	700	2,500	2,600	2,300	32,300	**25,700**	63%
Total	**101,700**	**129,100**	**157,100**	**387,900**	**10,500**	**7,700**	**26,500**	**10,200**	**21,400**	**50,500**	**464,100**	**84%**
% from Edmonton	88%	92%	88%	**89%**	18%	8%	25%	8%	19%	20%	**77%**	

Source: Edmonton and Region Household Travel Survey, 2015.

Exhibit 2.11: Origin-Destination matrix of all trips starting between 7 AM and 9 AM in the region in 2015

Destinations / Origins	Central Edmonton	Inner Edmonton	Outer Edmonton	Edmonton Total	City of Leduc	Fort Sask.	Sherwood Park	Spruce Grove	St. Albert	Other	Total	% to Edmonton
Central Edmonton	29,700	12,900	7,200	**49,800**	-	200	700	100	600	1,000	**52,500**	95%
Inner Edmonton	33,100	85,800	34,800	**153,700**	500	200	3,100	300	1,900	3,700	**163,300**	94%
Outer Edmonton	48,300	71,000	176,000	**295,300**	1,600	600	4,900	700	2,900	8,900	**314,900**	94%
Edmonton Total	**111,100**	**169,700**	**218,100**	**498,800**	**2,200**	**900**	**8,700**	**1,100**	**5,400**	**13,700**	**530,700**	**94%**
City of Leduc	400	600	1,100	**2,100**	10,000	-	100	-	-	2,500	**14,700**	14%
Fort Saskatchewan	500	600	900	**2,000**	100	9,900	900	-	-	1,400	**14,400**	14%
Sherwood Park	5,200	3,500	4,800	**13,500**	100	400	24,800	-	300	3,100	**42,100**	32%
Spruce Grove	900	700	2,700	**4,200**	100	100	100	10,500	200	2,600	**17,800**	24%
St. Albert	3,700	2,600	5,300	**11,600**	-	100	100	200	23,700	1,600	**37,200**	31%
Other	4,200	7,100	10,500	**21,900**	2,400	1,100	4,000	3,500	3,600	46,200	**82,600**	27%
Total	**126,000**	**184,700**	**243,300**	**554,000**	**14,900**	**12,400**	**38,700**	**15,400**	**33,100**	**71,000**	**739,500**	**75%**
% from Edmonton	88%	92%	90%	**90%**	15%	7%	22%	7%	16%	19%	**72%**	

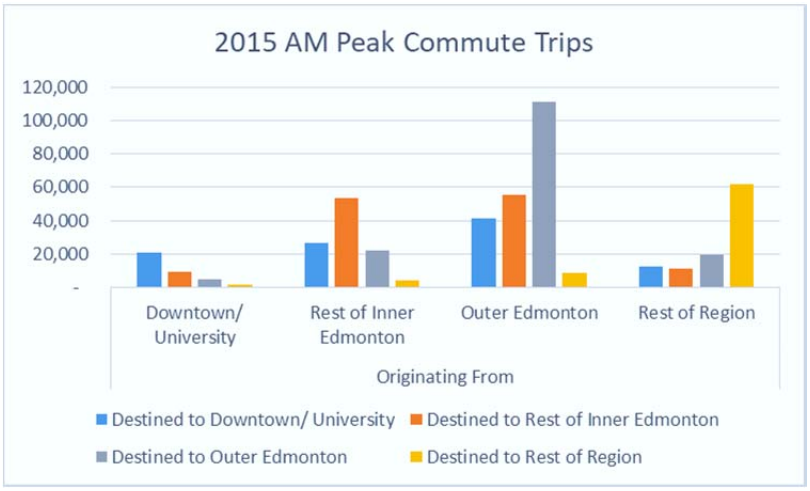
Source: Edmonton and Region Household Travel Survey, 2015

The exhibits highlight a few notable points as follows:

- The close relationship between St. Albert and Sherwood Park and Edmonton is clear—40% of commutes from Sherwood Park and 36% of those from St. Albert end in Edmonton;
- 27,000 morning peak commutes are counter-peak, starting in Central or Inner Edmonton and ending in Outer Edmonton. This is 8% of the Edmonton commutes.
- In a similar vein, 94% of Edmonton-based commutes stay in Edmonton while 6% are outbound into the region.
- 111,000 of 216,000 (51%) commutes from Outer Edmonton also end in Outer Edmonton.

Exhibit 2.12 illustrates these patterns by grouping Central (Downtown/University), Inner, Outer Edmonton and the rest of the Region, and showing how the aggregate patterns compare for the 7-9 AM commute (work and school) trips.

Exhibit 2.12: Commute Patterns between Edmonton and the rest of the Region, 2015



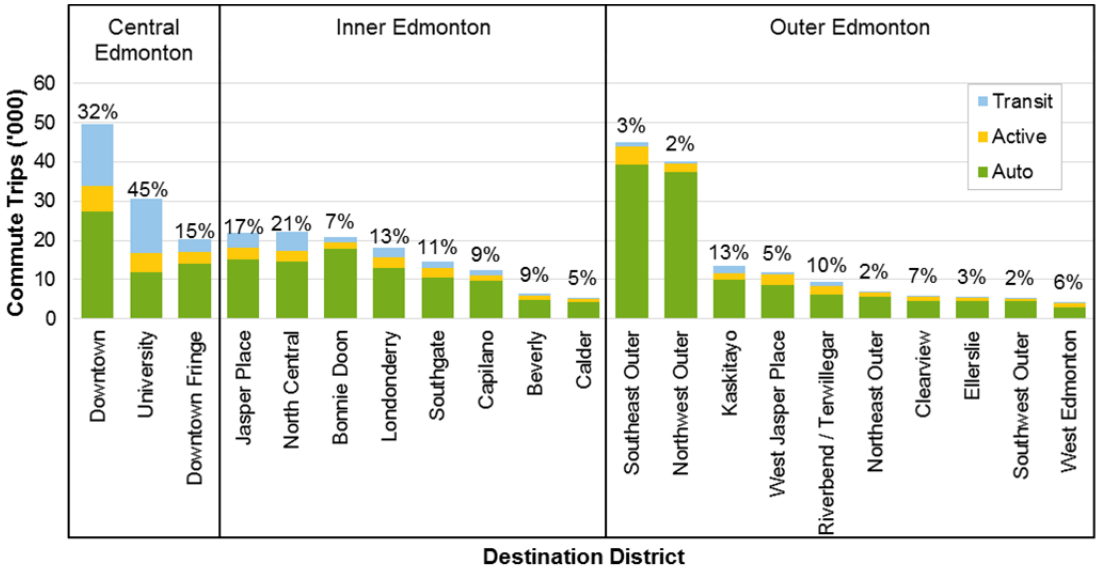
2.3.2 Decentralization and Reverse Commuting

Reverse commuting is rising, but few are choosing transit for trips to the suburbs

The trend of decentralization of employment in Edmonton is clear, as discussed in Section 2.1. It is a potentially good sign that Edmonton is developing balanced suburban communities where people can both live and work. One result of this shift is the rise in reverse commuting—13% of commutes from Central Edmonton and 20% of those from Inner Edmonton are outbound to the suburbs between 7-9 AM.

Exhibit 2.13 shows the number of commute trips ending in each traffic district between 7-9 AM, along with the mode used. The Southeast Outer group of traffic districts (including Mill Woods, South Industrial, Southeast Industrial, Meadows, and Cloverbar) and Northwest Outer sector (Northwest Industrial, Mistatim, Castle Downs, and Winterburn traffic districts) are major work destinations attracting thousands of work trips daily, but transit mode shares are less than 3%.

Exhibit 2.13: Number of 7-9 AM work and school trips ending in each traffic district, by mode, 2015



Note: Percentages indicate 2015 AM transit mode split for work and school commutes.

Source: Edmonton and Region Household Travel Survey, 2015. Districts used in the survey are shown on Exhibit 1.1.

There is no rapid transit in these two areas of the city, which partly explains the low transit shares. Unlike Central Edmonton, jobs in these outer areas are more dispersed and more difficult to serve by fast, frequent service. A strategy for improving mass transit in Edmonton must not only consider modes that can quickly bring workers to the suburbs, but also cost-effective ways to serve multiple suburban corridors over a wide area.

2.3.3 Mode Choices in 2015 versus 2005

Accounting for 77.6% of daily trips in the city in 2015, travel by auto has long been the dominant mode in Edmonton. Active modes (walking and cycling) account for the second largest share of daily trips at 12.5% in the city. Exhibit 2.2 shows mode shares reported by the 2005 and 2015 household travel surveys, and shows that transit has accounted for the lowest share among the three major modes over the decade.

Exhibit 2.2: Mode shares for weekday trips in City of Edmonton and Region, 2005 and 2015

Mode	2005 Share	2015 Share	Change
City of Edmonton			
Auto	77.4%	77.6%	+0.4
Transit	8.6%	8.6%	-
Active	12.1%	12.5%	+0.4
Region			
Auto	85.9%	86.8%	+0.9
Transit	1.8%	2.1%	+0.3
Active	8.2%	7.2%	-1.0

Sources: Edmonton and Region Household Travel Surveys, 2005 and 2015

The exhibit shows that transit mode share in the City of Edmonton had not changed significantly over the ten-year period. However, at the same time, total transit ridership grew by 64%, topping 88.7 million riders in 2015. This apparent disparity points to several factors that are working in opposite ways to influence mode choice.

Strong population growth in Outer Edmonton, where auto mode share was about 84% in 2015, has offset transit ridership gains in areas where transit is more competitive.

- As shown previously in Exhibit 2.12, the large commute markets in SE and NW Outer Edmonton only achieve 2-3% transit mode shares, and the increased relative size of trips to and from Outer Edmonton would tend to lower the average mode split across the City.

- The parts of the City where transit mode share is 2% to 8%, below the City's average, are the faster-growing areas.

- Auto mode share was just 53.5% for trips within Central Edmonton in 2015 while transit share was over 13%. For trips into Central Edmonton from the rest of Edmonton, the shares was 25% in 2015, and this had in fact increased from 21% in 2005.

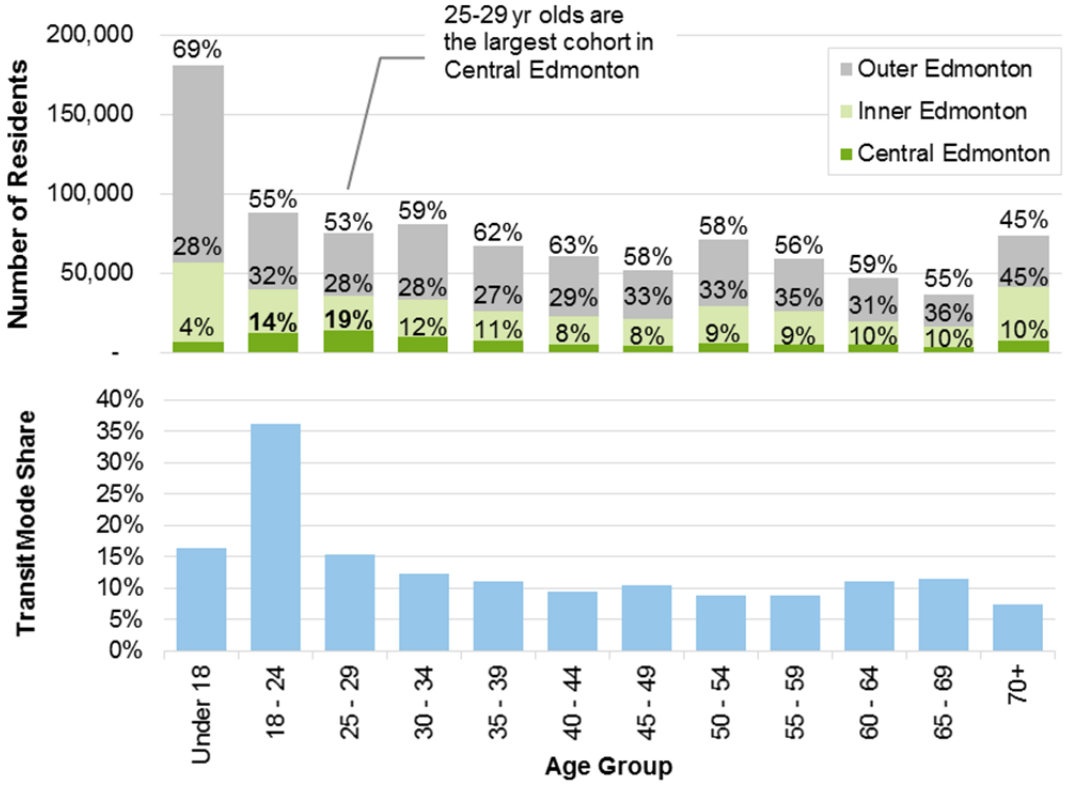
It must be recognized that the City of Edmonton has 'held its ground' against trends seen in many other North American cities, and avoided a decline in transit mode share. (Many North American cities saw a spike in transit ridership from 2008-10 and then a gradual decline starting 2011.)

Through the LRT expansions and other transit investments, transit usage for the travel markets being served has actually increased. Transit service expansion on a year-to-year basis is needed just to keep pace with the city's growth. In fact, as the city increases in size – with a larger developed land area – the potential range of origin-destination combinations increases even faster. This poses an ongoing challenge to transit service planning.

Young adults are not choosing transit, even while living in Central Edmonton

It is noteworthy that there is a sharp decline in transit mode share for commute trips between the 18 – 24 age group and the 25 – 29 age group. Exhibit 2.15 highlights that the 2015 transit share falls from 36% in the younger cohort to just 15% in the latter group. This is not a new trend and suggests that even though youth are familiar with using transit to navigate the city, they change to the auto mode as they enter the workforce and/or start families. This results in more dispersed travel patterns once they leave school and have more disposable income to potentially spend on a private vehicle.

Exhibit 2.15: Number of residents living in different parts of Edmonton (top) and transit mode shares for work or school commute trips (bottom), by age group in the City in 2015



Source: Edmonton and Region Household Travel Survey, 2015

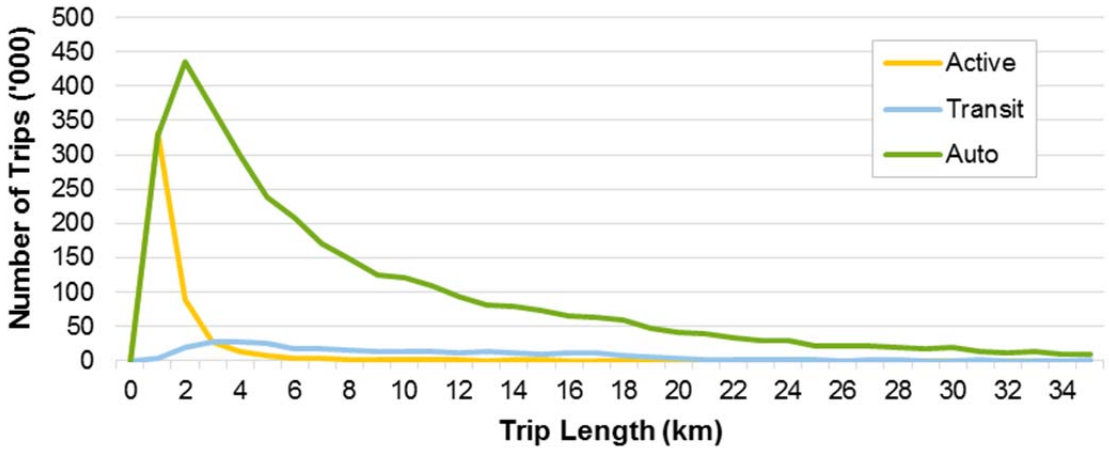
The exhibit also shows that the 25 – 29 cohort is actually the largest in Central Edmonton where transit supply is plentiful. It is only after age 30 that the share of residents living in Outer Edmonton starts to increase. Those in their late 20s are choosing to drive even before moving farther from downtown.

There is an opportunity for transit to gain market share for trips less than 10 km long

The growing Outer Edmonton area may also be a factor in the significant 9% decline in walking mode share by youth under 16 years in the city between 1994 and 2015. At the same time, there was a 6% increase in auto passenger mode share by this age group. While this could suggest that parents are choosing to drive their children to activities rather than allowing the children to walk or bike, this change could also reflect the longer distances associated with the suburban areas. The average trip length in the city increased from 6.7 km in 1994 to 8.0 km in 2015. In areas that lack competitive transit, or where developments are car-oriented, parents and children favour the auto for these longer trips.

Exhibit 2.16 shows the mode choices by the region's residents for trip lengths up to 35 km. The exhibit shows high active mode (walking and cycling) use for short trips up to 2 km, as expected. However, where one would expect transit to be an attractive choice for trips up to 10 km long, for example trips to work or to a shopping district, transit fails to capture many riders. The auto mode (combined passenger and driver) spikes for trips as short as 3 km.

Exhibit 2.16: Number of trips in the Region by each major mode and trip length, 2015



Note: Trip lengths are Manhattan distances.
Source: Edmonton and Region Household Travel Survey, 2015

There seems to be a gap, either in the types of transit service available to serve that 2 – 10 km trip market, or in the destinations served by existing transit services.

2.4 Travel Markets

Sections 2.1 through 2.3 highlight important factors that will need to be reflected in future public transit planning. These include:

- Central and Outer Edmonton are both important destinations for employment trips. However, only the CBD (Central Business District/downtown) and post-secondary travel markets achieve above-average mode choice relative to the rest of the city. The outer employment areas are lower density and more dispersed, resulting in low mode choice.
- The ratio of employment to residents has been increasing across the Region for the past ten years, resulting in travel demand growing faster than population.
- While most existing housing is single-family, there has been a recent uptick in multiple-family housing starts, and this could be the start of a trend towards intensification if City policies point that way. Higher densities tend to be more productive for transit to serve.
- There could be a potential opportunity to capture a greater share of travel by commuters over the age of 25. Currently, when students entering the job market reach this age, their travel patterns become more dispersed and their income increases. This makes it more likely for them to purchase a private automobile and stop taking transit regularly.
- There may be growth opportunities for trips of around 2-4 km, which are currently dominated by the private automobile.

The travel patterns and demographic-linked mode choices in the region are related to the major markets that could be prioritized in the mass transit strategy. These include travel markets that are already strong (or well used) and others where there is much more opportunity to make gains.

- **Commuters to the CBD and Post-Secondary** institutions. These are the strongest transit markets in Edmonton today and are likely to continue as such into the future. Assuming that employment would intensify in Central Edmonton, then this commuter market could increase to the point where, along with other passengers, the associated demand will exceed existing and planned peak capacities, and the structure of the future network will need to provide alternative paths and connections across the city so that trips downtown are focused on making it a destination and not layering on pass-through trips.
- **Inter-Municipal Commuter** – 20,000 morning peak period commute trips enter Edmonton from Sherwood Park and St. Albert. These trips are 15 – 20 km long and about 15% of them are served by transit (all of which head downtown). Virtually all of the 12,000 trips heading to suburban Edmonton are by auto. 14% of trips from Sherwood Park head to Southeast Outer and 32% of trips from St. Albert head to Northwest Outer.
- **Suburban Worker** – Residents in the growing Outer Edmonton area may find it difficult to use transit for their daily commute, even though their destinations are nearby. 15% of these morning peak period trips are by walking or cycling, but only 4% of the 111,000 commutes are by transit even though the average trip is just 6.5 km long. The SE and NW outer sectors of Edmonton are both large existing employment destinations, but with only 2-3% of workers using transit. The orientation and street patterns of these areas might suggest a more flexible, low cost form of mass transit and/or supporting transit service enhancements could be the key to building this transit market.
- **Future Developed Areas**. As the city expands into new annexation lands and infill starts to take place, there is an opportunity to structure the overall transportation network in these areas to ensure that transit is a realistic and competitive option. This would include extending an appropriate range of transit service types and potentially providing direct service on one or more types of mass transit to and through these areas in the future.
- **Central Urbanite** – Central Edmonton remains a vibrant activity hub and ensuring that its 87,000 residents have choices on how to travel is important to maintaining its attractiveness. Internal trips are quite short—just 1.5 km—and active modes dominate. The 134,000 trips to nearby destinations in Inner Edmonton average just 5.5 km and 67% are made by auto. There may be opportunities to improve transit service for these travellers who already live in transit-supportive neighbourhoods.
- **Neighbourhood Traveller** – Short non-commute trips, for example for shopping or entertainment are important since having fast, reliable access to neighbourhood amenities is key to keeping neighbourhoods vibrant. Every day in neighbourhoods outside of Central Edmonton, there are 1.2 million trips shorter than 8.5 km but only 3% of these are done by transit compared to 85% by auto.

Much of the detailed analysis and modelling as part of this study will centre on the transit network scenarios that would result in the best service for these important travel markets.

3 Edmonton's Transportation Future

This chapter provides a forward-looking overview of transportation in Edmonton, focusing on proposed near- and medium-term modifications to the city's transit networks and a broad analysis of how travel demand will evolve over the next 40+ years. This analysis sets the stage for identifying gaps in the planned transit network by highlighting emerging travel demand trends as the city grows to an urban area of over 2 million people.

Our analysis considers the near-term future (2020), which sets the stage with a restructuring of the urban transit services in Edmonton, and the long term of 2 million residents. Several regional initiatives, including the Regional Transit Services Commission, are also outlined, as these may have a long-term influence on future networks or regional policies.

3.1 2020 Transit Network Plan

The near-term future for Edmonton's transit system includes the implementation of two major initiatives:

- Completion of the Valley Line SE Light Rail Transit (LRT) line from downtown Edmonton to Mill Woods; and
- A restructuring of bus transit services to fewer routes than there are today (2018), but operating more frequently.

3.1.1 Transit Strategy

To build towards the rethink of bus services, the City of Edmonton carried out overview studies of its transit services in 2015-2016, to benchmark how the system compared to peer agencies, review different ways to plan the network and deliver service, and enhance the customer experience. These background studies fed into a consultative and technical process to develop a new ***Transit Strategy*** for the City.

Adopted in July 2017, the Transit Strategy is based on five broad themes, or pillars:

1. Integrating service with community planning and design;
2. Balancing the approaches to system funding and fare revenue sources and policies;
3. Adopting a market-responsive approach to transit network and service design;
4. Improving the customer experience; and
5. Developing organizational capacity to manage, plan and operate the system effectively.

The market-responsive approach to transit network planning led to the conclusion that a greater focus on frequency, reliability and speed was needed in Edmonton. This would allow the system "to focus on what people want transit to do." For the inner neighbourhoods of the city, this means modifying services to make transit a feasible lifestyle choice for residents, where spontaneous trip making is possible because of frequency of service. For the outer neighbourhoods, making transit a more competitive commuter option is the primary focus, with services running faster and more directly between origins and destinations.

The overall structure of the transit network would be built around ***Light Rail Transit*** as the backbone of the system, with a connecting set of bus routes forming a ***Primary Transit Network (PTN).***

The PTN would include:

- **Rapid buses** will connect the outer neighbourhoods where there is no direct Light Rail Transit (LRT) service to major destinations such as downtown, the University of Alberta and shopping centres. These could operate non-stop or limited stop, and hours of service would be mapped to level of demand. Some of the services would be peak period operations for commute purposes, while other routes would serve major travel corridors all-day. One of the planned services is a connector into Century Park LRT station;
- **Crosstown** services will connect major destinations and LRT stations in the outer areas of the city without running through the downtown. They will operate on major streets (including segments of the Inner Ring Road) and not travel on neighbourhood roads. They will operate every 20 to 30 minutes when there is sufficient demand;
- **Frequent** services operating mostly within the inner and central neighbourhoods to serve major corridors. These will operate at least every 15 minutes for most of the day on weekdays and Saturdays, and every 20 minutes or better on Sundays and late at night.

Overlaid on this would be a broad network of **Local** Services to connect between neighbourhoods around the city, and link them to LRT stations, transit centres and other major destinations. In addition, **Community** services would cater to seniors by connecting major seniors' residences with neighbourhood destinations such as shopping, medical facilities, and community and recreation centres. Each of these types of services would be tailored to match up with demand and with the functional role of each type of route.

The City is now undertaking a ***Bus Network Redesign***, which has taken the conceptual outcomes from the strategy, and defined proposed bus transit routes within each of the groupings (Rapid, Crosstown, Frequent, Local and Community), showing how they connect to each other and the LRT system.

The 2017 Transit Strategy included conceptual maps illustrating the PTN, which has evolved through technical analysis and an extensive public and internal stakeholder consultation process into the overview map shown in Exhibit 3.1. This reflects the revised bus network plan that was issued in October 2018.

This map shows the proposed 2020 transit network, which encompasses the built-up parts of Edmonton. The 2020 transit network assumes the existing LRT lines and the new low-floor Valley Line SE will be operating, which helps shape the bus route structure and connections to LRT stations and other transit centres.

Exhibit 3.1– Transit Strategy Network (2020) for Edmonton, including LRT and Bus Services

Source: City of Edmonton, October 2018.

Exhibit 3.2 summarizes the categories of service envisioned for the new ETS transit network.

Exhibit 3.2: Expected characteristics of redesigned transit services

Service Type	Description	Headway (min.)	Service Span
LRT	Light rail service similar to Capital and Metro lines	≤15	18-20 hrs.
Frequent Bus	Run in major corridors in the inner area near downtown	≤15	18-20 hrs.
Rapid Bus	Limited-stop or non-stop service connecting to major destinations	D	D
Crosstown Bus	Connect major destinations along arterial roads and do not travel through downtown	20 – 30	D
Local Bus	Provide neighbourhood coverage with frequent stops and connections to LRT and Frequent Bus routes	D	D
Community Bus	Targeted to serve seniors, using smaller buses operating on neighbourhood streets serving local destinations	D	D

D – Varies based on demand

Source: Edmonton 2017 Transit Strategy

This network will evolve over time, for example as development starts to take place in the annexation lands south of the current city limits.

3.1.2 Near-Term Light Rail Transit Network

As of 2020, the LRT network will consist of three lines, as summarized here:

- Capital Line, currently running between Clareview and Century Park stations;
- Metro Line, from NAIT to Health Sciences, interlined with the Capital Line south of Churchill station; and
- Valley Line SE, from Centre West (on 102 Ave NE downtown) to Mill Woods station.

The characteristics of these lines are indicated in Exhibit 3.3. The headways are those planned for 2020, and average speeds are based on current conditions on the existing alignments.

Exhibit 3.3: Characteristics of Edmonton's LRT lines – in 2020 *Source: (Edmonton Transit Service, 2018);*

LRT Line	Headway (min.)	Service Span	Average Op. Speed (kph)	Length (km) [1]	Peak Hour Capacity (pax/hr.) [2]
Capital	5 (peak) 10-15 (off peak)	5:10 AM – 1:45 AM	36	21	9,600 per direction (160 passengers/car x 5 cars/train x 12 trains/hour)
Metro	15 currently, could be more frequent in future	5:15 AM – 12:45 AM	32	16	1,920 per direction (160 passengers/car x 3 cars/train x 4 trains/hour)
Valley SE	5 (peak) 10-15 (off peak)	Approx. 5AM-1AM	30	13	6,600 per direction (275 passengers/car x 2 cars/train x 12 trains/hour)

[1] The Capital and Metro lines overlap for about 13 km, sharing all stations from Churchill south to Century Park.

[2] The peak capacity values per LRT car are per industry standard AW2 peak capacity. Operationally in Edmonton, the LRT train capacities will be less.

The capacity shown in this table based on the closest headways the LRT operations could support at this time, the length of high-floor or low-floor trains as dictated by constraints on station lengths, and the passenger loading (seated plus standing) that can practically be carried during peak hour:

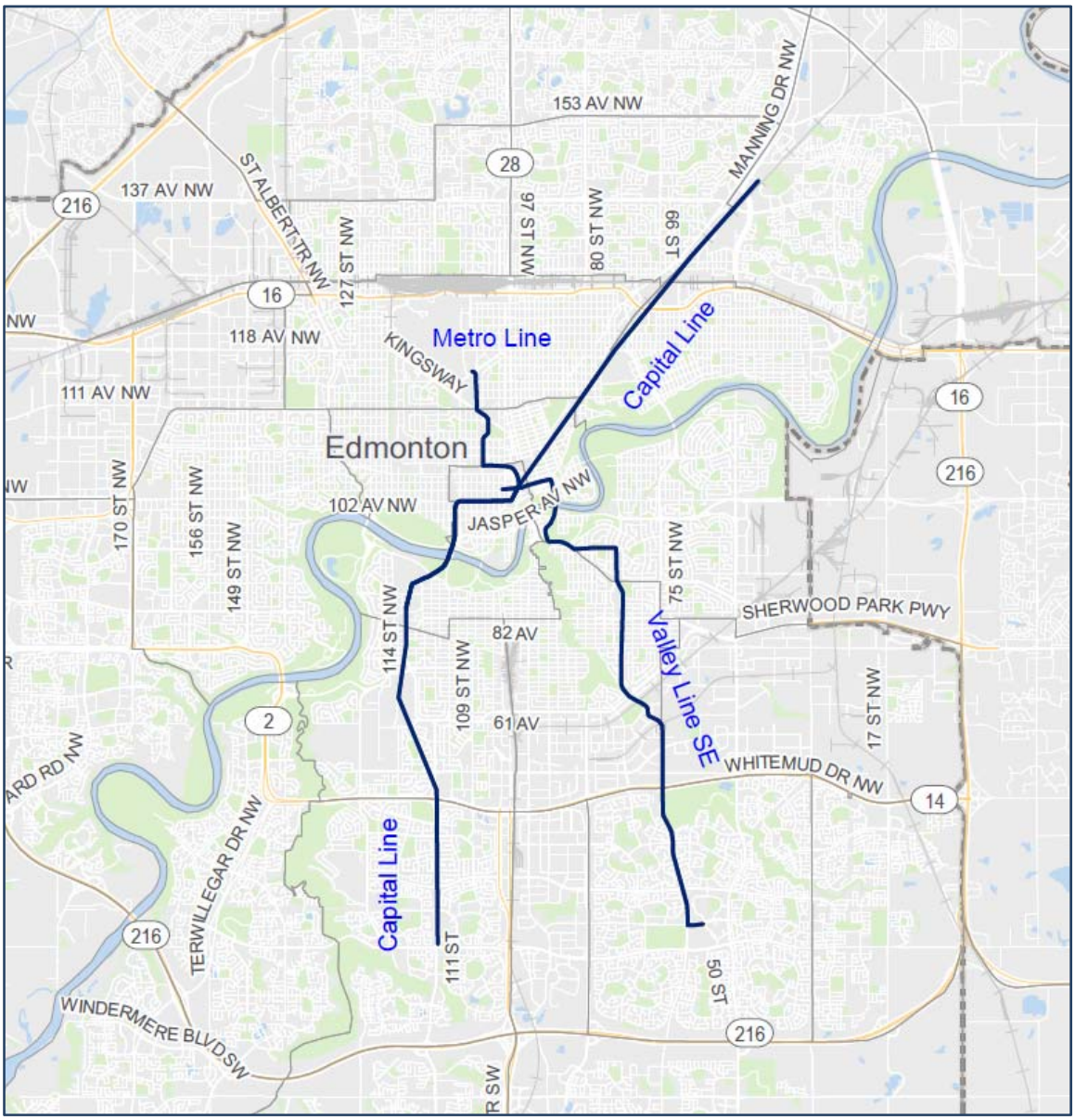
- The high-floor trains have a higher potential capacity on the fully grade-separated - segments, but the overall limit on each line is governed by the at-grade segments, where there are policy limits on how many trains (and pre-emptions of traffic signals) per hour are practical. The limits of a grade separated line have to with safe spacing of trains, boarding and alighting times for passengers at the busiest stations, and the turn-around time achievable at the ends of the line.

  ETS indicates that the high-floor trains operate at up to 600 passengers per train (120 per car compared to 160 per car shown in Exhibit 3.3). For planning purposes, this lower value is a reasonable upper limit per car for assessing peak hour service capacity. The higher capacities indicated by industry standards (as shown in Exhibit 3.3) usually apply under special event conditions and are not used to set service standards. Under current conditions, the combined Capital/Metro lines together provide 16 trains per hour per direction where the routes currently overlap.

- The low-floor trains on the Valley Line are intended to be integrated into an urban environment, with stops located in downtown city blocks, thus setting a maximum length per train. Given that parts of that line will also be at grade, again there is a practical limitation to the number of trains passing in each direction.

The alignments of the three LRT lines in 2020 are indicated by Exhibit 3.4.

Exhibit 3.4 – Map of 2020 Light Rail Transit Extent



3.1.3 Projected 2020 Transit Demand

The City's Regional Transportation Model was used to prepare projections of year 2020 and of long-term future demand, to help assess the needs and opportunities confirmed by trends that continue and differences that arise over that time period.

In this section, several important details from the 2020 forecasts are presented, to quantify the metrics associated with the mass transit system and the transit network as a whole. These results assume the restructured bus transit network (as depicted in Exhibit 3.1) from the Transit Strategy, and the addition of the Valley Line SE to the existing LRT services. Transit services within other municipalities and to/from Edmonton are reflected in the model, based on the most recent understanding of their transit service plans.

Exhibit 3.5 presents the high-level statistics resulting from the model run for the AM peak hour. These numbers are somewhat higher than the 2015 travel survey, reflecting growth in the City and Region, and the effects of the near-term transit network changes.

Overall, the Edmonton Region, including the surrounding counties, generates 731 thousand AM peak period trips (covering the purposes in the travel model, including commuting to work, school, shopping, and recreation, other destinations, and returning home). Isolating the trips to, from and within Edmonton, there are 600 thousand trips, and of those, 470 thousand are between two points within the city.

The regional mode share for transit is 10.6% in the AM in the 2020 projections, and this climbs to 13.2% when focusing on trips entirely within Edmonton. Most of the transit trips are accessed by walk, bike, or being dropped off (at a station); however the estimate includes 8500 trips through park and ride facilities, where the passenger transfers to/from bus or LRT.

Exhibit 3.5 – AM Peak (2020) Transit Travel Projections, including Boardings by LRT Line

Measure	Region	to/from City	within City
All AM Peak Pd Trips	**731,000**	**600,000**	**470,000**
Transit (Total)	77,500	74,800	62,100
Transit Mode Share	10.6%	12.5%	13.2%
Total Transit Boardings	88,900		
Transfer Rate	15%		
LRT Boarding	26,300		
Bus Boarding	62,600		

Summary of Transit Boardings by Line

LRT Boarding	Total
Capital Line	16,600
Metro Line	5,500
Valley Line	4,200
Total	**26,300**

The tabulation also shows transit boardings, with nearly 89 thousand in the AM peak period. This is naturally higher than the number of trips because 15% of these are transfers, where a passenger has used more than one transit route within the same trip. Bus boardings across the region account for most of the transit activity, while the LRT lines are the busiest individual transit lines and concentration of passengers. Note that the Capital Line in 2020 extends from Century Park to Clareview (current route), the Metro Line operates NAIT to Health Sciences, and the Valley Line is the SE portion from 102 Avenue to Mill Woods.

The 2020 AM and PM peak hours were compared, and it was found that the existing trend of the AM peak being shorter in duration but having higher 'peak of peak' demand stays consistent. This occurs because morning peak travel includes home-based work and school trips that mostly start within the same 2-hour period. The afternoon peak includes all of the reverse commute trips, plus a higher number of discretionary trips such as shopping and recreation. However, since the departure times from school and work are more spread out, this higher volume of trips does not peak as sharply as the AM.

This is borne out by the transit loading plots in Exhibits 3.6 and 3.7, which show the AM and PM peak hours respectively. The combined directional loads of all transit services were determined for all routes on common segments, the totals are shaded by category, and the highest volume parts of the network (over 1500 riders per direction per hour) have been labelled. This includes most of the LRT system and some of the higher-concentration parts of the bus network.

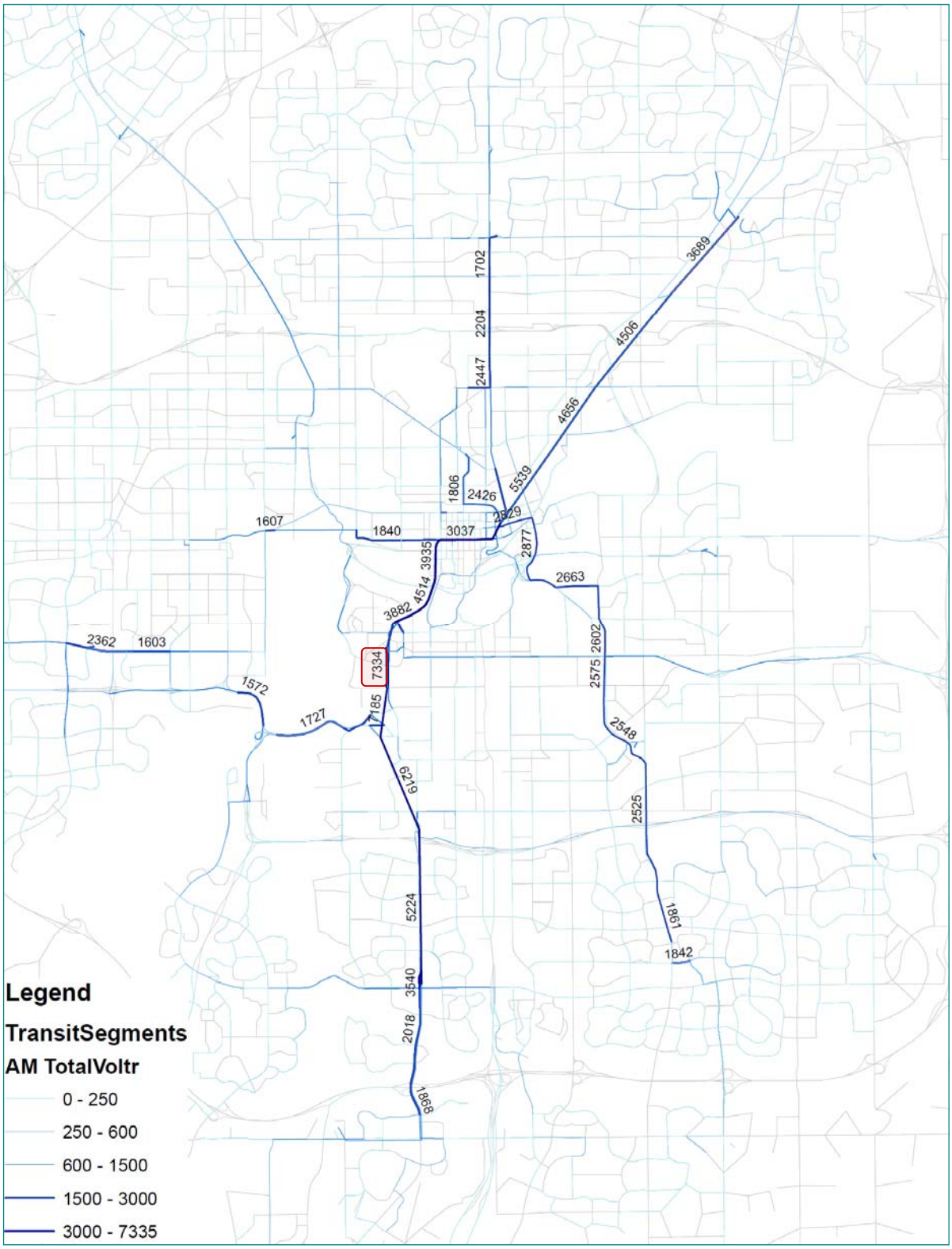
Consistent with recent passenger counts on the LRT network, the peak load point is outside of downtown, between the Health Sciences and University stations. In the AM peak hour, the peak direction demand (northbound) is projected at 7,300 riders. The corresponding PM peak load is lower. The peaking of mass transit demand outside of the Central Business District has precedent in other locations. (One need look no farther than Calgary, where the NW Red Line has its AM peak demand inbound towards the University, and then the peak load into downtown is somewhat lower.) The demand coming into downtown Edmonton from the northeast also peaks on the Capital Line, inbound towards Churchill Station, at over 5,500 riders.

The section of the current combined Capital and Metro Lines through the Churchill – Health Sciences segment is capped at a theoretical 24 trains per hour in the peak direction (arrivals 2.5 minutes apart). Using the effective capacity of the system, this translates to approximately 14,400 passengers per hour in the peak direction *if all trains were equally loaded*. (Because the LRT has different routes, demand is not equal from train to train.)

South of Health Sciences, the LRT line encounters several grade crossings and the effects of these on travel across the tracks imposes a practical limitation on how many trains can operate through this segment. This results in a lower capacity limit on parts of the system that are 'semi-exclusive', that is, the LRT travels in its own track bed, but the route includes street and pathway crossings at grade. This same limitation would exist on other semi-exclusive segments, such as – but not limited to -- the Metro Line north of downtown to NAIT, and the downtown segment of the Valley Line (under construction).

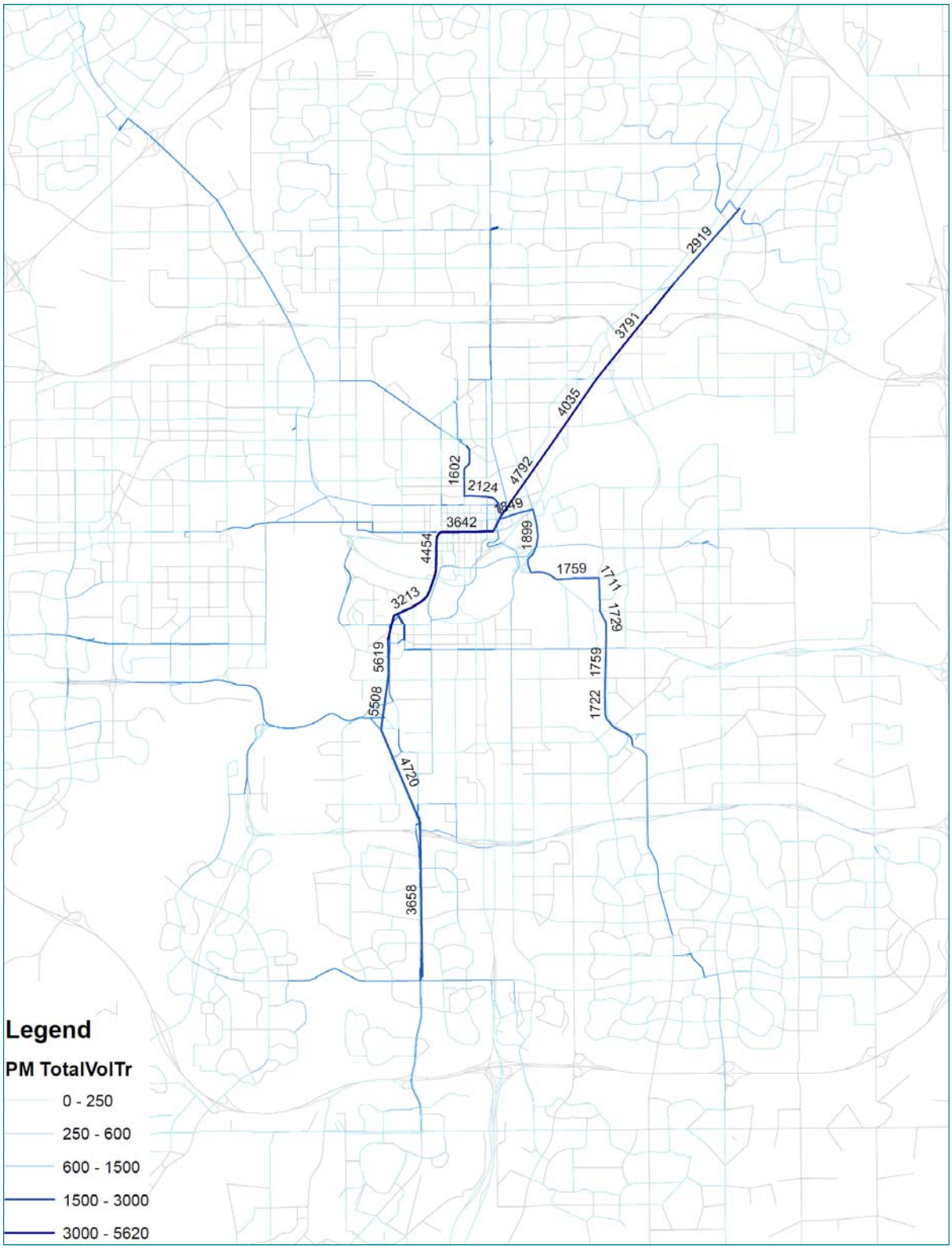
The peak loads on the Metro Line NW of downtown and the Valley Line SE of downtown have lower peak directional loads as of 2020, and would not initially be pinch points on the system.

Exhibit 3.6 – AM Peak Hour (2020) Transit Passenger Loads



Source: RTM2, plot by IBI Group

Exhibit 3.7 – PM Peak Hour (2020) Transit Passenger Loads



Source: RTM2, plot by IBI Group

Exhibit 3.8 summarizes the AM peak hour transit boardings estimated by the model for the full range of services, including 26,300 LRT boardings, 53,700 Edmonton bus transit boardings, and some 8000 passengers on other municipal systems, including several routes (for example, the 747 shuttle from Century Park to Edmonton International Airport) operated by ETS into those service areas. This is fairly consistent with recent boarding patterns in Edmonton where the ratio of bus to LRT boardings is approximately 2:1.

Exhibit 3.8 – AM Peak Period (2020) Transit Boardings by Route Type

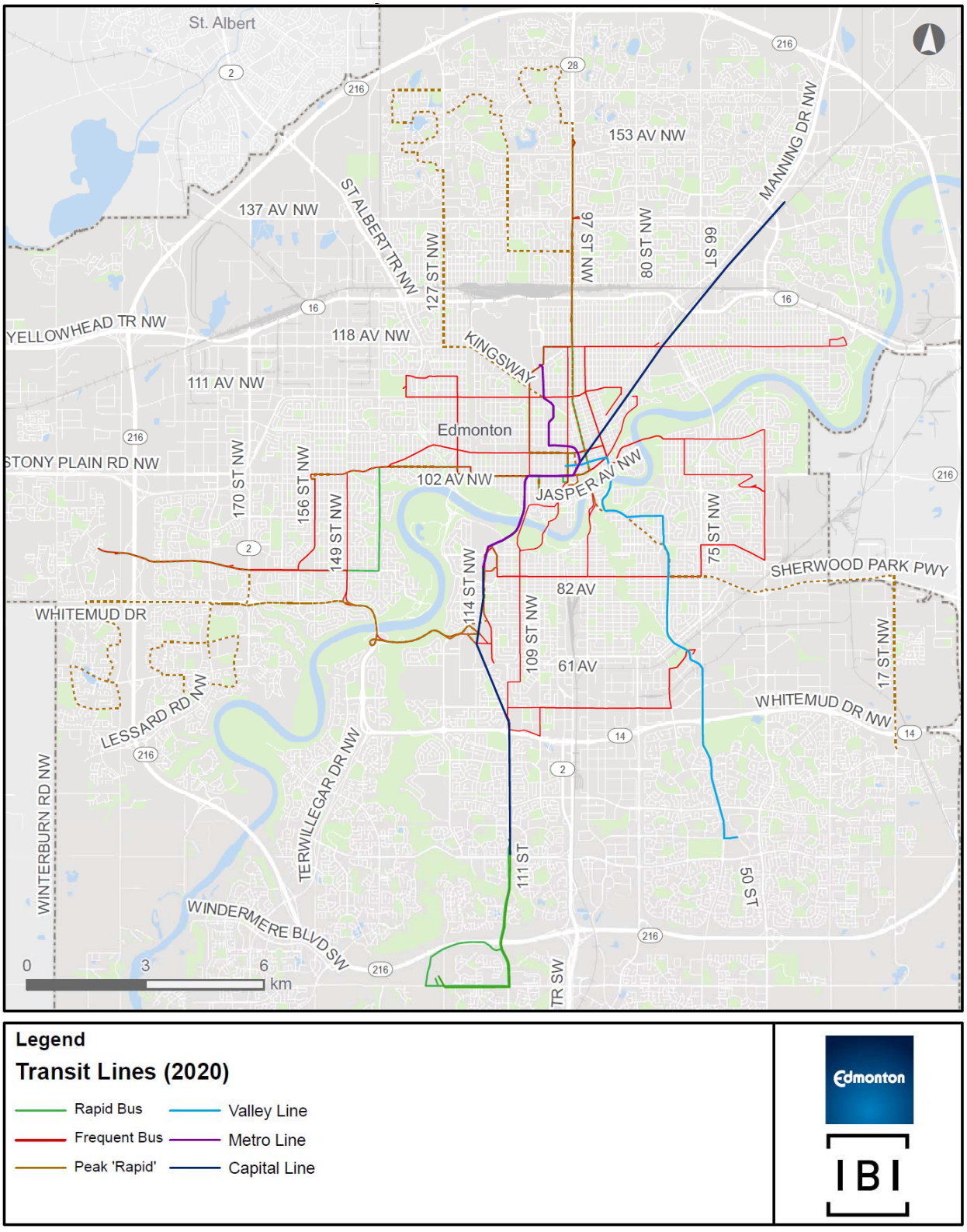
Transit Lines (2020)	Boardings	Average Peak Headway (minutes)
LRT		
Capital Line	16,600	5
Valley Line	5,500	5
Metro Line	4,200	10
Primary Transit Network - Rapid		
All-Day	3,000	7
Peak	2,700	13
Primary Transit Network - Non Rapid		
Frequent	11,200	9
Crosstown	4,400	14
Local ETS Services		
N	10,600	16
SW	8,400	17
SE	8,000	19
W	5,400	20
Edmonton	**80,000**	
Other Municipalities		
St. Albert	1,900	
Strathcona Co./Sherwood Park	3,000	
All Others	4,100	
Subtotal	**9,000**	
Grand Total	**89,000**	

Source: RTM2, summary by IBI Group

Exhibit 3.9 presents a reference map showing the extent of the peak and all-day Rapid and Frequent bus services that will complement the LRT[1] as of 2020.

[1] Note: Depending on the work of the RTSC, this network may be expanded to include certain transit lines that are currently provided by bus transit services of Edmonton's adjacent municipalities. Several existing routes may qualify as 'peak rapid' if considered together along their common route segments, e.g. St. Albert Trail and Kingsway in/out of downtown Edmonton, Sherwood Park Freeway/82 Avenue from Strathcona into the University;

Exhibit 3.9 – Map – Rapid and Frequent Urban Bus Services in Assumed 2020 Transit Network



3.2 LRT Network Plan

The current version of the LRT Network Plan is based on technical studies that have been undertaken continuously. A long-range LRT plan was formally adopted in 2012, and includes extensions to the existing 'high-floor' LRT lines, as well as new 'low-floor' LRT lines providing additional routes across the city. Ongoing studies lead to refinements of the alignments, stations, orientation to the street, and technology.

The newest element of the system in 2020 will be the Valley Line SE, which was under construction when this study commenced in 2018. As noted previously, when new elements of the LRT system are opened, there is restructuring of the bus network to connect to new stations, and any savings in service hours and vehicles from reductions in redundant bus service can be redistributed within the City.

Exhibit 3.10 summarizes the status and current understanding of the LRT network, including how they are addressed in this current study when looking at 2065, the long-term horizon. Certain longer-term assumptions (noted as TBD) will be tested within this study.

Exhibit 3.10 – Light Rail/Mass Transit Network – Current Status and Assumptions for Long Range

Line	Segment	Vehicle Type	Alignment	Assumptions
Capital	Clareview-Century Park	High Floor	Exclusive from Churchill to University, otherwise semi-exclusive with strategic grade separations	Already exists
	S to Ellerslie	""		Included in 2065 base
	S to Heritage Valley TC (41 Ave SE)	""		Included in 2065 base
	NE to Gorman	""		Included in 2065 base
	NE to Alberta Hospital; NE to Energy Park	TBD	TBD	Assumed in 2065 base
Metro	NAIT-junction with Capital Line	High Floor	Semi-exclusive with strategic grade separations	Already exists
	NAIT to Blatchford N; to Campbell Rd	""		Included in 2065
	Beyond City Limits	TBD	TBD	Not Included in 2065 base
Valley SE	To Mill Woods	Low Floor	Semi-exclusive with strategic grade separations	Included in 2020 and 2065
	To Ellerslie	""	TBD	Assumed in 2065 base
Valley West	Downtown to Lewis Farms	Low Floor	Semi-exclusive with strategic grade separations	Included in 2065, likely next project after Valley SE
Centre LRT (Festival Line)	Downtown to University	TBD	Could be partly exclusive, semi-exclusive or in-street	Alignment under study (downtown-82 Ave); partially adopted (82 Ave to Bonnie Doon) but technology unconfirmed, not assumed in 2065 base
	University to Bonnie Doon	TBD		
TBD	To City Limit/ Sherwood Park	TBD	TBD	Not assumed in 2065 base
TBD	To Edmonton International Airport	TBD	TBD	Not assumed in 2065 base

Notes: 1. For vehicle type, LRT extensions are assumed High-Floor; for newer LRT it will be low-floor. Where LRT, BRT, or other technology is unconfirmed, this remains To Be Determined (TBD). .2 Exclusive means the LRT is completely separate; semi-exclusive is a dedicated route but with some street or pathway crossings.

3.3 Regional Initiatives Related to Mass Transit

There are several Edmonton Metropolitan Region Board (EMRB) initiatives associated with implementation of the Regional Growth Plan that address regional transit. The initiatives that are currently underway, namely the Regional Transit Services Commission and the Smart Fare Project, will likely be informed by and provide input back into the later stages of this study.

- Regional Transit Services Commission (RTSC) has the purpose of defining a structure for transit services on a regional basis, including services between municipalities. A Memorandum of Understanding was signed by the Edmonton Region municipalities in fall 2018.
- The Regional Smart Fare project is developing a system for electronic fare payment that would allow passengers on participating systems to use common fare media (such as transit smart cards, debit or credit cards) to pay different transit fares. Over time, such a system would have the potential to simplify transfers between systems. Fare policy changes become more feasible technically and could include fare by distance, premium fares for different service types, zonal fares, etc.

  The Smart Fare program is a separate initiative but it is recognized by this study that long-term fare policy assumptions in the model will need to be confirmed and may form part of the stress testing of results later in the study.

There are also several inter-municipal initiatives that have been previously identified for the Edmonton Region. These existing plans will provide conceptual input to the next step of the Mass Transit Study when scenarios are developed for evaluation. The scenarios defined by this study will be related to the City Plan concepts and later, the preferred concept, and as such will represent an update that builds upon earlier work.

- Integrated Regional Transportation Master Plan (IRTMP, 2011). The IRTMP identifies priorities for the regional transportation system 35 years into the future. The report identified six corridors connecting Edmonton and surrounding municipalities, and identified concepts for BRT and/or HOV lanes on portions of these corridors, which included:
  - Highway 2 (QE2) from Century Park LRT to 65 Ave Leduc
  - Baseline Road/98 Avenue
  - Wye Road/Sherwood Park Freeway
  - Highway 15, Clareview LRT to Fort Saskatchewan
  - Highway 28 (97 St NW) from 118 Avenue to TWP Road 544
  - Highways 16/16A through Edmonton from Stony Plain to Hwy 21
- In 2011, the Capital Region Board (predecessor to EMRB) developed a 30 Year Transit Service Plan for the region, including service standards for inter-municipal transit.
- An EMRB plan comes out annually identifying the shorter term (10-year) top Transportation Priorities. The list focuses mostly on roadway-focused projects but several are transit-related, including park and ride facilities and LRT extensions. The development of the list is intended to foster coordination of regional transportation initiatives between municipalities, as well as to influence the Provincial Three Year Capital Plan, which identifies funding.

3.4 Long-Range Travel Demand

Future travel demand is initially being estimated on the basis of the near-term future (2020), and a longer-term 'Future Baseline', with the nominal 2 million population. The initial distributions of population and employment presented here and reflected in the travel demand estimates are based on this future total for the City.

As part of The City Plan, there will be multiple future land use scenarios where the overall totals will be the same, or very close, but with different concentrations of development assumed in different areas. The 2065 projections reflected here were developed by City staff based on the recently developed policies, and then projecting those to absorb the additional growth needed to reach the target population. These are presented as a starting point for the discussion of travel demand, and will be superseded by later land use work by the City.

3.4.1 Regional and City Growth: The 'Future Baseline'

For the purpose of comparing 2020 with 2065, Exhibit 3.11 presents some high-level indicative estimates of population and employment. The "City" values for 2020 and 2065 include some areas adjacent to the City that fell within the same Traffic District in the transportation model, hence the future population slightly exceeding 2 million.

Exhibit 3.11 – Comparison of Projected Population and Employment, 2020 versus 2065

LOCATION	POP 2020	EMP 2020	POP 2065	EMP 2065
City[2]	1,056,000	619,000	2,062,000	1,110,000
Region	446,000	148,000	901,000	371,000
Total	**1,502,000**	**767,000**	**2,963,000**	**1,481,000**

Exhibits 3.12 and 3.13 present the forecast distributions of residents and employment across the centre of the Edmonton region for 2020 and 2065. The 'dot scale' has been selected because it helps to visualize the relative increases from one planning horizon to the next quite effectively. The exact locations of the dots are not significant; it is the density and clustering that is representative of the patterns that are input to the demand model.

The longer-term forecast is a future baseline, showing one possible way that the population and employment could be distributed, if following current trends and policies from previous municipal and regional plans. The

[2] City population target for 2065 is approximately 2 Million. This higher figure includes portions of Leduc County (such as Town of Beaumont) that form part of the travel demand district that includes the annexation lands, within the travel demand model in use to the end of 2018. The City's new travel model, calibrated against the 2015 Household Travel Survey and upgraded with new features, is available in 2019 for the analysis of networks in this study. The newer model will subdivide the southern sector between City and non-City areas.

Exhibit 3.12 – Residential and Employment Density Map for 2020

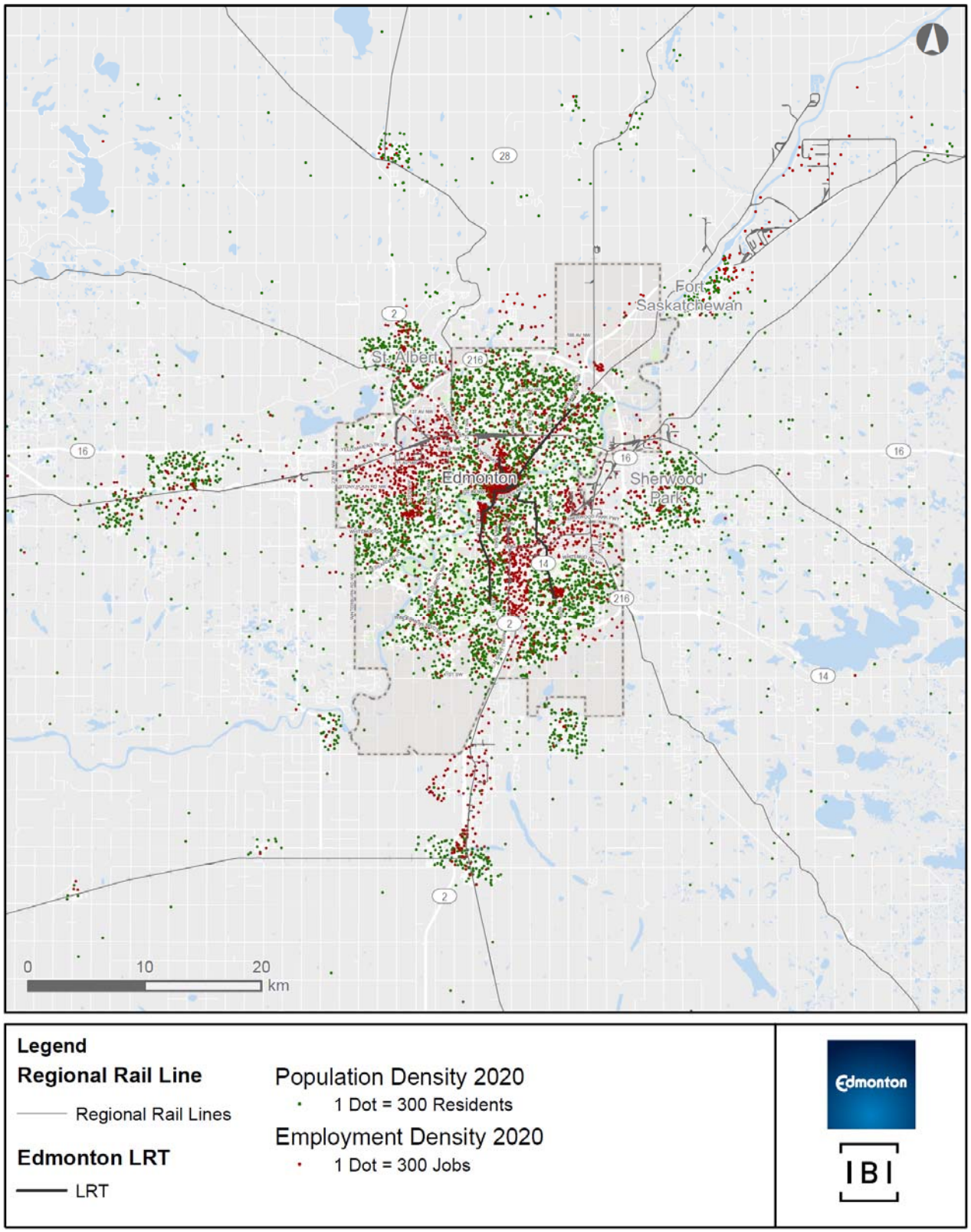
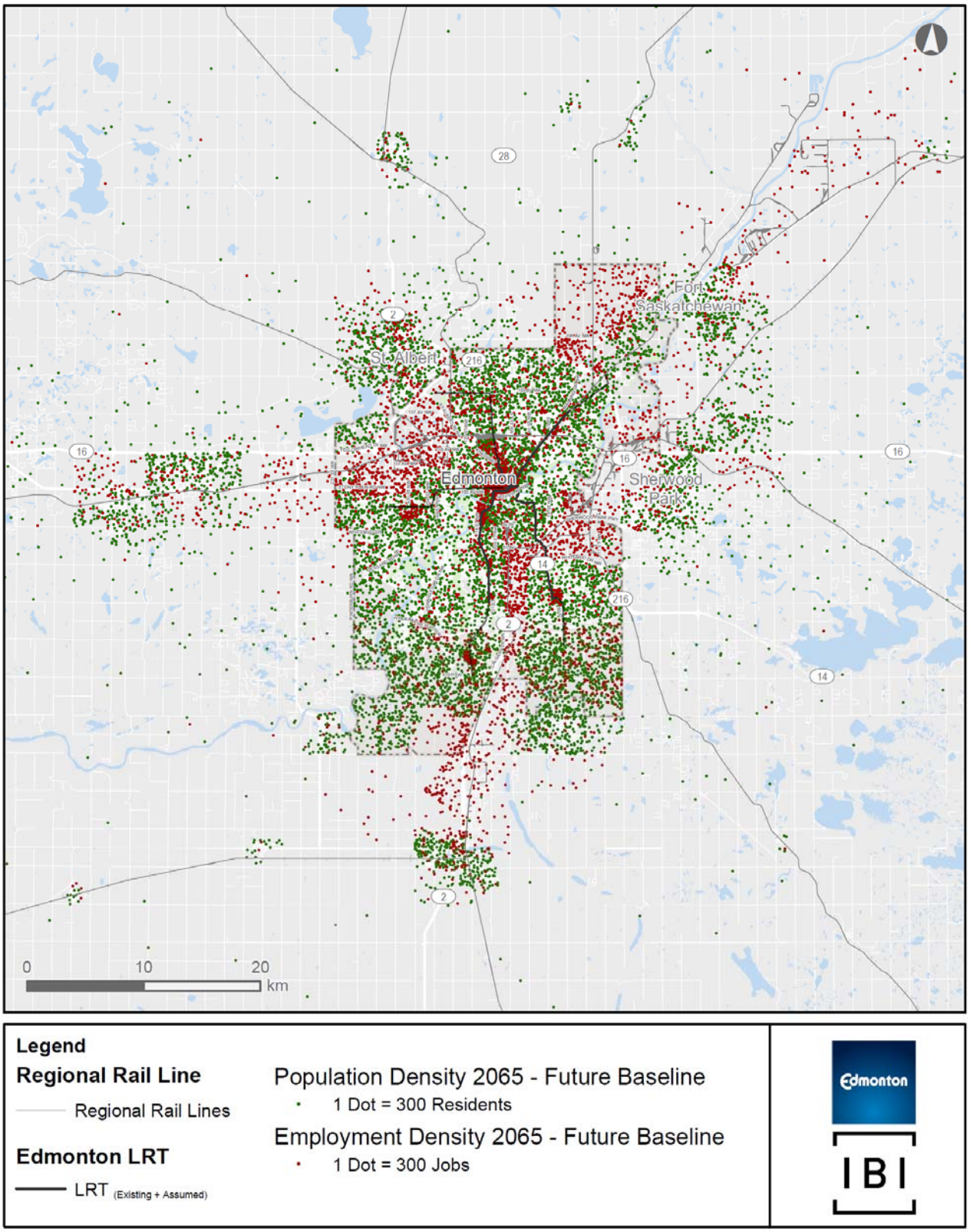


Exhibit 3.13 – Residential and Employment Density Map for Future Baseline (2065)



3.4.2 Travel Demand Trends, 2020 to 2065

Exhibit 3.14 summarizes the projected travel demands in the AM peak period for 2020 and for 2065. The latter year shows there would be nearly double the current travel demand within the Edmonton Region, increasing from 0.7 to over 1.3 million AM peak hour trips. This appears to consistently produce nearly double the number of trips within the City, between the City and the rest of the Region, and between regional locations.

The information for the City of Edmonton includes the areas north/west and south of the Saskatchewan River, plus the planned 2019 annexation lands. For the purpose of this comparison, the entire traffic district that includes the annexation has been counted, since most of the population and employment will be within the new city limits, with the exception of some that will be based around the Edmonton International Airport. This spread of the city was shown by Exhibit 3.13 on the previous page. Due to much of the growth in these lands being post-2020, the travel demand increases are much greater than the average for the rest of the region.

Exhibit 3.14 Overall Travel Demand Changes 2020-2065 (7-9 AM Peak Period)

2020 AM Peak	Destination				
Origin	City N/W of Riv	City S of Riv	Annex 2019	Region	Total (for Orig.)
City N/W of Riv	204,100	53,900	1,600	21,500	**281,100**
City S of Riv	58,900	153,400	5,000	12,900	**230,200**
Annex 2019	3,500	7,200	9,800	2,900	**23,400**
Region	47,100	23,100	3,000	97,400	**170,600**
Total (for Dest)	**313,600**	**237,600**	**19,400**	**134,700**	**705,300**

Trips within the City	497,400	(Includes Annexation Zone and adjacent communities)

2065 AM Pk Hr	Destination				
Origin	City N/W of Riv	City S of Riv	Annex 2019	Region	Total (for Orig.)
City N/W of Riv	342,570	77,840	9,730	46,710	**476,860**
City S of Riv	85,190	235,030	39,610	23,870	**383,700**
Annex 2019	10,600	32,130	97,230	8,920	**148,870**
Region	73,480	28,730	15,030	206,430	**323,670**
Total (for Dest)	**511,840**	**373,730**	**161,600**	**285,920**	**1,333,090**

Trips within the City	929,930

Patterns

Exhibits 3.14 and 3.15 show the major AM peak hour travel flows between and within traffic districts for 2020 and for 2065, respectively. The desire lines (arrows) show the 67-68% of travel that is medium to longer distance and occurs between different traffic districts or municipalities. The other 32-33% of trips are short to medium distance and remain within the individual traffic districts of Edmonton, or within the nearby municipalities and do not appear on the ‘arrow maps’.

In 2020, the most significant travel patterns include the connections to the Central Business District, with some secondary destinations in the University, West Edmonton, Southgate and Mill Woods. Due in part to the size of the traffic district with the 2019 annexation lands, by 2065 that area will account for a significant number of the larger origin-destination flows, even while travel between the origins and destinations in 2020 continue to increases. These evolving patterns are an important factor in identifying the travel demands, and the potential future mass transit needs and opportunities in addressing these demands.

Exhibit 3.15 Major Origin-Destination Flows, AM Peak, 2020 – Between and Within Traffic Districts

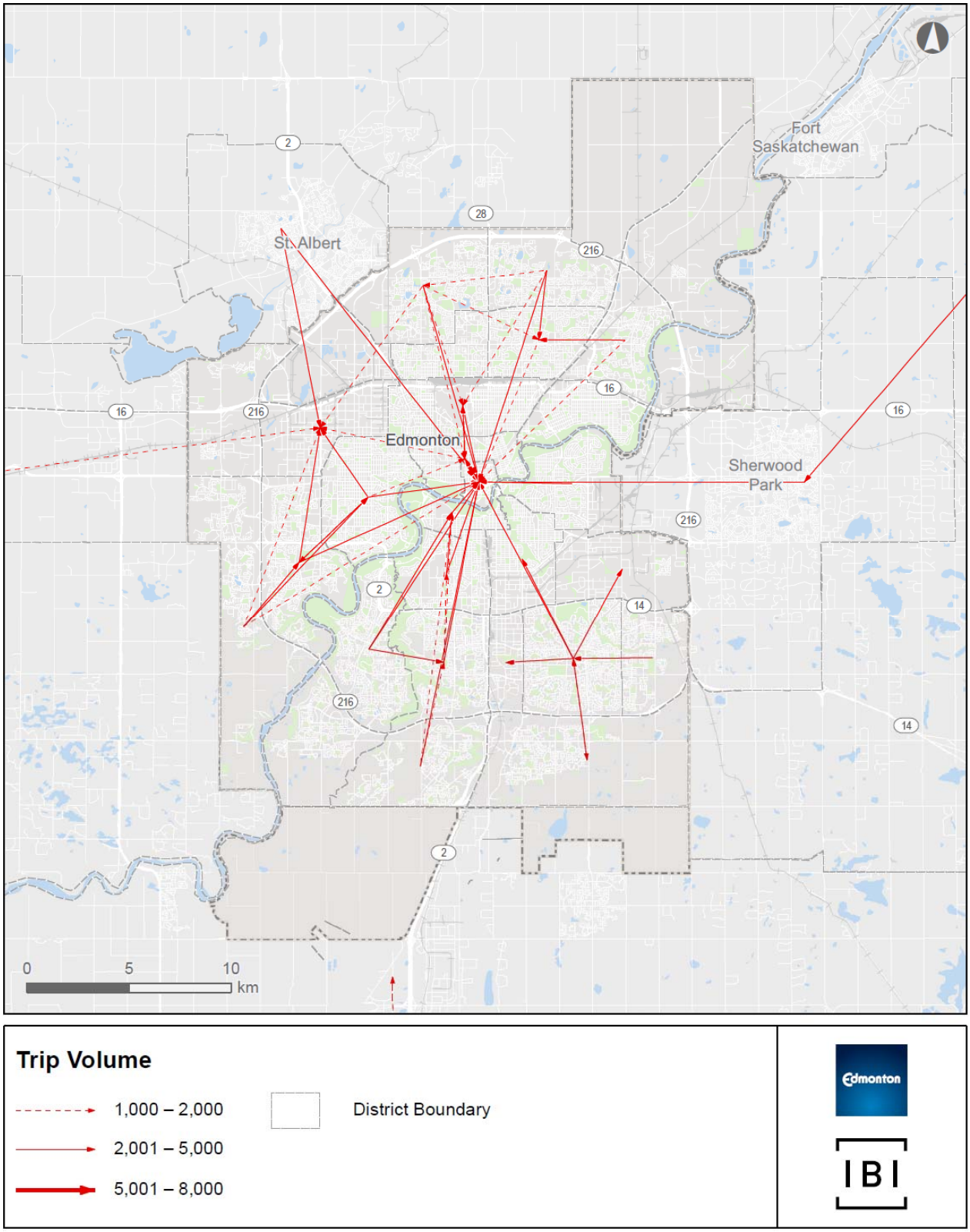
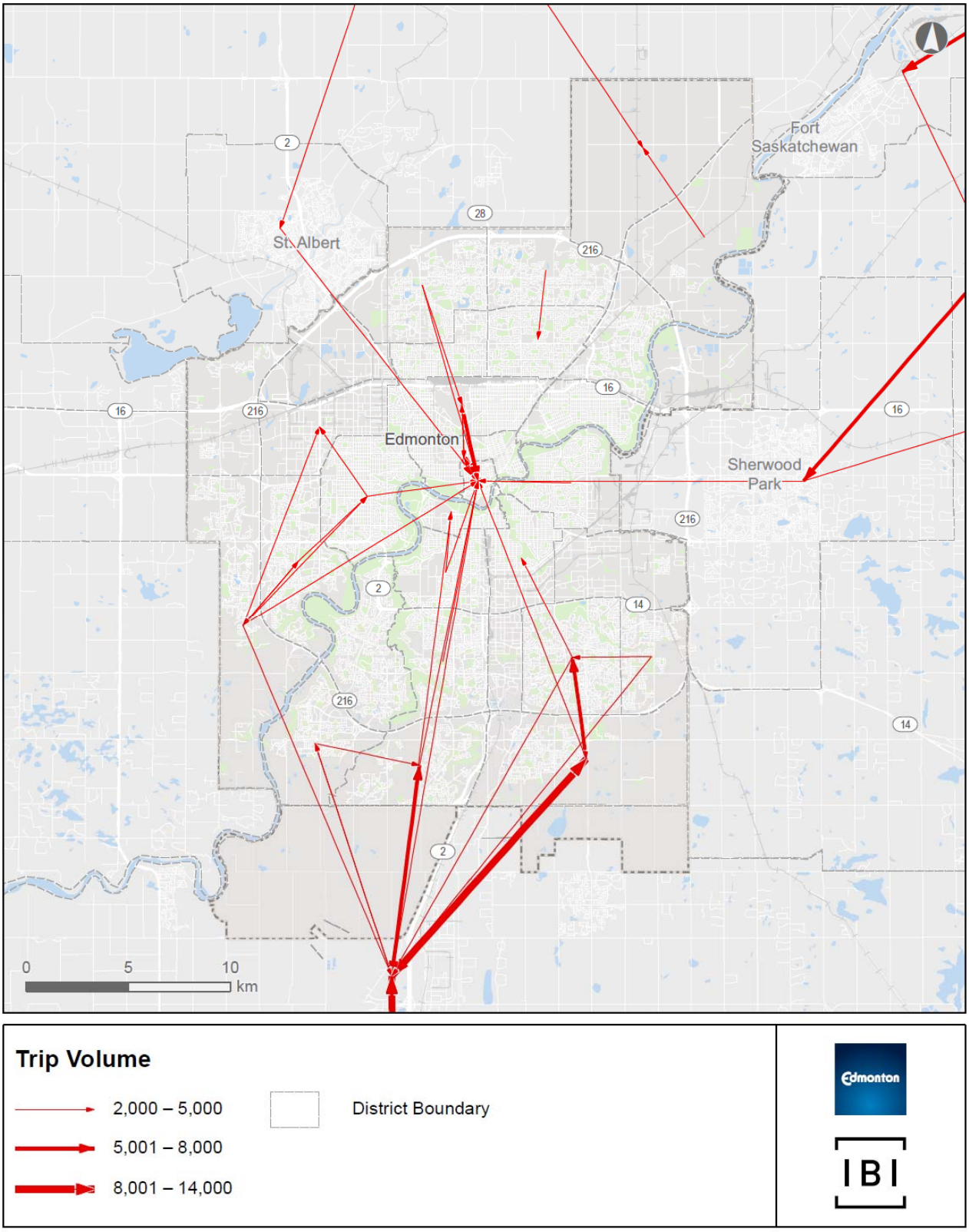


Exhibit 3.16 Major Origin-Destination Flows, AM Peak, 2065– Between and Within Traffic Districts



4 Peer Review

Edmonton is not alone in facing the dilemma of providing fast, reliable, convenient transit within a limited budget and challenging urban structure. This chapter reviews mass transit in five cities across North America that have similarities to Edmonton now or as examples for a possible future. It highlights both positive and negative experiences that the City should consider as it develops its Mass Transit Strategy.

The peer regions selected are Calgary, Metro Vancouver, Ottawa, Allegheny County in Pennsylvania (centred on Pittsburgh), and Denver-Aurora-Boulder in Colorado. Transit in these regions serve between 1 million and just over 2.5 million people, with transit mode shares of 8-22%.

These peers are all instructive for Edmonton. Metro Vancouver and Denver-Aurora-Boulder are both home to about 2.5 million people, but represent distinctly different transportation visions, evident by transit mode shares of 8% in Denver vs 22% in Vancouver. Ottawa and Allegheny County show how BRT supported by strong frequent transit can encourage ridership, and Calgary illustrates the use of low-cost LRT technology to build more rapid transit for less.

Sections 4.1 through 4.5 present each of the peers in more detail, while section 4.6 summarizes the key transit success factors and lessons learned.

Unless otherwise noted, all data in this chapter is sourced from the following:

- Canadian transit service area, population served, ridership, and investment and utilization data are based on (Canadian Urban Transit Association, 2016);
- US transit service area, population served, ridership, and investment and utilization data are based on the National Transit Database (Federal Transit Administration, 2016);
- Canadian city transit mode shares are based on commute to work data from (Statistics Canada, 2017e);
- US city transit mode shares are based on commute to work data from (U.S. Census Bureau, 2016);
- Rapid Transit network lengths are based on the extent of the network that was in operation by the end of 2015 and available to commuters at the time the respective commuting mode share and ridership data were collected; and
- USD to CAD currency exchange rates are based on the Bank of Canada’s historical exchange rates.

4.1 Calgary

Calgary Transit is a municipal organization responsible for transit service in the City of Calgary. Its service area spans 896 km^2 with a population of 1.2 million residents. Like many municipal transit agencies, its scope is limited to transit service and does not directly plan or operate other transportation modes.

Service Area

Calgary is very similar to Edmonton—weather, economy, governance, and population are comparable between the cities. Calgary Transit is responsible for transit within the city's boundaries, although there is a commuter-shed that extends into neighbouring municipalities. These are served by other public transit operators.

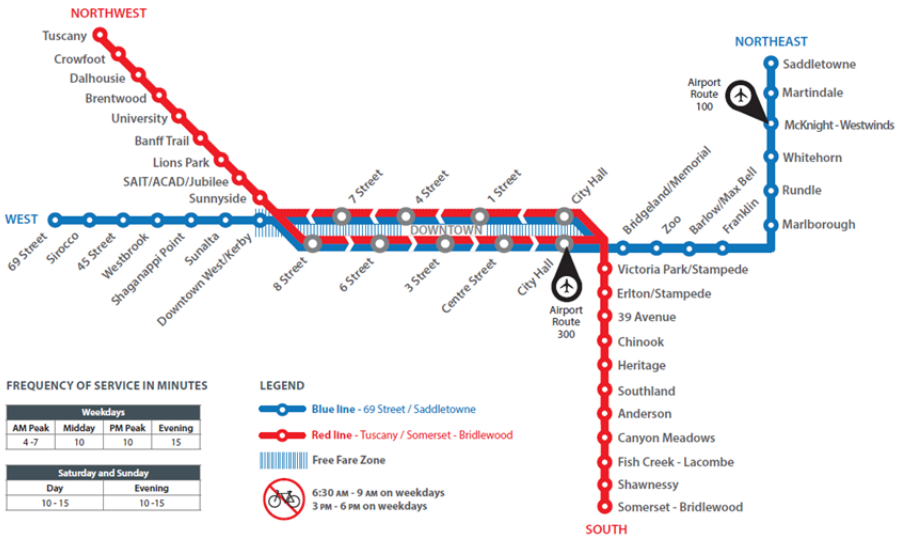
Like Edmonton, Calgary has a high proportion of single-family houses at 58% (Statistics Canada, 2017b), giving it a very suburban character. Downtown Calgary, however, is quite densely developed and is the major employment hub of the area. It is notable that the recent recession has led to a downtown office vacancy rate as high as 27.7% (CBC News, 2018). Calgary's east end has many industrial jobs, often oriented around freight rail corridors, and urban development is less dense in these areas.

Transit Network

Calgary's rapid transit network primarily consists of two LRT lines centred on downtown. These evolved from a limited stop bus system that started in 1972, and the first LRT line (7 Street to Anderson) launched in 1981. The C-Train LRT is mostly surface-running, even downtown, using controlled level crossings to prioritize train movements throughout the city. Portions of the northwest, northeast and south branches are grade-separated from river crossings, major railway corridors, and the TransCanada Highway. The west LRT branch is the most recent addition, and includes significant elevated and tunneled sections making up much of its length.

Exhibit 4.1 shows the current system, which comprises 58.7 km of LRT.

Exhibit 4.1: Map of Calgary's LRT network



Source: (City of Calgary, 2016)

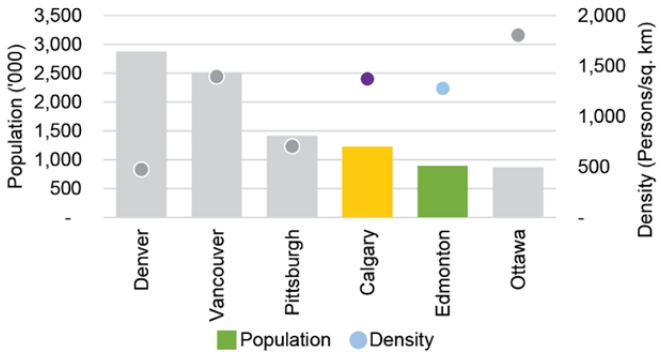
The initial segments of the C-Train were notable for relatively low capital costs. Operating mostly above ground with minimalist stations, simple rolling stock, and having preserved many rights-of-way well before construction began, all contributed to capital costs of USD$2,400 per

passenger-mile in year 2000 (Hubbell & Colquhoun, 2006). Edmonton's network cost USD$8,900, and comparable US systems range from USD$9,100 to USD$44,000. This low cost helped Calgary to build a relatively long LRT system even before reaching a population of 1 million. The West LRT had a much higher average capital cost due to the challenges along its alignment, and large-scale underground and elevated stations.

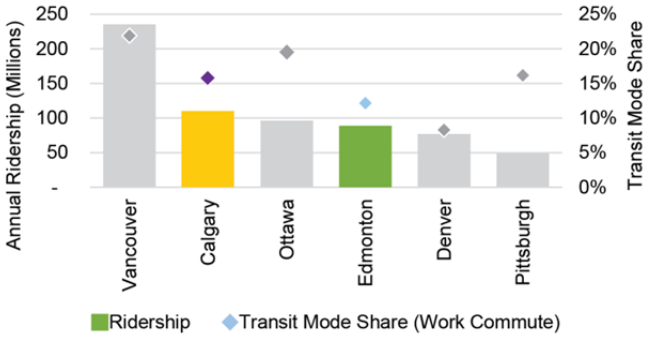
Exhibit 4.2 shows several transportation metrics for Calgary as well as the other peer regions. Please note, the riders per capita is based on linked trips, rather than vehicle boardings, which is a higher number that would include transfers.

Exhibit 4.2: Table showing key transportation statistics for Calgary and peer regions

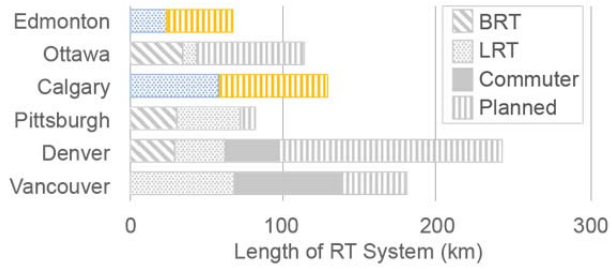
Service Area Population and Population Density[3]



Ridership and Transit Mode Share



Rapid Transit System Length



Transit Investment and Utilization

City	Rev. Hrs. per Capita	OpEx per Rider ($CAD)	Riders per Capita	Riders per Rev. Hr.
Ottawa	2.61	$3.82	111.3	42.7
Edmonton	2.26	$3.38	99.1	43.8
Calgary	2.03	$3.48	89.3	44.1
Vancouver	2.01	$3.95	93.7	46.5
Pittsburgh	1.67	$7.13	46.1	27.6
Denver	1.43	$5.68	26.7	18.7

Key success factors

- Strong downtown employment centre helps ridership, despite dispersed suburban population.
- Urbanized area is fully contained in city limits, allowing centralized municipal control of both land use and transportation planning.
- Low capital cost of LRT with few bridges and tunnels, at-grade crossings with signal priority, limited park-and-ride, and minimalist stations

Key challenges

- Greenfield land readily available, low density land uses, and 58% of housing is single-family detached.
- East-end industrial employment and west-end suburban homes are difficult to connect efficiently by high-capacity lines

[3] Service Area refers to the built-up area that receives regular scheduled transit service. This may be different from the municipal area as service may not extend to all parts of a city, or may extend well beyond municipal boundaries.

Calgary's mass transit plans include an additional LRT line connecting the North to the Southeast through downtown Calgary; this is known as the Green Line. This is planned as an urban low-floor LRT system that would not be directly connected to the existing Red and Blue Lines, and in fact would have an underground station below them at 7th Avenue and 2nd Street, to act as the City's future LRT hub.

The City has also implemented bus routes it has branded as BRT, including the predecessor route to the West LRT. Most of these BRT lines are in fact in-street rapid bus routes serving limited stops. However, the City has recently constructed its first segment of dedicated bus transitway in the median of 17 Avenue SE, from Barlow Trail to Hubalta Drive. This BRT segment interacts with other traffic at signalized intersections but runs in its own median lanes free of other vehicles.

While Calgary's initial low-cost LRT was perhaps a major factor in its ability to outpace Edmonton in total LRT length, it still faces challenges attracting a larger share of travellers. The network's focus on downtown and the relative lack of all-day frequent bus routes connecting to the LRT means that only 12% of residents and 37% of jobs are within walking distance of fast, frequent transit (City of Calgary, 2013). The implementation of the BRT lines, whether they are limited stop or true BRT services, will help address part of this issue.

Greenfield land is still available in the city, and the demand for low-density development is still strong, presenting a challenge for improved bus productivity. The City's growth and transportation plans both recognize the challenge and seek to encourage more compact growth.

4.2 Vancouver

TransLink is the transit agency for the Metro Vancouver area. It provides service to 21 municipalities across a 1700 km^2 service area with 2.5 million residents. TransLink is unique in having a mandate for both transit planning and major roadway planning in the region, and has dedicated funding sources legislated by the provincial government.

Service Area

Vancouver is home to about 630,000 people according to the 2016 Census, and is the largest municipality in the service area. Surrey to the south-east (population 518,000), Burnaby to the east (population 233,000) and Richmond (198,000) to the south are the other large cities in the region. TransLink therefore has a truly regional mandate, with 21 municipalities in its primary service area.

The Vancouver area has a very low proportion of single-family homes at just 29.4% (Statistics Canada, 2017b), which is just over half the rate of Edmonton at 57%. Housing is not, however, dominated by high-rise towers—only 16% of housing is over five storeys, with 25% of housing being five storeys or less. Employment is spread across the region due to a diversity in employment types, with downtown Vancouver, Central Broadway and University of BC being the largest employment districts. However, the centres of the other large cities such as Richmond and Surrey, the port areas, and railway lands are all significant.

Transit Network

TransLink operates three fully automated rail transit lines, a ferry, and a commuter rail line. The Expo line is the oldest SkyTrain line, opening in 1985. Subsequent expansion has built the 68 km network of lines spanning the region in exclusive rights-of-way, including elevated, underground and in trenched sections. While the system was initially marketed under the name ALRT, the system is not in fact LRT, as it is powered by third-rail style systems and cannot be crossed at grade. The Canada Line uses different tracks, power system and vehicles from the Expo and Millennium Lines, and is not interoperable with the other two.

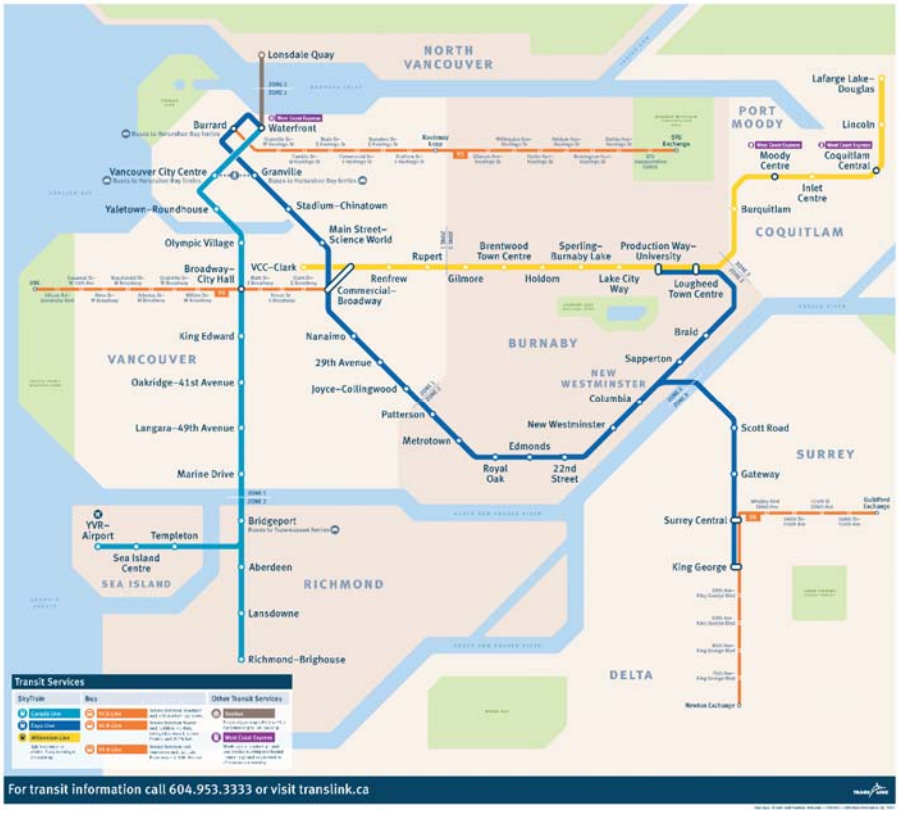
The West Coast Express commuter rail launched in 1995, extending 69 km from downtown to Mission providing peak period service.

TransLink also runs highly-successful express “B-Line” bus routes that feature some BRT elements. Exhibit 4.3 shows the current system, including the B-Line bus routes in Vancouver, Burnaby and Surrey.

TransLink is currently planning and carrying out preparations to extent the rapid transit system using several technologies, and in several parts of the region. To address regional growth objectives and deal with overcrowding on the 99 B-Line (on Broadway), the Millennium Line is planned to be extended west by several more stations, including an interchange with the Canada Line. There are also plans for a project in the City of Surrey; until recently this was going to be low-floor LRT, but local opinion appears to have shifted in favour of a SkyTrain extension and further B-Line services.

As part of its 10-year plan, other B-Line services are currently being developed and are expected to start entering service by the end of 2019, with four new corridors initially and others to be studied in the next few years.

Exhibit 4.3: Diagram of Metro Vancouver's existing rapid transit network (2018)



Source: TransLink

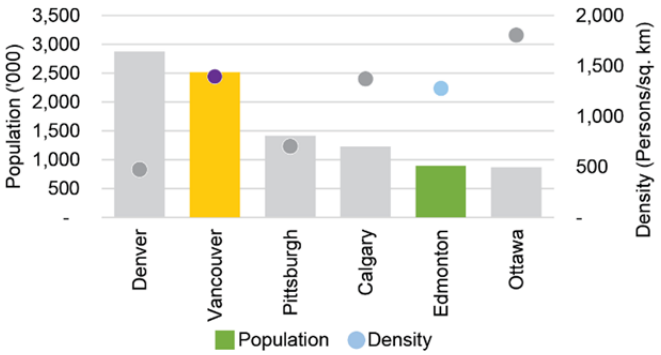
TransLink has also maintains a Frequent Transit Network (FTN)—a grid of bus routes operating at 15 minute headways or better in both directions, all day, every day. FTN routes connect with the rapid transit lines to effectively extend the catchment areas of the rapid transit lines, and as of 2015, 55% of residents lived within walking distance[4] of this subset of high-frequency transit services. Metro Vancouver's growth planning policies designate these same corridors as Frequent Transit Development Corridors (FTDC) for higher growth and densification, thereby funnelling people and jobs into areas with high-quality transit.

Exhibit 4.4 shows some important transportation statistics for the Metro Vancouver area. The population density is actually quite variable across the service area, with several downtown areas across the region, such as Vancouver, Burnaby, Surrey and Richmond, all featuring high-rise and dense mid-rise development. However, the service area also includes crossings of ocean inlets (many transit routes run non-stop across long bridges), the various channels of the Fraser River, and agricultural reserve lands, all of which are very lightly developed but have transit services. This makes the apparent density of the metropolitan area lower than perceived by residents, and by most users of the transit system.

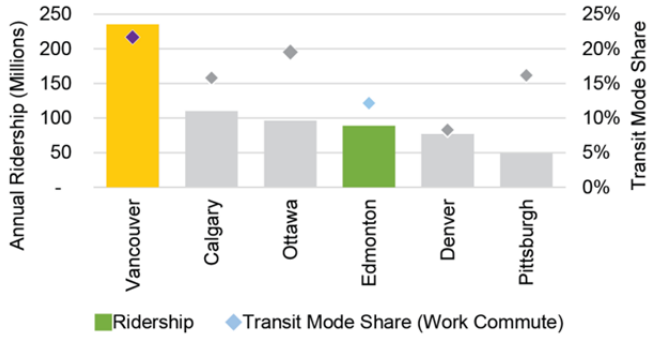
[4] Metro Vancouver's 2040 growth strategy uses a threshold of 400 m from a frequent transit stop and 800 m from a rapid transit station as the "walkable" area.

Exhibit 4.4: Key statistics for transportation in Metro Vancouver and peer regions

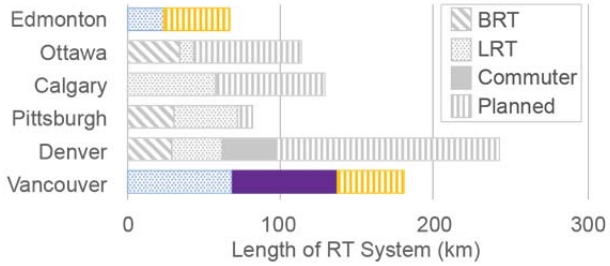
Service Area Population and Population Density[5]



Ridership and Transit Mode Share



Rapid Transit System Length



Transit Investment and Utilization

City	Rev. Hrs. per Capita	OpEx per Rider ($CAD)	Riders per Capita	Riders per Rev. Hr.
Ottawa	2.61	$3.82	111.3	42.7
Edmonton	2.26	$3.38	99.1	43.8
Calgary	2.03	$3.48	89.3	44.1
Vancouver	2.01	$3.95	93.7	46.5
Pittsburgh	1.67	$7.13	46.1	27.6
Denver	1.43	$5.68	26.7	18.7

Key success factors

- Frequent Transit Network (FTN) grid, even on weekends, provides access to quality transit to most residents in the central area.
- Co-manages major roads and bridges, with ability to make multi-modal transportation decisions.
- Vancouver includes some of the highest densities around transit stations in Canada, providing a large ridership base around transit.

Key challenges

- Major capital investments needed to keep pace with urban growth, but funding challenges remain
- Peak period overcrowding on rapid transit and FTN routes, including parts of the weekend, due to funding limitations versus high passenger demand
- High housing costs in the core are causing families to migrate to the suburbs where the transit network is not as frequent or convenient.
- Traffic congestion is starting to slow buses, and 1 in 3 routes had downward-trending travel speeds

Metro Vancouver stands out as a region with a long history of transit-focused development, both in terms of investment in transit service as well as encouragement of transit-supportive urban forms. Compact land uses, preservation of green space, and facilitation of active transportation modes are factors that make the region one where people want to live and transit succeeds.

TransLink's multi-modal mandate, stable funding, and deep involvement in transit-oriented and transit-adjacent development position it well to shape transport and land use in the region.

[5] Service Area refers to the built-up area that receives regular scheduled transit service. This may be different from the municipal area as service may not extend to all parts of a city, or may extend well beyond municipal boundaries.

4.3 Ottawa

OC Transpo provides transit service throughout the Ontario side of the National Capital Region. The agency serves the 480 km^2 urbanized area of the city, which was home to 867,000 people in 2015. OC Transpo exclusively manages transit issues, but reports directly to the City of Ottawa, which oversees all transportation modes in the service area.

Service Area

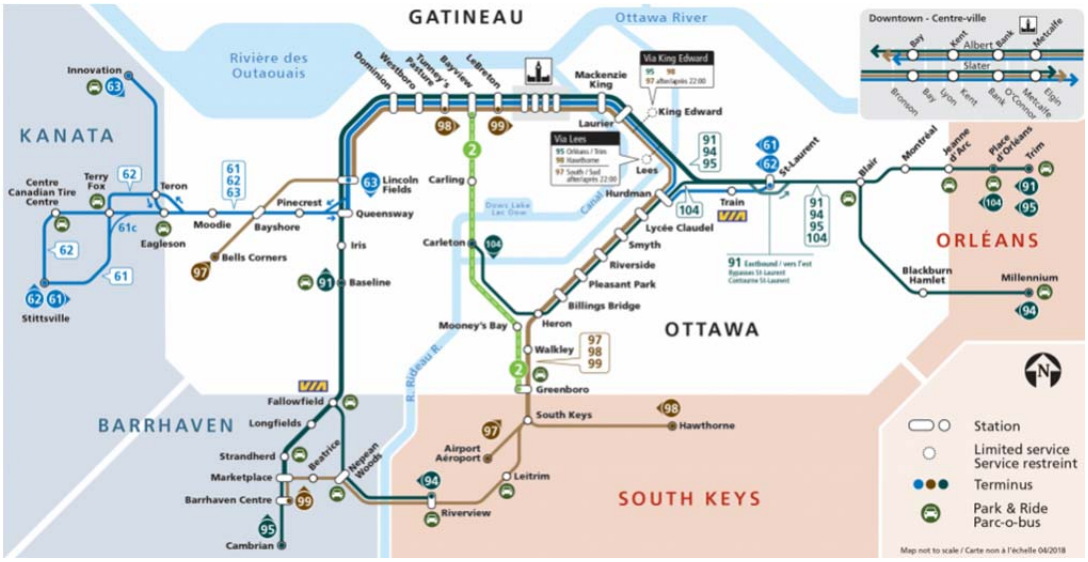
The National Capital Region's downtown core is split between Ottawa and neighbouring Gatineau in Quebec, which operates its own transit system. While some routes traverse the boundary, the two systems are only loosely integrated.

Roughly 45% of housing in the Ottawa-Gatineau region are single-family detached (Statistics Canada, 2017b), which is lower than Edmonton at 57%. Ottawa has a less suburban character than Edmonton, but is has a similar pattern of a dense downtown surrounded by a large suburban area. Downtown Ottawa is the centre of the federal government and accounts for 19% of jobs in the region (IBI Group, 2016). Suburban employment is growing—Kanata in the west is an emerging high-tech centre—and the suburbs are becoming more self-contained.

Transit Network

OC Transpo's existing rapid transit network is almost exclusively bus-based. The Transitway BRT opened in 1983 as an exclusive busway allowing fast, reliable bus travel. It has since expanded to a 35.4 km network spanning the entire city. The 8 km O-Train LRT opened in 2001, bisecting the city and linking the Transitway along a north-south axis. Downtown, the Transitway runs in a single bus-only lane in each direction along two busy streets, rather than exclusive rights-of-way like the rest of the system. Exhibit 4.5 shows a map of the current rapid transit network in Ottawa.

Exhibit 4.5: Map of Ottawa's rapid transit network



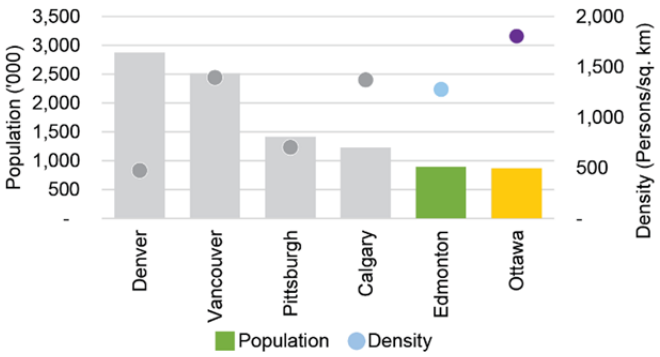
Source: (OCTranspo, 2018)

Ottawa's conversion of 12.5 km of the east-west segment of the Transitway through downtown from BRT to LRT will open in 2019. A much-debated element of the upgrade was whether to bury the downtown segment as was done in Edmonton and Pittsburgh. High traffic congestion along the Transitway in this segment has long been a problem, as dozens of buses from across the city converge here during peak periods. Three underground stations have been built so far, with the expectation that speed and reliability through the segment will be much improved.

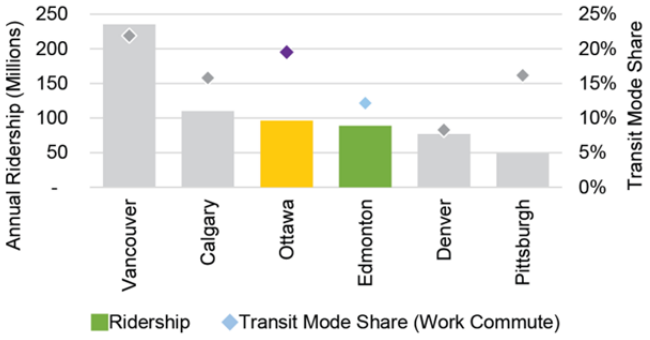
Exhibit 4.6 shows some important transportation statistics for Ottawa and other peer regions.

Exhibit 4.6: Table of key transportation statistics in Ottawa and peer regions

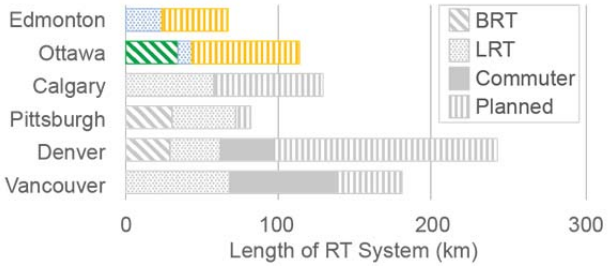
Service Area Population and Population Density[6]



Ridership and Transit Mode Share



Rapid Transit System Length



*Much of Ottawa's BRT is being replaced by LRT over multiple phases of upgrades opening in 2018, 2021, 2022, and 2023.

Transit Investment and Utilization

City	Rev. Hrs. per Capita	OpEx per Rider ($CAD)	Riders per Capita	Riders per Rev. Hr.
Ottawa	2.61	$3.82	111.3	42.7
Edmonton	2.26	$3.38	99.1	43.8
Calgary	2.03	$3.48	89.3	44.1
Vancouver	2.01	$3.95	93.7	46.5
Pittsburgh	1.67	$7.13	46.1	27.6
Denver	1.43	$5.68	26.7	18.7

Key success factors

- Local buses provide coverage and feed the BRT at well-designed, integrated stations.
- Express bus lines extend well into the suburbs and join the BRT for fast travel times to downtown.
- Strong core of destinations creates a natural focal point for high-capacity BRT from the suburbs.

Key challenges

- Dozens of buses converge on single-lane downtown segments, causing major congestion.
- Slow densification of brownfield sites in some station areas due to issues unrelated to transit
- Rapid greenfield suburban growth is lengthening average transit trips in the region.

Ottawa's high transit mode share is notable for a city its size, and reflects the success of the Transitway. OC Transpo has leveraged the flexibility of the busway to route many frequent local buses directly onto the corridor, so riders benefit from quick transfers in heated, sheltered stations. Suburban riders also benefit from park-and-ride lots adjacent to BRT stations as well as express bus routes that operate like local routes in the outer suburbs and join the Transitway for limited stop service to downtown.

[6] Service Area refers to the built-up area that receives regular scheduled transit service. This may be different from the municipal area as service may not extend to all parts of a city, or may extend well beyond municipal boundaries.

Suburban growth has outpaced urban intensification, but transit ridership in the suburbs is growing as well. Focusing employment in areas that are served by transit has helped the city to keep ridership strong, even as new jobs emerge in the suburbs. The replacement of the central section of the bus transitway with LRT is anticipated to boost capacity on that line, and allow reallocation of bus service hours to other parts of the transit system.

Weather/Climate Effects

There is some speculation in the public and the news media from time to time that weather or climate can act as a barrier to transit usage. On an anecdotal basis, this is going to be true for individuals, either because of personal preferences or mobility-related issues that factor into travel decisions.

To make a transit system more attractive to regular, occasional and potential passengers, it is possible to invest in service, infrastructure and public information enhancements that make travel easier and more comfortable.

It is interesting to note, however, that cities like Ottawa, Edmonton and Calgary all experience significant winter weather, and manage to significantly out-perform the peer Cities from the US that are included in this report, in terms of transit rides per capita. This is not restricted to the Cities in this report, studies conducted for the BC Ministry of Transportation in 2007 revealed that the pattern was consistent across nearly all Canadian and US cities: for similar sized metropolitan areas, Canadian cities, which by and large experience as much or more winter, outperform their US peers. The only exception to this was New York City, which is more in alignment with the ‘demand curve’ of Canadian cities than with the rest of the United States.

On a related note, November is often the heaviest month of rainfall in Vancouver, which one would might expect would be a barrier to ridership. In fact, November is often one of the busiest months each calendar year, with November 2018 being the highest single month of transit boardings (nearly 40 million), even more than during the 2010 Olympics when demand management was in effect to reduce automobile usage.

4.4 Pittsburgh

The Port Authority of Allegheny County (PAAC) is the transit provider for Allegheny County in Pennsylvania, which includes Pittsburgh and 129 surrounding municipalities. PAAC serves a region of 2,007 km^2 with over 1.4 million residents. It focuses on planning and delivering transit and some tourist-oriented services, but is not involved in delivering other modes.

Service Area

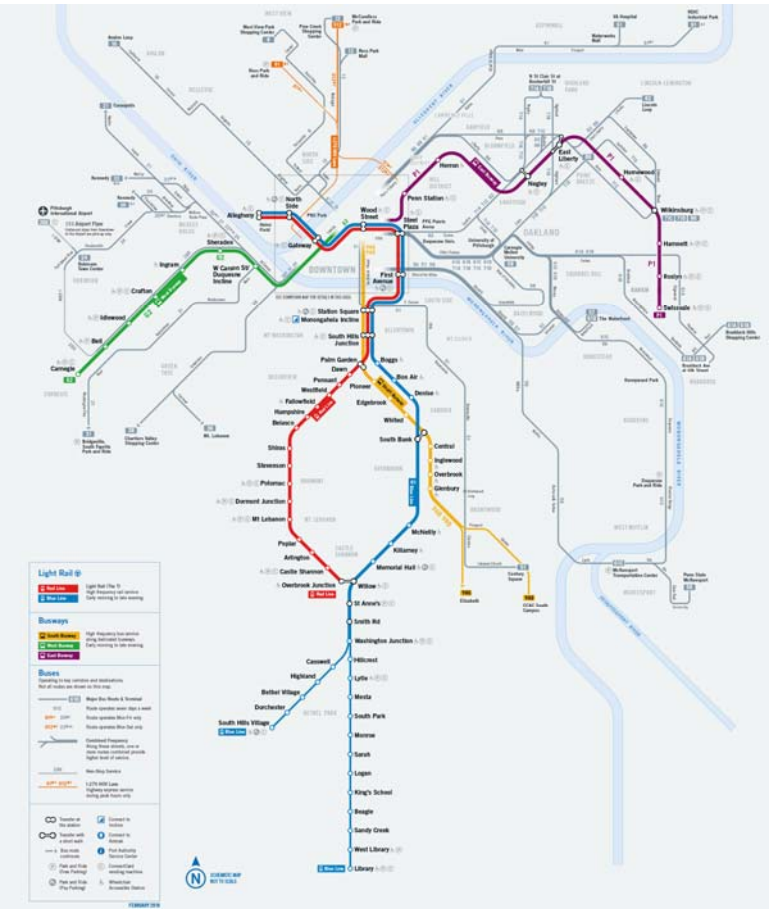
Pittsburgh, with 306,000 people in 2015, is by far the largest city in the region. The next largest community is the Township of Penn Hills at 42,000. Coordinating transit and developing dense, walkable communities across dozens of small municipalities can be complex but PAAC is supported by a County government with executive and legislative powers.

Allegheny is very suburban—single-family detached homes make up 61% of housing (U.S. Census Bureau, 2016). Downtown Pittsburgh and the Oakland neighbourhood 5 km away (home to Carnegie Mellon University, University of Pittsburgh, and the Carnegie Cultural Complex) are key employment centres.

Transit Network

PAAC's radial network evolved from streetcar and heavy rail corridors. The Martin Luther King Jr. exclusive busway opened in 1983, and the first LRT opened in 1984 along dedicated tracks running south from downtown. Exhibit 4.7 shows the current system, which comprises 30 km of BRT and 42 km of LRT, including a downtown underground segment.

Exhibit 4.7: Map of Allegheny County's rapid transit network

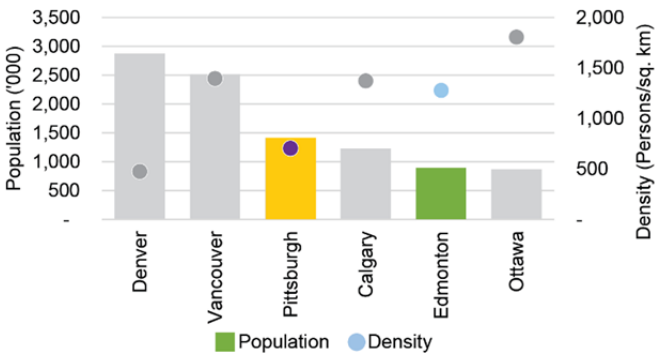


Source: (Negoda, 2016)

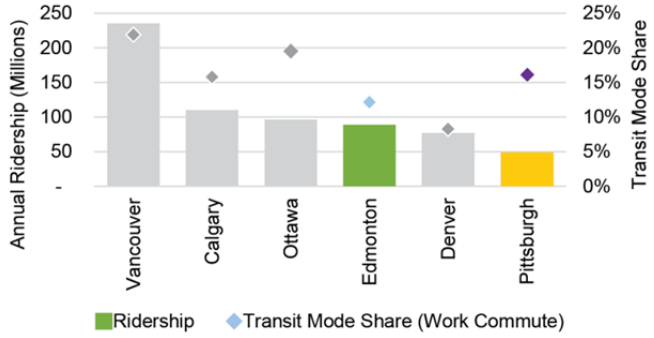
PAAC has kept up expansion and is currently planning 12 km of new BRT operating in exclusive lanes along existing streets. Capital and operational funding challenges have been persistent, however, with no dedicated funding before a 2013 State law7 was passed. Exhibit 4.8highlights some key statistics for the Pittsburgh region, as well as comparisons with other peer regions.

Exhibit 4.8: Table of key transportation statistics in Allegheny County and peer regions

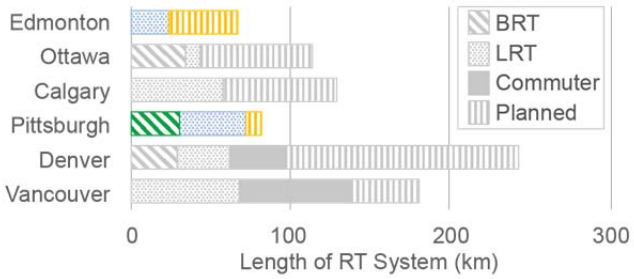
Service Area Population and Population Density[8]



Ridership and Transit Mode Share



Rapid Transit System Length



Transit Investment and Utilization

City	Rev. Hrs. per Capita	OpEx per Rider ($CAD)	Riders per Capita	Riders per Rev. Hr.
Ottawa	2.61	$3.82	111.3	42.7
Edmonton	2.26	$3.38	99.1	43.8
Calgary	2.03	$3.48	89.3	44.1
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Pittsburgh	1.67	$7.13	46.1	27.6
Denver	1.43	$5.68	26.7	18.7

Key success factors

- Old rail corridors provided suitable rights-of-way for modern rapid transit lines.
- BRT and LRT rarely operate in mixed traffic, so travel times are very competitive with driving.
- Employment remains strong downtown, even as many residents have moved to the suburbs.

Key challenges

- Steep hills and rivers form natural constraints to development of the network.
- Core city has many old narrow streets where it is difficult to operate a lot of large buses.
- Many station areas are brownfield sites that are expensive to redevelop as transit-oriented

PAAC has simultaneously built out its core rapid transit lines and frequent bus network, given that the high-capacity lines alone would not serve the region. 71% of residents and 90% of jobs are within walking distance of the FTN (Center for Neighborhood Technology, 2018), partly explaining the strong transit mode share.

Local and express buses in the suburbs connect to the exclusive busways, improving reliability and travel times while reducing the need for transfers in some cases. Travel by transit from the suburbs to the main employment areas in Pittsburgh is competitive with cars for many residents.

[7] Act 89 creates a new Multimodal Fund that ensures funding is available for non-auto modes (Pennsylvania Department of Transportation, 2014)
[8] Service Area refers to the built-up area that receives regular scheduled transit service. This may be different from the municipal area as service may not extend to all parts of a city, or may extend well beyond municipal boundaries.

4.5 Denver

Transit in the Denver-Aurora-Boulder region in Colorado is provided by the Denver Regional Transit District (DRTD). Centred on downtown Denver, DRTD's service area spans 6,061 km^2 across 40 municipalities and 2.8 million people. While their jurisdiction is geographically large, it is narrowly focused on transit and does not plan, build, or operate other modes in the region.

Service Area

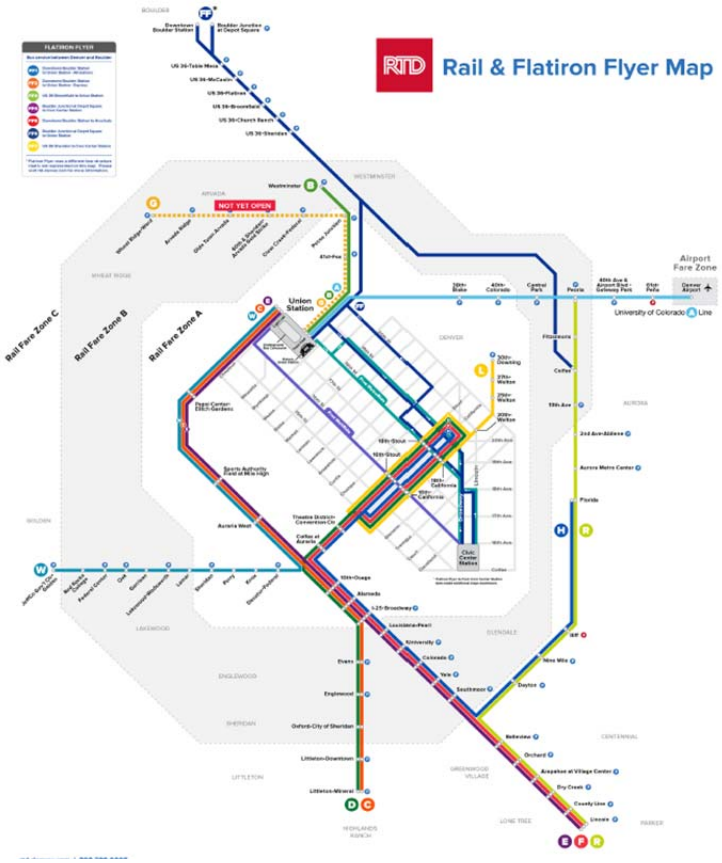
Denver, with a 2015 population of 681,000, lies at the heart of the region, and the region's other large cities include Aurora (359,000 people) and Boulder (107,000 people). DRTD therefore has significant service obligations beyond the urban core, creating the type of city-region dynamic that Edmonton may face as its region approaches 3 million people.

Single-family detached homes make up 59% of housing in the region (U.S. Census Bureau, 2016), giving it a suburban character much like Edmonton. Downtown is the largest employment hub, followed by the Denver Tech Center that straddles the border of Denver and Greenwood Village about 24 km to the south.

Transit Network

DRTD has a radial, LRT-focused network, with some BRT and commuter rail as shown in Exhibit 4.9. The first LRT line opened in 1994 with just 8.5 km of track, with another 90 km of routes built from 2000-2015. The approach has been to build rapid transit lines first, with less emphasis on building a frequent grid of buses connecting the lines.

Exhibit 4.9: Map of Denver Regional Transit District's rapid transit network

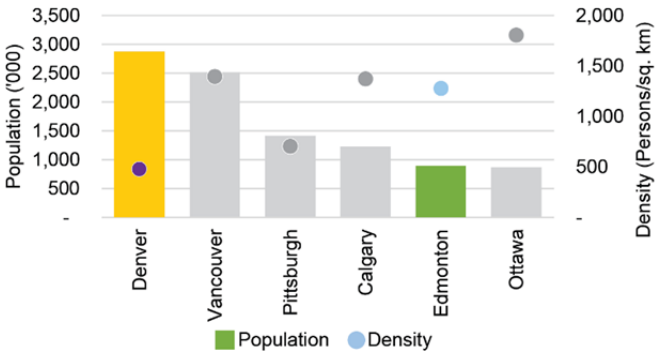


Source: (Denver Regional Transit District, 2018a)

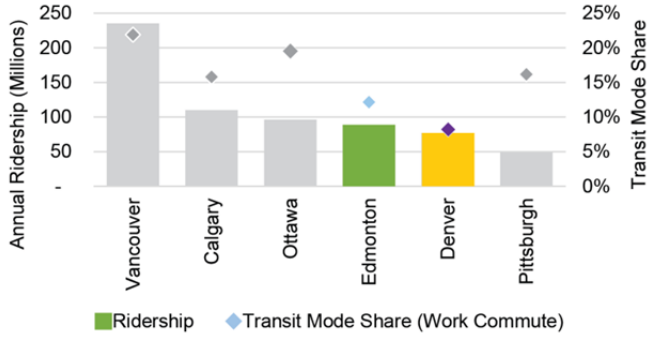
DRTD's mass transit expansion program, called FasTracks, launched in 2004 with a plan to build 225 km of new LRT, BRT and commuter rail, funded in part by a 0.4% sales tax approved by residents in a vote. FasTracks is also funded by public-private partnerships and DRTD is allowed to enter debt financing arrangements for capital expansion. Exhibit 4.10 highlights some key statistics for the Denver region, as well as comparisons with other peer regions.

Exhibit 4.10: Key transportation statistics and observations in Denver-Aurora-Boulder

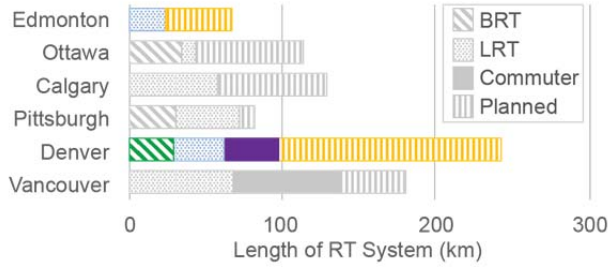
Service Area Population and Population Density



Ridership and Transit Mode Share



Rapid Transit System Length



Transit Investment and Utilization

City	Rev. Hrs. per Capita	OpEx per Rider ($CAD)	Riders per Capita	Riders per Rev. Hr.
Ottawa	2.61	$3.82	111.3	42.7
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Vancouver	2.01	$3.95	93.7	46.5
Pittsburgh	1.67	$7.13	46.1	27.6
Denver	1.43	$5.68	26.7	18.7

Key success factors

- Dedicated funding source through sales tax, ability to take on debt, and novel public-private deals
- Actively promotes dense transit-oriented developments in station areas, adding ridership
- LRT and BRT operate in dedicated rights-of-way, maintaining speed and reliability along the lines

Key challenges

- Front-loading major rail projects makes the system costly to operate presently in per-capita terms
- Denver is only 25% of regional population, and bus productivity is low in the low-density suburbs
- Suburban TOD projects still auto-oriented with large parcels, surface parking, little walkability

The Denver region illustrates the path of an urban area that has historically not emphasized rapid transit development, densification and walkability in urban areas, or strong grids of frequent, high-quality transit. The recent push to alleviate the region's traffic congestion and address urban sprawl won public support for higher taxes, and DRTD has been successful in opening 90 km of new rapid transit in just 15 years.

However, the low transit mode share of about 8% for peak period commuters is instructive. Rapid transit corridors tend to have narrow catchment areas when not supported by high quality, frequent buses to bring riders to the stations. Moreover, densification of station areas must follow a well-planned, walkable urban form to result in the large ridership and transit mode share gains typically expected from transit-oriented development projects.

4.6 Success Factors

Many studies have been done under the Transit Cooperative Research Program (TCRP) to identify, through empirical research and advanced modelling, the elements of a successful transit system. In the context of the TCRP reports, “success” is narrowly measured through improved transit mode share and increases in transit ridership, since those measures tend to lead the way in competing for Federal funds in the United States.

For Edmonton, these are just two of the factors, and since this study is being carried out as one component of the City Plan, the selection of a land use concept and supporting policies (including the mass transit strategy) will be based on factors related to all four aspects of the Council Strategy, as identified in Section 1.

Four TCRP reports were reviewed to provide context for the successes and challenges observed across the peer systems in this paper, as follows:

- Report 167 looked at the best investments to improve ridership on rapid transit systems (Chatman, et al., 2014);
- Report 111 assessed the elements of successful transit systems across the US (TranSystems, 2007);
- Report 16 looked at the link between transit and urban form (Parsons Brinckerhoff Quade & Douglas Inc., 1996); and
- Report 102 focused on the benefits, challenges, and prospects of Transit Oriented Development (TOD) in the US (Cervero, et al., 2004).

4.6.1 Recurring Success Factors for Mass Transit

Taken together, alongside data from the peer systems, the following success factors were identified:

- Supportive urban form and densities (measured as number of people and jobs located near rapid transit stations);
- Length of exclusive right-of-way transit available, and the strongly related Travel time competitiveness with the car; and
- Frequent Transit Network (FTN) coverage.

This section further defines these factors, drawing on illustrative examples from the peer systems reviewed. These factors can be applied to the definition of mass transit options for the City of Edmonton, but should also help inform the policy framework of the broader City Plan. The specific measures and metrics that have been identified here will be applied during the next steps of the study to help define and evaluate options during the course of this study.

Supportive Urban Form and Densities

What it is	A measure of how many residents and jobs are within walking distance of fast, reliable transit; fostered by coordination between mass transit planning and the adjacent land use conditions, planning and policies
How we can measure it	Share of service area population and employment within 800 m of rapid transit stations.

The density of people and jobs within 800 m of rapid transit stations is highly correlated with ridership. It follows that the more people that can easily access high quality transit, the higher ridership will be (densities that support various forms of transit are presented in Chapter 5). However, density alone is not sufficient and compact urban form, a rich mix of land uses in

station areas, well planned pedestrian and cyclist amenities, and good supporting transit routes are major contributors to success.

Transit-Oriented Development (TOD)—defined by (Cervero, et al., 2004) as a pattern of dense, diverse, pedestrian-friendly land uses near transit nodes that, under the right conditions, translates into higher patronage—is one way to concentrate growth near stations.

TransLink in Metro Vancouver has long encouraged TOD and transit service in TOD areas involves much more than just the central rapid transit station. Its Frequent Transit Network serve the station area well and is tightly integrated with Metro Vancouver's "Centres and Corridors" development strategy while TransLink's Adjacent and Integrated Development program seeks to physically integrate developments and transit. Ridership and transit mode share partly reflect the success TransLink has had. The Vancouver region and the municipalities on its rail-based rapid transit lines have quite deliberately staged the development around stations to ensure that 'critical mass' is achieved when infill development and redevelopment take place. A visual scan of the skyline in the Vancouver area reveals a pattern where higher-density nodes occur every three to four stations apart, encouraged by zoning regulations around specific stations (or pairs of adjacent stations).

Conversely, TOD is new to the Denver area. The 30 km Southeast Rail Corridor is a light rail corridor that parallels a major freeway and connects two employment areas—central Denver and the Southeast Business District, together employing over 180,000 people[9]—with suburban neighbourhoods in the south. Prior to opening of the LRT in 2006, suburban station areas were a mix of auto-oriented business parks and large parcels of recently-converted agricultural land. The push for TOD around these stations did encourage development: residential development infill complemented the existing suburban commercial lands and new land uses emerged on previously vacant land.

However, many of the developments around the suburban stations feature superblocks (reflecting the large agricultural parcels), sparse connecting bus lines, and buildings oriented toward large parking lots rather than toward the stations. Only 11% of 138 businesses surveyed in the corridor rated proximity to transit highly as a reason for locating there (Fogarty & Austin, 2011).

Length of Dedicated/Exclusive Rapid Transit Infrastructure

What it is	The total length of rapid transit infrastructure in the service area
How we measure it	Length of rapid transit running at short headways in exclusive rights of way, measured in km

Dedicated rapid transit infrastructure helps to ensure the reliability and speed of transit, even in busy downtown neighbourhoods. These attributes have a strong influence on a traveller's mode choice, making them important to a city's overall ridership and transit mode share. Studies confirm that separating high-capacity transit from car traffic is one of the strongest determinants of transit success (Chatman, et al., 2014).

Ottawa's Transitway BRT is almost entirely separated, except the critical downtown segments where buses only have a dedicated lane along busy city streets. The extent of these exclusive corridors makes downtown Ottawa very accessible by transit from all corners of the city, and is a large factor in Ottawa's high transit mode share for a city its size. Given that a large share of jobs are in the core, providing dedicated infrastructure here was an important factor in the city's

[9] An additional 30,000 jobs are located along the corridor (Denver Regional Transit District, 2007).

debates on how best to upgrade from BRT to LRT.

Denver RTD's transit enhancement plans have focused almost exclusively on building dedicated rights-of-way for rapid transit, recognizing that strong reliable arteries are needed to move the millions of people in the region. Commuter rail and LRT are mostly separate (some LRT segments run in dedicated curb lanes downtown) and BRT runs in express lanes along the freeway. The goal is to grow from less than 10 km of dedicated infrastructure that existed prior to 2000, to about 225 km of higher-order corridors.

This particular factor is strongly related to the next one, but is specifically related to the speed and reliability of the rapid transit elements of the mass transit system.

This measure goes beyond travel time competitiveness, because it also speaks to the convenience of the system to transit passengers who are non-auto users either by choice or due to other factors such as age, auto ownership or health issues.

Travel Time Competitiveness (Transit-Auto Travel Time Ratio)

What it is	A comparison of the average travel time by transit versus by car
How we measure it	Weighted average travel time by transit for typical trip versus travel time by car for a similar trip

Travel time is one of the strongest influences on a traveller's mode choice. Transit that offers competitive travel times with the car tends to attract more riders.

In Metro Vancouver, the West Coast Express commuter line offers faster travel times to downtown Vancouver compared to driving, making it a popular choice. In the Denver area, the average transit travel time in five out of seven rapid transit corridors was similar to the average auto travel time according to (Denver Regional Transit District, 2018b). Notably, auto travel times and travel time variability are increasing as congestion worsens, putting transit on track to become the faster mode into the CBD.

Commuter rail lines often match or beat auto travel times, but for rapid and frequent transit it is not necessary for transit to match auto travel times to be attractive. The Transit Capacity and Quality of Service Manual indicates that transit travel times up to 30 minutes longer than auto are still tolerable by "choice riders". [One of the reasons this can be true is that auto operating costs, especially parking at the destination end, can be a deterrent that offsets some of the travel time difference, if any exists, of using transit instead.] As cities become very large and traffic congestion grows, opportunities emerge to develop reliable transit infrastructure that can effectively compete with the car in key corridors, typically for trips into the CBD.

It is critical, however, to consider wait times and transfer times when evaluating transit travel times. As (Charles River Associates Inc, 1997) highlights, very competitive travel times on a rapid transit corridor do not result in strong ridership gains if the access and transfer times at the ends of the line are long or highly variable.

Frequent Transit Network (FTN) Coverage

What it is	A measure of the extent of the network of high quality transit service
How we measure it	Percentage of service area population and jobs that are within 400-800 m of frequent transit (defined as routes running every 15 minutes or better)

Rapid transit lines provide strong corridors of service but in many cities, the bulk of ridership is carried by the supporting bus network. As discussed before, densifying transit station areas creates destinations along a line but it is the grid of frequent services that connect to those stations that funnel riders to and from the main corridors every day. TCRP Report 111 (TranSystems, 2007) concluded that improving frequency is a cost-effective way to boost

ridership across transit modes, and is a key element of success seen with agencies serving more than 1 million people.

Exhibit 4.11 compares the FTN coverage of Allegheny County and Denver, as well as the respective commuter transit mode shares in those regions. Denver's transit evolution has so far focused on the large rapid transit infrastructure projects, meaning that while residents living and working directly along the corridors have access to quality transit, many of the region's 2.8 million residents still lack access. In these US examples, the FTN coverage is defined as 15 minute (or better) service during peak periods.

Exhibit 4.11: Comparison of Frequent Transit Network coverage and transit mode shares in Pittsburgh and Denver

Peer Region	% of Pop. Near FTN	% of Jobs Near FTN	Commuter Transit Mode Share
Allegheny County (Pittsburgh)	71%	90%	16%
Denver	31%	52%	8%

Sources: (Center for Neighborhood Technology, 2018)

Metro Vancouver has a well-defined FTN consisting of a grid of routes running at 15 minute headways or better in both directions, *throughout the day, every day*. This goes well beyond the peak period definition used by the US examples.

TransLink's service guidelines specify that stops are typically 300-800 m apart and corridors are relatively dense at 40-100 people and jobs per hectare (ha). The FTN works in tandem with the region's "Centres and Corridors" strategy that funnels development to areas that can be well served by transit. The rapid transit network, including rail-base and limited stop rapid buses, is complemented by the FTN to form a much larger and more extensive mass transit system.

4.6.2 Other Transit-Supportive Policies

Improving transit alone is not always sufficient to improve transit mode share and ridership significantly. Other peer studies (Charles River Associates Inc, 1997) confirm that given relatively high car ownership rates, car owners not only need incentives to take transit, but also strong disincentives to driving.

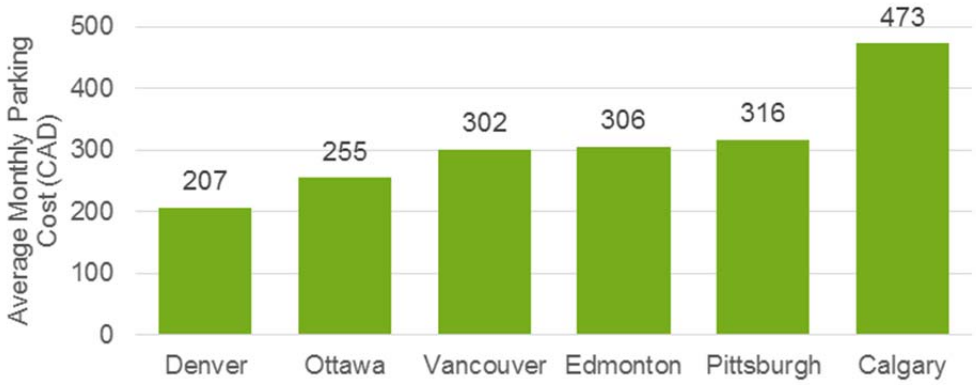
Two broad categories of policies that relate to this are:

- Parking availability (supply) and pricing – including park and ride strategies; and
- Multi-modal transportation planning and system management.

Parking Availability and Pricing

Calgary has pursued a deliberate policy of strictly managing parking through its Downtown Parking Strategy. For example, the strategy limits the amount of parking that can be built for office towers and eliminates the cash-in-lieu policy that is common in many cities. Exhibit 4.12 shows the average monthly parking cost in the peer regions. Parking in downtown Calgary is the most expensive in Canada and second only to New York City in North America, making auto commutes into the core relatively expensive compared to taking transit.

Exhibit 4.12: Average monthly cost of parking in downtown core of peer cities



Sources:
US Cities – City Observatory 2016 data compiled from independent parking providers: http://cityobservatory.org/the-price-of-parking/. Costs converted to CAD using Bank of Canada's 2016 exchange rates.
Canadian Cities (2014 data) – (Toneguzzi, 2014)

In addition to raising parking rates or constraining the amount of parking, it is important to simultaneously improve transit. The University of British Columbia's Vancouver campus (UBC) is the second largest commuter destination in Metro Vancouver so policies that influence travel choices to the campus have a significant impact on the rest of the region. When UBC cut on-campus parking and introduced its TREK TDM program in 1997 (enhanced by the U-Pass discounted transit program in 2003), TransLink worked with the university to add new local and rapid routes, increase transit frequencies, and expand its late night service. Transit mode share to UBC increased from 18% to 55% between 1997 and 2012 as a result (University of British Columbia, 2014).

Park and Ride Strategy

Provision of Park and Ride can be a contributing factor to building ridership on transit systems. Park and ride lots have traditionally been across North America and much of Europe and Australia to attract passengers onto rail transit (commuter rail, heavy rail or light rail), to regional transit centres, and to rapid/express bus stations. Passengers from more dispersed origins may lack direct or frequent local transit service to the station or transit centre, and so that leg of the journey is more convenient by automobile. Incentives for passengers include avoidance of traffic congestion, lower parking and auto operating costs, and better use of commute time.

Park and ride is complex but planned and managed properly can be a contributor to higher ridership. The demand for park and ride depends on several factors: travel time comparison with drive-only, availability and cost of parking at the ultimate destination, and distance. Some cities have formal rules (or planning policies) that park and ride lots only be located outside a minimum radius (for example 5km) from the Central Business District and other major destinations. In addition, park and ride lots are sometimes minimized or restricted from transit stations serving as suburban hub locations, since the transit system's objective is usually not to provide spillover parking for developments, nor to undermine transit mode share targets for designated hubs.

Park and Ride demand is linked to providing access to the right services going to the right destinations. As noted in Section 3.1, the Edmonton region sees over 8,500 passengers in the AM peak using park-and-ride access to transit.

Multi-Modal Mobility Management (Coordinated Transit, Active Modes and Streets Planning)

Another transit-forward approach is to adopt a multi-modal approach to transportation planning. This is referred to as the "Mobility Management" approach to coordination of all transportation

(Hemily, 2004), and academic studies have shown how it has been successful in jurisdictions beyond the scope of this peer review.

TransLink in Metro Vancouver stands out among the peers for having responsibility for both transit and major road planning, allowing a more holistic approach to moving people and goods. That organization is able to push right-of-way designs that facilitate pedestrian and cyclist access to transit facilities, and prioritize transit vehicles in key corridors. It should be noted that while TransLink partners with municipalities through the Major Road Network and Regional Cycling Networks, the provincial Ministry of Transportation retains control over the highway system. Investments there are driven by different objectives, sometimes supporting transit, but also encouraging greater usage of SOV/HOV automobiles. This challenge is common to many North American urban regions.

While RTD in Denver and the Port Authority in Allegheny County have broad authority to build comprehensive transit across multiple municipalities, they lack this multi-modal mandate that has made TransLink in Metro Vancouver successful.

Note, however, that it is not a requirement for transit agencies to also manage roads in order to engage in multi-modal planning. (Litman, 2017) highlights that beyond integrated institutions, multi-modal planning involves consideration of indirect impacts of roadway expansion, which could include quality of access for non-drivers and land use development impacts among other factors. Generally, given the limited funds typically available to cities for transportation infrastructure investment, the ability to balance the pace of auto-focused investment with investment in transit, pedestrian, and cycling networks significantly impacts the range of mobility choices available to residents.

4.6.3 Summary – Key Measures

Exhibit 4.13 is a brief summary of the key measures of success identified through the peer review. Most of these measures relate directly to the mass transit and the land use around the station locations. One measure, the FTN coverage, pertains to the mass transit network – it performs better if operated frequently, but also to the urban transit network around the mass transit spine, which is what connects the rest of the city.

Exhibit 4.13: Key Measure of Success Metrics for Mass Transit

Measurement/Metric	Why It Matters
Number of residents and jobs located near rapid transit stations	Serving More Passengers, Supporting Land Use Objectives
Length of exclusive right-of-way transit available	Reflects Speed and Reliability for Transit Dependent and Choice Riders; *also supports the next measure*
Travel time competitiveness with the car	Support mode share and sustainability objectives
Frequent Transit Network (FTN) coverage	Connectivity beyond the basic rapid transit network, integration of services
Parking cost/availability at destination(s)	Higher parking prices are a stronger deterrent than fuel or ‘sunk costs’ of auto ownership

Measures such as these will be applied once the general shape of the different transit networks has been identified, to select representative alignments and stations that hold the most promise, based on the information the team will have at hand in early 2019.

Other lessons learned, which can be applied in part to defining network structure:

- Having **multiple anchor destinations** along a mass transit line increases ridership and spreads demand across more of the day;
- Exclusive infrastructure is one way to **improve transit speed and reliability**, with the capacity limitations of what is built. Operating transit in mixed traffic tends to reach a capacity limitation sooner, often due to platform space at stations. This points to the importance of considering multiple parallel or crossing services into a major node or hub, rather than strictly interlining services.
- **Bus rapid transit and busways** can be an effective and flexible way to connect disperse trips ends to a set of more central destinations, such as what was achieved in Ottawa and to a lesser extent in Pittsburgh.
- **Limited stop buses** are a highly flexible form of mass transit, with some limitations due to operations in traffic; nevertheless, these routes can be highly productive, especially when linked to a major destination. Vancouver's University of British Columbia is such a significant focal point that several rapid and semi-rapid routes **operate in parallel on different corridors** to share the demand, with the added benefit of providing limited stop service to other passengers. Note that these busy routes are crosstown.
- Investment in **higher-capacity infrastructure** can sometimes be the long-term outcome of a highly successful mass transit service with medium to medium-high capacity. Continuing from the previous point, the service to UBC in Vancouver will be provided by medium-capacity heavy rail (a SkyTrain extension) working in parallel with limited stop and local bus routes on other corridors.

5 Transit Mode Classifications

At its most basic, public transportation is simply a means of conveyance made available by a government agency, but there is a wide range of infrastructure, vehicles, and operational characteristics that distinguish transit modes. Carefully matching each mode to the operating environment and to City's strategic goals is essential to effective use of the City's resources.

This chapter presents the characteristics of a range of transit modes to formally categorize the options available to Edmonton as it approaches 2 million residents. Section 5.1 presents the categories of service and types of right of way, while Section 5.2 provides an overview of the range of capital and operating costs. As expected, there are trade-offs between the level of investment and the quality of transit service that can be provided. In Section 5.3 the existing services in Edmonton are discussed to highlight what is available, and what gaps may need to be filled as the city and the region grow.

5.1 Family of Transit Services

Increases in suburban populations and development of job opportunities outside the CBD have led to a shift in traditional radial travel patterns that historically focused on a dense urban core. In many regions, transit must now cater to a variety of travel markets that demand multiple modes. A family of transit services, each targeted at a specific market segment, provides a customer-oriented approach that optimizes resources to best serve residents (Hemily, 2004).

Transit services can be summarized into the three categories shown in Exhibit 5.1. Each major category is distinguished by whether mobility (the ability to move quickly over long distances) or accessibility (how many places can be reached within walking distance) is prioritized.

Exhibit 5.1: Summary of main categories of transit services

Category	Description	Trip Market
Regional	Routes are typically over 25 km long connecting distant urban centres with relatively few stops along the way. These services compete with freeway driving for long trips between urban centres, and amenities like free WiFi, park-and-ride lots, and comfortable seating are prioritized. **Mobility is prioritized over accessibility.**	Long inter-community; Commuters
Rapid	Lines connect neighbourhoods within dense urbanized areas. Stop spacing can be as close as 500 m in the CBD, and up to 2 km at suburban ends of the lines, typically in exclusive rights of way. They provide a fast alternative to driving on congested city streets. Moving a lot of people quickly is prioritized over high-end amenities. **Mobility and accessibility are typically balanced.**	Intermediate length intra-community
Urban	Routes provide coverage within neighbourhoods and connect to rapid transit lines. Close stop spacing (even on-demand routing) ensures that almost all residents are within walking distance. Mixed traffic operations make these the most flexible and least capital intensive services offered. **Accessibility is prioritized over mobility.**	Short intra-community; Connection to higher order modes

Exhibit 5.2 shows typical attributes of various transit modes that make up the family of services, grouped into the categories presented in Exhibit 5.1. It is the combination of these attributes that defines a transit mode, rather than any specific attribute viewed in isolation. Furthermore, the values provided are not precise and local conditions sometimes warrant services that do not fall squarely into these definitions.

Exhibit 5.2: Attributes of each mode in the Family of Transit Services

Mode	Right of Way[1]	Stop Spacing (km)	Operating Speed (kph)	Trip Length (km)	Peak Headway (min.)	Density (people + jobs/ha)	Capacity (1000 riders/hr.)[3]	Examples	Benefits	Challenges
Regional										
All Day	A/B	2-8	30-60	>15	≤15	Varies[2]	3 – 40	• Passenger train • Highway coach (Bus)	• Competitive with auto for long trips • Reduces CBD congestion	• ROW A can be costly given long distances • Costly station parking & road improvements
Peak Only	A/B	2-8	30-60	>15	≤30	Varies[2]	3 – 40	• As above, but only commuter services	• Reduces CBD congestion • Restricting service times lowers OpEx	• Does not serve non-work based trips well • Costly station parking & road improvements
Rapid										
Exclusive ROW	A	1-2	30-40	5-15	≤5	>200	12 – 70	• Subway • Automated • LRT or BRT in tunnel, trench or on structure	• Very high capacity • Can encourage densification	• Very high CapEx • Can be very loud if running above ground
Semi-Exclusive ROW	B	0.5-1	20-30	5-15	≤10	100-200	4 – 25	• LRT or BRT in exclusive path, but with intersections	• High capacity at lower CapEx than ROW A • Can encourage densification	• Degraded reliability due to intersections • Can be loud if running above ground
Limited Stop	C	0.8-1.5	15-30	5-15	≤20	50-100	1 – 5	• Limited stop 'rapid' bus	• Reduced travel times attracts new riders • Low cost, flexible route designs	• Degraded reliability due to mixed traffic • Limited impact on densification
Urban										
Frequent	C	0.3-0.5	15-20	<10	≤15	50-100	2.5 – 5	• Bus or streetcar/tram in frequent/primary transit network	• Precursor to rapid service at low CapEx • Extend reach of rapid services	• Can be costly in lower density corridors • Need many intersecting routes to work well
Base	C	0.3-0.5	15-20	<10	≤30	30-50	3 – 20	• Bus or streetcar/tram	• Low cost, flexible route designs • High accessibility to local destinations	• Limited attractiveness to potential riders • Very low impact on densification
Demand Responsive/ Circulator	C	0.3-0.5	15-20	<10	≤30	10-30	< 1	• Bus including smaller shuttles	• Fill gaps in lowest density areas • Flexible route designs	• High cost per rider • Limited attractiveness to potential riders

1 – A: Exclusive right-of-way, B: Semi-Exclusive right-of-way, C: Mixed Traffic 2 – Regional lines operate along corridors with very uneven densities, often with urban centres separated by large rural areas. 3 – Sources: (Ministry of Transportation for Ontario, 2012); (Vuchic, 2005)

In this report, the *category and mode of operation* are discussed, leaving specific technological solutions to more detailed analysis of specific corridors and markets that may be done later.

In considering whether a given mode is required in Edmonton, the potential role and market to be served should guide decision making. Exhibit 5.3 shows the primary trip markets served by each mode, and describes the role that each mode plays in developing an integrated, accessible, convenient transit network that serves the entire region beyond the city.

Exhibit 5.3: Roles and primary trip markets of each mode in the Family of Transit Services

Mode	Role in Network	Primary Trip Market
Regional		
All Day	• Links edge cities together and to the CBD • Supports long bi-directional trips between major centres	• Long commuter trips • Long off-peak discretionary trips
Peak Only	• Connect distant residential suburbs to employment centres	• Long commuter trips
Rapid		
Exclusive ROW	• High capacity corridors acting as major spines of the entire network • Support majority of high-density development in the region	• Long and intermediate distance trips, all times of day
Semi-Exclusive ROW	• High capacity corridors acting as major spines of the entire network • Support majority of high-density development in the region	• Long and intermediate distance trips, all times of day
Limited Stop	• Shortens travel times between major destinations • Supports development of future RT corridors	• Long and intermediate distance commuter trips
Urban		
Frequent	• Shortens wait times, making transit more competitive with cars • Improves access to RT stations • Supports development of future RT corridors	• Long and intermediate distance commuter trips • Off-peak discretionary trips in major nodes and corridors
Base	• Provides coverage in the heart of less dense areas, serving smaller neighbourhood scale destinations	• Short trips within a neighbourhood • First & last mile connector service
Demand Responsive/ Circulator	• Provides basic mobility where density is too low to support regular scheduled transit	• Off-peak discretionary trips • First & last mile connector service

5.2 Capital and Operating Costs of Transit

There is significant variability in the cost of constructing and operating transit in an urban context like Edmonton, making it difficult to provide precise costs for each mode category presented in Exhibit 5.2. The specific technology adopted, station spacing, station amenities, and level of service all have a significant impact on the final cost of building and operating transit service. This section presents information sourced from a range of mass transit projects completed across North America recently[10].

5.2.1 Capital Costs

The cost to build a mass transit project is affected by a number of conditions, as follows:

[10] Most of the capital expenditure data pertains to projects built since 2010, recognizing that inflation of costs over time can drastically increase project budgets.

- While a region may benefit from economies of scale if a number of large projects are undertaken simultaneously, the sudden large demand for materials and labour often drives up unit costs;
- Local market conditions can vary widely across North America—transportation costs for materials and labour costs are two examples of this;
- The cost of rolling stock is directly related to the level of service that is anticipated. A frequent BRT service intended to run at 5 minute headways would cost much more than similar service running at 15 minute headways. Similarly, the land acquisition and construction cost of maintenance and storage facilities is greatly impacted by the size of the fleet and the planning horizon used;
- The availability of existing infrastructure (e.g. an existing rail corridor, or freeway with space for transit in the median) is a major consideration in costing; and
- Site preparation costs and environmental mitigation is very context-sensitive, and could vary widely within a single city where topography and existing land uses change from neighbourhood to neighbourhood.

With these considerations in mind, Exhibit 5.4 shows the ranges of capital costs based on recently completed projects in North America.

Exhibit 5.4: Range of capital costs of various transit technologies

Transit Technology	Capital Cost ($M per km)
Passenger Rail	1 – 10
Highway Coach	(Depends mostly on vehicle costs)
Subway	130 – 1,800
LRT (ROW A)	100 – 800
LRT (ROW B)	75 – 100
BRT*	5 – 40
Streetcar	20 – 90
Municipal Bus	(Depends mostly on vehicle costs)

Note: ROW A = exclusive right of way, ROW B = semi-exclusive right of way (i.e. may have at-grade intersections with mixed traffic)

*BRT data based on Institute for Transportation & Development Policy https://brtguide.itdp.org/branch/master/guide/why-brt/costs), plus range of costs for recent BRT designs in York Region, Calgary

Source: IBI Group based on a scan of over 30 projects across North America

Some of the cost ranges are notable, as follows:

- Passenger rail capital costs can be very low because many lines operate in existing freight rail rights-of-way, and most of the capital expenditure is on station construction (which can be inexpensive in suburban areas with low land prices) and rolling stock.
- Subway costs can vary widely, with New York City's 2nd Avenue Subway costing almost $2 billion per km. Excavating in a dense urban environment with extremely high land values and labour costs like New York City contributes to this abnormally high cost. Typical costs are closer to $400-500M per km.
- Underground LRT can be expensive to build, as tunnelling costs can be similar to those for higher-capacity subway systems. At-grade LRT in exclusive rights-of-way can also be costly due to expensive land acquisition in existing urban environments. Topographical features may also add to the variability in LRT costs.

- The Institute for Transportation & Development Policy notes that BRT capital costs can be lower than LRT because maintenance and storage facilities can be located farther away on cheaper land not connected to the BRT. The similar technology to existing municipal buses also allows for significant overlap with the maintenance and storage facilities already used by the municipality.

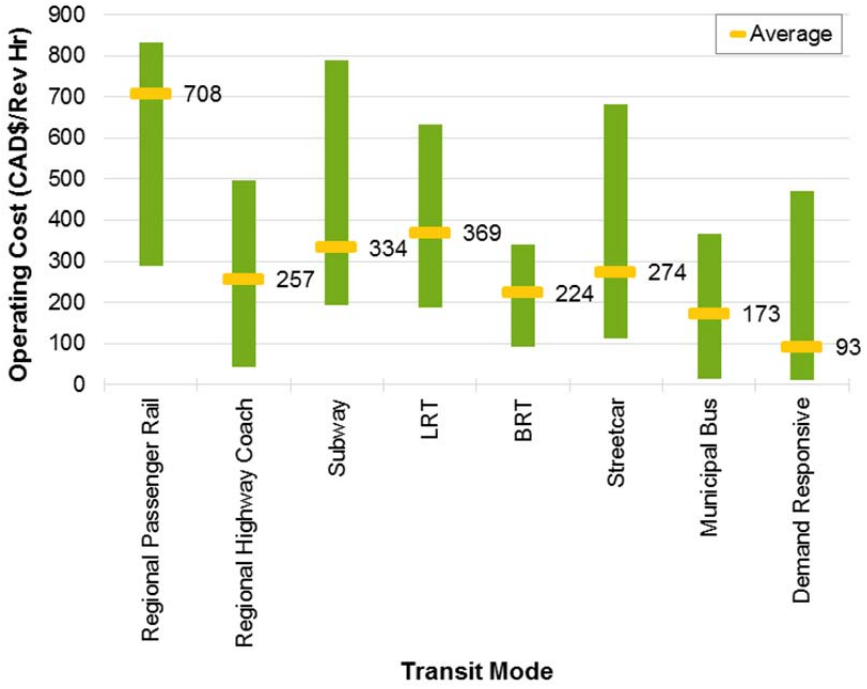
5.2.2 Operating Costs

Similar to the caveats noted for capital costs, the cost of operating a mass transit service can also vary due to the following:

- Large, dense cities tend to operate larger, more complex, more costly systems to accommodate high travel demands, even if the level of service is the same as a smaller city;
- The age of the fleet is a major factor in operating cost—older, less efficient locomotives that have lower Mean-Time-Between-Failure rates, for example, may make a commuter rail system much more expensive than a newer fleet given the same level of service; and
- Station amenities beyond the minimum needed to run the system, as well as the number of stations in the system, both impact operating costs.

With these considerations in mind, Exhibit 5.5 shows the range and average operating costs of the example transit technologies mentioned in Exhibit 5.2.

Exhibit 5.5: Range and average operating costs in CAD for various transit technologies



Sources: (US Federal Transit Administration, 2017a), (US Federal Transit Administration, 2017b), (Bank of Canada, 2018)

The exhibit shows a few notable points:

- Regional passenger rail can be relatively inexpensive at less than $300/Rev-Hr (Utah's Front Runner service) where four-car trains operate on single-tracked lines every 30 minutes during peak periods. On the other hand, the Long Island Rail Road (LIRR) is a costly system to run at over $800/Rev-Hr, with 12-car trains running 24 hours per day, every day on a 513 km network that is solely used by LIRR. Most commuter rail systems are on the higher end of this cost range.
- Highway coach buses can be among the least expensive systems to operate. Windham Region Transit District in Connecticut runs a flag-stop commuter service along existing regional roads with no special stations at a cost of $52/Rev Hr. MTA New York City Transit, on the other hand, operates a complex system of routes and stations that costs almost 10 times as much.
- At almost $800/Rev Hr, the Port Authority Trans-Hudson subway system connected New Jersey with New York is a very expensive system to run, partly reflecting the high costs of operating any rapid transit service in the area around New York City where infrastructure is aging and labour costs are high. Comparatively, Chicago's L costs just under $200/Rev Hr, and most subways in North America operate at the lower end of this cost range.
- The cost range of BRT is narrow compared to the other technologies, reflecting greater similarity between jurisdictions providing this type of service. Roadway maintenance can share labour, materials, and equipment with municipal road maintenance programs, and some systems operate in designated lanes on existing roadways, which can further drive down operating costs.
- The Atlanta streetcar costs over $680/Rev Hr, which is very high for a streetcar system. The US Federal Transit Administration has noted management concerns regarding the system, but it is unclear why costs are so high. Typical operating costs of streetcars are much lower.
- Demand Responsive Services are typically the least expensive to operate (although cost-recovery from farebox revenues also tends to be very low), given that they usually do not require costly infrastructure aside from the ride booking and dispatching system. The Transit Authority of River City, at $470/Rev Hr, is abnormally costly but the reasons are unclear.

5.3 Transit Modes in Edmonton

Edmonton has transit service that falls into each of the major categories, although not all of the modes presented in Exhibit 5.2 currently exist in the city. The following discussion places the existing services, and the proposed new services described at length in Section 3 of this report, within the context of the family of transit modes.

Regional – All Day

St. Albert and Strathcona County both operate commuter bus services to Downtown Edmonton, LRT stations, and other major destinations in the city. Headways range from 15 minutes in peak periods to 60 minutes or longer off peak, and some lines operate on weekends.

The population of St. Albert is over 65,000 and Sherwood Park in Strathcona County has over 70,000 residents according to the 2016 Federal Census. These are relatively large municipalities in their own rights, possibly with the potential for all day, two-way travel volumes to justify this transit mode. There is also a bus connecting Century Park station to the Edmonton International Airport.

Summary: The Edmonton region has a low –capacity bus-based version of regional services connecting outside municipalities to central Edmonton, the University of Alberta, and West Edmonton Mall areas.

Regional – Peak Only

Edmonton Transit Service (ETS) runs six commuter bus routes between Edmonton and the communities of Beaumont, Edmonton Garrison, Spruce Grove, and Fort Saskatchewan. Additionally, St. Albert, Strathcona County, and Leduc County provide peak period bus service into Edmonton. These communities are home to less than 35,000 residents each and have yet to develop enough counter-peak or off-peak demand to warrant the Regional – All Day transit mode.

Summary: The Edmonton region has a low –capacity bus-based version of peak-only regional services connecting outside municipalities to Edmonton.

Rapid – Semi-Exclusive ROW

Two existing LRT lines—Capital and Metro—provide rapid transit service in dedicated rights-of-way, with an underground tunnel serving five downtown stations and one station at the University of Alberta. The remainder of the alignments follow existing streets and the former CN rail corridor, with some roads being grade separated while others are level crossings controlled through LRT pre-emption and protected by gates.

These lines form the backbone of Edmonton's transit network by connecting transit centres and major employment nodes, and integrating with local and regional transit at several stations. Free park and ride lots exist at four of the 18 stations.

As noted earlier in the report, a third line is now under construction, the Valley Line, which is not directly connected to the other two lines but will feature a transfer station at Churchill Square. The surface stop on the Valley Line will be directly above the underground station on the Capital and Metro Lines.

Summary: The Edmonton region has a medium-high capacity mass transit system comprised of two high-floor and one low-floor LRT, the latter under construction. While portions of these routes are grade separated (in particular downtown), the routes do cross through intersections, and so the service uses a semi-exclusive Right of Way.

Rapid – Limited Stop

ETS runs limited-stop services to major destinations that are not served by rapid transit such as West Edmonton Mall, Lewis Farms TC, Mill Woods TC, Millgate, Northgate and Eaux Claires. These routes typically connect to other services at transit centres or LRT stations, and operate in mixed traffic along main arterial roads or freeways.

In 2020, this family of service will include rapid bus routes between West Edmonton, downtown, Kingsway/NAIT and Eaux Claires, as well as a rapid shuttle service between Century Park LRT station and the Ellerslie Park and Ride. There will also be peak-only services inbound to Central Edmonton in the AM peak and outbound in the PM. The routes to West Edmonton and Ellerslie are 'ridership builders' that will be replaced by LRT in the future, while the other routes are intended to complement the existing and planned LRT network by serving other corridors.

Summary: Edmonton has a growing number of limited-stop rapid bus routes, operating mostly in mixed traffic. Note that these will benefit from certain forms of transit priority in some locations, such as lane management (HOV or Bus lanes), physical or signal modifications at critical intersections.

Urban – Frequent

ETS is adopting this category of regular bus services to help explain the key service attribute of these planned routes in the 2020 network. These are routes that operate through higher-density corridors in the urban core and sometimes extent into surrounding parts of the city to connect to major activity centres. This type of service operates often enough during most of the day to form a part of a so-called Frequent Transit Network. During peak periods these buses run often enough (e.g. every 5 to 10 minutes) that passengers can arrive randomly at stops and count on catching a bus fairly soon. During the midday and evenings, service runs several times per hour (usually every 5 to 15 minutes depending on demand) and thereby makes travel for non-work purposes convenient enough to attract passengers,

Summary: Edmonton has an existing system of base transit services, several of which would qualify as frequent service for most of the day. These are being restructured in the near future to better map to the urban transit markets identified in the city: commutes radiating to and from employment and education areas, and convenient travel in all communities, with the higher frequencies serving higher-density areas.

Urban – Base Service

Most ETS routes fall within this mode. These include peak-only routes and all day routes. Stops along these routes can be as close as 300 m apart and they operate in mixed traffic. Headways on these routes range widely based on demand and operating speeds will depend on the stopping pattern and mixed traffic operations.

Depending on how they are operated (speed and stop spacing), the 2020 network of Crosstown, and Local routes will both fit into this broad category, with some routes doing more than others to carry passenger loads.

Summary: Edmonton has a robust system of base transit services, which are being restructured in the near future to better map to the urban transit markets identified in the City: commutes radiating to and from employment and education areas, and convenient travel in all communities, with the higher frequencies serving higher-density areas.

Urban – Demand Responsive

The Disabled Adult Transit Service (DATS) is Edmonton's demand-responsive service reserved for persons with disabilities. The service is available between roughly 6:00 AM and 11:00 PM and reservations are accepted between one and three days in advance of the trip.

In 2020, the family of transit services will include community routes to fill in some of the off-peak gaps in service frequency and connect destinations within fairly concentrated areas.

Summary: Edmonton has a growing system of strategically allocated demand responsive services.

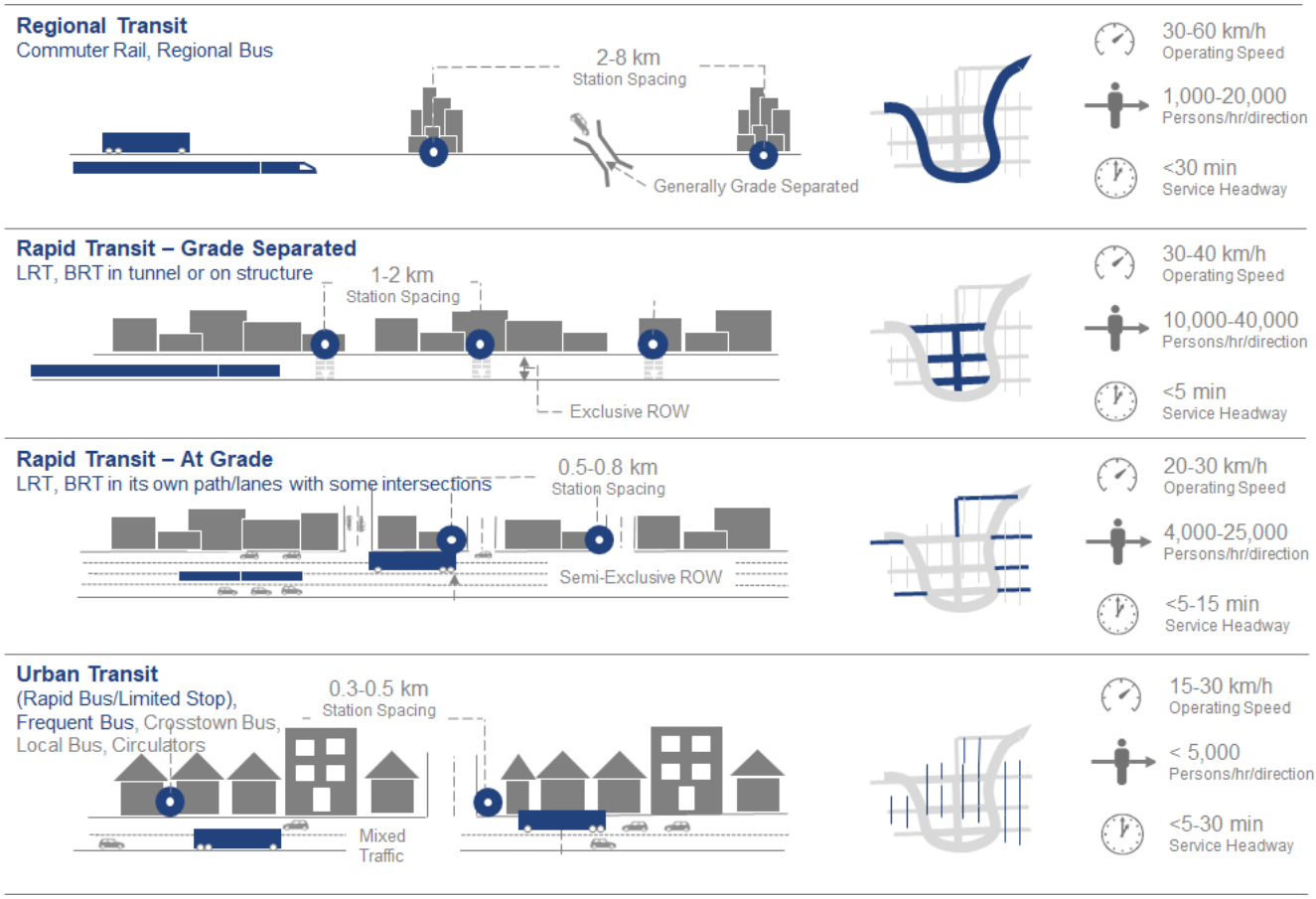
5.4 Focus for this Study

While it is important to recognize the full spectrum of transit services that make up a network, the focus of this study is the **mass transit network** for the future '2 Million Resident' set of development scenarios within the City Plan initiative.

Therefore, the options developed within this study will address the **Regional** and **Rapid** modes of transit, as well as the **Urban Rapid** and **Urban Frequent** services, as these all constitute elements of Mass Transit as defined for this study. Other forms of urban transit will be assumed to continue, and to expand as needed as demand warrants.

Exhibit 5.4 presents an illustration of the types of transit, including the regional and rapid services, and the forms of Urban Transit which will be under investigation.

Exhibit 5.6: Mass Transit Modes – Ranges of Characteristics



6 Needs and Opportunities

This section is a synthesis of the needs and opportunities for mass transit in Edmonton, which will become more apparent in a geographic sense during the next part of the study when the future City Concepts and Transit Network Options are defined.

Edmonton's transportation context is unique, but the challenges it faces are similar to those in other large Canadian cities

- Edmonton is a particularly youthful and wealthy city in the Canadian context, two attributes that simultaneously work with and against developing a strong transit culture. While transit usage is high among the youngest of Edmonton's adults, the data suggest that transit use declines very rapidly after the age of 25. This could be related to the city's high median income and high rate of auto ownership.
- However, the city shares many common challenges with other large municipalities. Perhaps most notably, the city is continuing to suburbanize and travel markets are changing as a result. The significant majority of residential development is occurring at the urban fringe, and a high percentage of employment is locating in suburban areas. The resulting travel patterns—from low-density suburban residence to low-density suburban job—are very difficult to serve by transit in a manner that is both economical and time-competitive with the car. This is a contributing factor to the paradoxical stagnation of transit mode share in an era of increasing transit ridership: while the number of transit users is increasing, it is dwarfed by the number of people living and working in areas where transit is not as feasible a travel alterative.

The regional and rapid transit network is highly-focused on the downtown core, but travel demands are evolving

- The proposed 2020 bus network is intended to provide enhanced connections to the evolving LRT network, and also re-focus the bus routes on providing market-based services: a commuting focus including crosstown trips in the outer parts of the City, and more streamlined and frequent services within the inner and central parts of the City. These are what will connect to the mass transit system.
- As a step to build ridership and serve parallel corridors where there isn't currently LRT, several all-day rapid bus services operating in mixed traffic will start in 2020. These services and others of this type may also be an appropriate option for many of the future connections in 2065.
- The LRT plan addresses future demands following a mostly radial pattern outward from the Central Business District. Demands will increase on the network as these routes are extended due to a higher number of locations directly served, and growth in the overall catchment area for each corridor. Some parts of the LRT Network Plan require validation by this study, to determine if LRT or some other form of mass transit could be most appropriate to serve the future markets.
- There are several gaps in the mass transit system suggested by the future travel patterns and the potential distribution of future residents and employment. Some of these include:
    - More direct connections to employment areas outside the central business district, such as NW Edmonton;

- Whether to continue direct bus service to nearby municipalities (such as Sherwood Park and St. Albert) and/or extend mass transit to intercept those services earlier in their journey;
- Connections into the vast annexation areas and to Edmonton International Airport. These areas are nearly unserved in the near term 2020 network;
- SW and more of SE Edmonton will continue to grow and become more remote from the near-term LRT network;
- Crosstown connections to provide additional travel options and take some of the burden off the central part of the network.

The future distribution of people and jobs will be a critical determinant of where, when, and how new mass transit lines will be built

The Mass Transit Study is being conducted concurrently with a long-range review of land use planning in the Edmonton region. This presents an excellent and rare opportunity to ensure that critical decisions about development influence the design of the transit network, and, conversely, that transit and transportation concerns influence the planned urban structure.

These two domains are inextricably linked, and exploring the relationship between the two will help best achieve the City's urban and transportation planning goals. Testing and modelling the transportation impact of different urban structure alternatives will provide critical insight into how the distribution of people and jobs will influence travel demand and, by extension, the city's ideal transit network.

Peer cities provide important insight on the key factors that lead to transit success

An examination of Edmonton's peers and other cities suggests there are four key mass transit success factors that should be considered in the development of plans and projects:

- **Urban structure and land use:** As previously described, transit is most successful when it is convenient, and it is most convenient when it is located close to where many people live, work, or both. As such, more people and jobs near rapid transit is linked to higher transit ridership.
- **Priority:** An exclusive right-of-way reduces travel times and improves reliability, both of which contribute to making transit more convenient. However, providing priority is often costly, and needs to be balanced against the ability to provide high-quality service over a wide area.
- **Competitiveness:** Many of the world's most successful transit systems are in urban areas in which travel by car is either inconvenient, expensive, or both. This is not a coincidence—transit needs to be time- and/or cost-competitive with alternative modes in order to attract riders. While an efficient and resilient multi-modal transportation system is critical to the economy of any city, policies and capital projects that seek to drastically improve auto travel time—even in conjunction with transit improvements—can have negative impacts on transit ridership.
- **Frequent transit network:** Even under the most ambitious plans for transit-oriented development, the substantial majority of transit riders will not live within walking distance of rapid transit. Therefore, any mass transit network planning must be paired with the development of a network of high-frequency bus routes that complement and feed higher-order services.

An integrated and coordinated family of transit modes is necessary to best meet the needs of evolving travel markets

As Edmonton develops into a city of 2 million people, it will require a diverse and complementary system of transit modes to meet the needs of the travelling public. The nature of this service must naturally be tailored to Edmonton's unique needs: there is no one-size-fits-all solution.

Continued outward expansion will be best served by improvements to the **regional transit** network. Connecting the growing suburbs to the central business district by commuter rail, for example, would help to improve travel time competitiveness, while relieving ridership congestion on LRT lines. Expansion of the regional bus network with "hub-to-hub" service would serve a similar purpose for trips with origin and destination outside of the downtown. This will be investigated within this study and will also be one of the focus areas of the emerging RTSC.

Increased development in key nodes and corridors is likely to spur the need for a more comprehensive **rapid transit** network, linking key trip generators and providing high-speed, high-capacity transit service within the densest areas of the city.

Both the regional and rapid transit networks must be underpinned by a strong **urban transit** network, offering higher levels of accessibility to the majority of the city's developed areas. This network encompass a broad range of services, with a focus in this study on the higher-capacity limited stop express services and frequent transit network.

Looking Ahead

The focus of the next tasks in this investigation of Mass Transit for Edmonton will focus primarily on the Regional and Rapid services, which are expected to remain important components of transit well into the future. Mobility as a service, connected and automated vehicles, the potential disruptors that will influence future trends, will be addressed during stress testing of the future transit network options. Based on the knowledge we have to date, one possible outcome is that these "disruptors" might become complementary to the mass transit system (for example, reducing park and ride spatial needs, or replacing circulators) as part of any trips that are medium to longer in length.

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Appendix A – Additional Exhibits

Mode Choice Factors

An analysis was carried out of the income levels versus likelihood to use transit, and the pattern is similar to that observed in other Canadian cities. The highest percentages are seen at lower household incomes, where transit-dependency and greater use of active modes are seen.

These results are relevant in the short term but more challenging to apply to a long-term strategy, to the extent that income levels are subject to change over longer periods. The areas that have lower average incomes today can be measured through the Census, whereas future income concentrations become more speculative.

Exhibit A-1: Mode Choice versus Income Level

Income ($000's)	% of House-holds	% of People	% of Trips	Daily Trips/ Person	Driver	Auto Pass.	Walk	**Transit**	School Bus	Bicycle
City										
Under 30	17%	10%	10%	3.21	42%	14%	20%	**19%**	1%	3%
30 to 59.9	23%	19%	18%	3.42	57%	18%	12%	**10%**	1%	2%
60 to 99.9	26%	27%	27%	3.48	58%	22%	10%	**8%**	1%	2%
100 to 124.9	11%	15%	15%	3.55	57%	23%	10%	**7%**	2%	1%
125+	23%	30%	31%	3.68	62%	21%	8%	**6%**	1%	2%
All/Total	367,400	894,400		3.51	57%	20%	11%	**9%**	1%	2%

Source: Household Travel Survey, 2015

The income levels in this chart are partially related to age, since people under 24 and over 65 will tend to have lower annual incomes due to working part-time while in school, or having left the full-time workforce. Those same age groups, in particular the younger age cohort, were shown (in Exhibit 2.15) to be more frequent transit users than middle-aged adults.

Maps Related to the 2020 Transit Network

Exhibit A-2 is a map of the park and ride lots assumed for the year 2020. Most of these are situated at strategic bus transit centres and near the terminus stations of the LRT lines. Assumptions related to park and ride will be developed as part of the investigation of future mass transit options.

Exhibit A-3 is a map illustrating the distribution of just the AM peak transit trips from the 2020 horizon, using the RTM2 demand model. This complements the findings from Section 3, and the geographic concentrations are similar (but with higher ridership) to those uncovered for 2015 and documented by Exhibit 2.13.

For comparison, Exhibit A-4 shows all the trip origins and destinations for the AM peak, and the dominance of the downtown and U of A areas becomes much less prominent, since the travel markets to other zones are also quite substantial, but were less prominent on the transit trip map.

Exhibit A-2: Park and Ride Lots in the Edmonton Region, 2020

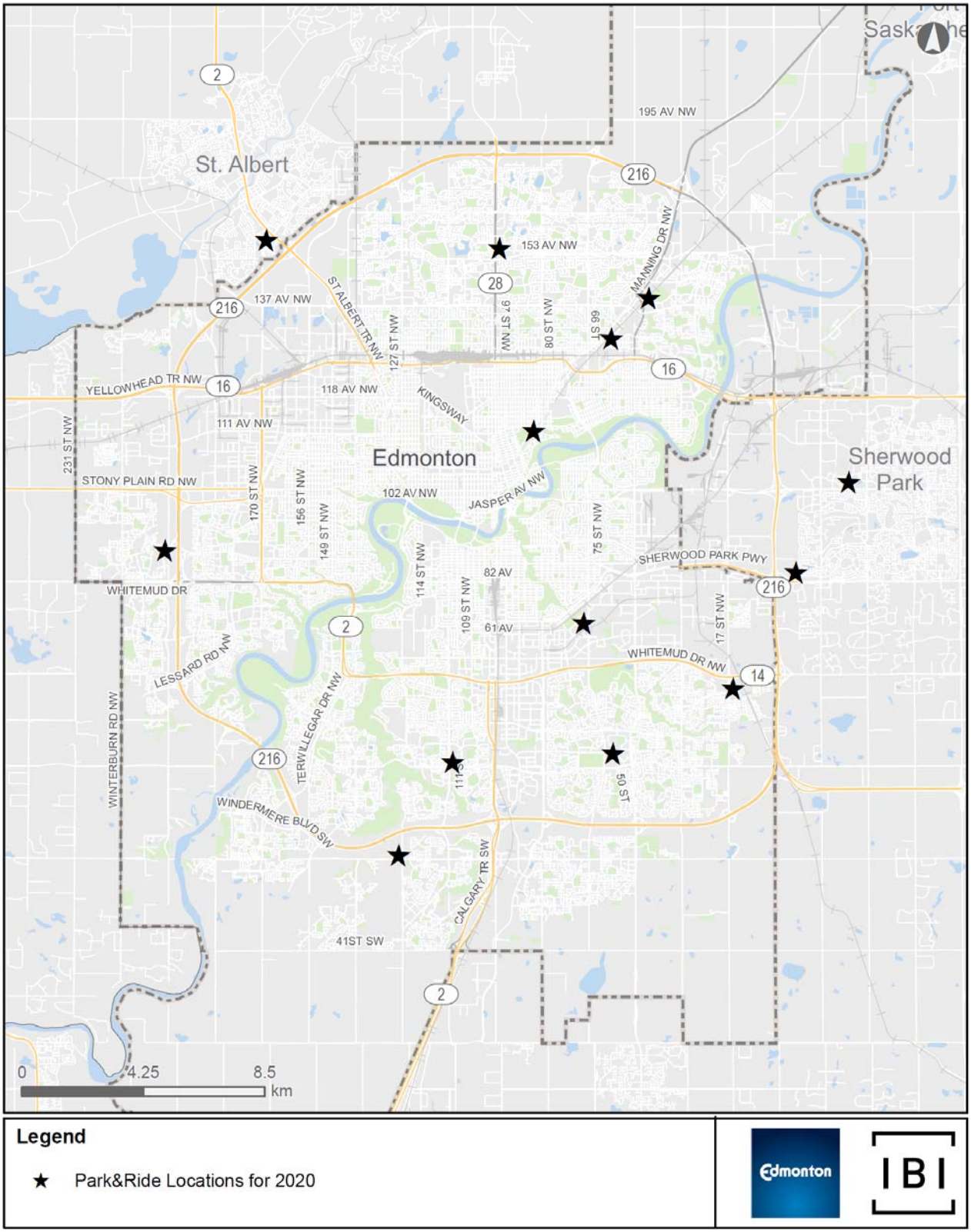

Exhibit A-3: Distribution of AM Peak Transit Origins and Destinations, by Traffic District, 2020

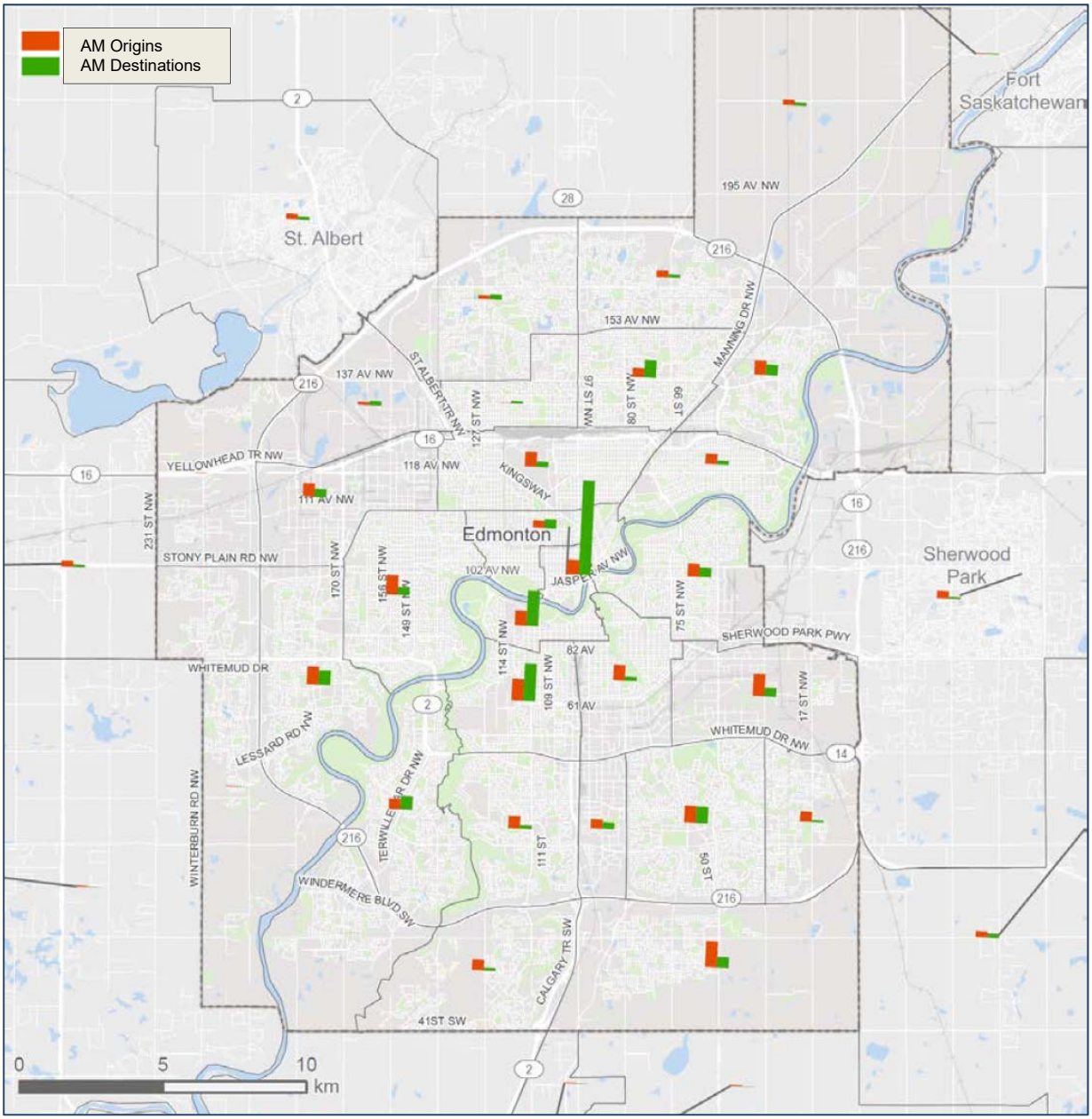

Exhibit A-4: Distribution of AM Peak Origins (productions) and Destinations (attractions), 2020 – Transit and non-Transit Trips