Technical Memo

# City Plan Mass Transit Scenario Analysis

## Evaluation of City I/II/III Transit Network Options

Prepared for City of Edmonton
by IBI Group
July 31, 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.

July, 2019

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## Disclaimer



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# Abbreviations and Definitions

| | |
|---|---|
| AM/MD/PM | The morning (7am to 8am), typical midday (9 am to 3:30pm) and late afternoon (4:30pm to 5:30pm) weekday time periods. |
| BAP | Business As Planned (land use baseline used for this study for the future horizon) |
| BRT | Bus Rapid Transit |
| CBD | Central Business District (downtown Edmonton in this report) |
| CR | Commuter Rail |
| ETS | Edmonton Transit System |
| HOV | High Occupancy Vehicles (can include carpools, transit and taxis) |
| LRT | Light Rail Transit |

| | |
|---|---|
| Passenger Boardings | This is how many passengers get onto (board) transit vehicles. It is a measure of how many people use a transit route or transit system. |
| Passenger Load | The number of passengers on board a transit vehicle at a specific point on the route. At any given time, this is how many people boarded the vehicle since the start of the route, minus the number who have already left the vehicle at an earlier stop. |
| Peak Hour Passenger Loads | The total number of passengers travelling in the peak direction on one or more transit routes, operating in the same direction, during a one-hour period. This value is the sum of the passenger loads on the individual vehicles during that hour. It indicates how busy the route (or corridor) is during the time period. |
| Critical/Maximum Load Point | This is the location or segment of a route where the highest passenger loads are experienced in one direction during the time period in question. It is also referred to as the maximum passenger load or volume. This number is often compared with the capacity of a transit route to assess if the right amount of service is being provided. |
| Peak Passenger Volumes | Same as peak passenger loads. |
| Directional Peak Load | This is the passenger load at the critical load point, only counting the peak (higher value) direction. |
| Transit Vehicle Capacity | This is the number of passengers a transit vehicle can carry if full. It counts the seats on a transit vehicle plus an estimated number of people standing, assuming ‘x’ people per square metre of floor space in the vehicle. Since the ‘x’ value for number of people depends on operational needs and practices, there can be a range for this capacity value. (Please see Peak Hour Capacity and Service Planning Capacity) |

| | |
|---|---|
| Peak Hour Capacity | This is the theoretical number of passengers that can be carried on a transit route or transit mode past a single point or location, in one hour. It is a function of vehicle space × number of vehicles per hour. The peak capacity assumes that vehicles arrive as scheduled and counts all passenger spaces (seated or standing) that are provided in the peak direction of a transit service. It is challenging to achieve peak capacity because passengers are not evenly distributed throughout transit vehicles, and when vehicles are fuller, slower passenger alighting and boarding can end up delaying service. |
| Service Planning Capacity | This is a lower threshold for transit route capacity where the density of standing passengers is lower than the design load for that type of vehicle. It implies greater ease of passengers circulating on board, alighting and boarding the vehicle. This planning capacity is used to estimate how many vehicles a transit route should be allocated, with a safety margin built in for extra demand. |
| Productivity Index | This is a simplified measure of a route's relative attraction for passengers. As used in this report, it is the AM + PM boardings per route-kilometre. This is calculated as the number of people in the AM and PM peak hours that board the route, divided by the length of a round trip. The higher the number, the more passengers are attracted to the service. This provides an indication of what hierarchy of service could be appropriate, with higher numbers indicating a need for more frequent service, and greater capacities. |
| Constrained model run | In brief, a demand model run where limits are imposed on how many people or vehicles would use a transit route or street, and excess demand shifts somewhere else. In the regional demand model, future trips (origin, destination, purpose) are forecast and then the mode choice is determined. The trips on transit and trips using vehicles are assigned to the model to see how the networks of transit routes and roads can manage the travel demands. A constrained model run imposes limits on how many people can board transit routes, and how many vehicles can drive on different types of streets. When the number of people wanting to use a route is too high, the model shifts some of them to the 'next best' route, and repeats this process until there is a balance in the network. This result reveals how people typically respond to capacity limits and congestion in the transportation system. |
| Unconstrained model run | An unconstrained model run allows travel demand to be allocated to the route that travellers are likely to prefer, due to a combination of the lowest cost, fastest time and most convenience. It reveals the 'desire line' demand for travel since it reveals how many people (or vehicles) would choose a route if there was enough capacity. |

# 1 Introduction

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 municipal needs, and the form the infrastructure and services will take. As the city physically grows, this increases the needs for community connections, jobs, housing, amenities and services such as transit. 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 Transit Study is one of several studies looking ahead at the “2 million people” horizon, and working towards building a future vision. 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 however more important than the exact year.

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, aligned with the Mass Transit Backgrounder finalized in February 2019. The third phase, Framing the Plan, includes the current work being carried out, and has developed several hypothetical growth scenarios.

The fourth phase of City Plan, called Building Up, will develop a draft City Plan land use concept, including selection of a Mass Transit Network that builds on the results in this technical memorandum. The fifth phase relates to public hearings and Plan Approval.

The remainder of this introductory section describes the City Plan Evaluation Scenarios developed by City of Edmonton staff for analysis purposes, and then the associated Mass Transit Scenarios defined within this study.

## 1.1 Edmonton City Plan Evaluation Scenarios

The City Plan scenarios were developed to help explore potential outcomes of policy levers that could theoretically be applied to shape future growth in the city. They represent three different policy directions and aggressively apply each of these across the city, with the objective of exploring the implications of the different patterns and densities, and the requirements associated with servicing them. Each of the scenarios has a target population of 2 million people. Where they differ is how and where the higher-density parts of the city are distributed:

- **Strong Central Core (Referred to as City I)**. Development more concentrated in central Edmonton, around the University, West Edmonton Mall, and a small set of surrounding nodes.
- **Node City (Referred to as City II)**. Development throughout the city but with peaks at nodes, and intermediate density along certain connecting corridors.
- **Corridor City (Referred to as City III)**. Development peaking along corridors criss-crossing the city with strategic nodes located across the city.

These city Scenarios, developed for analysis purposes, are illustrated in Exhibits 1.1 through 1.3.

**Exhibit 1.1: Map of Edmonton, Strong Central Core Scenario (City I)**

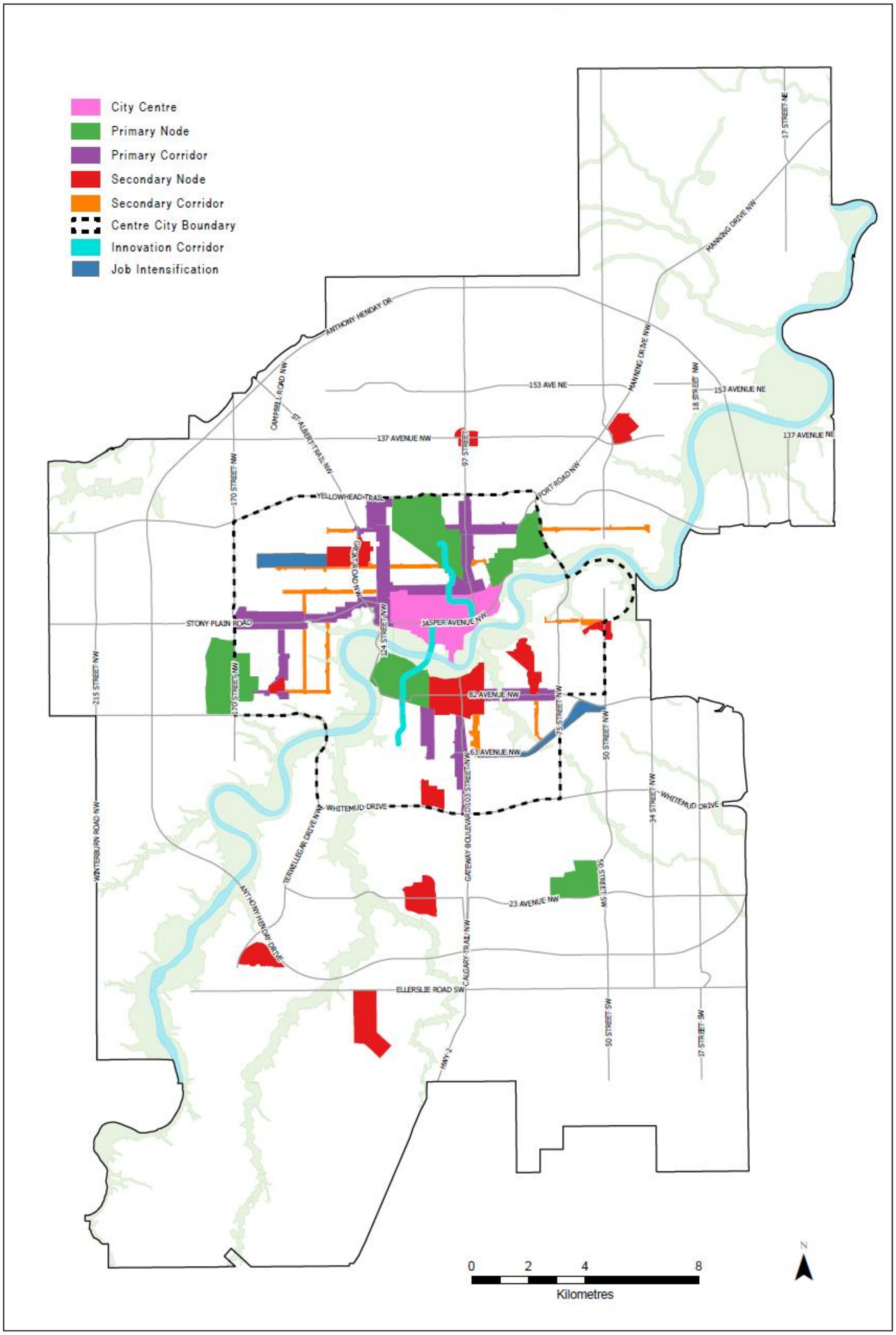


**Exhibit 1.2: Map of Edmonton, Node City Scenario (City II)**

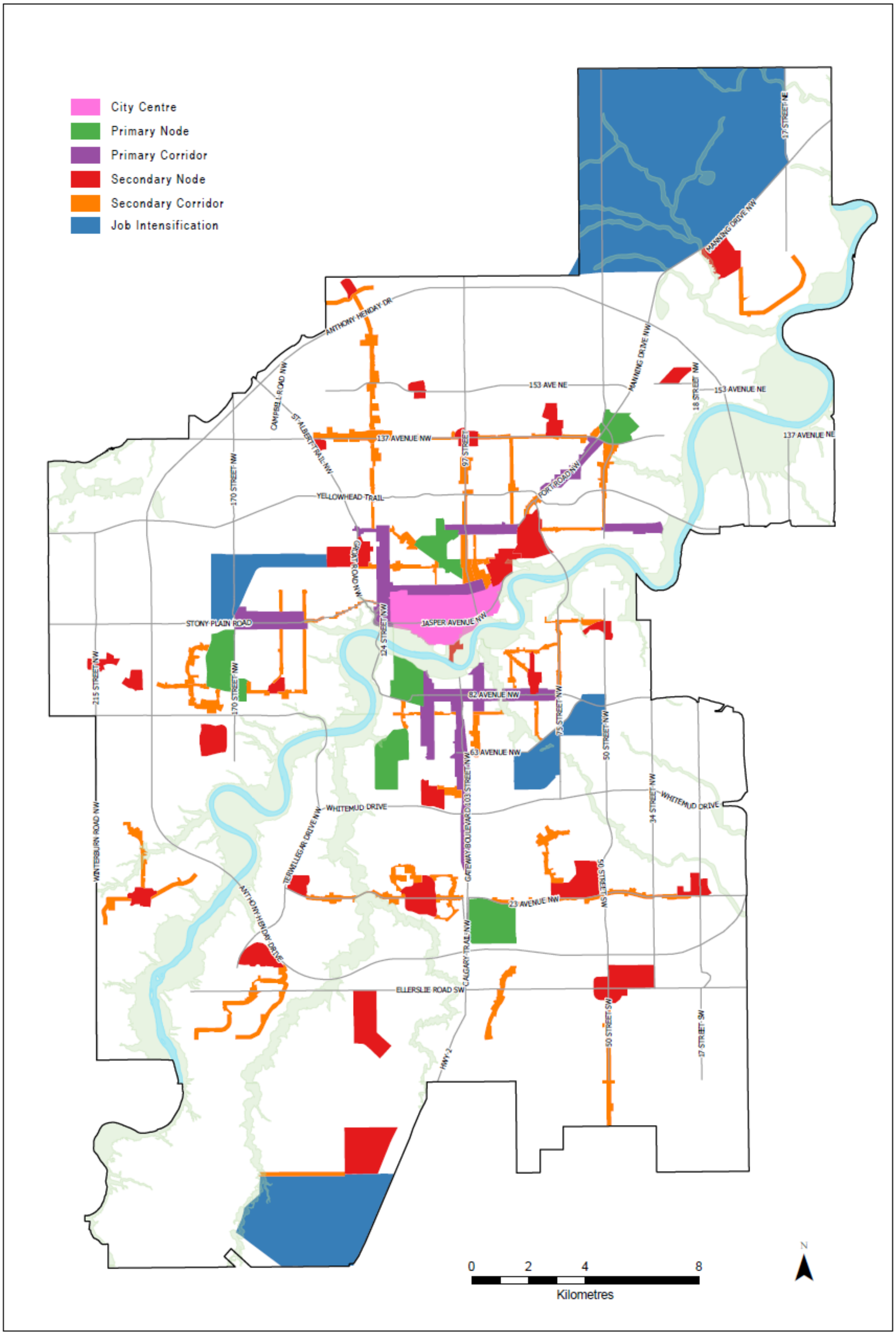
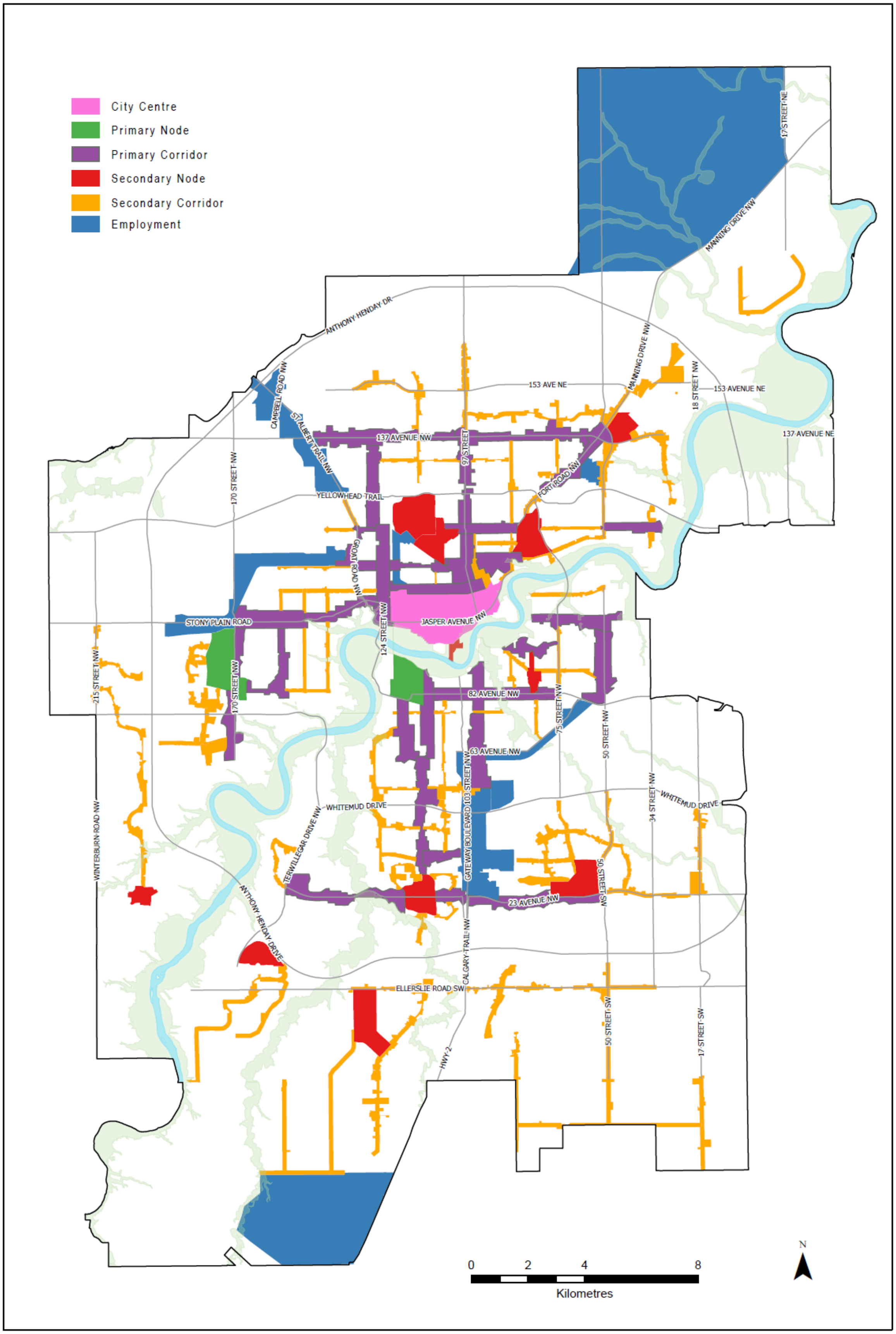


**Exhibit 1.3: Map of Edmonton, Corridor City Scenario (City III)**



## 1.2 Development of Mass Transit Scenarios

The Mass Transit Scenarios represented here were developed to align with the City Plan evaluation scenarios, and also to allow for testing of different mass transit network elements. This section provides an overview of the scenarios that were developed, including the distinguishing features of each.

### 1.2.1 The Story So Far

The mass transit scenarios were developed through an iterative and consultative process, with the following main steps in compiling and applying the relevant input:

- The Mass Transit Backgrounder provided background on the current context and some of the future plans already in place for the transit network. It also looked at how different travel markets respond to the transit service on offer, and reviewed several cities in Edmonton's peer group to draw out lessons about coordinated transit and land use planning.
- A full-day workshop was held with stakeholders from several City departments, which included an introduction of the city scenarios to the participants. The exercises collected feedback on the challenges and opportunities perceived for each of the three cities. A mapping exercise followed, where three groups each worked independently to map out ideas for each of the three future city evaluation scenarios.
- The result was three group concepts for each of the three city evaluation scenarios. These were defined using the transit mode 'tiers' (which are not technology-specific). These building blocks for mass transit are explained in Section 1.2.2.
- The consulting team compiled the inputs and produced composite maps. Each resulting transit concept included common, core elements that had been defined by multiple groups, plus a wide range of options – where different connections had been nominated for consideration.
- The City's Steering Committee and Consultant's Expert Panel recommended some additions and modifications to the draft transit scenarios, including some additional transit elements.
- A future 'Business as Planned' (BAP) scenario was defined as the benchmark for modelling and other analysis purposes. This included population and employment projections for the 2065 horizon, as well as build-up of the transportation network. This assumed that highway, street and transit service would include most planned or projected future projects and these would also extend into the city's annexation and future growth areas. This scenario was modelled to ensure that it did not assume too much growth for the transportation network to handle, nor did it overcommit on future project assumptions.
- City I, II, and III land use assumptions and networks were defined and refined for modelling. City II was modelled first, and on the basis of how the initial transit network performed, both the BAP and City II transit assumptions were refined to match the amounts and types of service with demand. This refinement included changes to assumed frequencies of service.
- The City I and City III transit networks were built upon the refined City II assumptions, and so benefited from that refinement of the initial network.

The results presented in this memo reflect the refined versions of BAP and cities I, II and III. The descriptions of the scenarios (as they were presented for technical analysis) are presented in the order that they were generated.

### 1.2.2 Mass Transit Building Blocks

Before continuing into a description of the future 'Mass Transit Scenarios', it is useful to take a step back and review the purpose of the modelling exercise. This section is framed by four basic questions and a series of answers related to the purpose and general assumptions applied in this part of the study.

**What Is the Purpose of the Scenarios?**

- To estimate future levels of transit demand related to the land use assumptions.
- To evaluate how well transit networks meet City Plan objectives.
- To test variations in proposed transit services and evaluate which options might be more effective. To achieve this, the three new scenarios were defined with different mass transit features and connections focusing on different corridors, so that we can see the differences in the results.

**What Is Mass Transit?**

- This is a broad family of strategic public transit services that carry higher volumes of passengers within urbanized areas, such as the Edmonton Metropolitan Region.
- Mass transit includes major regional connections for longer-distance trips, rapid transit for faster trips of varying lengths within the urban area, and for the purpose of this study, it also includes the frequent 'urban' transit services that provide reliable local connections.

Exhibit 1.4 (next page) outlines the types of services that are included in mass transit, and explains their role and some examples of each type of service. Most of the services can be provided by more than one technology option (rail and bus variations, primarily).

This is important to keep in mind, as this study has to make some assumptions for analysis purposes, but those should not be interpreted as final decisions on technology, alignment or station locations.

The exhibit also identifies the range of typical operations usually seen with the different modes of transit operation for the regional, rapid and urban forms of mass transit.

**What Does the Analysis Assume?**

- The connections provided by the different mass transit routes attract greater ridership.
- The assumed speeds and directness of routes affect how fast and therefore competitive the transit route is in serving travel markets.
- High frequency on the routes is important, as is minimizing the number and time spent transferring between routes.
- Access to transit routes is either by walking or cycling, transferring between transit routes, or using park and ride. The park and ride lots in the future were assumed to continue providing service at existing locations and, applying the same logic, where major transit stations and transit centres are served by multiple routes there would be parking available.
- The new mass transit routes included in the scenarios are given names for tracking purposes, but it is the **type of service and its characteristics** that matter:

  - The regional services are assumed to be bus if following streets, and rail if mostly following tracks (such as CP corridor).
  - Rapid transit – exclusive is assumed to be LRT, in particular where it is an extension of the existing network.
  - Semi-exclusive routes are referred to as BRT.
  - Limited stop routes are referred to as the rapid bus network.
  - Frequent routes are assumed to be served by bus.
  - However, with the exception of projects where the technology has already been chosen and approved by Council, the rest are all **subject to future study and the technology could be different**.
- The alignments used in the analysis build upon existing travel patterns and also focus on the areas where land use was assumed to intensify in each City evaluation scenario. While these are informed projections, they are not hard predictions of the future and the development and associated transit focus could change to other alignments.

### How Will the Results Be Used?

- The transit service options and network combinations that perform well in the analysis will be considered for inclusion in the mass transit network. This will include network elements that work together and align with the recommended draft land use concept being developed through the City Plan.
- Since the analysis results will be driven more by the service assumptions than the naming conventions for routes, the recommendations will be technology-neutral.

**Exhibit 1.4: Mass Transit Modes, Technology Examples and Service Assumptions**

| Mode | Primary Trip Markets | Technology Examples | Typical Service |
|---|---|---|---|
| **Regional Transit (Link Cities Together)** | | | |
| All Day | • Long commuter trips<br>• Long off-peak discretionary trips | • Passenger train<br>• Highway coach (Bus) | • Peak headway, 5 to 15 minutes<br>• 800 m to 4 km spacing |
| Peak Only | • Long commuter trips | • As above, but only commuter services | • Peak headway, 10 to 20 minutes<br>• 800 m to 4 km spacing |
| **Rapid Transit (High Speed Travel, and Support High Density Development)** | | | |
| Exclusive ROW | • Long and intermediate distance trips, all times of day | • Subway<br>• LRT or BRT in tunnel, trench or on structure<br>• Signal Pre-emption<br>• Automated | • Peak headway, 3 to 6 minutes<br>• 400 m to 2 km spacing |
| Semi-Exclusive ROW | • Long and intermediate distance trips, all times of day | • LRT or BRT in exclusive path, but with traffic intersections | • Peak headway, 3 to 10 minutes<br>• 400-800 m stop spacing |
| Limited Stop | • Long and intermediate distance commuter trips | • Limited stop 'rapid' bus in bus lanes and mixed traffic | • Peak headway, 5 to 12 minutes<br>• 400-800 m stop spacing. |
| **Urban Mass Transit– Convenient Access to Local Destinations** | | | |
| Frequent Routes | • Long and intermediate distance commuter trips<br>• Off-peak discretionary trips in | • Bus or streetcar/tram in frequent/primary transit network | • Peak headway, 5 to 10 minutes<br>• Spacing same as |

| | | | |
|---|---|---|---|
| | major nodes and corridors | | currently done, 100-200m. |

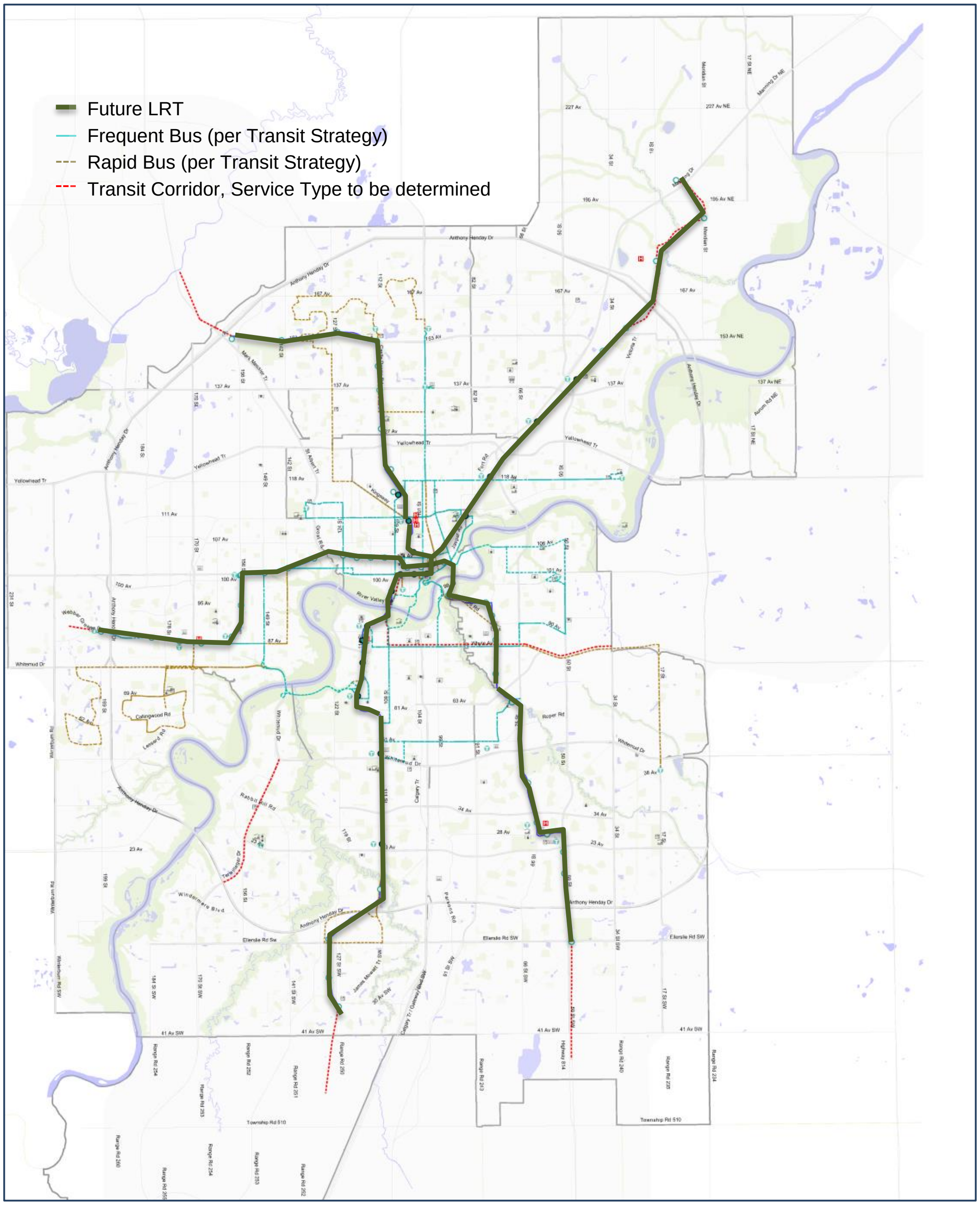
### 1.2.3 Future BAP –2065 Benchmark

The future BAP transit network includes the following major features:

- Capital Line LRT, from Heritage Valley to Energy Park;
- Metro Line LRT, from Health Sciences to Campbell Road;
- Valley Line LRT, from Lewis Farms to Ellerslie;
- Transit strategy bus network redesign, using the assumptions and principles of the current (2018-19) redesign. This network is operated by ETS, and assumes a provisional route structure extending into the City lands annexed in January 2019 and future growth areas.
- Regional services based in the surrounding municipalities, including St. Albert, Fort Saskatchewan, Sherwood Park, Beaumont, Leduc County (Leduc, Nisku and Devon), and Parkland County (Stony Plain and Spruce Grove).

Exhibit 1.5 shows the assumed LRT (bold), frequent bus (turquoise), and peak express routes (brown) that form the backbone of the BAP transit network. In addition, the entire built-up area of Edmonton and the surrounding municipalities is served by local and regional express routes.

**Exhibit 1.5: Map of Edmonton, Business as Planned (BAP) Scenario**

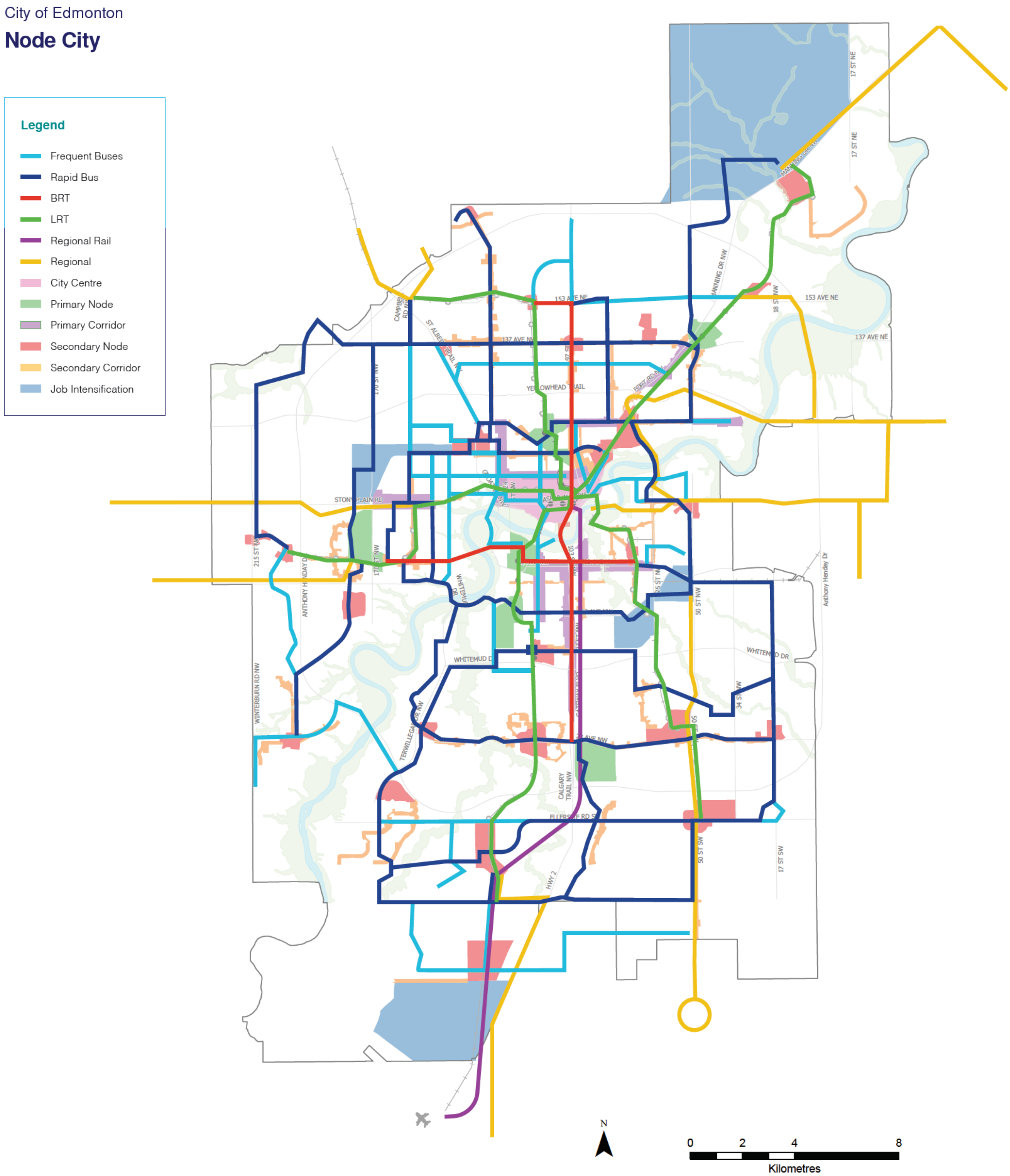


### 1.2.4 Node City Scenario (City II) - Mass Transit Network

The node city network was the first to be developed as part of this analysis and serves a base network for the other two city scenarios. It therefore builds on the BAP assumptions by adding mass transit elements and refining the service assumptions for the underlying local transit network. Exhibit 1.6 shows the structure of the network, including the rail elements (LRT in green and commuter rail in purple), semi-exclusive transit (shown in red), and routes operating in mixed traffic (rapid bus in dark blue, frequent bus in light blue, and major regional routes in yellow). These are the highlights of the network:

- Frequent buses. These include the routes from the BAP, with some refinements to service levels moving some routes in outer Edmonton into this category. These routes operate in mixed traffic, make all local stops, and operate at least once every ten minutes in the AM and PM peak and 15 minutes in the midday.
- Rapid buses. These are limited stop buses, serving transit centres, LRT stations, activity nodes and other transfer points. They function as feeder routes but also support corridors. The buses are often larger and while they operate in mixed traffic they run faster than typical buses because of the stop spacing. They are also sometimes sped up by allowing all-door boarding and providing transit priority measures (such as HOV lanes) in busy corridors where these routes operate.
- The node city network includes two semi-exclusive transit routes (red on the map). The transit vehicles are able to operate at the full posted speed of the corridor between traffic signals, as they run in dedicated lanes (or on tracks), and are not in mixed traffic. They do cross other traffic at intersections; however, these services are often sped along by transit priority measures and by having off-vehicle fare payment at the platform, to reduce dwell times. The node city network includes two routes:
  - A north-south route named 'BRT 1' running on 97 Street, 101 Street (south of 118 Avenue), 104 Street and Calgary Trail between the planned Castle Downs LRT station and a proposed 23 Avenue transit station (just east of Calgary Trail). This would use dedicated lanes except for the segment downtown. Between 101 Street/Kingsway and the Saskatchewan River, it would use bus/HOV lanes.
  - An east-west route named 'BRT 2' operating on 87 Avenue and 82/Whyte Avenue between Meadowlark LRT and Bonnie Doon LRT stations. This would include a new direct connection (bridge) across the River west of the University.
- LRT is the same as the BAP network. This includes Capital Line LRT, from Heritage Valley to Energy Park; Metro Line LRT, from Health Sciences to Campbell Road; and Valley Line LRT, from Lewis Farms to Ellerslie.
- Regional (commuter) rail was assumed to operate between a grade-separated station downtown – with walk connections to each of the LRT lines nearby – and an elevated station at the airport terminal entrance. Stops would be every 3-4 km, and the service would operate every 15 to 20 minutes. Intermediate stations would include transit centres for connecting bus routes. Of special note, stations would include the Heritage Valley LRT, the 23 Avenue BRT, and 82/Whyte BRT connections.
- Regional bus services were carried over from BAP, plus three new express services. Two connected Sherwood Park and Bremner areas to Coliseum and Gorman LRT stations; a third ran semi-express on 50 Street, connecting Coliseum, Capilano, Ellerslie/50th LRT, and Beaumont.

**Exhibit 1.6: Schematic Map of Edmonton, Node City Scenario (City II) – Mass Transit Network**

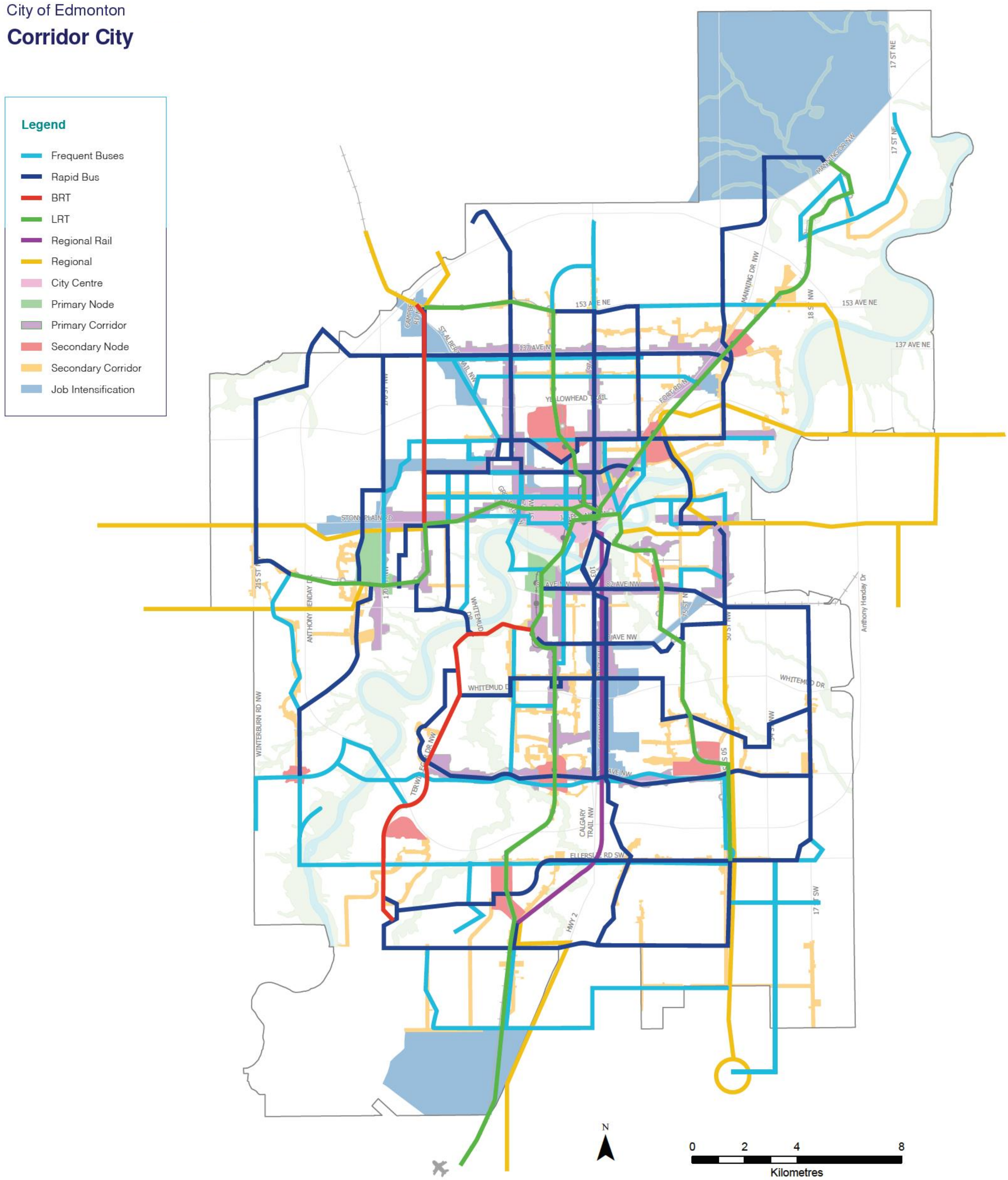


### 1.2.5 Corridor City Scenario (City III) – Mass Transit Network

The corridor city network differs from the node city network in the assumed mass transit elements and includes some refinements to assumed local bus service assumptions. Exhibit 1.7 shows the structure of the network, including the rail elements, semi-exclusive transit, and routes operating in mixed traffic. These are the highlights of the network:

- Frequent buses. These are generally the same as in the node city network, but some routes in the northeast, southeast and southwest corners of the city were assumed to have slightly increased frequencies, which pushed them onto the list of frequent routes.
- Rapid buses. All of the routes from the node city network were carried over, although service was reduced on the one route that overlapped part of a BRT route, to reduce duplication. The two routes referred to as 'BRT 1' and 'BRT 2' from the node city network were evaluated as rapid bus routes instead in the corridor city network:
  - Rapid 1 – from 97 Street/Eaux Claires Transit Centre to Heritage Valley LRT and Windermere South Transit Centre. This would operate in mixed traffic on 97 Street, 101 Street (south of 118 Avenue), 104 Street, Calgary Trail, and 41 Ave SW.
  - Rapid 2 -- 82/Whyte Avenue between University LRT and Bonnie Doon LRT stations. Unlike the node city network, there would be no direct continuation to the west.
- Corridor city network includes two different semi-exclusive transit routes:
  - A north-south route named 'BRT 3' between South Campus LRT station and Windermere South Transit Centre. This would use dedicated lanes on Terwillegar and Fox Drive.
  - A north-south route named 'BRT 4' operating on 156 Street. This would connect the Campbell Road and Stony Plain/156 LRT stations.
- LRT would include two variations from BAP or node city network. In this scenario:
  - The Capital Line would be extended from Heritage Valley to the Airport, and it was assumed the same interim stations identified for the regional rail (Twp. Road 510, Highway 19) would also be appropriate for LRT.
  - The Metro Line would operate between Campbell Road (St. Albert Park and Ride and South Campus instead of turning back after Health Sciences. This assumes measures such as grade separation are in place to permit 24 trains per hour, per direction, to cross University Avenue. (This extension adds service at the busiest point in the LRT system)
- Regional (commuter) rail was assumed to operate between a grade-separated station downtown – with walk connections to each of the LRT lines nearby – and the Heritage Valley LRT. Passengers going to/from the airport could use the LRT.
- Regional bus services were carried over from the node city network.

**Exhibit 1.7: Schematic Map of Edmonton, Corridor City Scenario (City III) - Mass Transit Network**

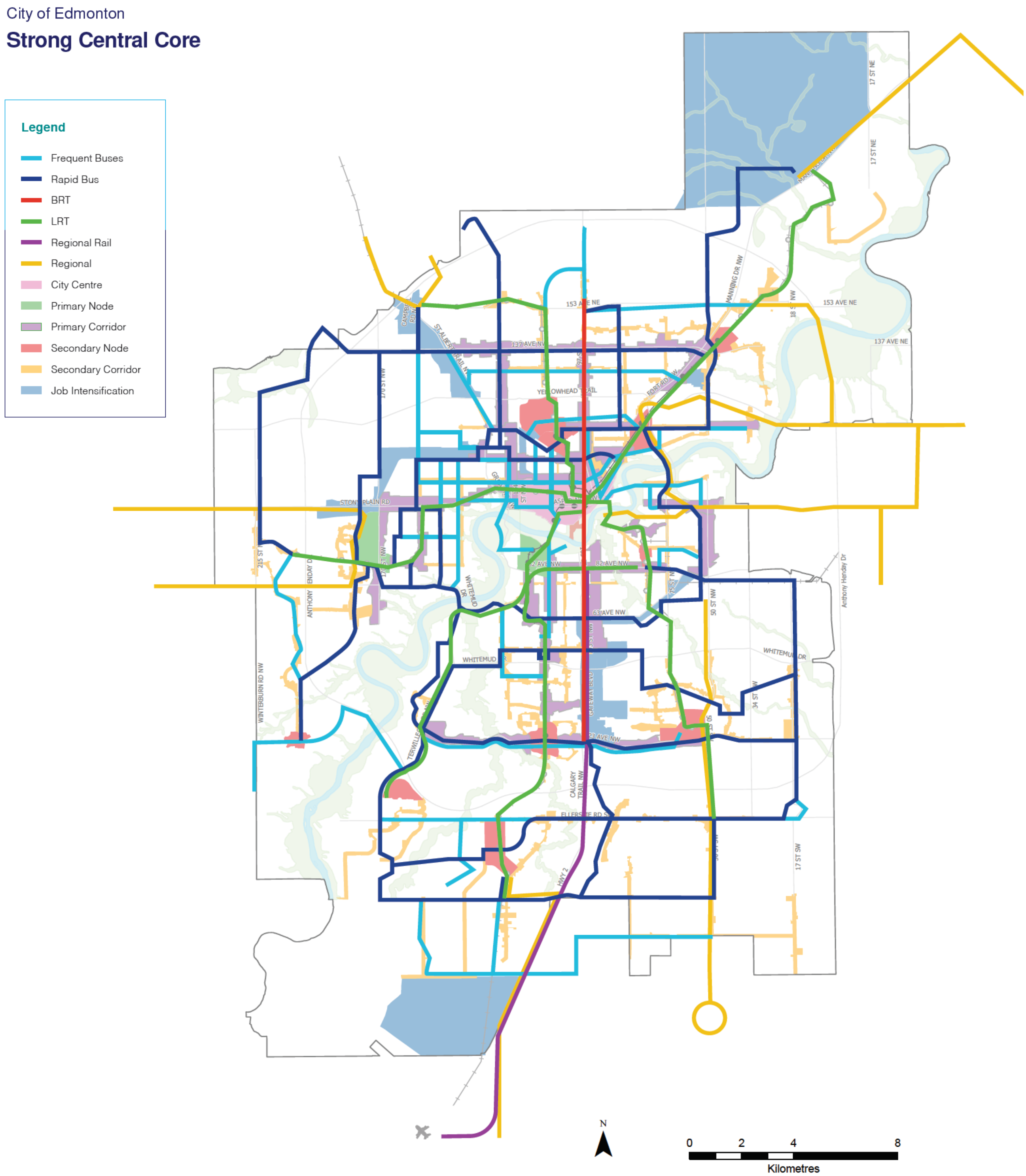


### 1.2.6 Strong Central Core Scenario (City I) – Mass Transit Network

This network differs from the node city network in the assumed mass transit elements and includes significant refinements to assumed local bus service assumptions. This scenario assumes more concentrated land use, focused on the downtown, University and West Edmonton Mall areas. Exhibit 1.8 shows the structure, including these highlights:

- Frequent buses. These include the routes from the node city network, but with more emphasis on denser areas, and several brand-new routes added specifically to this scenario to intensify central area service. This approach was based on peer examples in other cities where the spacing of the frequent network was as close as 400 metres in denser areas. The routes included the northern part of the CBD, Blatchford, and areas just west of downtown.
- Rapid buses. All of the routes from the node city network were carried over; service was added between 87 Avenue west of the River on new routes to South Campus and to Health Sciences via Whitemud Drive.
- The strong central core network includes one semi-exclusive corridor (represented as BRT) split into two overlapping transit routes:
  - A north-south route named 'BRT 1B' running on 97 Street, 101 Street (south of 118 Avenue), and south across the River to Scona Road, then along Saskatchewan Drive to 104 Street and Calgary Trail. This route would terminate at the 82/Whyte Avenue LRT/rail station. The route was assumed to use bus/HOV lanes between Kingsway and Jasper Avenue, then follow dedicated lanes (either converted or new) over the Saskatchewan River.
  - A second route ('BRT 1C') would also serve between 101/Kingsway and a proposed 23 Avenue transit station. The central segment between Kingsway and Whyte Avenue would be served by both the 1B and 1C routes.
- Segregated rapid transit (represented by LRT) would include two variations from BAP or the node city network. In this scenario:
  - A new LRT line would operate along the 82/Whyte Avenue Corridor, and continue along the Terwillegar corridor. This new LRT was assumed to extend from Bonnie Doon to Windermere Ambleside Transit Centre. It was assumed to be a continuous route with a transfer available to the Capital and Metro Lines from a new station opposite Belgravia/McKernan (it would not share the same tracks at the existing station). There would also be a brand new University area LRT station between 109 and 114 Streets.
  - The Metro Line would operate between Campbell Road (St. Albert Park and Ride and South Campus instead of turning back after Health Sciences. This assumes measures such as grade separation are in place to permit 24 trains per hour, per direction, to cross University Avenue. (This extension of service was also included in the corridor city network.)
- Regional (commuter) rail was assumed to operate between 82/Whyte Avenue– with walk connections to the LRT line on 82 Avenue – and the Airport. This would stop at similar stations to the node city network, but would follow more of the CP railway corridor and remain east of Calgary Trail until near the Airport, instead of making a direct connection to Heritage Valley. This alignment avoids a bridge or tunnel for the railway to extend to a downtown station, and instead relies on the two BRT services to provide that connection.
- Regional bus services were carried over from the node city network, with some small route modifications tested to see the effects of terminus location on demand.

**Exhibit 1.8: Schematic Map of Edmonton, Strong Central Core Scenario (City I) – Mass Transit Network**



# 2 Broad Performance Outcomes

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 Transit Mode Share Comparison

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.

**Exhibit 2.1: Mode Shares by Time Period for BAP and Three City Scenarios**

| MEASURE | | BAP | CITY I | CITY II | CITY III |
|---|---|---|---|---|---|
| Transit Trips to/from and within Edmonton | AM Peak | 14.5% | 19.0% | 16.2% | 15.5% |
| | MD | 6.2% | 9.0% | 7.6% | 7.4% |
| | PM Peak | 9.9% | 14.5% | 12.3% | 11.9% |
| AM Peak auto travel, Millions of Vehicle-km | | 8.41 | 7.69 | 8.08 | 8.06 |

These values all represent an increase from the AM peak hour projection for 2020, which reflected Edmonton with just under 1 Million people, the LRT Network as it is today plus the Valley Line SE opened, and the Transit Strategy bus restructuring implemented. Trips within Edmonton were **12.5%** transit (as per the Backgrounder report) when including all trips to and from (and within) the city, and 10.6% (as per the Backgrounder report) for the Edmonton Metropolitan Region.

### Common Themes – Scenario Results

- All 3 Scenarios have greater transit usage relative to BAP.
- Conversely, the vehicle-kilometres of auto travel is lower than BAP for all three scenarios.
- City I has the highest transit mode share – much of the ‘extra’ is due to this city having the most concentrated density. The amount of bus service was also the highest due to the extra routes added in the central and inner parts of the city.

- City II was next best, followed by City III. City II partly benefits from certain transit elements being more robust, for example the secondary corridors having semi-exclusive mass transit in addition to the web of rapid buses forming a crosstown grid.

## 2.2 Overall Performance of Scenarios

Exhibit 2.2 illustrates several outcomes from the model related to the performance of the BAP scenario, including transit mode choice (for trips to, from or within Edmonton). This is expressed for the AM, MD and PM time periods for the tabulation in the top left corner.

In the top right, the mode choice for the AM peak is presented for trips based in Edmonton (either starting or ending – or both – within city limits) and for the Edmonton Metro Region. Unsurprisingly, the overall region has higher auto mode shares and lower transit than Edmonton since the travel distances increase and availability of regular transit service to all destinations diminishes outside the city.

The other tables within the exhibit present travel information related to the AM peak, which tends to have higher transit usage and lower walking percentages than the midday, or a typical weekday as a whole.

The table categorizing the trips by general pattern has the origins in rows and the destinations in columns. For the BAP, there were an estimated 498 thousand AM peak trips starting in Edmonton (row total), and 538 thousand (column total) ending there, reflecting its role as an employment destination for other parts of the region. A second table below it presents the number of transit trips (including walk to transit and park and ride to transit). The set of percentages over to the right of that are the transit mode splits for the specific groups of trips based in Edmonton and the rest of the region. The green highlighted number of trips and percentage reflect the transit usage where the start and end of the trip are both within the city. In the case of BAP, this is 16.2%.

The final summary table within the exhibit represents several measures of road network performance, including estimated cumulative vehicle-hours (volume of each street segment × average travel time, added over the network) and vehicle-kilometres (volume × distance). These tend to increase when travel is more convenient by automobile, and tend to decrease – the distance and often the time as well – when other modes such as transit gain in prominence.

Exhibits 2.3, 2.4 and 2.5 present the same results for City I, City II and City III.

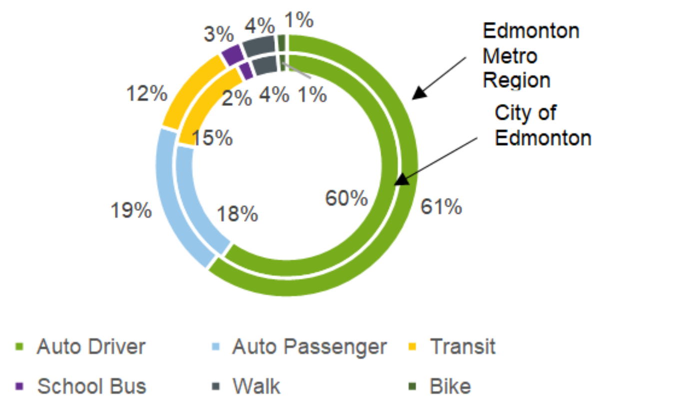
City II and City III both achieve higher mode shares for transit than BAP, partly because of the transit services on offer, but also because a higher proportion of AM peak trips are point to point connectons. in Edmonton, which gives the city more control over its ability to serve them with transit. This distinction is even more pronounced with City I – it has far more ‘Edmonton-Edmonton’ travel (482,000 trips versus 424,000 in BAP), higher mode choice for transit (19.0% versus 14.5% in the AM peak), and lower vehicle usage (139 thousand vehicle hours versus 153 thousand for BAP).

These observations support the premise that a coupling of the land use pattern with the mass transit network can produce a significant difference in the sustainability outcomes.

**Exhibit 2.2: Performance Indicators – Mode Choice and AM Peak Hour Travel Summary - BAP**

| Transit (Within, To and From Edmonton) | | BAP 2065 |
|---|---|---|
| | | |
| AM | | 14.5% |
| Midday | | 6.2% |
| PM | | 9.9% |

**Mode Share in Edmonton** BAP



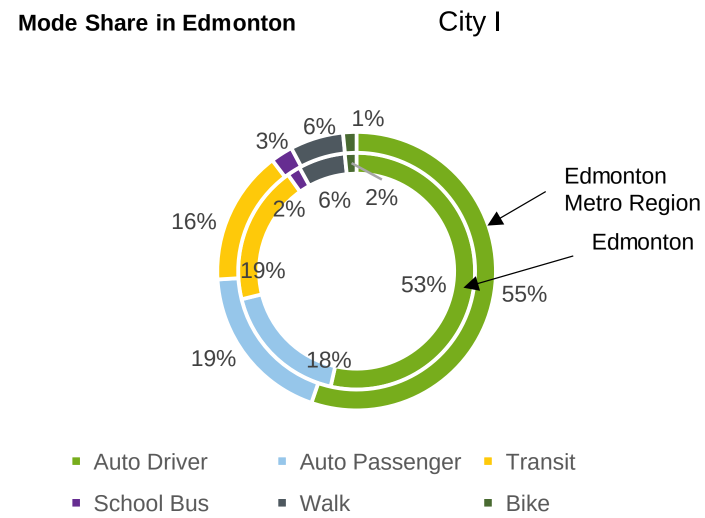

| Trip Distribution By Geography | | | | |
|---|---|---|---|---|
| **AM Peak Hour Total Trip Distribution** | **Edmonton** | **External to City** | **External to Region** | **Total** |
| Edmonton | 424,657 | 70,673 | 2,355 | **497,685** |
| External to City | 110,572 | 189,097 | 1,984 | **301,653** |
| External to Region | 2,831 | 2,367 | 743 | **5,941** |
| **Total** | **538,060** | **262,137** | **5,082** | **805,279** |

| AM Peak Hour Transit Trip Distribution | Edmonton | External to City | External to Region | Total | | | |
|---|---|---|---|---|---|---|---|
| Edmonton | 68,819 | 3,182 | - | **72,001** | | 16.2% | 4.5% |
| External to City | 15,574 | 4,682 | - | **20,256** | | 14.1% | 2.5% |
| External to Region | - | - | - | - | | | |
| **Total** | **84,393** | **7,864** | - | **92,257** | | | |

| Road Network Summary | AM Peak Hour | | |
|---|---|---|---|
| | Edmonton | Other | Total |
| veh-hrs | 106,684 | 46,102 | 152,786 |
| veh-kms | 4,900,289 | 3,509,441 | 8,409,730 |
| avg. speed | 46 | 76 | 55 |

Note: Road Network Summary includes external volume but excludes centroids and commercial volumes

**Exhibit 2.3: Performance Indicators – Mode Choice and AM Peak Hour Travel Summary –City I**




| Transit | City | BAP 2065 |
|---|---|---|
| | | |
| AM | 19.0% | 14.5% |
| Midday | 9.0% | 6.2% |
| PM | 14.5% | 9.9% |

**Trip Distribution By Geography**

| AM Peak Hour Total Trip Distribution | Edmonton | External to City | External to Region | Total |
|---|---|---|---|---|
| Edmonton | 481,568 | 53,987 | 2,460 | **538,015** |
| External to City | 93,345 | 160,122 | 1,876 | **255,343** |
| External to Region | 2,965 | 2,234 | 743 | **5,942** |
| **Total** | **577,878** | **216,343** | **5,079** | **799,300** |

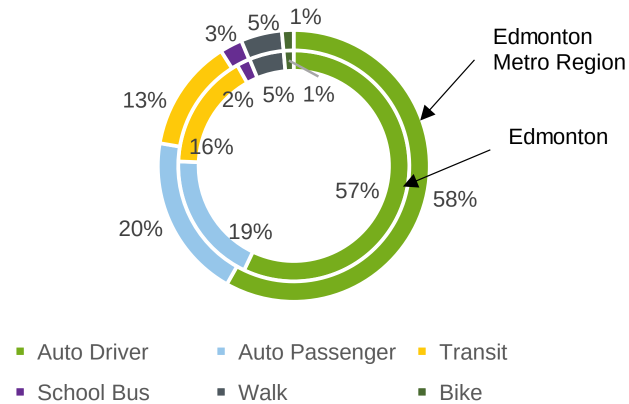
| AM Peak Hour Transit Trip Distribution | Edmonton | External to City | External to Region | Total | | | |
|---|---|---|---|---|---|---|---|
| Edmonton | 101,264 | 2,511 | - | **103,775** | | 21.0% | 4.7% |
| External to City | 15,584 | 3,796 | - | **19,380** | | 16.7% | 2.4% |
| External to Region | - | - | - | - | | | |
| **Total** | **116,848** | **6,307** | - | **123,155** | | | |

**Road Network**

| Road Network Summary | AM Peak Hour | | |
|---|---|---|---|
| | Edmonton | Other | Total |
| veh-hrs | 97,901 | 40,917 | 138,818 |
| veh-kms | 4,462,098 | 3,226,168 | 7,688,265 |
| avg. speed | 46 | 79 | 55 |

**Exhibit 2.4: Performance Indicators – Mode Choice and AM Peak Hour Travel Summary – City II**

**Mode Share in Edmonton** City II




| Transit | City | BAP 2065 |
|---|---|---|
| | | |
| AM | 16.2% | 14.5% |
| Midday | 7.6% | 6.2% |
| PM | 12.3% | 9.9% |

**Trip Distribution By City**

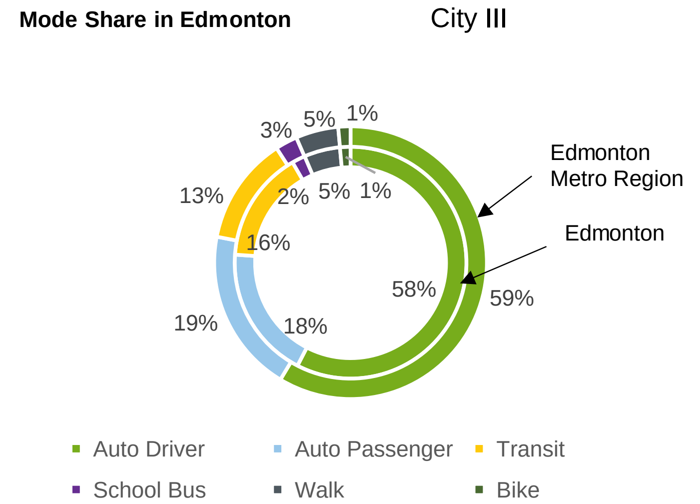
| AM Peak Hour Total Trip Distribution | Edmonton | External to City | External to Region | Total |
|---|---|---|---|---|
| Edmonton | 460,775 | 63,330 | 2,433 | **526,538** |
| External to City | 99,226 | 166,268 | 1,906 | **267,400** |
| External to Region | 2,926 | 2,271 | 743 | **5,940** |
| **Total** | **562,927** | **231,869** | **5,082** | **799,878** |

| AM Peak Hour Transit Trip Distribution | Edmonton | External to City | External to Region | Total | | | |
|---|---|---|---|---|---|---|---|
| Edmonton | 84,253 | 2,957 | - | **87,210** | | 18.3% | 4.7% |
| External to City | 14,073 | 4,100 | - | **18,173** | | 14.2% | 2.5% |
| External to Region | - | - | - | - | | | |
| **Total** | **98,326** | **7,057** | - | **105,383** | | | |

**Road Network**

| Road Network Summary | AM Peak Hour | | |
|---|---|---|---|
| | Edmonton | Other | Total |
| veh-hrs | 100,592 | 43,152 | 143,744 |
| veh-kms | 4,725,757 | 3,354,189 | 8,079,946 |
| avg. speed | 47 | 78 | 56 |

**Exhibit 2.5: Performance Indicators – Mode Choice and AM Peak Hour Travel Summary – City III**




| Transit (to/from/within) | City | BAP 2065 |
|---|---|---|
| AM | 15.5% | 14.5% |
| Midday | 7.4% | 6.2% |
| PM | 11.9% | 9.9% |

**Trip Distribution By Geography**

| AM Peak Hour Total Trip Distribution | Edmonton | External to City | External to Region | Total |
|---|---|---|---|---|
| Edmonton | 466,574 | 61,735 | 2,450 | 530,759 |
| External to City | 98,120 | 164,274 | 1,887 | 264,281 |
| External to Region | 2,953 | 2,250 | 743 | 5,946 |
| Total | 567,647 | 228,259 | 5,080 | 800,986 |

| AM Peak Hour Transit Trip Distribution | Edmonton | External to City | External to Region | Total | | | |
|---|---|---|---|---|---|---|---|
| Edmonton | 81,088 | 3,009 | - | 84,097 | | 17.4% | 4.9% |
| External to City | 13,303 | 3,991 | - | 17,294 | | 13.6% | 2.4% |
| External to Region | - | - | - | - | | | |
| Total | 94,391 | 7,000 | - | 101,391 | | | |

**Road Network**

| Road Network Summary | AM Peak Hour | | |
|---|---|---|---|
| | Edmonton | Other | Total |
| veh-hrs | 103,198 | 42,761 | 145,958 |
| veh-kms | 4,726,277 | 3,335,098 | 8,061,375 |
| avg. speed | 46 | 78 | 55 |

# 3 Network Review

One of the important aspects of the mass transit scenarios was the opportunity to evaluate different options for future transit services and connections. The study stakeholders and members of the steering committee had identified a number of topics for review, beyond the basic review of performance of the scenarios. These topics are listed here, and discussed in the next section.

### Concept Elements under Review

- Service on Whyte Avenue
- North-south service south of downtown
- Terwillegar Drive service
- Connection to Sherwood Park
- LRT termini
- 97 Street service
- Service to Annexation and Future Growth Lands
- Other Transit Network Elements
  - Rapid Bus Network
  - Regional service
  - New Frequent and Local Routes.

### Application of Model Outputs to Network Review

The subsequent sections of this report focus on specific connections and types of transit services. These were evaluated using the city transit scenarios as a means to compare and contrast different network assumptions. While each of the Cities benefited from some refinements during modelling, none of them should be seen as fully optimal. The results presented here are partly dependent on the underlying land uses in the evaluation scenarios, as well as the transit network structures.

The discussion focuses mostly on AM (7:00 to 8:00 am) and PM (4:30 to 5:30 pm) peak periods since those time periods account for the peak travel demands, and therefore require the transit system to operate at its fullest capacity. The MD time period (9:00 am to 3:30 pm) was also modeled and in nearly all cases, except for some of the community shuttle routes where demand tends to be off-peak, the required frequency and number of transit vehicles in service would be less in the MD and other off-peak times.

The outputs of all three time periods were used in other analyses for the City Plan, where all-day outcomes were reported.

## 3.1 Whyte (82) Avenue and Link to the West

The 2009 LRT network plan envisions LRT along Whyte Avenue as part of a Centre LRT alignment. However concerns raised through the strategy and concept design phase of the project have warranted a closer look at mass transit service on this corridor. The recommendations for mass transit service on Whyte Avenue are based on a network wide analysis that considers a combination of factors including passenger loads expected on Whyte Avenue, new bridge crossing requirements, north-south connections into downtown, LRT capacity adjustments and LRT end points. Although this section specifically speaks to the Whyte Avenue corridor, other sections in this report (including 3.3 and 3.6.1) should be kept in mind in order to understand the implications to a Centre LRT alignment.

The combination of scenarios allowed for testing of BRT to 87 Avenue, LRT connecting from LRT on Terwillegar Drive, and rapid bus overlay as examples of the exclusive, semi-exclusive and limited stop mass transit hierarchies. All three carried reasonably high volumes but would come with different costs and different implications.

Exhibit 3.1 helps illustrate the range of options:

- City I assumed 'LRT' (Fully segregated) on 82 Avenue connecting through to the Terwillegar Drive corridor, plus Rapid Bus from 87 Avenue via Whitemud Drive and Fox Drive to both South Campus and Health Sciences
- City II included 'BRT' (Semi-exclusive) on 82 Avenue with a new bridge over the river west to 87 Avenue.
- City III had rapid buses in mixed traffic.

**Exhibit 3.1– Comparison of options on Whyte Avenue including connections west and southwest**

**City I**

Exclusive ROW transit service (Grade separation or full pre-emption of signals)

Whyte Avenue plus direct route to Terwillegar Drive

**City II**

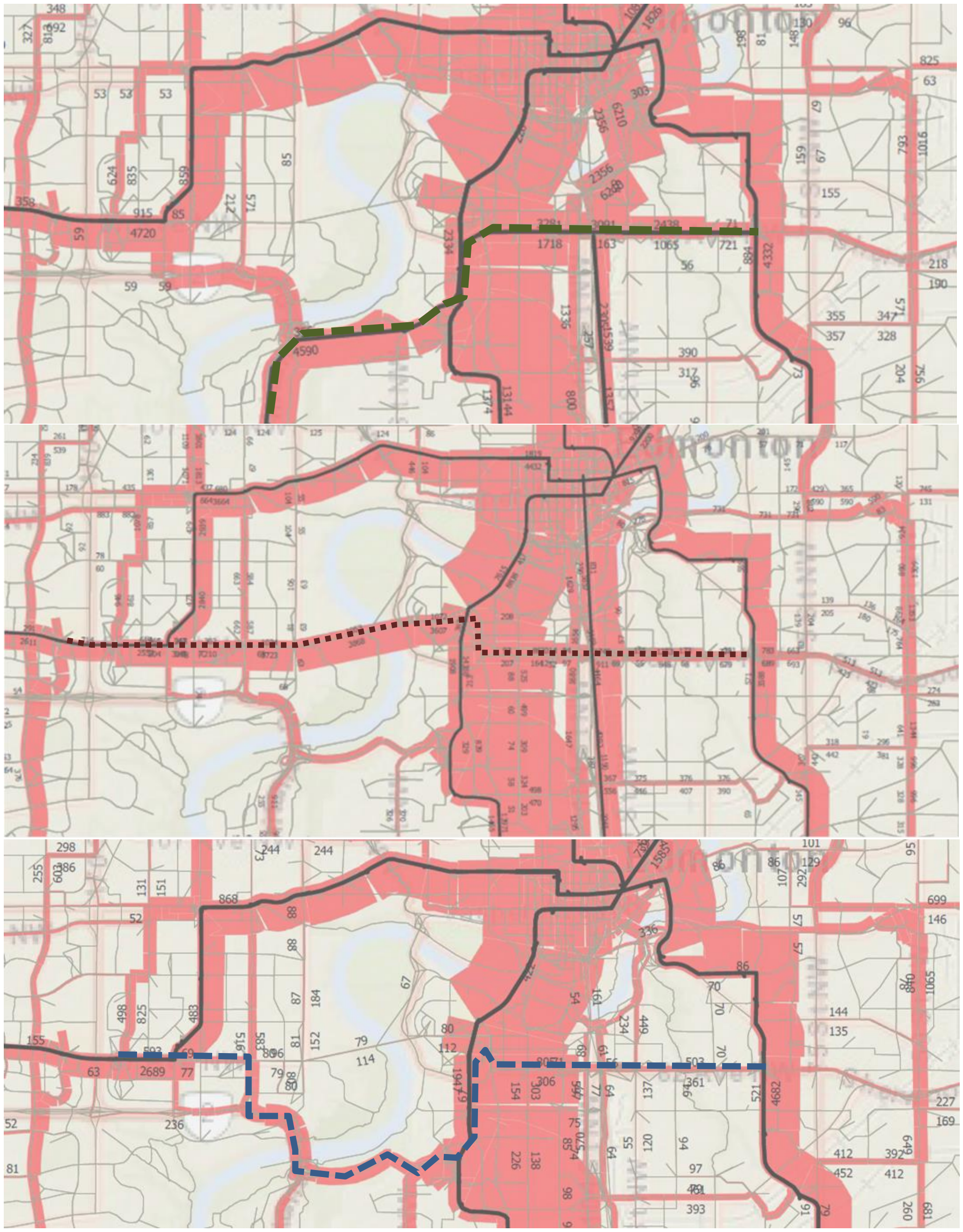
Semi-exclusive ROW transit service (Stopping at signals)

Whyte Avenue plus direct route to 87 Ave

**City III**

Rapid bus making limited stops, operating in mixed traffic

Whyte Avenue plus connection over Fox Drive and Whitemud to 87 Ave



*Note: Widths of red bands are a relative indication of AM peak hour passenger demands.*

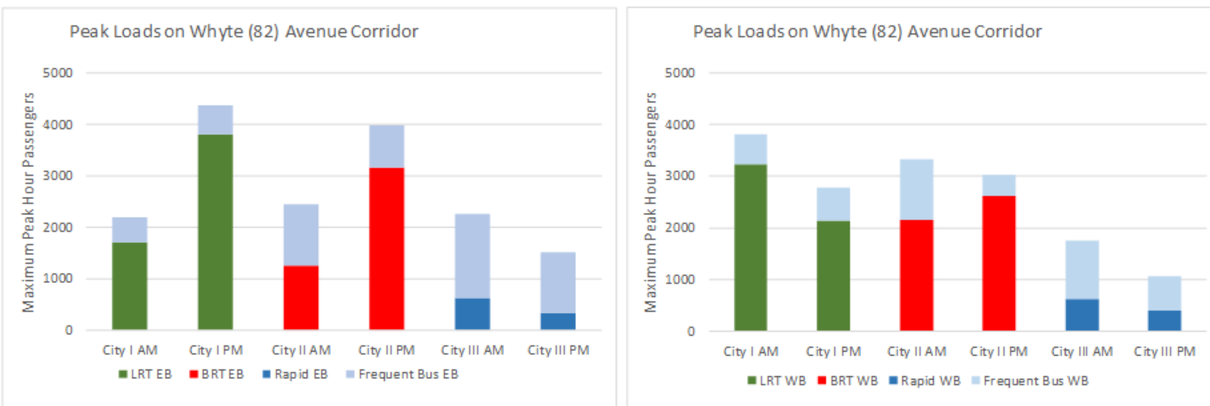
### AM and PM Peak Hour Passenger Loads

Exhibit 3.2 builds upon the map by indicating the peak hour passenger loads in the AM and PM peak hours for each of the three scenarios, with the two figures comparing the eastbound and westbound numbers. A location on Whyte Avenue near 112 Street was used as the reference point.

It is notable from this figure that the semi-exclusive (BRT modelled in City II) plus frequent bus achieves nearly 90% of the demand of the fully segregated or grade-separated (LRT modelled in City I) transit line. While a new bridge over the River would come with substantial cost, grade separation to achieve full LRT speeds in the 82/Whyte Avenue corridor would likely have an even greater cost increment.

The rapid bus option in City III had the lowest loads for several reasons. For one, the proposed route was shortest, which tends to produce lower peak hour passenger loads as the demand does not have as much distance to 'build up'. Second, the lower speeds that come with operating in mixed traffic would be less attractive to potential passengers.

**Exhibit 3.2: Peak Hour Passenger Loads on Whyte Avenue for City I, II and III Mass Transit Options**




**EB** **WB**

## 3.2 Between South of Downtown and the Airport

Connections south of downtown were analyzed with the following items in mind: How much additional capacity would be needed to connect downtown to Whyte Avenue and how to divert some of the potential overloading of the Capital Line LRT to other services that also served on key south connection points such as the Airport. In order to address these items, the study considered different options. The following three combinations were tested:

- City I tested commuter rail operating from Whyte Avenue to the Airport, following the CP line, plus BRT to 23 Avenue with a dedicated bus connection from Whyte Avenue to downtown
- City II tested commuter rail (downtown to Airport via Heritage Valley), with parallel BRT to 23 Avenue
- City III extended LRT from Heritage Valley to the Airport, with commuter rail from Heritage Valley to downtown, and the parallel rapid bus from Heritage Valley to downtown.

Exhibit 3.3 shows the configurations of the three city options, indicating how each connected to the rest of the network. The tick-marks are segments included in each option and the airport connections are indicated by an "airplane" (✈) symbol.

**Exhibit 3.3– Comparison of Options for Services to airport, Heritage Valley and Calgary Trail corridor, south of Downtown**

| ELEMENT | SEGMENT | CITY I | CITY II | CITY III |
|---|---|---|---|---|
| LRT (Capital Line) | To Heritage Valley | ✓ | ✓ | ✓ |
| | From Heritage Valley to Airport | | | ✓ ✈ |
| Commuter Rail (CP Rail and/or new alignment west of Hwy 2) | Downtown to Whyte Avenue | | ✓ | |
| | Whyte Avenue to Ellerslie | ✓ | ✓ | ✓ |
| | Ellerslie to Heritage Valley | | ✓ | ✓ |
| | Heritage Valley to Airport | | ✓ ✈ | |
| | Ellerslie on CP alignment to Airport | ✓ ✈ | | |
| Bus Service (Calgary Trail/104 Street corridors) | Semi-exclusive through downtown to 23 Avenue | ✓ | ✓ | |
| | Extra buses on Whyte Avenue-downtown portion | ✓ | | |
| | Rapid bus to Heritage Valley | | | ✓ |

## AM and PM Peak Hour Passenger Loads

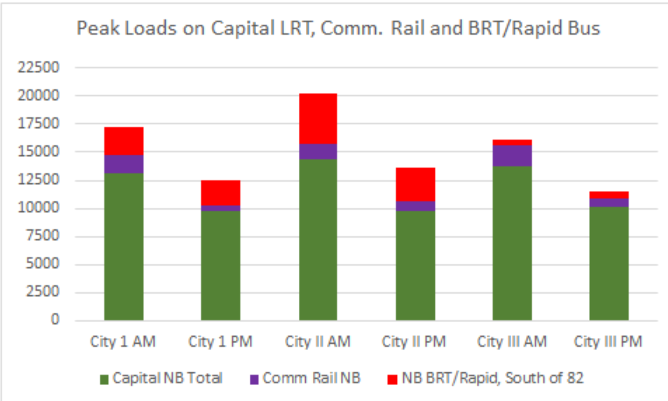
The resulting peak hour passenger loads for all three cities are summarized in Exhibit 3.4 (page following).

Overall, since headway assumptions were consistent for each route, City II had the highest passenger loads with its combination of a direct service downtown, and ability to transfer at several points between the commuter rail, LRT and BRT routes.

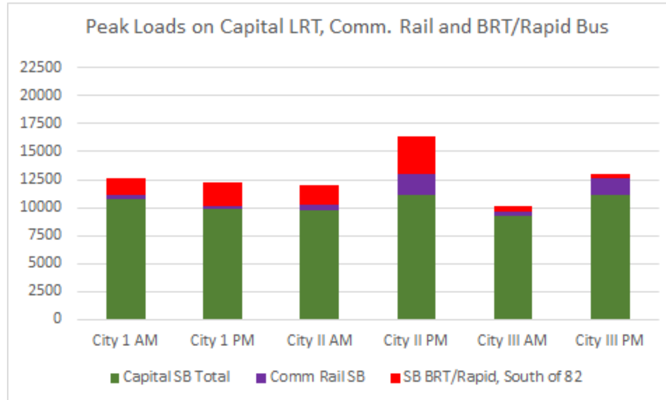
City I had the highest BRT passenger loads, helped in part by the high service frequency north of 82/Whyte Avenue, and its providing the connection between the commuter rail terminus station and downtown. The commuter rail loads were lowest, largely due to not directly going downtown. One potential advantage of this option is more of the existing CP rail corridor is used rather than brand new alignment being created, assuming that the City is able to negotiate usage with CP.

City III had higher commuter rail loads (owing to the direct connection downtown and transfer options) but lower rapid bus loads (lower speed than BRT).

**Exhibit 3.4 Combined Peak Hour Passenger Loads for north-south LRT, BRT, Rapid Bus and Commuter Rail, South of Downtown**




NB




SB

## 3.3 Capacity and Connectivity North-South across the River

The BAP and each of the evaluation scenario mass transit networks assume different types of north-south transit services across the Saskatchewan River, between downtown on the north and the University and Old Strathcona districts to the south. Considering the transit connections between Groat Road and the Low Level (Connors Rd) Bridge, the scenarios include a mix of LRT, buses on existing bridges, and new rail and bus connections into the downtown.

The assumptions for each scenario included:

- BAP – Capital and Metro Line LRT, and local buses on existing crossings. The capacity of the LRT is based on 5 minute peak hour headways on each service, or 12 trains per direction each.
- As discussed in the Mass Transit Backgrounder, the five-car trains on the high-floor LRT lines have a peak hour capacity of 800 passengers (160 per car); however, it was recommended to use 600 passengers (120 per car) for service planning purposes because the higher loading would be less comfortable for passengers, and would result in delays at stations when boarding and alighting are slowed by crowding. Using the service planning capacity yields 600 × 12 trains per hour × 2 routes = 14,400 passengers per direction. The higher theoretical peak capacity would be 19,200;
- City I – Same LRT and local bus, plus two semi-exclusive (BRT) routes across the river. The two BRT routes both serve a regional rail connection to the airport that terminates at Whyte Avenue and does not cross the river;
- City II – Same LRT and local bus, plus one semi-exclusive (BRT) route – assuming a different crossing location – and a regional rail connection to the airport direct from downtown;
- City III - Same LRT and local bus, plus one rapid bus on city streets – and a regional rail connection to the airport direct from downtown

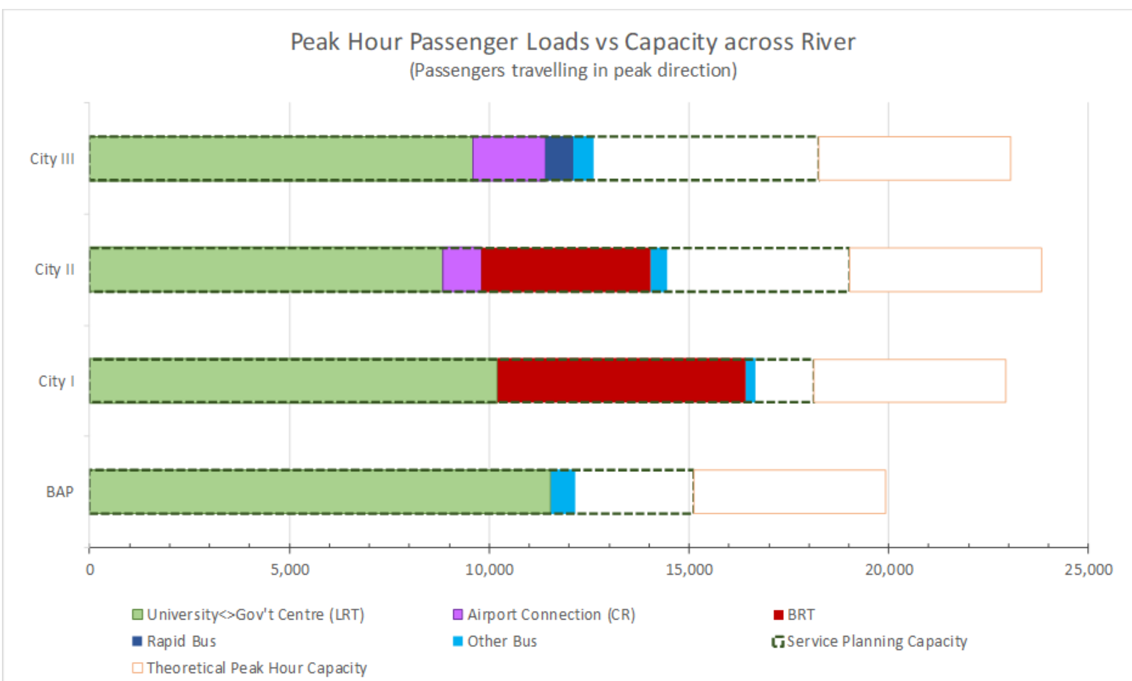
**Exhibit 3.5 – Summary of Assumed Mass Transit Services across the River, by Scenario**

| Scenario | BAP | City I | City II | City III |
|---|---|---|---|---|
| Capacity (Passengers Per Hour) | **15120** | **18120** | **19020** | **18240** |
| LRT | 14400 | 14400 | 14400 | 14400 |
| CR | | | 2400 | 2400 |
| BRT (Semi-Exclusive) | | 3000 | 1500 | |
| Rapid Bus | | | | 720 |
| Other Bus | 720 | 720 | 720 | 720 |

Because the model has been run assuming unconstrained capacity, the peak hour passenger loads represent the desire lines for travel, while the capacity numbers estimated in Exhibit 3.5 represent practical limits for service planning. Over time, as demand on some services starts to exceed these limits, passengers would likely choose to use parallel services or adjust their travel schedules (to just before or after the peak hour) in response.

In Exhibit 3.6, the peak demand for these modes is plotted and compared with their combined theoretical capacity. An interesting finding from the analysis shows that in Cities II and III, the capacity added by a commuter rail connection (direct to downtown) resulted in increased demand. Similarly, in Cities I and City II, the demand created by the addition of a semi-exclusive right of way services (BRT) was significant and overall less than the total available capacity. Therefore, over time, new capacity crossing the river will be desirable to grow transit ridership using exclusive right of way transit service resulting in increased mode choice for travellers. The analysis demonstrates that the generated transit demand can be serviced by the combined capacity of the different mass transit lines crossing the river.

**Exhibit 3.6– Comparison of Peak Hour Passenger Loads – Peak Direction Only – North-South across the River**




City I and City II both include what was modelled as 'BRT' but in fact represents semi-exclusive transit with limited stops. The demand estimates shown above, in the range of 4,000 to 6,000 peak direction passengers in the peak hour, could only be accommodated in the long term through dedicated lanes or a transitway (for bus or rail), to segregate it from congestion and help give the service priority.

## 3.4 Terwillegar Drive

The Terwillegar Drive corridor is an important connection to southwest Edmonton, and there was a desire to understand the types of service and connections that would yield the best transit ridership.

Testing suggests this is a secondary corridor compared to the major fully segregated (LRT) services such as the Capital Line. The effects of the North Saskatchewan River to the west, limits access to the catchment area beyond the river and reduces some of the potential demand on this route.

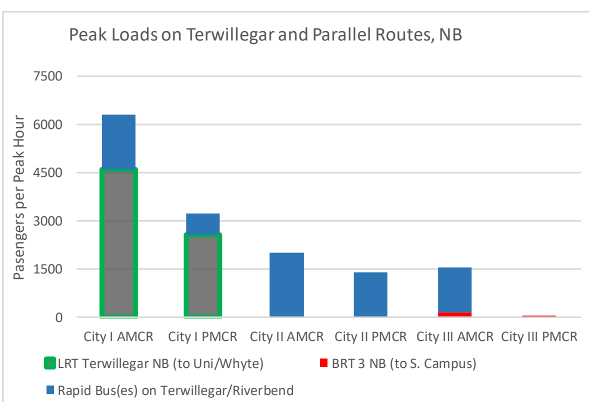
The three configurations that were tested along Terwillegar Drive included:

- City I - a fully segregated transit line (modelled as LRT but could also be BRT on transitway with full stations). This included a direct connection into the University district and through to Whyte Avenue.
- City II – a Rapid Bus with connections in/out of transit centres, and routes connecting to the Capital Line and Valley Line;
- City III - semi-exclusive buses along Terwillegar Drive, with the route ending at South Campus Transit Centre.

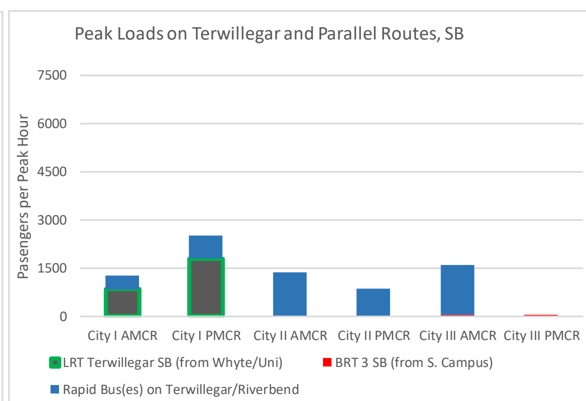
### AM and PM Peak Hour Passenger Loads

The resulting passenger loads for all three cities are summarized in Exhibit 3.7. The system (City I) with the direct connection into the core part of the University district and Whyte Ave performed the best.

**Exhibit 3.7– Peak Hour Passenger Loads for Mass Transit – Terwillegar and Parallel Corridors**




**NB**




**SB**

The BRT from City III under-performed relative to the rapid bus in City II, which suggests that the connections into intermediate transit centres was important as well as the avoidance of an additional transfer. Rapid bus is assumed to run on streets or highways and serve stops both on the main route and in the case of the Terwillegar Drive corridor, the routes make some deviations offline to serve transit centres, such as Leger on 23 Avenue. BRT operates in its own dedicated lanes, often separated by a barrier, and the higher potential speed was offset by the need for passengers to transfer to get onto the system. This would occur with a system that required passengers to access stations along Terwillegar Drive from other bus stops crossing the interchanges.

(This issue did not occur with the semi-exclusive 'BRT 1' or 'BRT 2' discussed in Sections 3.1 and 3.2, because those transit stops would be directly accessible from adjacent residential and commercial areas, and consequently achieved robust ridership.)

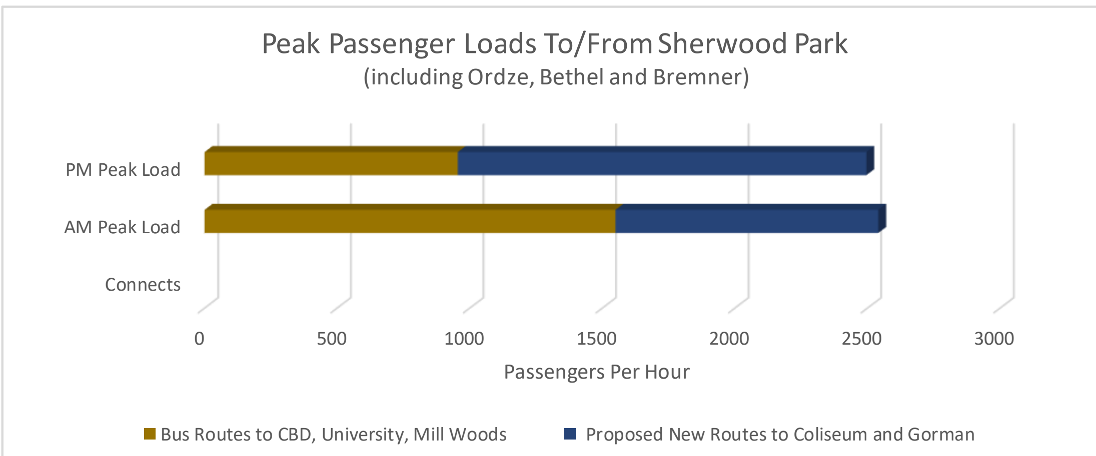
It would be reasonable to expect that a different service design, where the direct connection into the University was combined with more direct service into the area, would produce a better result for a hybrid of the City II and III transit services.

## 3.5 Sherwood Park Connection

Of interest was whether an LRT connection into Sherwood Park would be warranted by the planning horizon assumed for this study.

Exhibit 3.8 summarizes the peak hour passenger loads for the Sherwood Park transit routes connecting into Edmonton. This differentiates between the existing (2019) routes into the Central Business District (CBD) and other destinations that are assumed to continue into the future, and proposed new services intended to more directly connect growth areas in east Sherwood Park and northeast Edmonton.

**Exhibit 3.8– Peak Hour Passenger Loads – Routes between Sherwood Park and Edmonton**

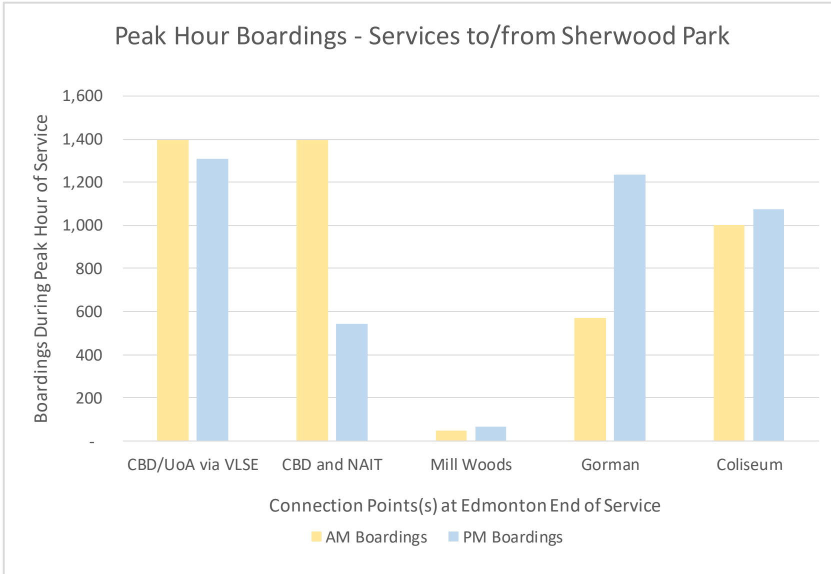



While the total demand of 2500 approaches the end-of-line LRT volumes on other services, neither of the two groups of regional bus connections, which operate in multiple corridors, is high enough on its own to warrant more than regional buses. This does not preclude some portions of these routes being considered for enhancement through transit priority or even partial segregation from traffic, provided that enough of these bus routes would benefit.

An interesting result here is that the new routes with connections to the Coliseum and Gorman [future] LRT stations performed well.

Exhibit 3.9 summarizes the peak passenger hour boardings on each route and indicates where each connects on the Edmonton end of the route. There was no single focal point of demand on Edmonton side (University of Alberta, NAIT, CBD, and the northeast employment area are all destinations). Overall, the origin-destination pattern is dispersed and it appears to make the most sense to link into Edmonton at multiple LRT stations. This is best served by multiple routes tailored to travel markets, with some concentration of service into the CBD as shown in Exhibit 3.9, since it is a major AM destination and PM origin.

**Exhibit 3.9 Peak Passenger Hour Boardings – Routes between Sherwood Park and Edmonton**




*VLSE = Valley Line Southeast

d

## 3.6 LRT Network

Analyses were carried out to review the assumed LRT end points and the potential for extensions.

### 3.6.1 Metro Line to South Campus

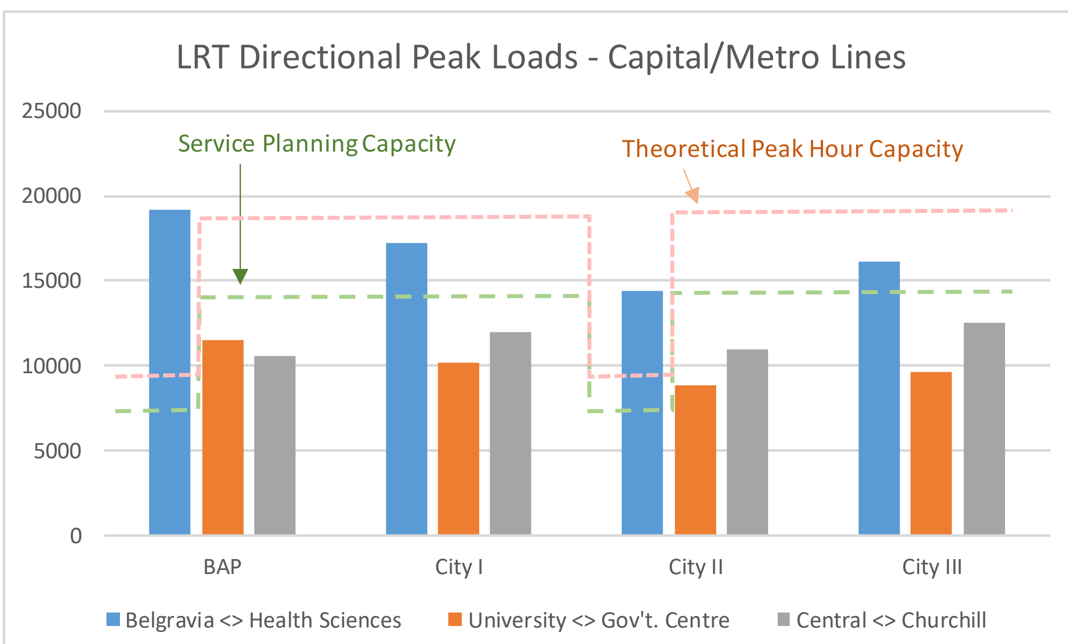
The current operation of the Capital and Metro Lines south of Health Sciences is constrained by the grade crossing of University Avenue. Operating higher frequencies of LRT could block the crossing frequently enough to effectively close it in the east-west direction to vehicles, pedestrians, cyclists.

The BAP network assumes that the Capital Line would operate every 5 minutes per direction at this crossing, or twelve hourly trains per direction. This same assumption was also carried through City II.

Extending the Metro Line to South Campus would be equivalent to operating 24 trains per direction (5 minute headway on Capital + 5 minute on Metro). Doing so would help address the peak load issue south of Health Sciences. There would be additional demand due to the extra service. City I and City III assume the extra service to South Campus.

Exhibit 3.10 summarizes the peak hour passenger loads at the system's highest passenger volume point (south of Health Sciences), over the river, and at the busiest segment in the downtown LRT tunnel. The capacity line indicated on the exhibit is based on an assumed service planning capacity of 600 passengers per LRT train per direction (consistent with the discussion in Section 3.3), resulting in the range of 7,200 (one LRT line) to 14,400 (two LRT lines) passengers per direction indicated here. The higher theoretical peak capacity for more fully loaded LRT trains is also shown.

**Exhibit 3.10 Peak Hour Passenger Loads – Metro and Capital Lines in Highest Demand Segment**



## Productivity Comparison

Exhibit 3.11 summarizes the total boardings (rather than peak hour passenger loads). In addition, a productivity index has been added where the number of AM plus PM peak hour boardings per km of route (counting each direction) is shown. This provides an indication of how popular the routes are to transit passengers. Higher numbers logically support more frequent transit services and higher levels of infrastructure investment.

City I has the highest LRT demand in the model, due to the extended Metro Line, plus 'LRT 2'. The extension of the Capital Line to the airport in City III also increases riders. The extended versions of these LRT lines are shown on different rows to help distinguish them in the table.

While the extensions tend to lower the index, the routes all fall within a range of 600 or more peak hour (AM plus PM) passengers boarding per route-km. This is the order of magnitude values that a transit line with full segregation (or pre-emption) from other traffic supports. For context, the current system has around 20,000 to 25,000 boardings in the AM+PM peak hours. This would result in an index value of approximately 400 for the existing system, so it can be reasoned that any routes or corridors with this type of attraction warrant very high frequency service. As the needed frequency increases, the need for separation from other modes to sustain the service becomes important.

As a peer comparison, the busiest surface route in Greater Vancouver, the 99 B-Line, is limited stop to/from University of British Columbia. Its comparable measure would be around 520 AM+PM boardings per km. The busier half of the 99 B-Line is planned to be upgraded to a grade-separated rail line (the Broadway subway) to address the high demands, because surface running service has effectively reached a practical limit of how many buses (over 20 per hour per direction) can operate in bus lanes and mixed traffic.

The Valley Line in City II experiences a dip in demand due to the parallel 'BRT 2' service competing for some of the same passengers, but it still remains in the range where segregation/pre-emption are well supported.

**Exhibit 3.11 Peak Hour Passenger Boardings – LRT System**

| | Peak Hour Transit Boardings | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | City I | | City II | | City III | | Distance (Route-km) | | | AMPM PkHr Boardings per km | | |
| # | AMCR | PMCR | AMCR | PMCR | AMCR | PMCR | City I | City II | City III | City I | City II | City III |
| LRT2 North East | 5,654 | 5,749 | - | - | - | - | 16.5 | | | 690 | | |
| LRT2 West South | 3,958 | 4,463 | - | - | - | - | 16.5 | | | 509 | | |
| Capital NB | 20,256 | 18,684 | 19,889 | 15,824 | | | 37.4 | 37.4 | | 1,041 | 955 | |
| Capital NB (extended) | - | - | - | - | 19,450 | 17,354 | - | - | 47.7 | | | 771 |
| Capital SB | 17,013 | 19,314 | 14,476 | 17,804 | | | 37.4 | 37.4 | | 971 | 863 | |
| Capital SB (extended) | - | - | - | - | 14,431 | 18,271 | - | - | 47.7 | | | 685 |
| Metro NB (extended) | 8,876 | 12,256 | - | - | 6,196 | 9,518 | 20.6 | - | 20.6 | 1,024 | | 762 |
| Metro NB | | | 4,105 | 6,918 | | | | 18.2 | | | 607 | |
| Metro SB (extended) | 12,113 | 10,085 | - | - | 9,468 | 8,083 | 20.9 | - | 20.9 | 1,063 | | 841 |
| Metro SB | | | 6,923 | 5,656 | | | | 18.4 | | | 683 | |
| Valley NB/WB | 10,844 | 16,451 | 7,367 | 8,242 | 9,673 | 11,568 | 31.4 | 31.4 | 31.4 | 869 | 497 | 676 |
| Valley EB/SB | 13,624 | 14,528 | 8,284 | 10,083 | 9,264 | 13,178 | 31.4 | 31.4 | 31.4 | 897 | 585 | 715 |
| | | | | | | | | | | | | |
| Capital+Metro Subtotal | 58,300 | 60,300 | 45,400 | 46,200 | 49,500 | 53,200 | 116 | 111 | 137 | | | |
| Total | 92,300 | 101,500 | 61,000 | 64,500 | 68,500 | 78,000 | **212** | **174** | **200** | **913** | **721** | **733** |

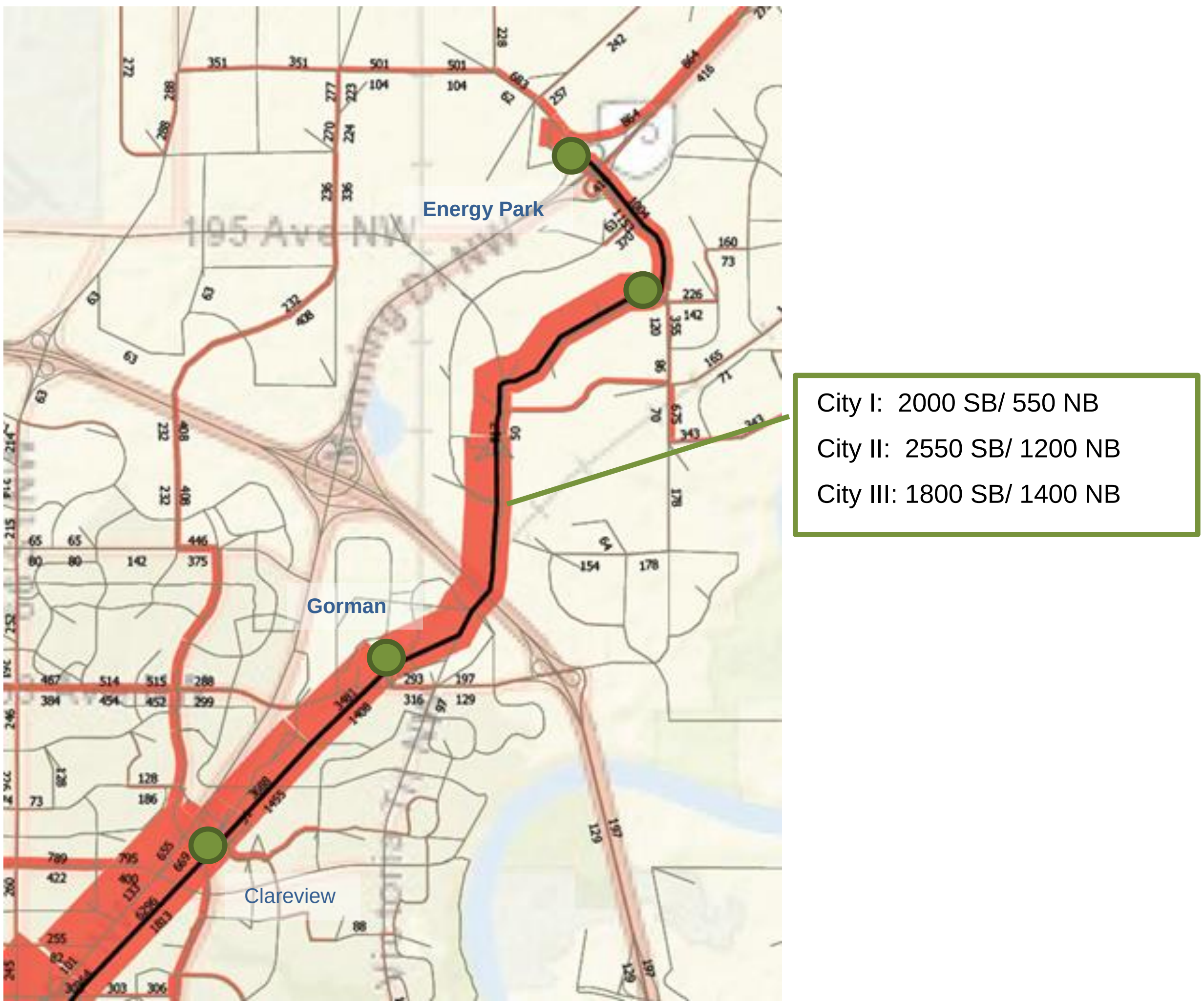
### 3.6.2 Gorman to Energy Park (Capital Line)

A brief analysis was undertaken to review the extension of LRT beyond Gorman.

- LRT through to Energy Park was included in BAP and each of three cities
- Passenger loads reflect no transfer needed beyond Gorman
- Results vary somewhat between scenarios because of assumed densities and assumed transit network

As shown on Exhibit 3.12, the peak hour passenger loads as far as north as Energy Park suggest LRT is the best fit. The continuation to Energy Park provides a good 'hub' location for local and regional bus services as well as a possible park and ride location.

**Exhibit 3.12 Morning Peak Hour Passenger Loads - Capital Line Northeast (City II)**



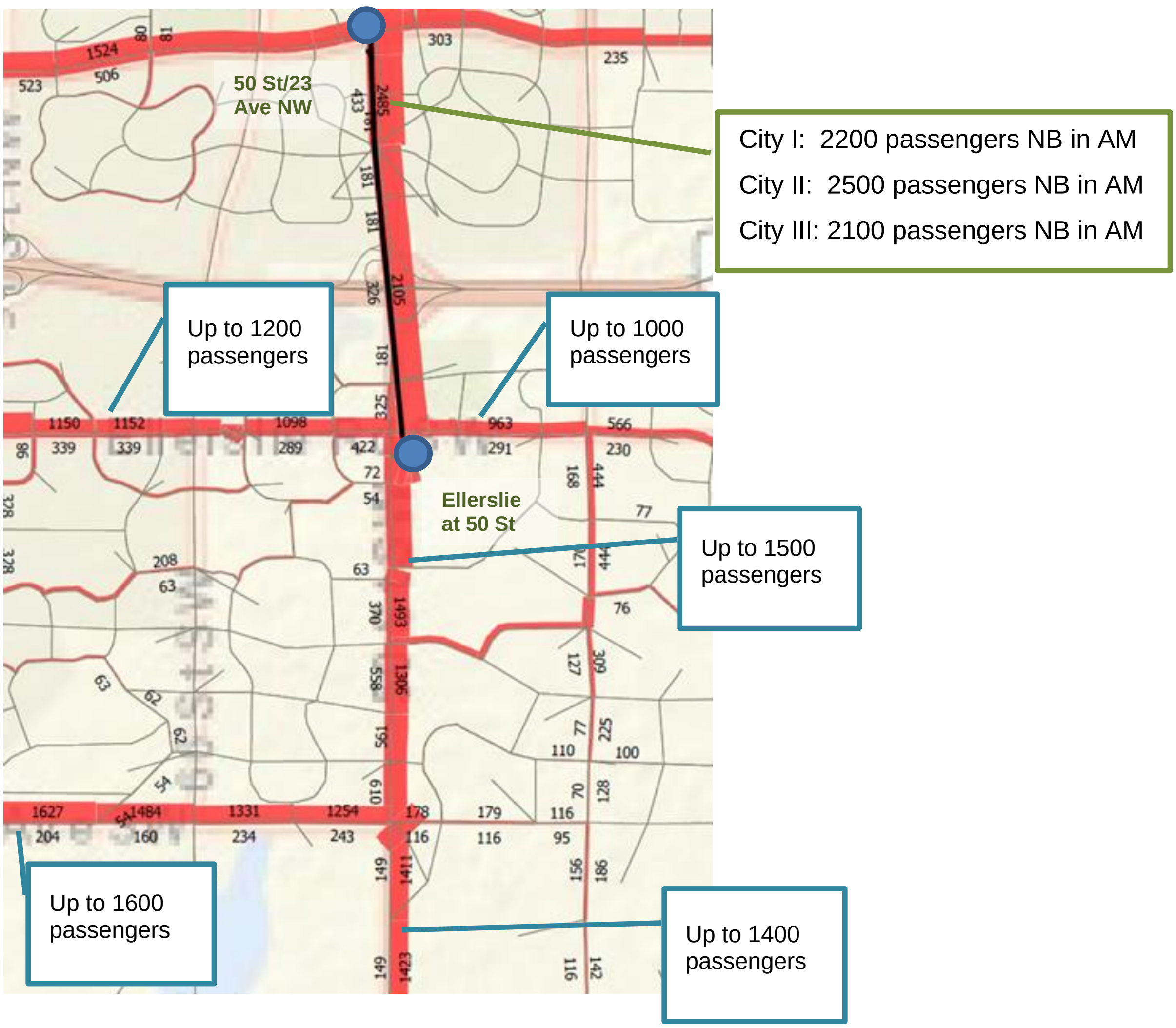
### 3.6.3 Ellerslie Road (Valley Line)

Each of the future scenarios includes the Valley Line SE extended from the Mill Woods station (now under construction) to Ellerslie Road at 50 Street in southeast Edmonton.

Exhibit 3.13 shows the peak hour passenger loads from City II, which included local feeder buses from the annexation lands and Beaumont into the LRT station. City II also includes a regional connection along 50 Street between this area, Capilano and Coliseum LRT stations.

Here, the demand appears to split in three directions– to the west, south and east. These appear to be well-served by the rapid and local buses in the area, and there is no single direction that commands attention as the logical direction to extend mass transit service.

**Exhibit 3.13 Morning Peak Hour Passenger Loads – Southeast (City II)**



### 3.6.4 Heritage Valley (Capital Line)

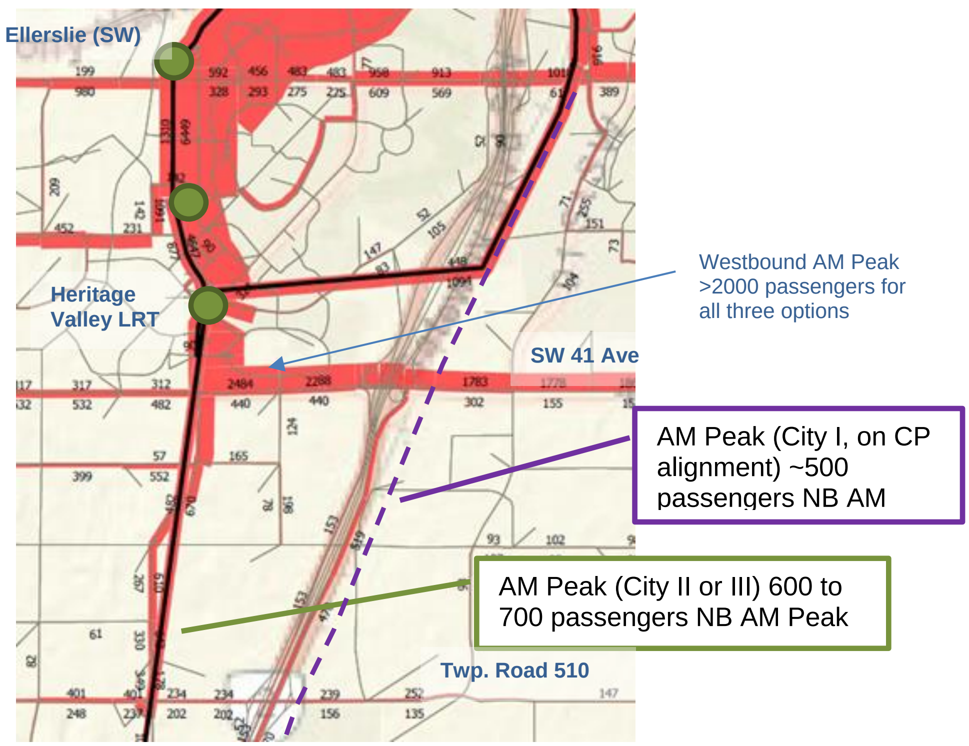
Several of the scenarios tested variations of service extensions past Heritage Valley in the Southwest:

- BAP includes bus connections to areas south within city limits, and to the airport, Leduc and Nisku
- City I commuter rail stays east of Hwy 2 and connections at Heritage Valley are rapid bus only
- City II commuter rail directly linked from Heritage Valley to the airport
- City III tested LRT through to Airport

The peak demand shown on Exhibit 3.14 is fairly high over the short segment south to 41 Avenue SW, and then begins to drop off. As seen here, there is a combination of a rail service towards the airport and bus services in the annexation lands.

South of Township Road 510 (at the bottom of the image), the loads drop further towards the end of the line. Given what was already seen with the peak hour passenger loads exceeding capacity south of Health Sciences LRT Station, a parallel connection towards the centre of Edmonton needs to be available to carry excess demand and provide another option. Any connection south from Heritage Valley – whether the Capital Line LRT or commuter rail - would need other options in place to mitigate the potential for excess demand.

**Exhibit 3.14 Morning Peak Hour Passenger Loads – Southwest (City I)**



### 3.6.5 Lewis Farms and Connections West (Valley Line)

The demand on regional bus routes past Lewis Estates Transit Centre in the west has been assessed to see if there is a potential need for LRT to extend farther.

The BAP and Cities I, II and III all assumed regional bus connections, with fairly frequent service. Different connection points were evaluated to see how that could affect demand.

Exhibit 3.15 shows that the range of peak directional load was under 1200 peak directional passengers, across all services. These volumes are best served by multiple bus connections.

**Exhibit 3.15 Peak Hour Passenger Loads – Connections from West**

| Peak Hour Transit Passenger Loads - Routes from Stony Plain/Acheson/Spruce Grove | | | | | | |
|---|---|---|---|---|---|---|
| | City I | | City II | | City III | |
| Connects To: | AMCR | PMCR | AMCR | PMCR | AMCR | PMCR |
| Lewis Farms | 80 | 180 | 90 | 130 | 80 | 140 |
| West Edmonton Mall | 170 | 400 | | | | |
| Lewis Farms | | | 50 | 70 | 50 | 80 |
| Local Services | 50 | 40 | 130 | 130 | 110 | 120 |
| West Jasper Place | 720 | 190 | | | | |
| West Edmonton Mall | | | 850 | 190 | 860 | 220 |
| West Edmonton Mall | 20 | 260 | 120 | 680 | 70 | 570 |
| **Sum (Peak Loads)** | 960 | 890 | 1,150 | 1,070 | 1,090 | 990 |

### 3.6.6 St. Albert (Metro Line)

Exhibit 3.16 illustrates where St. Albert Transit services connect into the future LRT system. In City II (shown), ETS is assumed to include LRT to Campbell Road and rapid buses on 137Av, 156 St, and 127 St. The bulk of the St. Albert demand connects via St. Albert Trail.

As indicated in Exhibit 3.17, the peak load arriving at the LRT station is up to 1,300 passengers, a number that could be managed by other forms of mass transit.

**Exhibit 3.16 Peak Hour Passenger Loads – Connections from Northwest**


**Exhibit 3.17 Peak Hour Passenger Loads – Bus Routes to/from St. Albert**

| ELEMENT | CITY I | CITY II | CITY III |
|---|---|---|---|
| Peak Hour Passengers at Campbell Road LRT/St. Albert Park and Ride (AM Arriving) | 1,330 | 1,240 | 1,270 |
| PM Departing | 590 | 560 | 640 |

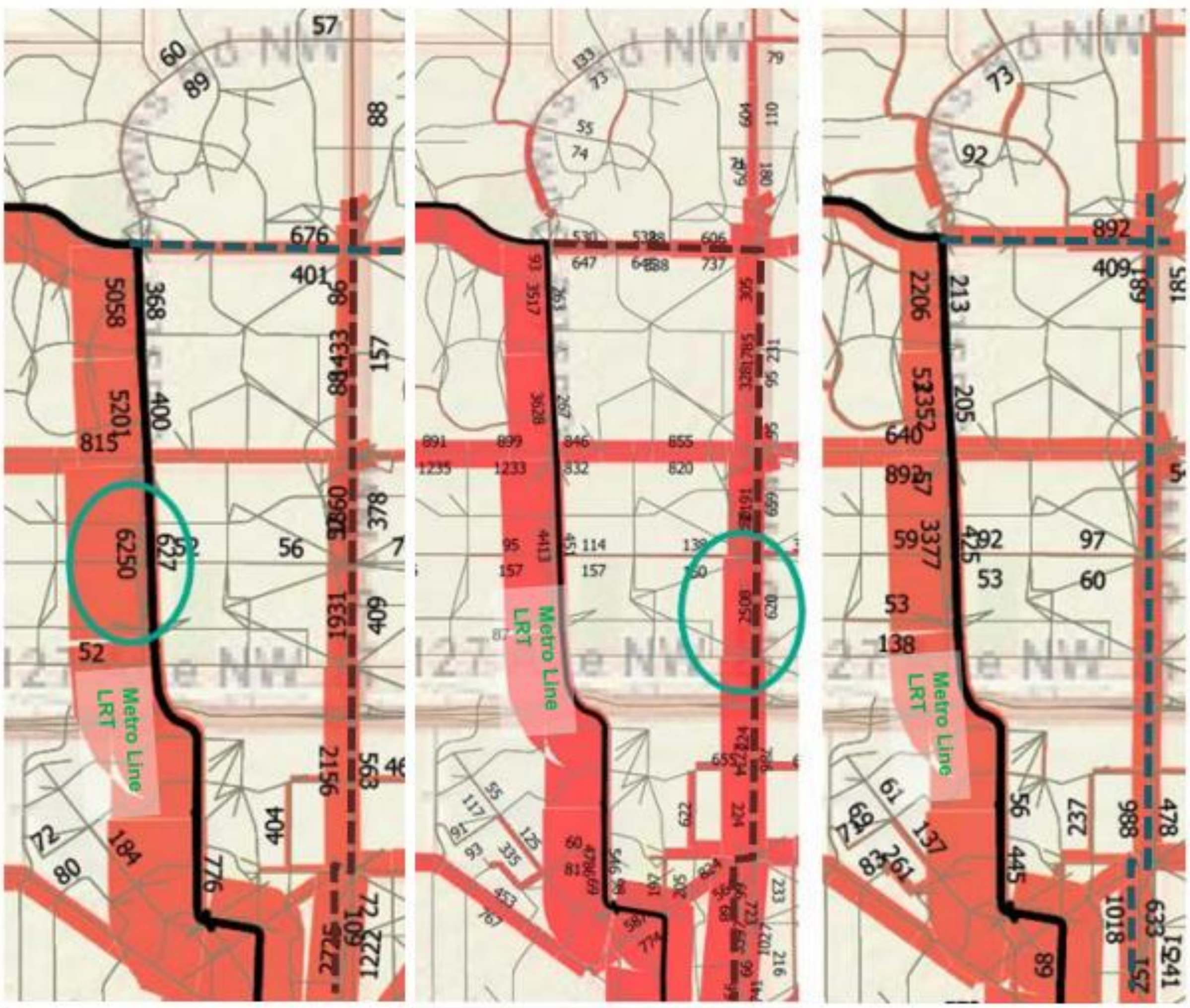
## 3.7 97 Street NW

All three of the city mass transit evaluation scenarios included new service on 97 Street (and 101Street) north of downtown. As shown from left to right on Exhibit 3.18, these included:

- City I – BRT from Eaux Claires, with rapid bus on 153 Avenue connecting both
- City II – BRT connecting to LRT at Castle Downs LRT Station
- City III – Rapid Bus

Demand for the semi-exclusive service was high. This increased when connected directly to the LRT at Castle Downs (City II), drawing some demand away from the LRT line.

**Exhibit 3.18 Peak Hour Passenger Loads – 97 Street NW and Metro Line (AM)**



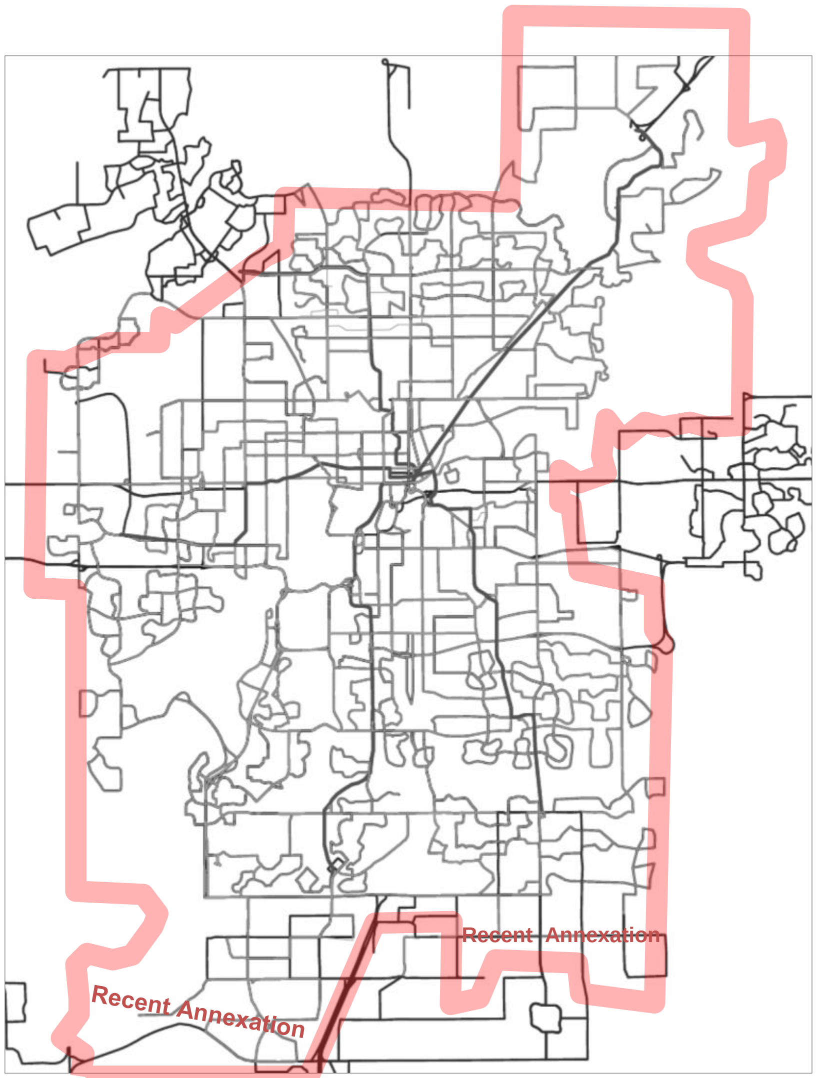

| City I | City II | City III |
|---|---|---|
| **City I**<br>Semi-exclusive ("BRT") from Eaux Claires; Rapid bus E-W<br>Highest loads overall; highest on Metro Line LRT (6250) | **City II**<br>Semi-exclusive ("BRT") from Castle Downs<br>Highest load on 97 Street (2500) | **City III**<br>Rapid bus in traffic<br>Lowest loads on 97 Street |

## 3.8 Serving Annexation and Future Growth Lands

The BAP scenario assumed additional services according to the strategic direction outlined in Edmonton's Transit Strategy. Exhibit 3.19 shows this underlying transit service pattern that was present in each of the scenarios.

In City I, II, and III, some refinements were made to headways based on projected land use density and initial estimates of demand. Parts of the annexation and future growth areas included nodes, and these were connected with higher-order mass transit, especially rapid bus. This provides a faster alternative for longer trips across the city and connecting to LRT, BRT or commuter rail. In the case of City I, some future growth and annexations areas were clearly lower density and consequently frequency was reduced in those areas.

**Exhibit 3.19 Service Pattern for City of Edmonton Annexation and Future Growth Areas**



## 3.9 Other Mass Transit Network Elements (Highlights)

This section provides a brief performance review of other elements of the transit network.

### 3.9.1 Rapid Bus Network

Exhibit 3.20 illustrates the AM and PM peak hour passenger boardings on each of the rapid bus services tested normalized using the productivity index (AM + PM peak boardings per route-km). All of the rapid bus routes contributed to the network performance but certain routes stood out:

- CBR1, CBR2, and CBR3 are crosstown routes
- NR1 goes from Energy Park to Westmount Transit Centre via 118 Av
- R111 is on 111 Avenue
- SWR2 is mostly on Ellerslie Rd
- WR1 is on 199, 178 and 170 Streets

Based on rapid bus services in other cities, a range of 100 boardings per km is a reasonable threshold to meet for a productive and frequent rapid bus service. Where values are lower, the service can be less frequent or potentially receive more local service to meet the demand.

**Exhibit 3.20 Boardings and Line Productivity of Rapid Bus Services Tested**

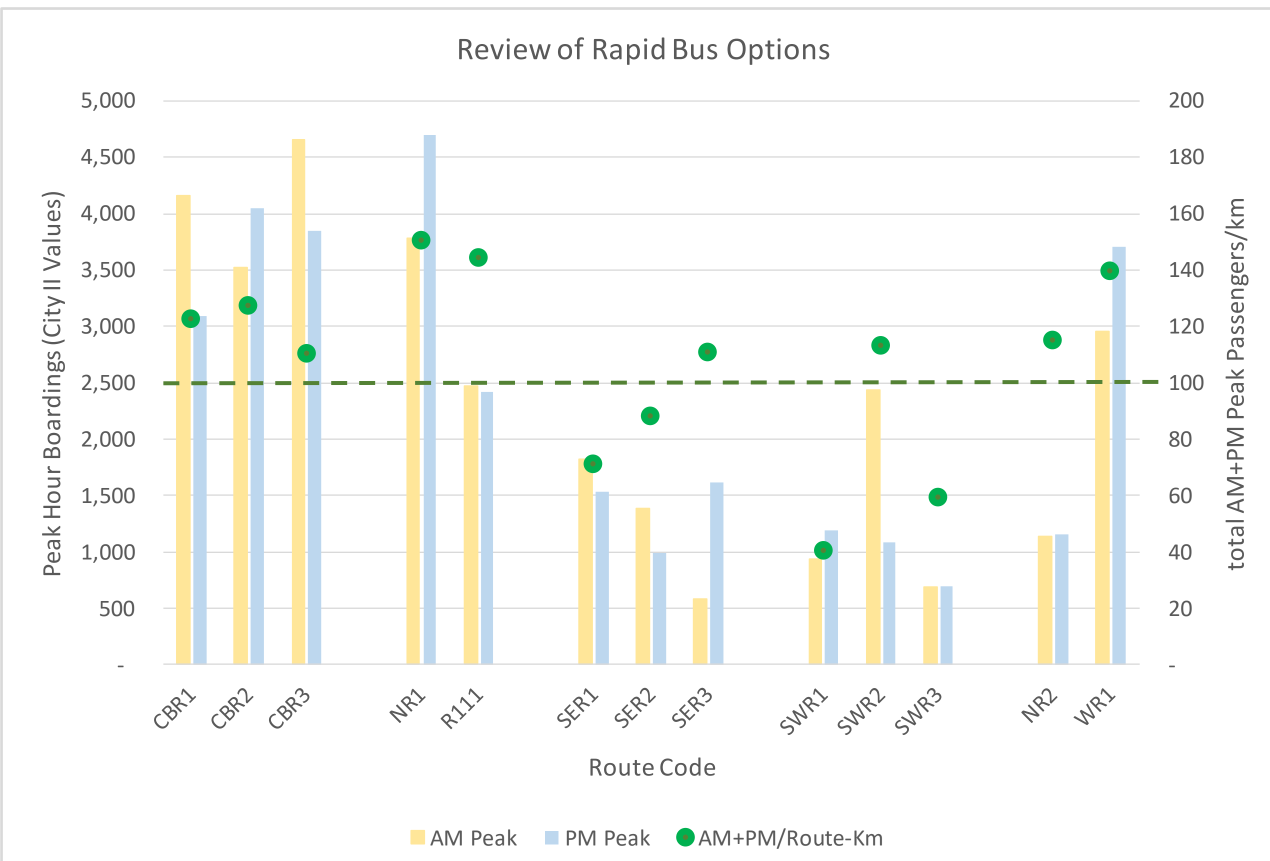
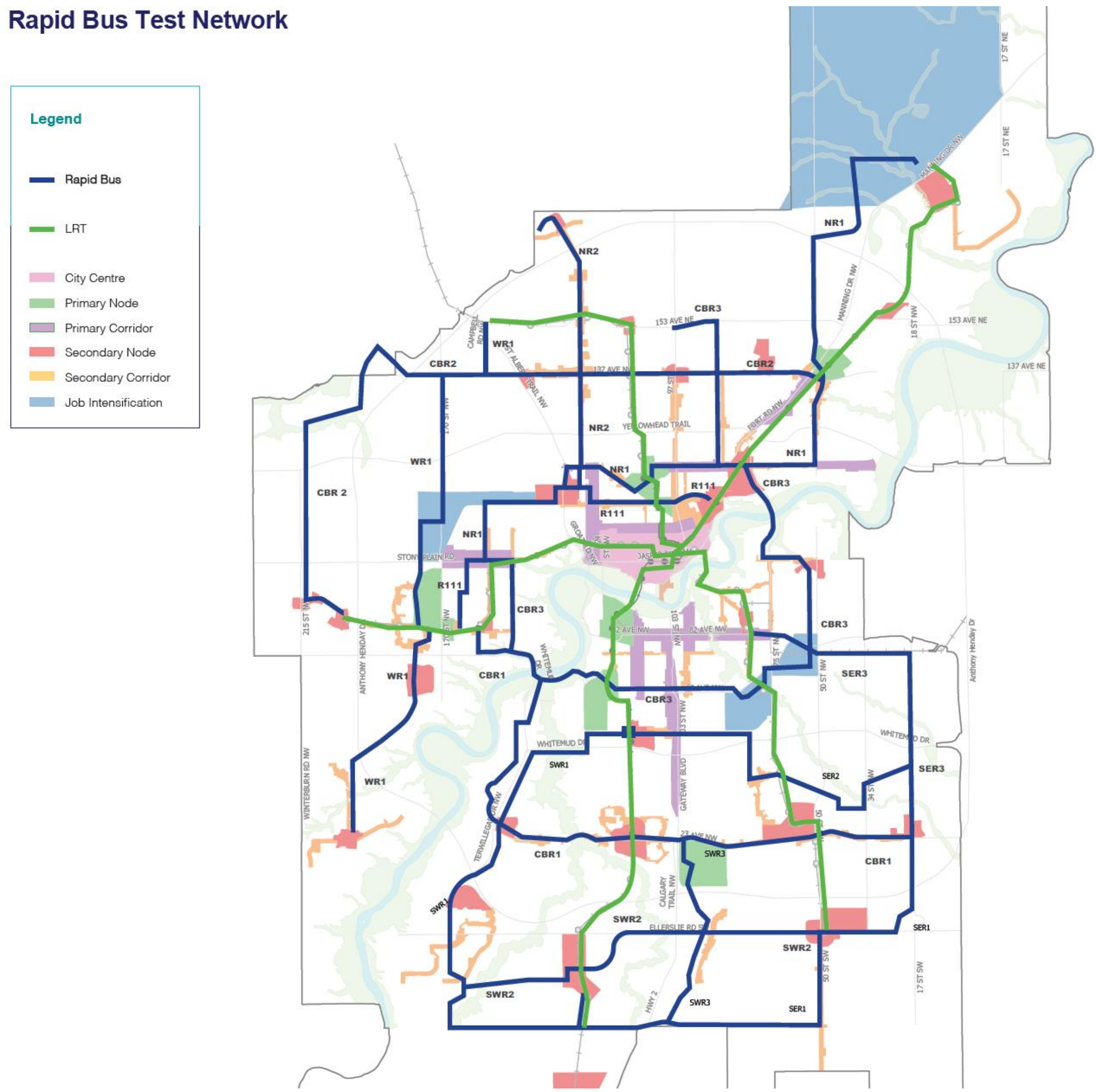


Exhibit 3.21 illustrates the test network of rapid bus routes that was evaluated, with the connections to the LRT lines shown to provide some context.

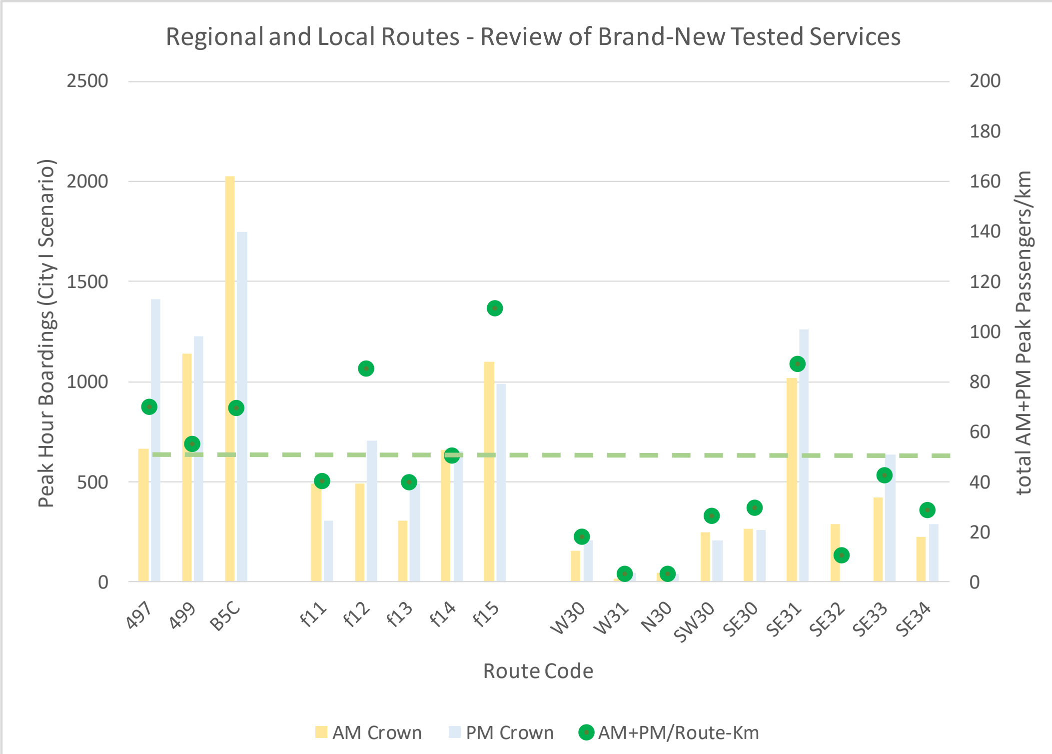
**Exhibit 3.21 Map - Rapid Bus Services Tested in City Transit Scenarios**



### 3.9.2 New Regional, Frequent and Local Routes

In City I, a number of new routes were created to serve the concentrated growth in the centre of the city, including frequent buses and additional locals. New regional bus routes were included in all three scenarios, and these are also indicated on Exhibit 3.22.

**Exhibit 3.22 Boardings and Line Productivity of New Routes in City Transit Scenarios**



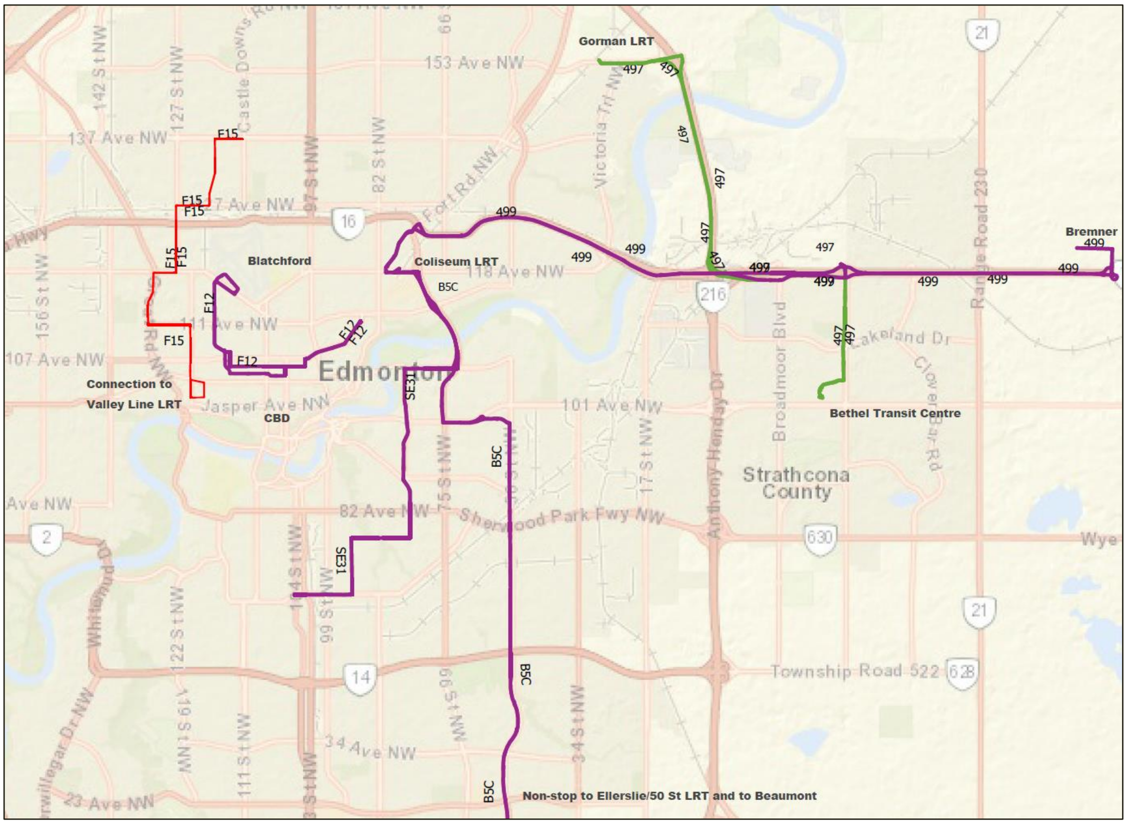

The best performing of the new local routes evaluated in City I were:

- F12 – Blatchford to Stadium, using 107 and 106 Avenues, and 119 Street;
- F15 – Oliver to Calder, using 124 and 127 Streets
- SE31 – Coliseum to Gateway (51), using 83, 85 and 84 Streets, and 76 Avenue.

While a part of this higher performance was due to land use, one would expect these routes at least to be worth carrying over to other scenarios. Routes above 50 peak hour boardings (AM plus PM) per kilometre are being considered as long-term transit elements. This lower productivity number is appropriate for this type of service, as it assumes lower capacity transit vehicles since these are a different type of transit route.

Exhibit 3.23 (the map on the next page) highlights the better- performing routes from this part of the assessment.

**Exhibit 3.23 Map – High-Performing Regional and Additional Routes from City I**




## 3.9.3 High Productivity Routes Common to BAP and City Scenarios

Exhibit 3.24 summarizes the boardings and productivity index ratings (AM and PM peak hour demand per kilometre of route) of the top frequent, crosstown and local routes that were included within the future scenarios, focusing on the City of Edmonton services.

While many of the stronger routes on the list include crosstown buses ($C_{\#\#\#}$) and frequent routes ($F_{\#\#\#}$), there were other local routes that seemed to tap into demand fairly successfully and these are shown here – the coded names indicate the quadrant of the city where the route operates (e.g. N10 is in the North).

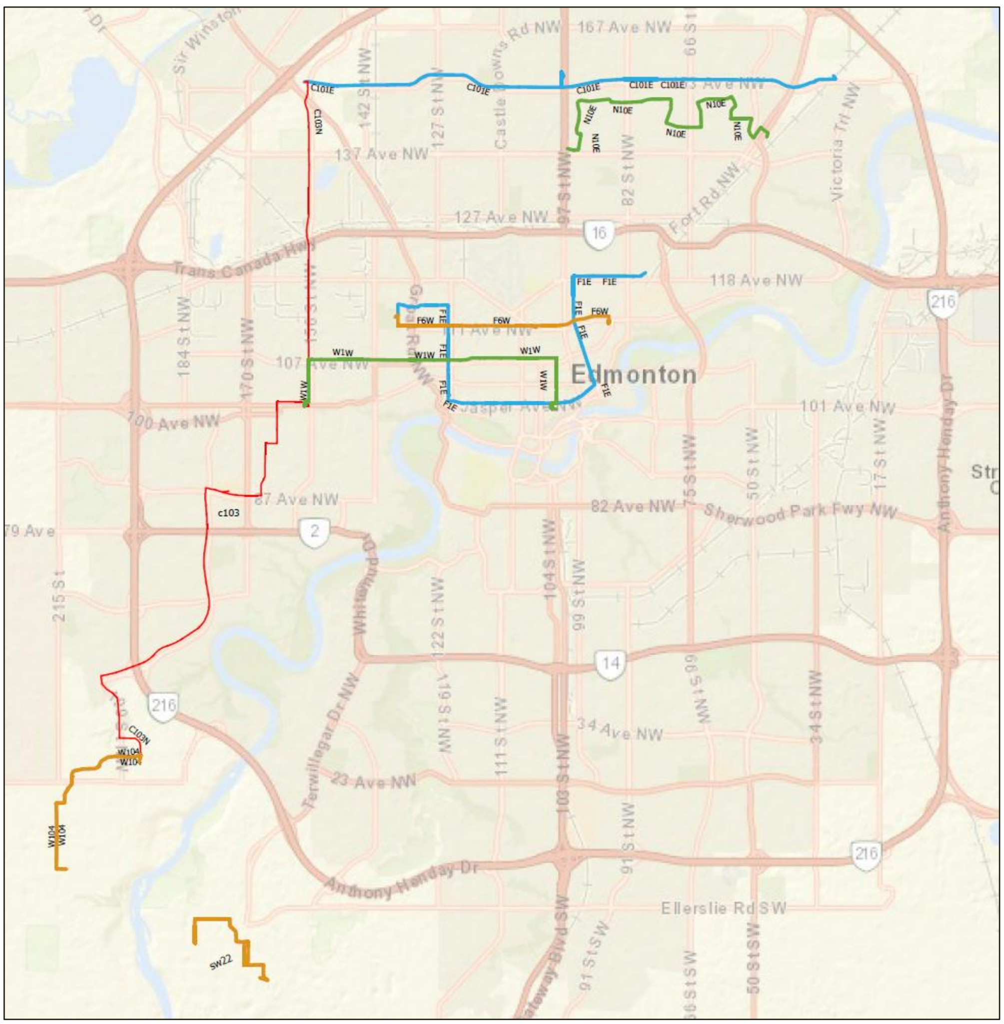
This subset of the top routes attracts 4 to 5 times the number of passengers per km of bus route, in comparison with the full set of bus routes assumed to form the network. The total for all routes (this does not include the LRT, "BRT", regional routes or rapid bus) is indicated in the bottom row. The full collection of routes, while less attractive than the top performers, still accounts for a large number of transit boardings and performs an important role in connecting to neighbourhoods and employment areas.

Exhibit 3.25 is a map indicating where this group of routes operates, as coded in the forecasting model. These routes are under consideration as part of the Mass Transit network.

### Exhibit 3.24 – Summary of High Productivity Routes Common to All Scenarios

| | Peak Hour Transit Boardings - Top Frequent, Crosstown and Local Routes | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | City I | | City II | | City III | | Distance | AM+PM PkHr Boardings per km | | |
| # | AMCR | PMCR | AMCR | PMCR | AMCR | PMCR | (bus-km) | City I | City II | City III |
| C101E | 1,000 | 1,190 | 1,140 | 1,060 | 1,030 | 1,200 | 15.1 | 145 | 146 | 148 |
| C101W | 1,640 | 960 | 1,230 | 1,060 | 1,620 | 1,090 | 15.1 | 172 | 152 | 179 |
| C103N | 2,960 | 1,830 | 2,620 | 1,620 | 2,570 | 1,870 | 23.4 | 205 | 182 | 190 |
| C103S | 1,650 | 3,450 | 1,550 | 2,940 | 1,360 | 3,220 | 23.4 | 218 | 192 | 196 |
| F1E | 1,560 | 1,090 | 1,440 | 940 | 1,280 | 850 | 12.8 | 207 | 186 | 166 |
| F1W | 840 | 1,020 | 800 | 890 | 800 | 910 | 12.8 | 145 | 132 | 133 |
| F6W | 770 | 690 | 520 | 500 | 490 | 390 | 6.4 | 230 | 160 | 138 |
| N10 | 540 | 800 | 500 | 530 | 430 | 440 | 5.5 | 242 | 186 | 157 |
| SW22 | 610 | 640 | 830 | 740 | 670 | 580 | 8.3 | 151 | 190 | 151 |
| W104 | 570 | 620 | 960 | 1,020 | 680 | 690 | 10.3 | 116 | 193 | 133 |
| W1W | 1,150 | 680 | 650 | 620 | 960 | 690 | 9.3 | 197 | 137 | 178 |
| | | | | | | | | | | |
| Subtotal for Top | 13,290 | 12,970 | 12,240 | 11,920 | 11,890 | 11,930 | 142 | 185 | 170 | 167 |
| ***Total for All Routes*** | 64,150 | 70,440 | 65,160 | 70,420 | 68,170 | 73,840 | 3,588 | 38 | 38 | 40 |

### Exhibit 3.25 Map – Top Performing Frequent, Crosstown and Local Routes



# 4 Key Findings and Recommendations

This section provides a summary of the main outcomes from Sections 2 and 3, and expands upon those observations with a recommendation for each of the transit service topics.

This section of the report also points towards ‘next steps’ which includes evaluation of the draft mass transit network elements that will be developed based on the conclusions of this memo, and to support the draft City Plan land use concept that has been developed.

## 4.1 Major Themes from the Modelling Exercise

The following is a brief summary of the recurring themes from the modelling results, as documented in Sections 2 and 3.

**Common Themes – Scenario Results**

- All 3 Scenarios have greater transit usage relative to BAP. For trips that were to, from or entirely within Edmonton, BAP achieved 14.5%, 6.2% and 9.9% transit mode shares in the AM peak hour, midday, and PM peak hour respectively.
- City I (Strong Central Core) achieved the highest transit mode shares (19.0% AM, 9.0% MD, 14.5% PM) – much of the ‘extra’ is due to this City having the most concentrated density, in particular a greater concentration of employment in the major centres. This was reflected in the travel patterns, where there were 482,000 AM peak trips staying within Edmonton, compared with a similar value of 424,000 for BAP. The amount of bus service was also the highest in City I due to the extra routes added in the central and inner parts of the city.
- City II (Node City) was next best, followed by City III (Corridor City). City II partly benefited from certain transit elements being more robust, for example the secondary corridors having semi-exclusive mass transit in addition to the web of rapid buses forming a crosstown grid.
- Trips within Edmonton tend to be the best served/most attractive for transit, followed by AM inbound/PM outbound to the rest of the region. The transit mode choice for trips both starting and ending in Edmonton was typically 2-3% higher than the overall average.
- For each of the transit evaluation scenarios, the amount of auto travel was lower than BAP. Again, this was most pronounced with City I (Strong Central Core), where there were 139 thousand vehicle hours of travel in the AM peak hour, versus 153 thousand vehicle hours for BAP.

**Common Themes – by Mode**

- Transit boardings continue to concentrate on fully segregated (or pre-emptive) transit as the first choice of riders, due to favourable travel times to major concentrations of activity. Productivity of these routes (including the existing LRT system and extensions) tended to be high even on new routes (where LRT was the assumed technology for modelling of this type of service).
- Commuter rail was modelled as an airport connection with full segregation from other travel modes, similar to how LRT is evaluated. The service options to the airport all assumed higher speeds, longer stop spacing, and less frequency. When tested, each of these services attracted additional downtown-based demand as well as drawing away some of the peak passenger volume from the north-south Capital Line. Even with an

unconstrained capacity model run, each of the city evaluation scenarios saw some of the travel demand switch to the airport connection, indicating that for some trips it offering more direct service.

- Partially/semi-exclusive transit corridors performed reasonably well provided that they were well connected to the origins and destinations along the corridor and did not require numerous transfers to be accessed. These routes are marginally slower than the segregated transit, due to the effects of traffic signals, and this was reflected in the modelled service speeds. This form of transit was designated as 'BRT' for the purposes of modelling. However, while this name suggests buses, the technology could alternatively be light rail or streetcars stopping at traffic signals, rather than using pre-emption.

  The major north-south route included in City I and City II performed strongly, and in City II, the east-west connection of Whyte Avenue and 87 Avenue NW was a strong performer. In both cases this was due to the areas being served and the travel time advantage of the direct route, for trips not destined to downtown.

- Rapid bus connected corridors across a large part of the city beyond the service offered by the LRT and acted as feeders. There was some notable success in carrying higher passenger volumes through employment areas on these higher-speed bus routes.

- Certain new regional connectors and local routes performed well with high demand versus bus capacity. This was in addition to strong performance by some of the crosstown local services, frequent bus network within inner Edmonton, and local buses on key corridors distributed around the city.

## 4.2 Network Components – Summary of Observations

Exhibit 4.1 is a summary of the observations and initial conclusions from the review of network components. The outcomes from this will form an important part of the decisions in the mass transit network for the draft City Plan land use concept.

The results of the network review focus on the service structure and resulting travel demand, peak hour passenger loads and transit passenger boardings, and some commentary is also provided to help contrast different options where implementation costs could be a factor. However, these conclusions are not based on a full set of evaluation criteria, and other City and community objectives and priorities may influence the projects as they are being further studied and developed.

**Exhibit 4.1 – Summary Review of Mass Transit Network Components**

| COMPONENT | OBSERVATIONS | RECOMMENDATIONS |
|---|---|---|
| Whyte Ave | Fully segregated transit service has highest ridership; however, semi-exclusive achieves 80-90% of same demand at a relatively lower cost.<br><br>Local buses in corridor still productive even with rapid transit in place. | Service needs to connect (either directly or short transfer) to the Capital Line in the University area.<br><br>For high ridership, service could be either semi –exclusive or fully segregated; however, there are potential trade-offs that must be considered when fitting the cross section of these hierarchies within the context of Whyte Avenue corridor.<br><br>Underlying local buses are still required to make connections off the corridor |

| COMPONENT | OBSERVATIONS | RECOMMENDATIONS |
|---|---|---|
| River Crossing east-west at 87 Ave NW | Demand on direct connection across 87 Avenue is considerably higher than bus options over Whitemud Drive. | Long-term demand warrants further exploration of this connection of not only financial costs but also social and environmental costs associated with this option. Alternative of interim improvements for less direct routes via Whitemud Drive should be considered as part of a possible interim service provided for this route. |
| Rail connections in southwest Edmonton and to Airport | Demand drops off south of Twp. Rd 510 for either commuter rail or LRT option.<br>Peak load point on Capital Line does not exceed capacity as critically when parallel mass transit services are provided. | Likely role for airport connector to help offload excess peak demand from Capital Line (in conjunction with other parallel mass transit routes).<br>Airport connection could initially be bus (with priority) followed by rail, with a transition over time. |
| 97 St. | Demand for the semi-exclusive service was high. This increased when connected directly to the LRT at Castle Downs LRT Station, drawing some demand away from the Metro LRT line. | Semi-exclusive transit in this corridor attracts additional riders and provides an alternative to Metro Line. This type of service could migrate from rapid bus through phased introduction of bus lanes and enhanced stops. |
| North-south service on Calgary Trail corridor | Options with semi-exclusive (“BRT”) and commuter rail served the north-south travel market fairly well and also provided transfer opportunities to east-west routes and within the annexation area. | Semi-exclusive transit performs fairly well on 104 Street/Calgary Trail and variations of this with connections to the airport service, Capital Line, or direct to the airport could be explored. |
| River Crossing north-south into downtown | Peak demand on Capital/Metro Line within assumed capacity.<br>Peak demands across River between Whyte Avenue and downtown responsive to BRT and commuter rail options. Reasonable peak hour passenger loads for rail link connection into downtown as well as for frequent BRT connection into downtown. | Additional north-south connection from centre of Whyte Avenue corridor and/or 104 Street/Calgary Trail corridor is desirable over the long term, as each option generates additional transit travel and provides an alternative to Capital Line.<br>Keep options for rail and bus open for evaluation. Options include re-purposing of existing bridge capacity, or a new crossing that could carry multiple services in addition to bikes and pedestrians. |

| COMPONENT | OBSERVATIONS | RECOMMENDATIONS |
|---|---|---|
| Terwillegar Drive | Segregated transit (modelled as LRT) with continuous service to University and Whyte Avenue, performed the best. Service dependent on multiple transfers did not attract many riders. | Corridor performs best with direct University link and avoiding a route structure where multiple transfers are required.<br><br>Options include LRT or bus transitway (BRT trunk) with rapid bus services gaining a speed advantage, then diverting into transit centres and neighbourhoods to connect with passengers. |
| Capital and Metro Line capacity south of University | Peak demand at the maximum load point (south of Health Sciences LRT Station) was critically exceeded in BAP and City II.<br><br>Still over capacity with service level doubled (no longer an issue at Health Sciences but the capacity 'gap' persists between South Campus and Southgate) but gap is much smaller. | Additional capacity is needed south of Health Sciences in all scenarios. However, reaching each successive station would require additional grade separations. Several challenges arise from this, including the need for signalling and other systems improvements to sustain more frequent service, as well as the major disruption of grade separating an existing line.<br><br>Providing parallel services to the Capital Line segment from Century Park to South Campus would also assist with this issue. (This would support the Terwillegar Drive and Calgary Trail options). |
| Capital Line to Energy Park | Demand is fairly high up to Energy Park which makes it a more logical transit hub and suitable for possible future park and ride site. | Carry forward the assumed LRT from Gorman to Energy Park, with a bus transit hub at Energy Park for ETS and for regional services. |
| Capital Line to Heritage Valley | The peak demand is fairly high to Heritage Valley, and then drops off.<br><br>Peak demand going north increases if Capital Line is extended past Heritage Valley | Terminate Capital Line at Heritage Valley to mitigate peak loads going north and adding to capacity issues at Health Sciences.<br><br>As mentioned previously, a parallel connection towards the centre of Edmonton needs to be available to carry excess demand and provide another option. |
| Northwest Regional Connections (St. Alberta) | Peak demand of combined bus routes inbound/outbound to Campbell Road LRT was <1500 passengers.<br><br>Analysis shows that regional bus service is sufficient in serving this passenger demand. | Within City Limits, the Capital Line should terminate at Campbell Road. The extension of the LRT into St. Albert should be subject to regional discussion however analysis shows demand can be accommodated by other hierarchies of mass transit. |
| West Regional Connections | Dispersed OD pattern; fairly modest peak hour passenger volume. | Recommendation is subject to regional discussion; however analysis indicates demand is within capacity of regional buses. Decisions on connection points to LRT to be |

| COMPONENT | OBSERVATIONS | RECOMMENDATIONS |
|---|---|---|
| | | coordinated between regional partners (including Enoch Cree Nation) and the City. |
| East Regional Connections (Sherwood Park) | Dispersed OD pattern; passenger volume at lower threshold for LRT but split across multiple routes connecting points several kilometres apart at both ends. | Recommendation is subject to regional discussion; however analysis suggests potential benefit of connecting to the current LRT system at multiple stations to increase potential ridership from Sherwood Park. This appears to produce significant transit demand in lieu of concentrating all services into a single LRT corridor. |
| South East Regional Connections (Beaumont) | Dispersed OD pattern; passenger volume at lower threshold for LRT but split across multiple routes connecting points several kilometres apart at both ends.<br><br>Station acts as hub for services from several directions. | Ellerslie Road is a logical endpoint for Valley Line LRT. To accommodate south east demand, the annexation lands should be served by rapid and frequent buses, Beaumont should be served by regional services connecting to Valley Line LRT endpoint, plus a proposed limited-stop regional service on 50 Street to Capilano and Coliseum Transit Centres. |
| Rapid Bus Network | Many of the proposed routes exhibited fairly high ridership and productivity. | The better performing segments, where not already included in the previous recommendations, will form part of a supporting network of rapid bus. |
| Frequent and Local Routes | Certain frequent and local routes in dense corridors had good ridership results in the model outputs. | The frequent bus routes, including routes that were not previously identified but are demonstrating strong performance, will be included in the frequent transit layer. |

## 4.3 Next Steps

The purpose of the analysis in this technical memo was to compare different urban mass transit networks, including variations in what modes were applied, and how they connected. The best of these elements are being carried forward into the recommended **Mass Transit Network**, and they will be adapted to remain compatible and consistent with the draft City Plan land use concept and City Plan.

### Where Next?

- "Scenario 4" will be a hybrid that takes the elements that performed best from the city Scenarios and their associated Mass Transit Networks
- Draft "Recommended City Concept" takes ideas from city Evaluation Scenarios I, II and III
- The same approach will be applied to transit for Scenario 4
    - General structure of network (alignments are subject to future land use planning and alternatives analysis)
    - Modes (technology is assumed for analysis purposes and not decided at this time)

### Draft Recommended City Concept

The draft City Plan land use concept draws upon elements of all three evaluation scenarios, and therefore the expectation is that the transit recommendations from 4.1, which are based on the outcomes from the city mass transit networks, would be applicable to this land use.

Since there are many components to the transit network recommendations, the team has stratified them into two layers:

- **Citywide Rapid Network**. This will consist of the existing and committed LRT lines, all of the proposed fully segregated and semi-exclusive transit routes (which could be LRT or BRT), and the highest-frequency, highest-demand rapid bus and regional connections identified from the evaluation to date. The expectation for these services is they would be high frequency and high demand, and serve many medium and longer-distance trips.
- **Rapid-Frequent Network**. This layer consists of the supporting grid of additional rapid and frequent transit routes, and additional regional connections from municipalities outside the city limits. These routes are expected to serve additional development nodes and corridors, provide connections to all sectors of the city, and allow for transfers to and from the Citywide Rapid Network.

Initial draft proposals for these two networks have been developed using the results of the modelling exercise described in this technical memo. These are draft networks and will be undergoing analysis and refinement once their interaction with the draft City Plan land use concept has been assessed.

These two strategic mass transit layers will undergo refinement and will be presented again in an updated form, as a final mass transit network recommended for The City Plan final land use concept later in mid-2020. There will be additional work to evaluate the recommendations given that the analysis is mostly driven by demand-related objectives while the costs and feasibility of certain components have only been evaluated at a strategic level to date. The outcomes from the additional work, along with steering committee input, will assist in refining the final mass transit network.

# Appendix A – Additional Exhibits and Reference Materials

### Modelling Inputs and Assumptions

### Additional Outputs from the Model

### Assumed Quantities of Transit Service

### Transit Tiers

**Exhibit A.1 – Residential and Employment Density Map – City I**

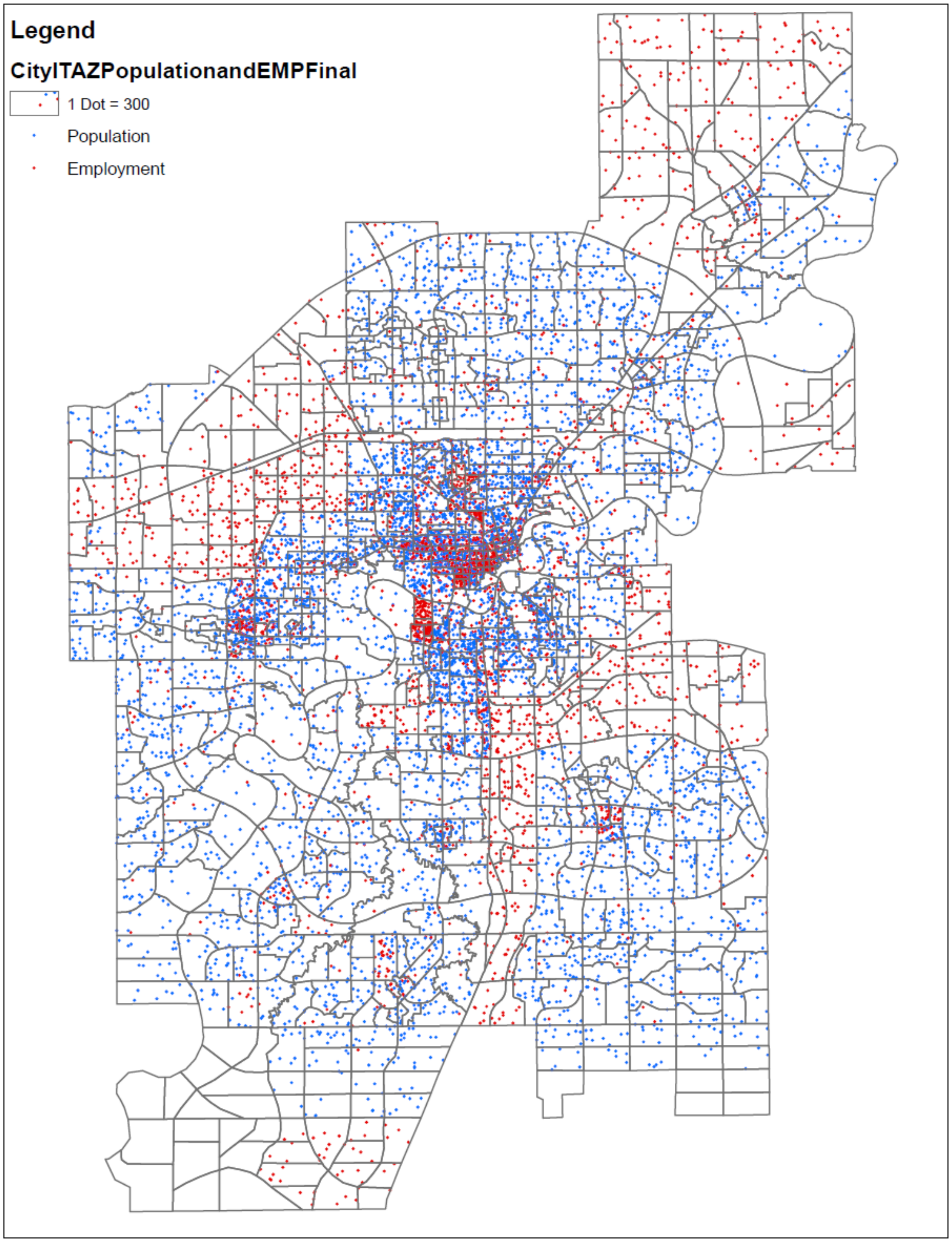


**Exhibit A.2 – Residential and Employment Density Map – City II**

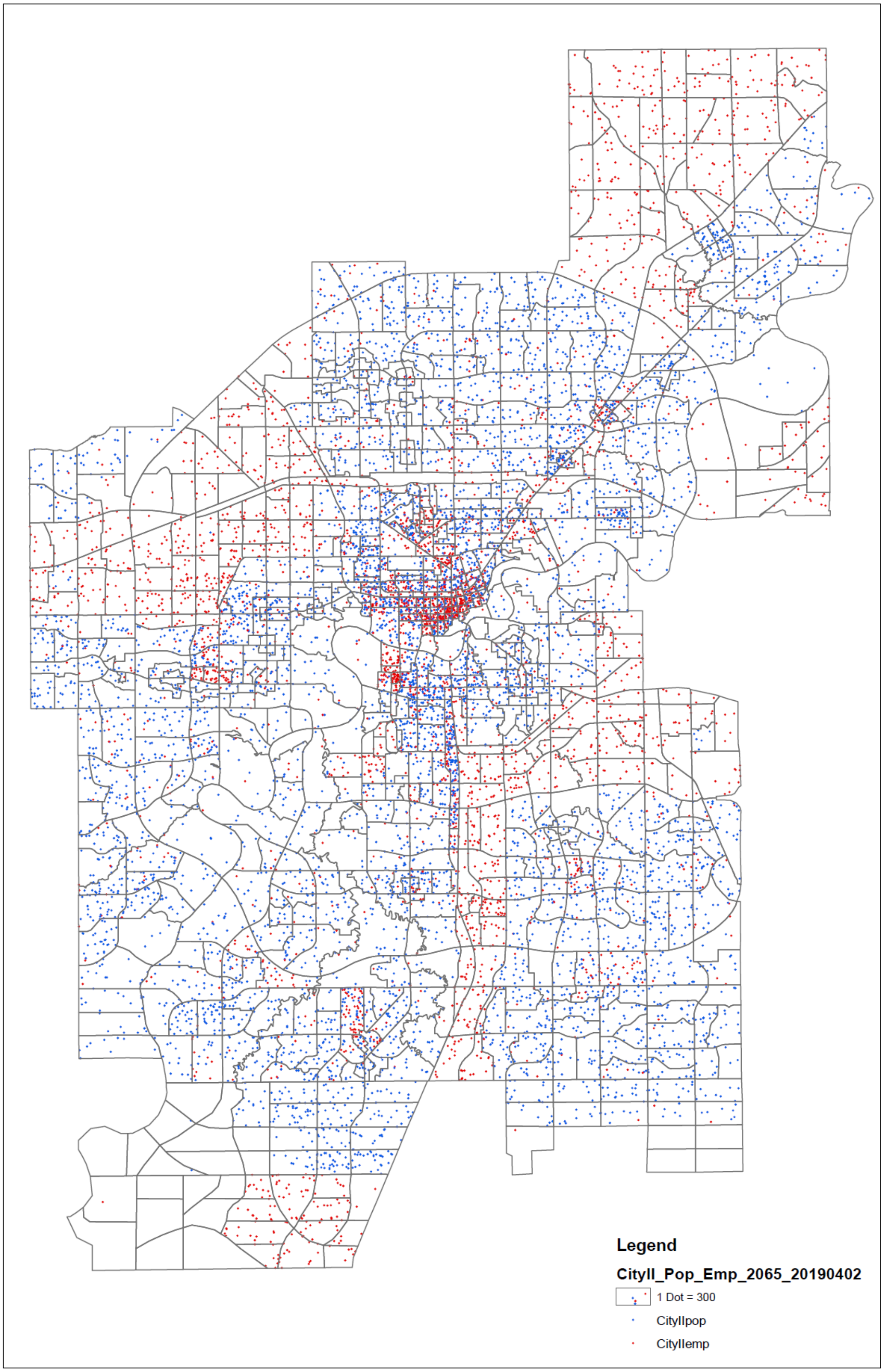


**Exhibit A.3 – Residential and Employment Density Map – City III**

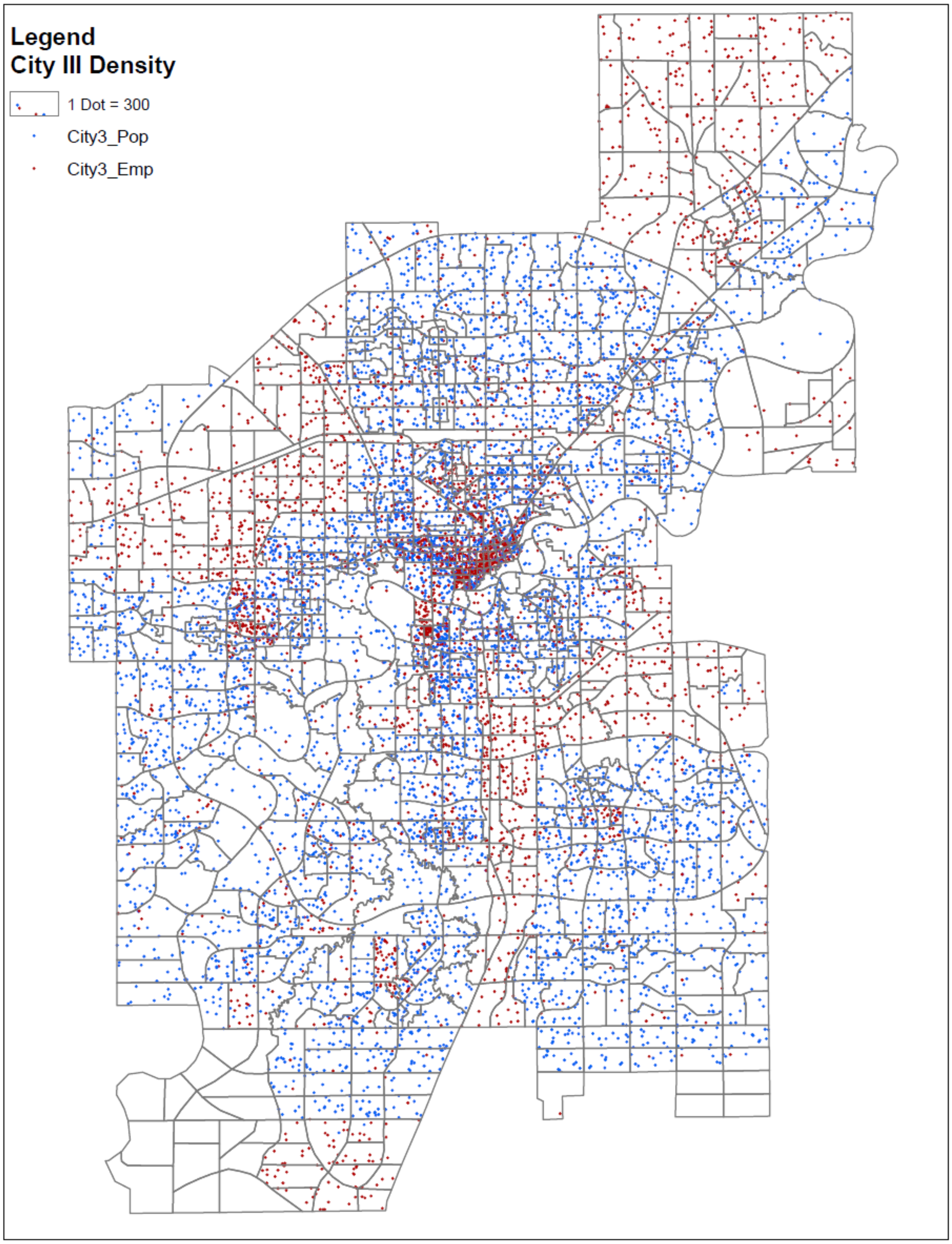
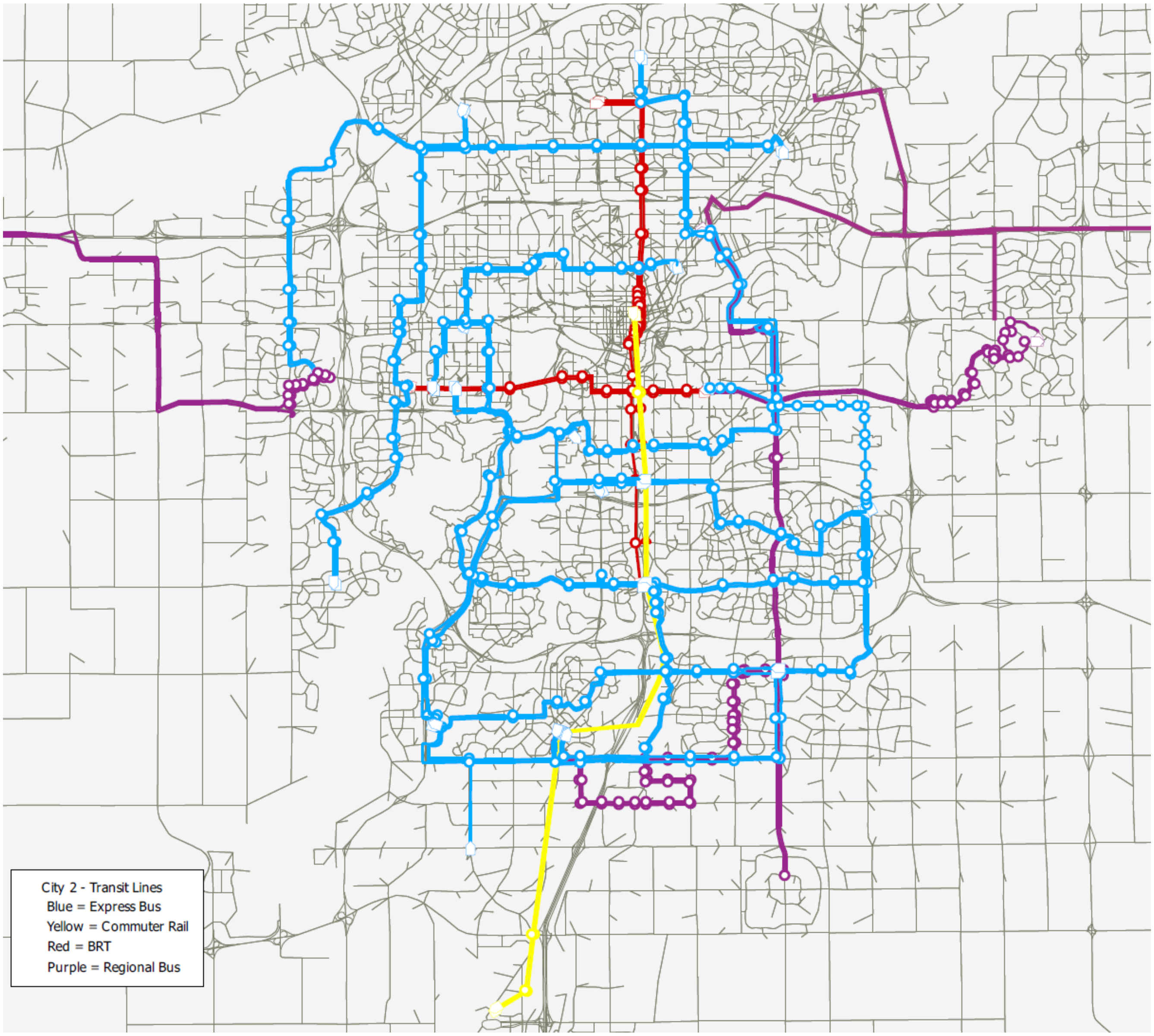
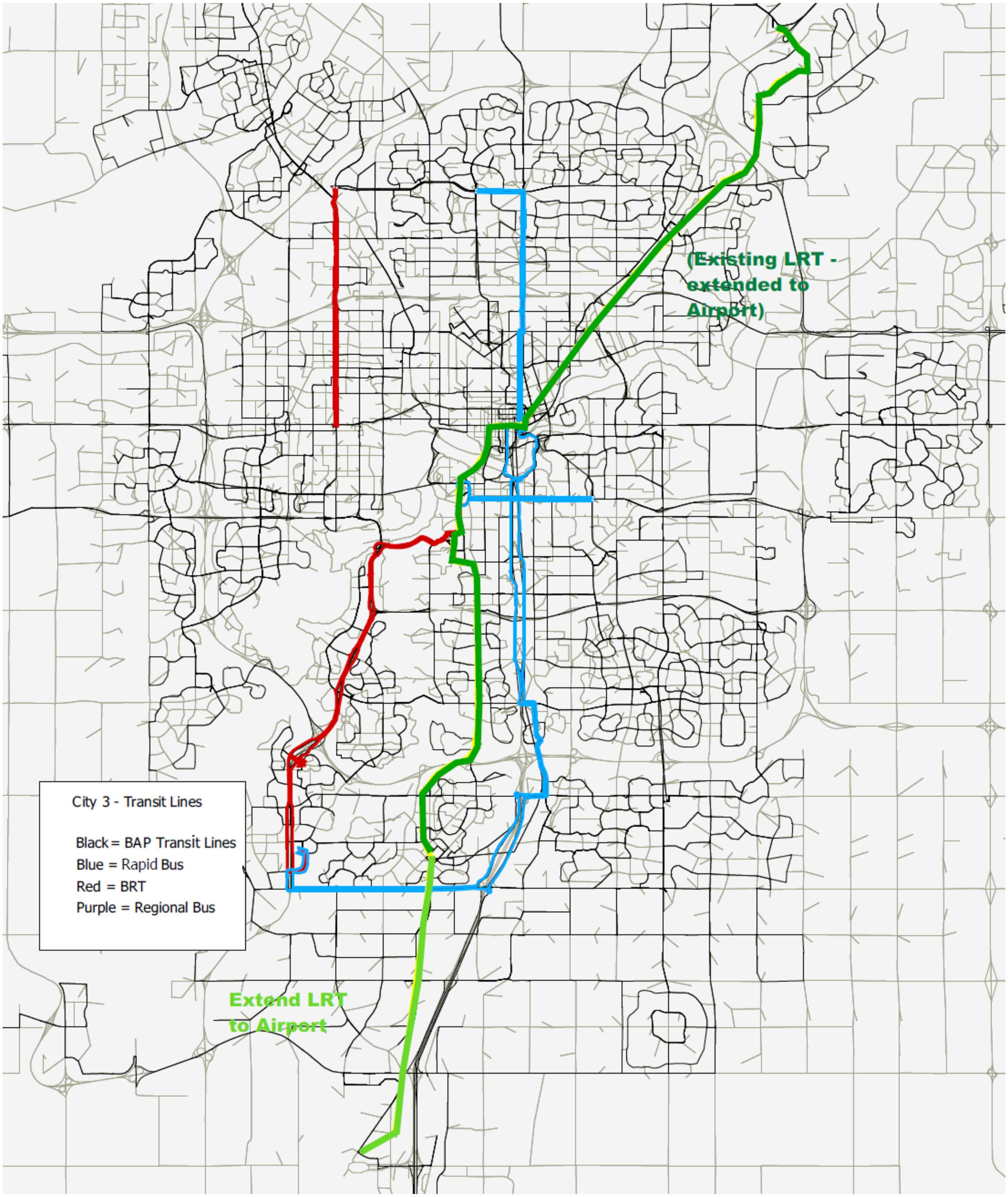


**Exhibit A-4: Node City Mass Transit Network – Reference Map of Added Transit Routes**



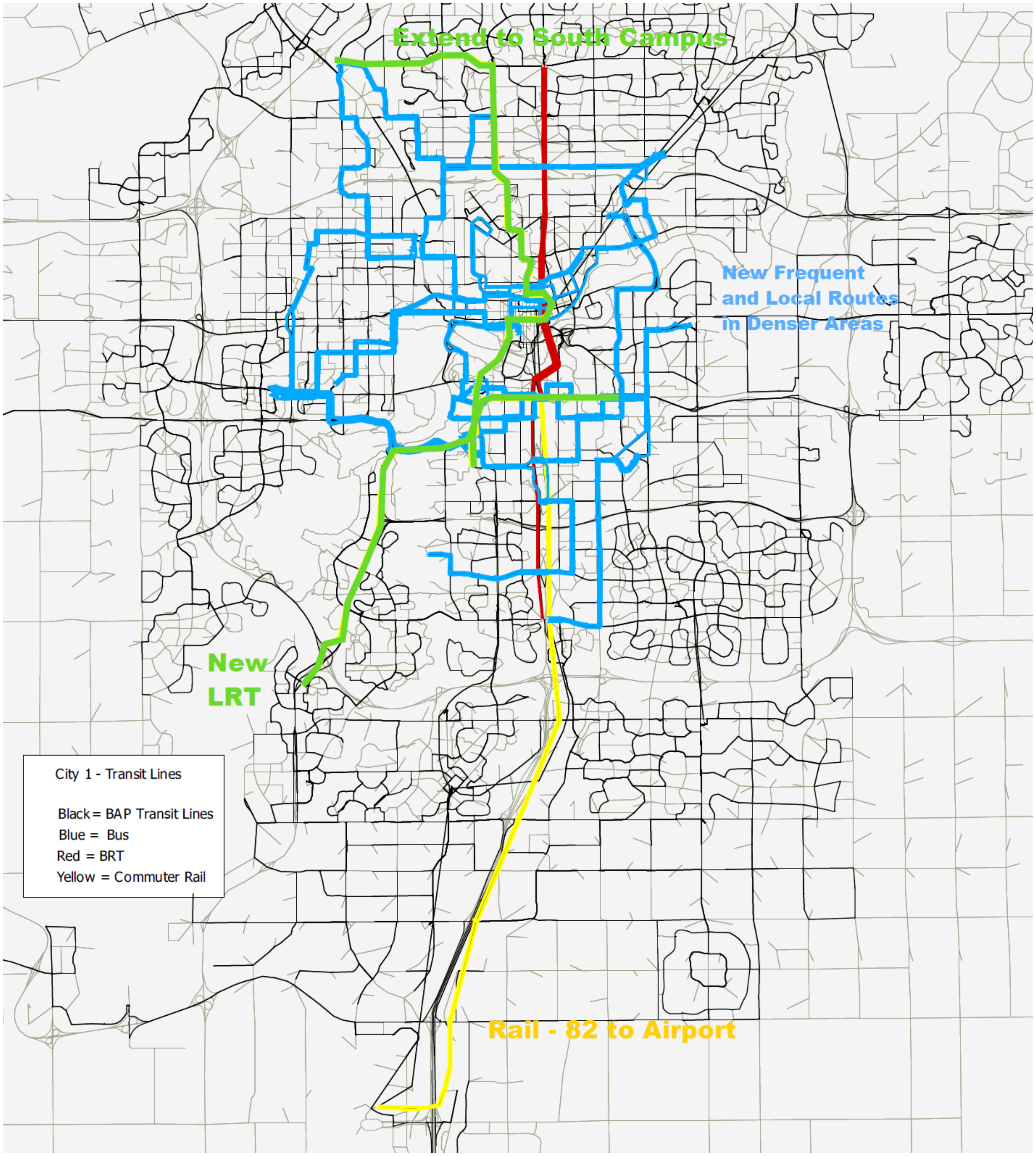

*Source: IBI Group, from EMME plot of selected transit routes, May 2019*

**Exhibit A-5: Corridor City Mass Transit Network – Reference Map of Added Transit Routes (Relative to Node City)**



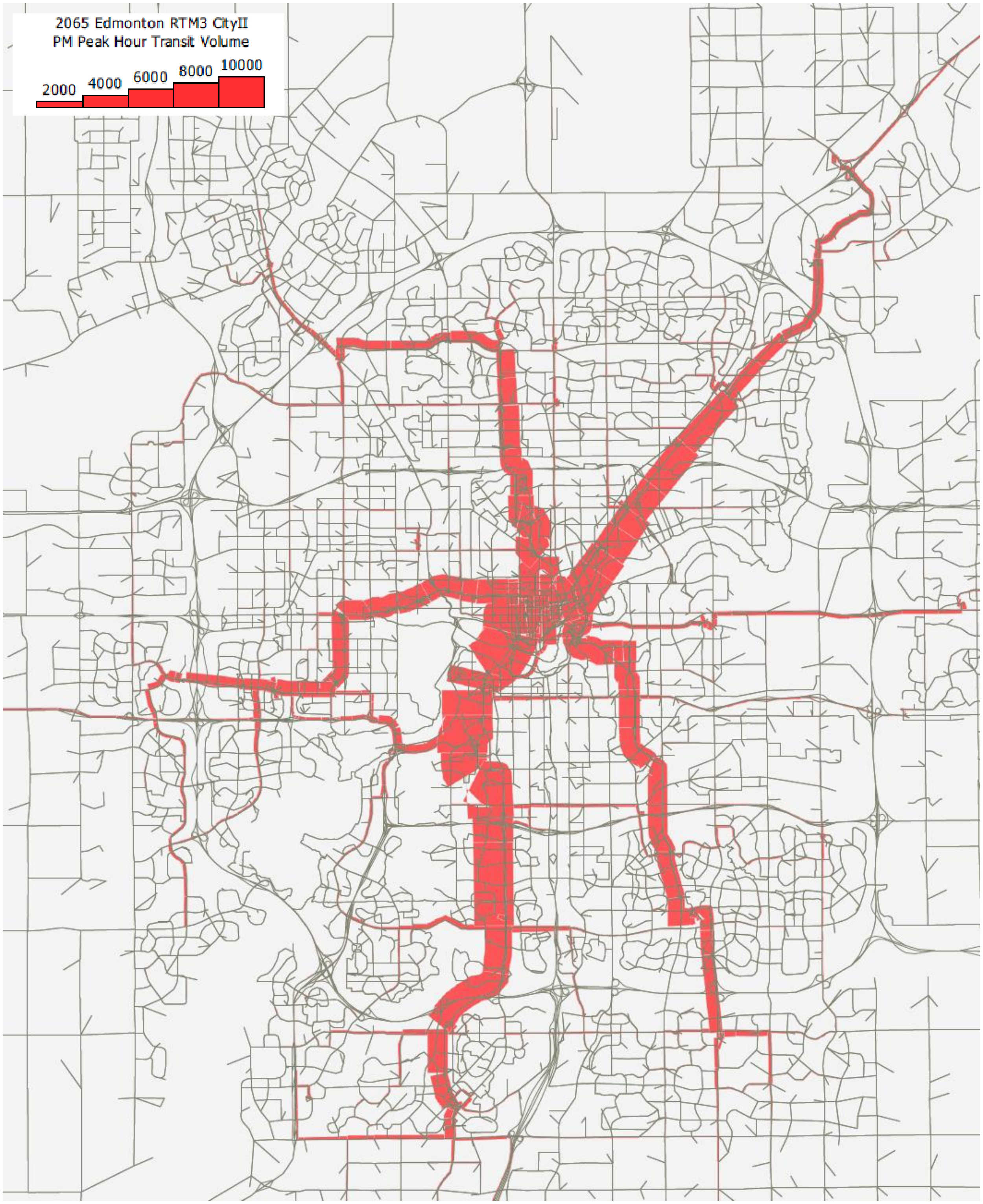

*Source: IBI Group, from EMME plot of selected transit routes, May 2019*

**Exhibit A-6: Strong Central City Mass Transit Network – Reference Map of Added Transit Routes (Relative to Node City)**



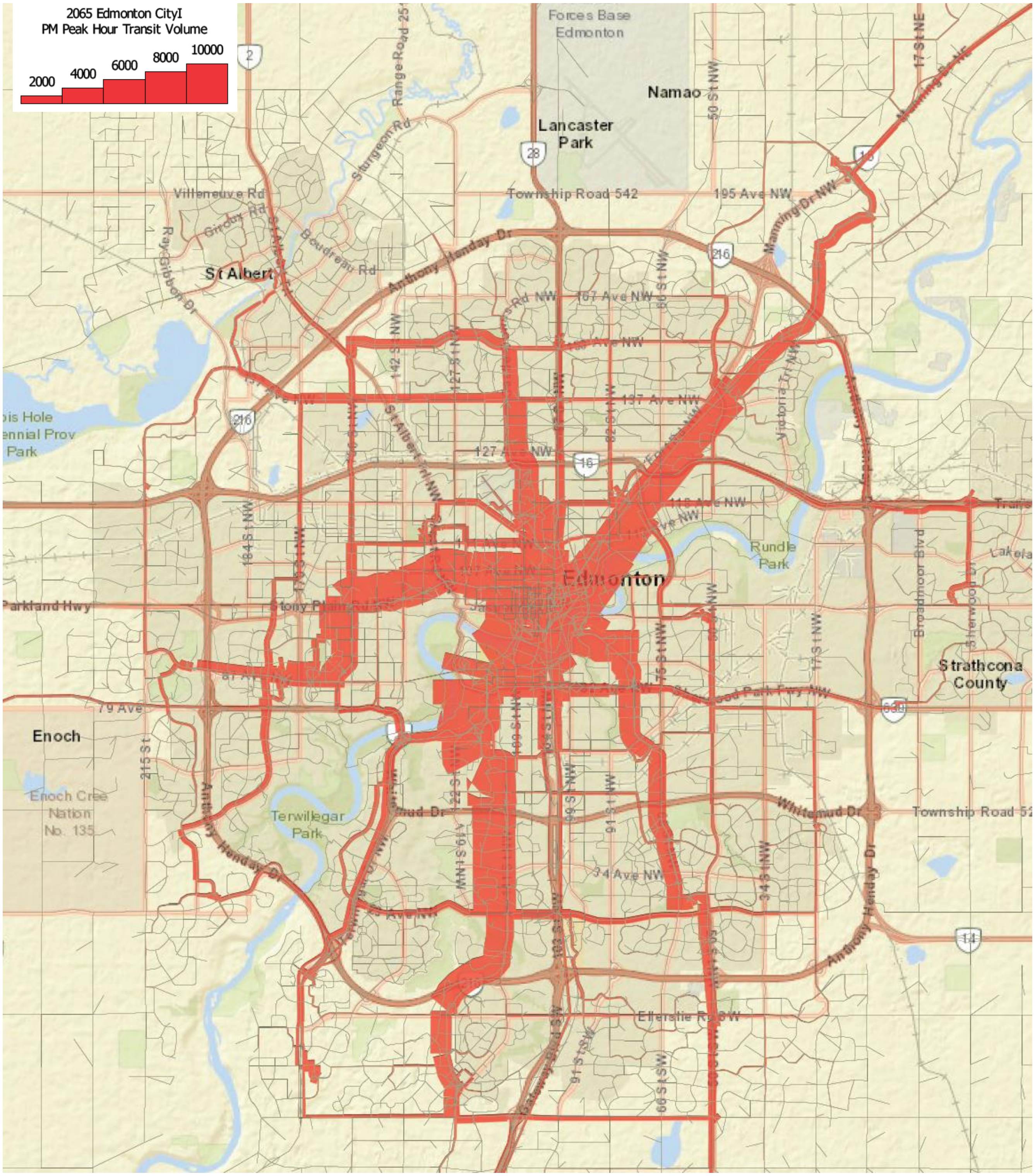

*Source: IBI Group, from EMME plot of selected transit routes, May 2019*

**Exhibit A.7 – PM Peak Transit Assignment Result – Business as Planned (BAP 2065)**



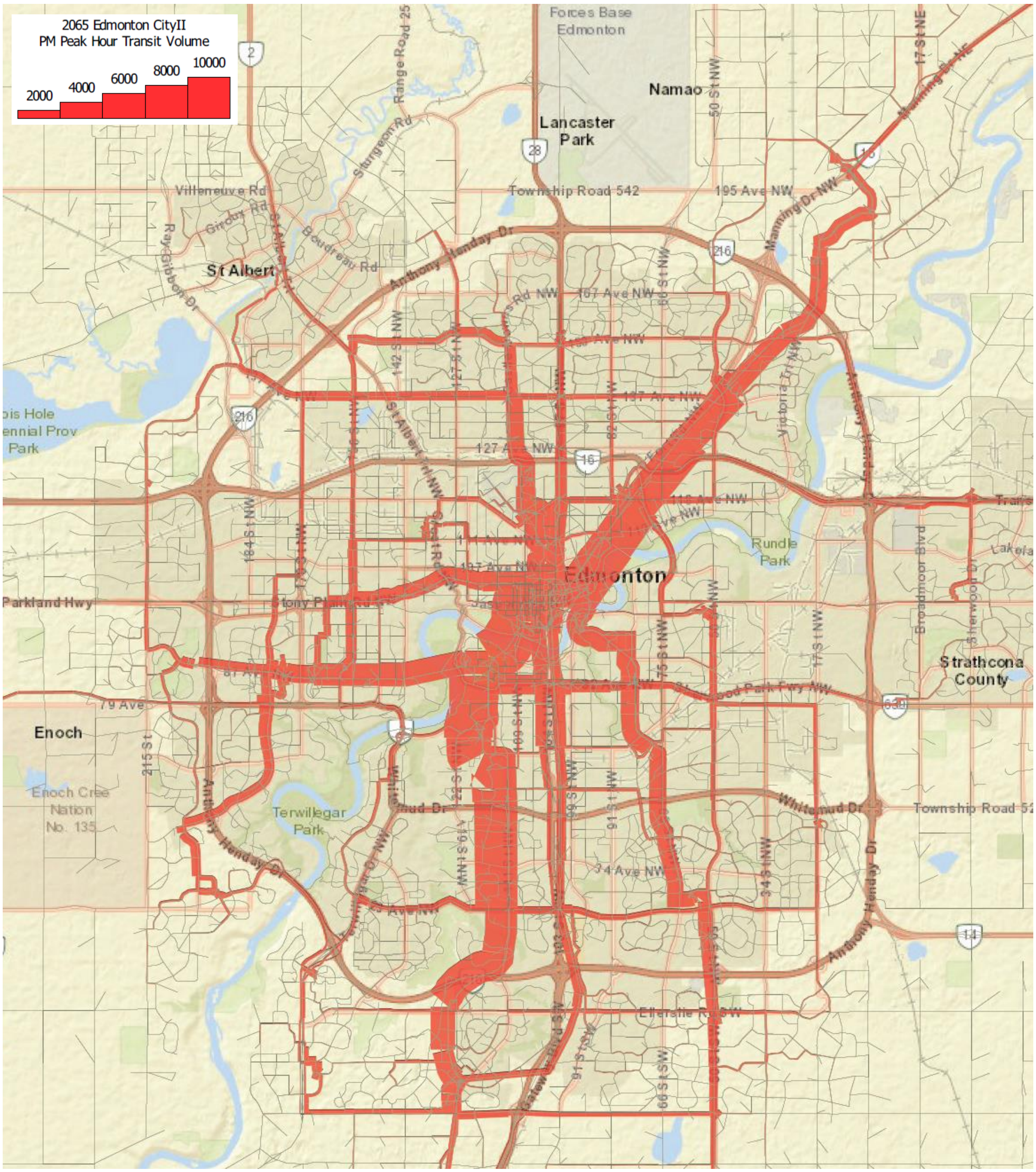

*Source: City of Edmonton. EMME Transit Passenger Demand - Volume Plot.*

**Exhibit A.8 – PM Peak Transit Assignment Result – City I**



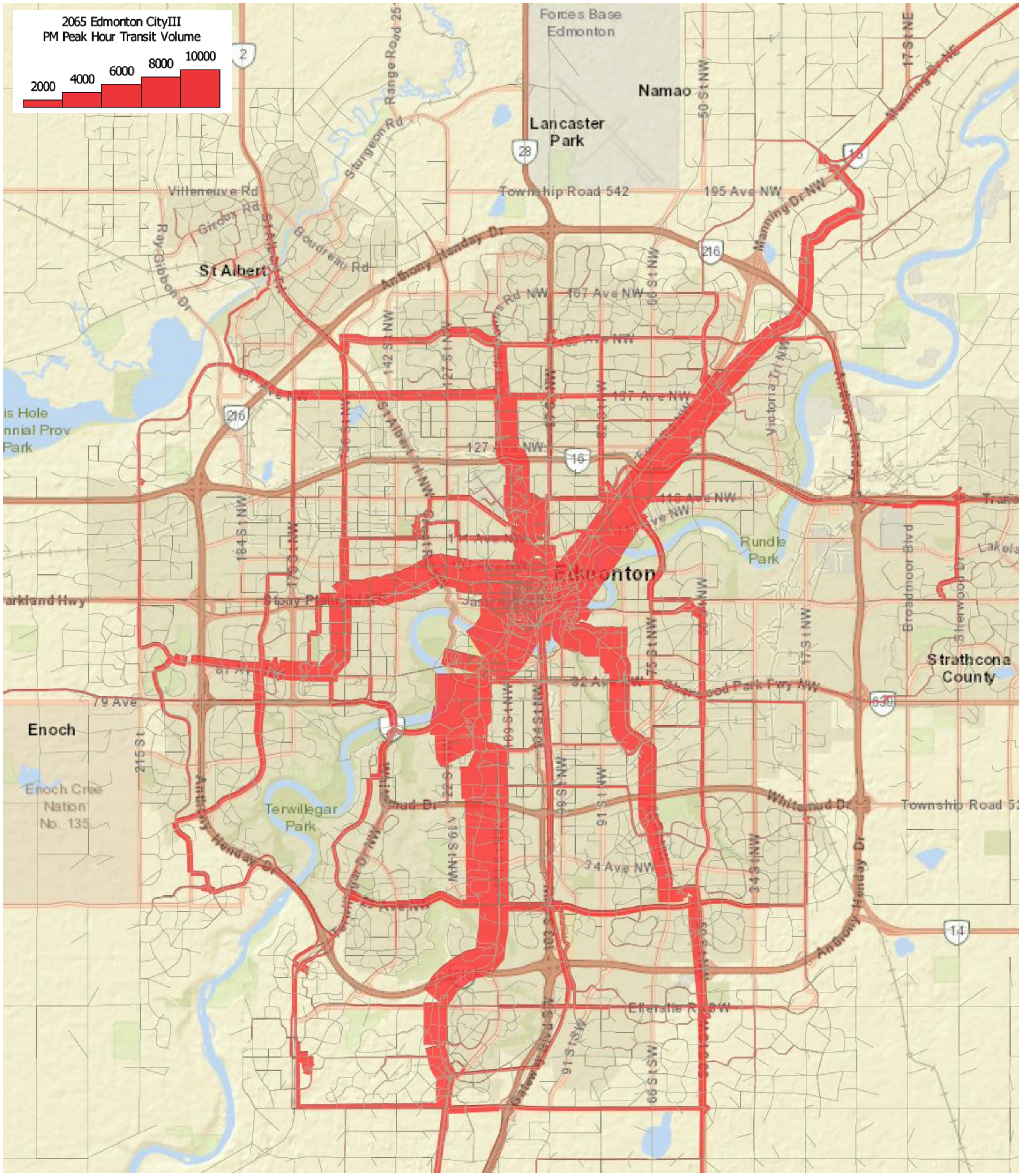

*Source: IBI Group/City of Edmonton. EMME Transit Volume Plot.*

**Exhibit A.9 – PM Peak Transit Assignment Result – City II**




*Source: IBI Group/City of Edmonton. EMME Transit Volume Plot.*

**Exhibit A.10 – PM Peak Transit Assignment Result – City III**




*Source: IBI Group/City of Edmonton. EMME Transit Volume Plot.*

**Exhibit A.11: Roles and primary trip markets of each mode in the Family of Transit Services**

| Mode | Role in Network | Primary Trip Market | Examples |
|---|---|---|---|
| **Regional** | | | |
| All Day | • Links edge cities together and to the CBD<br>• Supports long bi-directional trips between major centres | • Long commuter trips<br>• Long off-peak discretionary trips | • Passenger train<br>• Highway coach (Bus) |
| Peak Only | • Connect distant residential suburbs to employment centres | • Long commuter trips | • As above, but only commuter services |
| **Rapid** | | | |
| Exclusive ROW | • High capacity corridors acting as major spines of the entire network<br>• Support majority of high-density development in the region | • Long and intermediate distance trips, all times of day | • Subway<br>• LRT or BRT in tunnel, trench or on structure<br>• Signal Pre-Emption<br>• Automated rail |
| Semi-Exclusive ROW | • High capacity corridors acting as major spines of the entire network<br>• Support majority of high-density development in the region | • Long and intermediate distance trips, all times of day | • LRT or BRT in exclusive path, but with intersections |
| Limited Stop | • Shortens travel times between major destinations<br>• Supports development of future RT corridors | • Long and intermediate distance commuter trips | • Limited stop 'rapid' bus |
| **Urban** | | | |
| Frequent | • Shortens wait times, making transit more competitive with cars<br>• Improves access to RT stations<br>• Supports development of future RT corridors | • Long and intermediate distance commuter trips<br>• Off-peak discretionary trips in major nodes and corridors | • Bus or streetcar/tram in frequent/primary transit network |
| Base | • Provides coverage in the heart of less dense areas, serving smaller neighbourhood scale destinations | • Short trips within a neighbourhood<br>• First & last mile connector service | • Bus or streetcar/tram |
| Demand Responsive/ Circulator | • Provides basic mobility where density is too low to support regular scheduled transit | • Off-peak discretionary trips<br>• First & last mile connector service | • Bus including smaller shuttles |