



## GREEN LINE LRT TECHNICAL MEMORANDUM

### NORTH CENTRAL BRT IMPROVEMENT CONCEPTS

|                 |  |       |
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## 1 BACKGROUND

The Centre Street N and Harvest Hills Boulevard corridor in north central Calgary is Calgary Transit's busiest bus corridor, as illustrated in Figure 1. The corridor currently carries just under 1,000 busses per day in its highest volume section between Beddington Boulevard N and 64 Avenue N and over 800 busses per day in and out of downtown Calgary. The corridor supports a peak transit ridership of approximately 30,000 customers per day with approximately 20,000 of those customers traveling in and out of downtown Calgary.

This memo provides a review of existing bus service on the Centre Street N/Harvest Hills Boulevard N corridor and identifies bus operation improvements and infrastructure modifications that could strengthen bus operations in north Central Calgary.

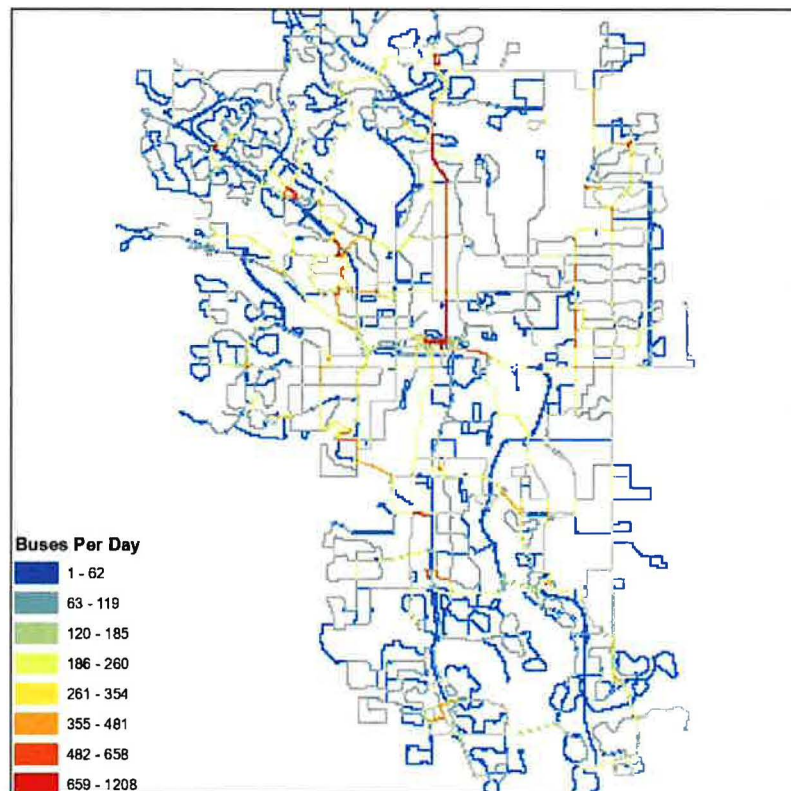


FIGURE 1 BUSSES PER DAY IN CALGARY

## 2 EXISTING BUS OPERATIONS

### 2.1 EXISTING ROUTES

A review of existing bus service was undertaken to identify opportunities to improve bus service in north central Calgary. Existing bus service in the corridor is comprised of a mix of in-street BRT, peak-hour express routes and local bus service.

#### BRT ROUTES

**Route 300 – Airport to City Centre:** This route provides service to and from the Calgary Airport seven days a week from 5 AM to midnight on a 20 to 30-minute frequency. It enters the corridor at 96 Avenue N.

*Stops along the corridor:* 96 Avenue N, Beddington Boulevard, 78 Avenue N, 64 Avenue N, Northmount Drive / 56 Avenue N, McKnight Boulevard N, 40/41 Avenue N, 28 Avenue N, 16 Avenue N and 3 Avenue N.

**Route 301 – BRT North/Downtown:** This route provides service between the North Pointe bus terminal and park and ride lot and downtown Calgary seven days a week from 5 AM to midnight (weekdays) on a 4 to 5-minute frequency during peak periods. This route runs the length of the corridor from the North Pointe park and ride lot to downtown.

*Stops along the corridor:* North Pointe, Panamount Gate N, Country Hills Boulevard N, Harvest Oak Gate N, Country Hills Road N/96 Avenue N, Beddington Boulevard N, 78 Avenue N, 64 Avenue N, Northmount Drive/56 Avenue N, 40 Avenue N, 28 Avenue N, 16 Avenue N and 5 Avenue N.

#### EXPRESS ROUTES

**Route 62 (Hidden Valley Express):** This route provides express service from Hidden Valley, MacEwan and Beddington to downtown. This route provides six inbound busses between 6 and 7 AM and five outbound busses between 4 and 5:15 PM. This route enters the corridor at Beddington Boulevard N.

*Stops along the corridor:* 40 Avenue N, 28 Avenue N, 16 Avenue N, 4 Avenue S and 5 Avenue S.

**Route 64 (MacEwan Express):** This route provides express service from MacEwan, Sandstone, and Beddington to downtown. This route provides nine inbound busses between 6 and 7:30 AM and 10 outbound busses between 4 and 5:30 PM. This route enters the corridor at Beddington Boulevard N.

*Stops along the corridor:* Beddington Boulevard N, 40 Avenue N, 28 Avenue N, 16 Avenue N, 4 Avenue S and 5 Avenue S.

**Route 109 (Harvest Hills Express):** This route provides express service from Harvest Hills to downtown. This route provides five inbound busses between 6 and 7 AM and four outbound busses between 4 and 5 PM. This route enters the corridor at Harvest Oak Gate N.

*Stops along the corridor:* Bergen Crescent N, Bergen Road N, 40 Avenue N, 28 Avenue N, 16 Avenue N, 4 Avenue S and 5 Avenue S.

**Route 116 (Coventry Hills Express):** This route provides express service from Coventry Hills to downtown. This route provides seven inbound busses between 6 and 7 AM and seven outbound busses between 4 and 5 PM. This route enters the corridor at County Hills Boulevard N.

*Stops along the corridor:* Country Village Way NE, Country Hills Boulevard N, Harvest Oak Gate N, Country Hills Road / 96 Avenue N, 40 Avenue N, 28 Avenue N, 16 Avenue N, 4 Avenue S and 5 Avenue S.

**Route 142 (Panorama Express):** This route provides express service from Panorama Hills, Country Hills Village, Harvest Hills and Country Hills to downtown. This route provides five inbound busses between 6 and 7 AM and five outbound busses between 4 and 5 PM. This route enters the corridor at County Hills Landing / 96 Avenue N.

*Stops along the corridor:* Country Hills Road / 96 Avenue N, 78 Avenue N, 40 Avenue N, 28 Avenue N, 16 Avenue N, 4 Avenue S and 5 Avenue S.

## LOCAL ROUTES

**Route 2 (Mt Pleasant to Killarney 17 Ave):** This route provides local service starting at the 78 Avenue bus terminal and generally along the parallel 4 Street corridor. This route provides approximately 5 busses per hour during peak periods and operates between 5 AM and midnight. This route enters the Center Street N corridor at 12 Avenue N and has 5 stops along the corridor.

**Route 3 (Sandstone to Heritage LRT Station):** This route provides the longest continuous local service along the Centre Street N corridor. This route provides approximately 8 busses per hour during peak periods and operates from 4:30 AM to midnight. This route enters the Centre Street N corridor at Beddington Boulevard N and has 28 stops along the corridor.

**Route 17 (Renfrew to Ramsay):** This route provides local service between Renfrew, downtown and Ramsay. This route provides approximately three busses per hour during peak periods and operates between 5 AM and midnight. This route enters the Center Street N corridor at 12 Avenue N and has five stops along the corridor.

**Route 32 (Huntington to Sunridge):** This local route travels along the corridor from the 78 Avenue Terminal to 64 Avenue to provide service to points east of the corridor. This route provides approximately four busses per hour during peak periods and operates between 5:30 AM and 11:30 PM and has five stops along the corridor.

**Route 88 (Harvest Hills):** This route provides local service between Harvest Hills and the 78 Avenue Bus Terminal entering the corridor at Harvest Oak Gate. This route provides service from 5 AM to 1 AM on a 30-minute frequency and has six stops along the corridor.

**Route 114 (Panorama/Country Hills):** This route provides service between the North Pointe park and ride and the 78 Avenue Bus Terminal through Panorama Hills and Country Hills. This route provides service between 5 AM and 1 AM on approximately 30-minute frequency and has seven stops along the corridor. This route enters the corridor at Country Hills Road / 96 Avenue N.

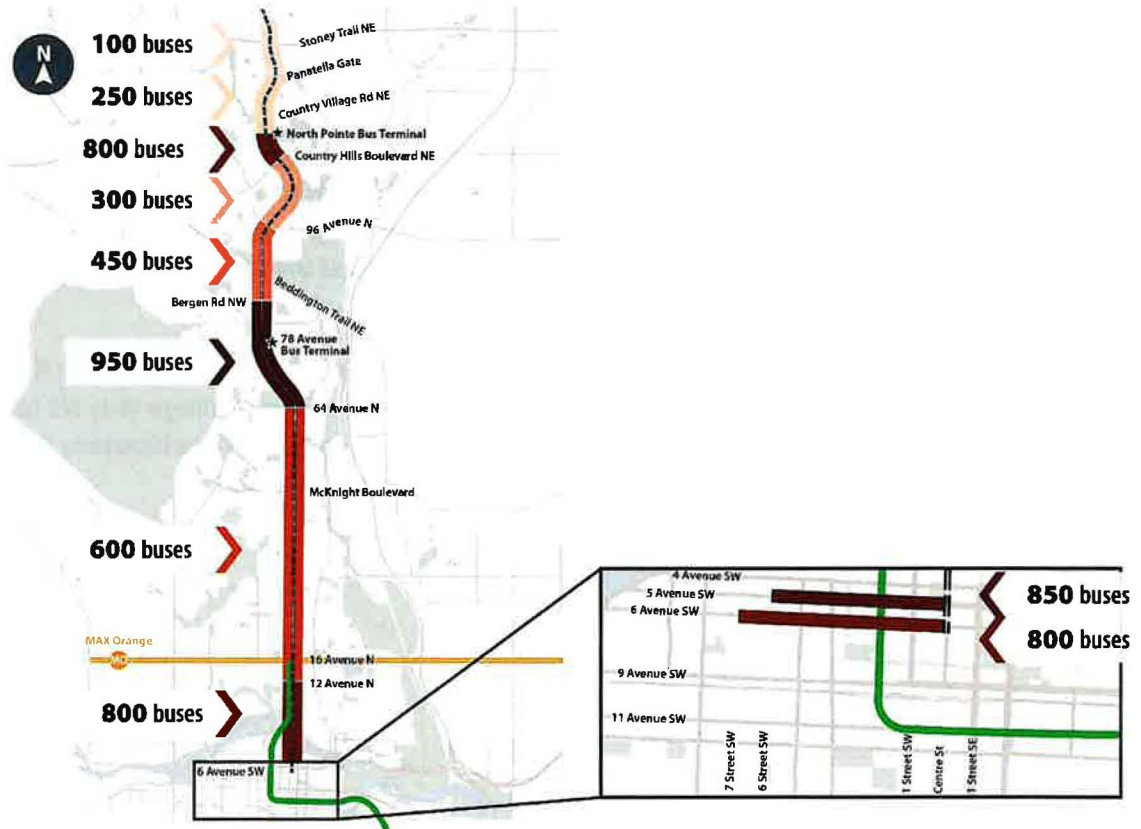
**Route 124 (Evanston):** This route provides service between the North Pointe park and ride and the community of Evanston. This route provides service between 5 AM and 1 AM on an approximately 20-minute frequency. This route enters the corridor at Country Village Link, but does not have any stops along the corridor other than North Pointe.

There are several other local routes that are on the corridor for a short segment to access the 78 Avenue Bus Terminal. These routes include Route 4 (Huntington – 78 Avenue N to 72 Avenue N), Route 5 (North Haven – 78 Avenue N to 72 Avenue N), Route 20 (Northmount Heritage – 78 Avenue N to 72 Avenue N), Route 46 (Beddington – Beddington Boulevard N to 78 Avenue N) and the Route 146 (Beddington – Beddington Boulevard N to 78 Avenue N).

There are also several local routes that are on the corridor for a short segment to access the North Pointe park and ride. These routes include Route 86 (Coventry Hills – Country Village Way NE to Country Village Road NE), Route 123 (Sage Hill / North Pointe – Country Village Road NE to Panatella Boulevard NW) and Route 421 (Panatella – Country Village Way NE to Panatella Gate NW).

## 2.2 EXISTING SERVICE / VOLUMES

Collectively, the various bus routes that operate within the Centre Street N and Harvest Hills Boulevard N corridor make this the busiest bus corridor in the city. The figures that follow provide additional information on the number of buses that operate within the corridor.

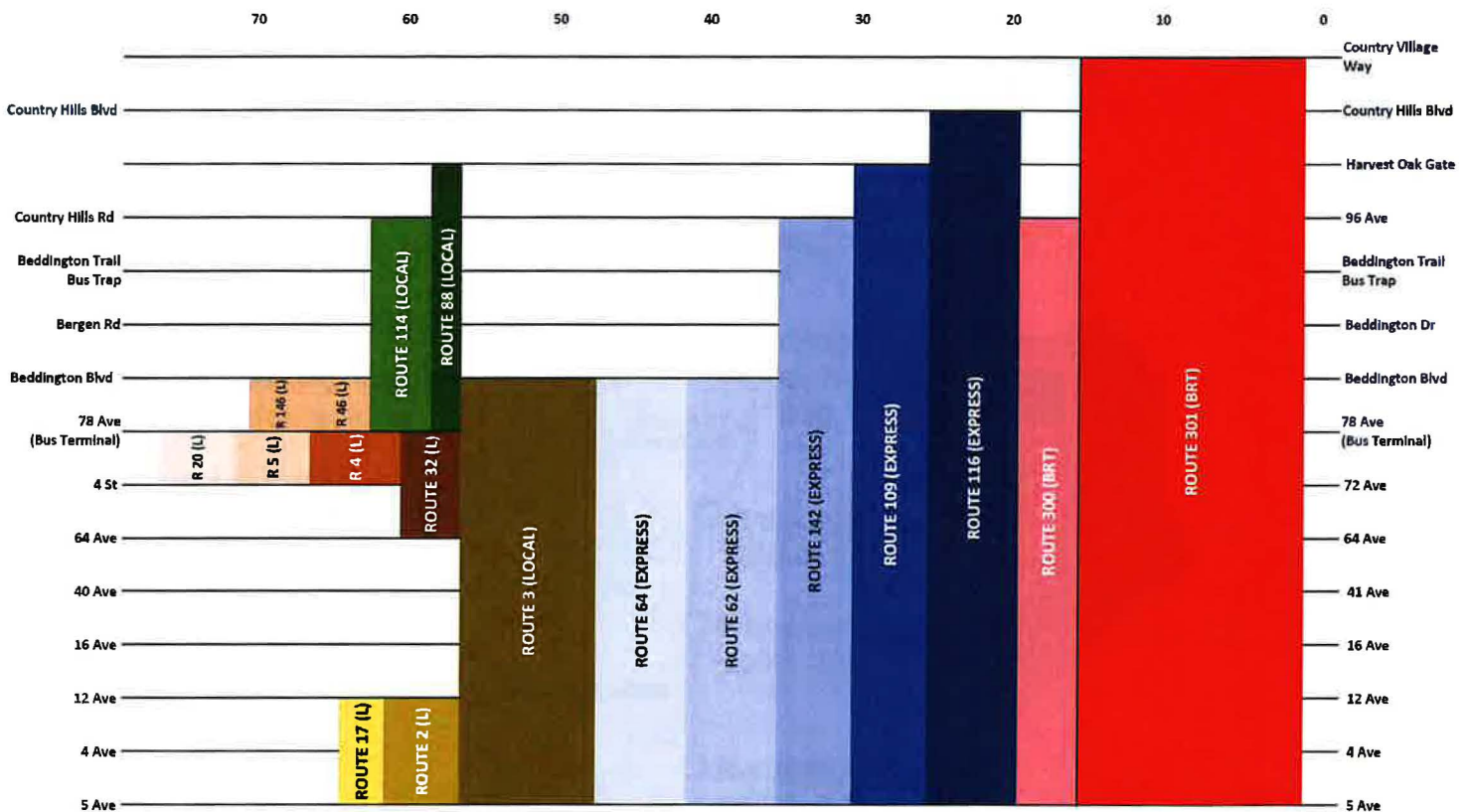


**FIGURE 2 WEEKDAY BUS VOLUMES (CENTRE STREET N AND HARVEST HILLS BOULEVARD N CORRIDOR)**

Figure 2 illustrates the total volume of busses on the corridor per day, on a segment by segment basis. The stretch of Centre Street N between Beddington Boulevard N and 64 Avenue N carries 950 busses daily, which is the highest concentration of busses within the corridor.



Figure 3 provides an approximate number of buses on the corridor in the peak period, by route and on a segment by segment basis. As illustrated in the figure, there are over 70 buses per hour in the peak direction of flow in the segments in and around the 78 Avenue Bus Terminal. Across Centre Street bridge, there are over 60 buses per hour in the peak direction of flow, which equates to more than one bus per minute.



**FIGURE 3 PEAK HOUR/DIRECTION OF FLOW BUS VOLUMES (CENTRE STREET N AND HARVEST HILLS BOULEVARD N CORRIDOR)**

Figure 4 illustrates the total boardings and off-boardings per day along the corridor. Note that the numbers shown on the map represent the total boardings and off-boardings within the surrounding area of the Route 301 stops, including those from other bus routes that use the Centre Street N and Harvest Hills Boulevard N corridor. This graphic illustrates that the areas around the North Pointe, Beddington Town Centre and 16 Avenue N bus stops are the busiest along the corridor.

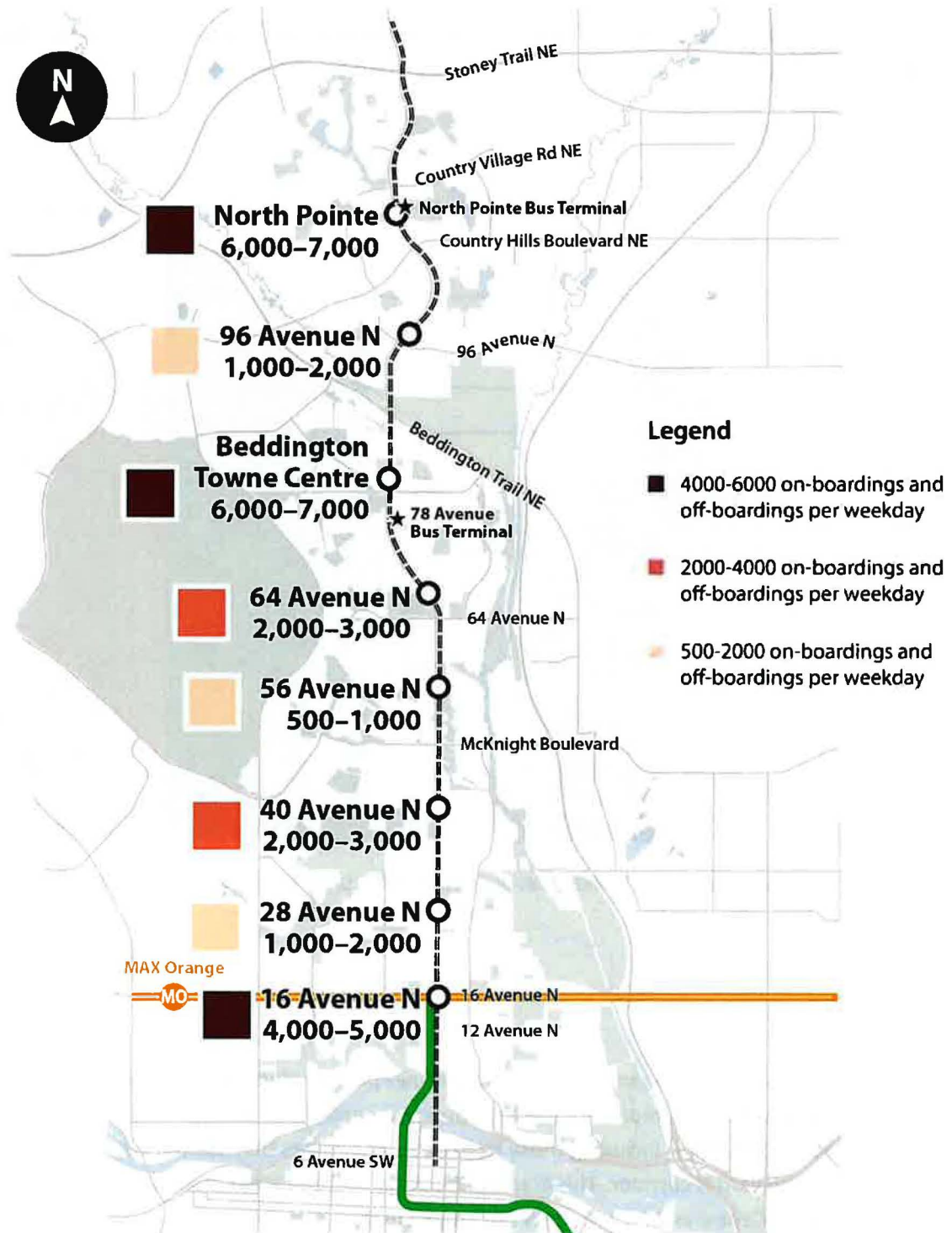
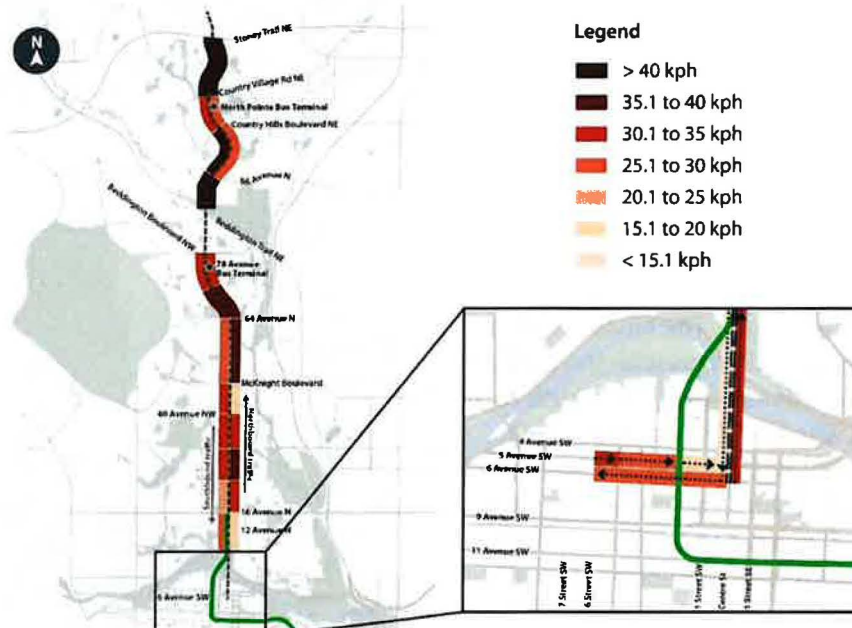


FIGURE 4 BOARDINGS AND OFF-BOARDINGS (CENTRE STREET N AND HARVEST HILLS BOULEVARD N CORRIDOR)

## 2.3 EXISTING TRAFFIC & BUS OPERATIONS

In evaluating the overall operations, we compared average general-purpose traffic and bus speeds within the Centre Street N and Harvest Hills Boulevard N corridor. Figure 5 illustrates the general-purpose traffic and bus speeds in the corridor.

GENERAL-PURPOSE TRAFFIC SPEEDS



BUS SPEEDS

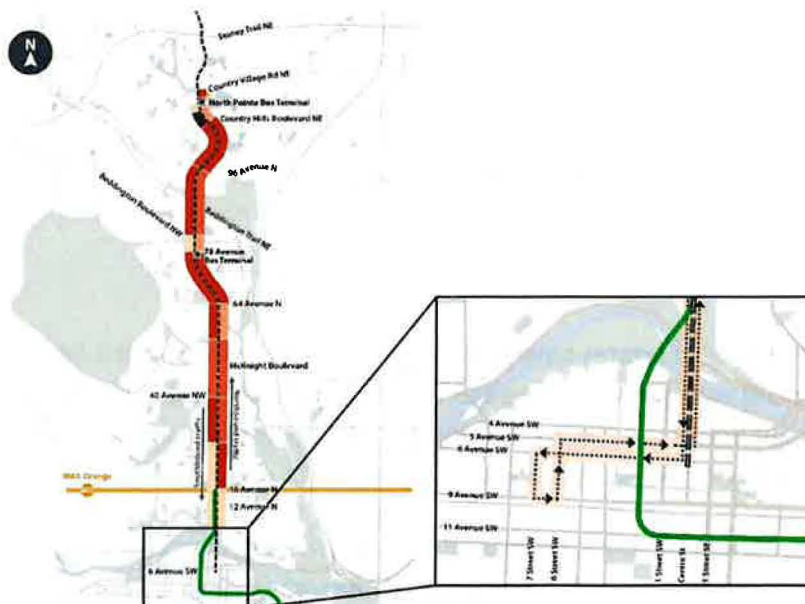
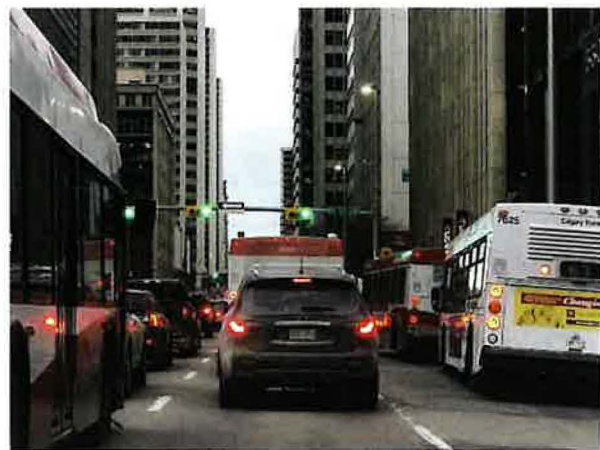


FIGURE 5 BUS AND GENERAL-PURPOSE TRAFFIC SPEEDS (CENTRE STREET N AND HARVEST HILLS BOULEVARD N CORRIDOR AND DOWNTOWN)

As illustrated in Figure 5, bus traffic along the Centre Street N and Harvest Hills Boulevard N corridor and through the downtown generally operates slower than the vehicular traffic in the same sections of roadway.

These bus speeds take into account acceleration and deceleration of the busses, but not dwell times at stops. Given the gap between bus and general-purpose traffic travel speeds there is room for improvement in the bus operations within the corridor.

The other observation that can be made from the corridor speed figure is how much busses slow down through the downtown core. The adjacent pictures illustrate some of the challenges with the existing downtown bus operations, which contribute to lower bus speeds. There is significant vehicular congestion throughout downtown. While busses generally overtake the curblane during peak periods at stop locations, they have to navigate turning traffic at intersections, parkade entrances and alleyways.



While not factored into the speed data presented in the above speed figure, one significant area where existing bus operations lose travel time is in the dwell time at bus stops along the corridor. This is due to the time it takes for each customer to board the bus and pay for their trip. An example of this can be observed at the stop located at the intersection of Centre Street and 4 Avenue S where it can regularly take 45 seconds or more for passengers to board the bus.

## 2.4 EXISTING TRANSIT PRIORITY MEASURES

A number of transit priority measures have been implemented throughout the Centre Street N and Harvest Hill Boulevard N corridor to improve bus operations. An understanding of the measures currently in place is important in order to identify areas for operational improvement throughout the corridor. A summary of existing transit priority measures is described below.

- **Transit Signal Priority (TSP):** Over 60% of the traffic signals along the corridor have TSP measures. These measures extend a signal's green time if a bus is approaching.
- **Bus Trap:** There is a bus trap located just south of Beddington Trail that allows bus-only access to travel between Centre Street N to the south and Harvest Hills Boulevard N to the north. This bus trap provides a significant travel time advantage for busses travelling along the corridor

from points north of Beddington Trail as the connections to Centre Street for general purpose traffic are much more circuitous. Northbound busses are required to stop and wait for a gap in the southbound Harvest Hills Boulevard to eastbound Beddington Trail on-ramp traffic.

- **Queue Jump:** Queue jumps provide a bus only lane on the approaches to an intersection to allow busses to bypass the queue of vehicles at an intersection and provide a priority movement through the intersection. These are currently provided on both the northbound and southbound approaches to the McKnight Boulevard N intersection (approximately 500m in the northbound direction beginning at 43 Avenue N and approximately 350m in the southbound direction beginning at 54 Avenue N).
- **High Occupancy Vehicle (HOV) Lanes:** HOV lanes are provided from approximately 20 Avenue N into downtown. These lanes are signed to allow busses, vehicles with two or more people in them and bicycles to share the curb lane during the peak hour in the peak direction (southbound in the AM and northbound in the PM). Based on field observations, there are a significant number of single occupancy vehicles that regularly utilize these lanes during peak hours, adding to congestion in the HOV lane and therefore reducing the benefit for busses.

### 3 BRT IMPROVEMENTS

The balance of this document reviews a series of bus operation improvements and infrastructure modifications that could strengthen bus operations in north central Calgary. For purposes of this review, we have considered what modifications would be most beneficial when paired with the Green Line updated Stage 1 alignment recommendation.

Green Line Stage 1 extends from 16 Avenue N to 126 Avenue SE. The terminus at 16 Avenue N is temporary, as the alignment will extend north along the Centre Street N corridor through incremental expansion projects. Given the initial terminus at 16 Avenue N, the project team has identified the need to improve bus operations along the Centre Street N and Harvest Hills Boulevard corridor. This report outlines a series of improvements. Some of these improvements will require additional investigation and analysis before determining a preferred suite of recommendations for implementation.

Several of the corridor modifications discussed below require further investigation and analysis before confirming if they are warranted for investment. This would be accomplished through the preparation of a functional plan. As part of the next steps for this work, The City will be advancing a more detailed study of the below noted improvements and preparing a functional plan that will be used to advance the preferred suite of improvements to implementation.

The below list outlines BRT improvements from north to south. For quick reference, a graphical summary of these improvements is shown in Figure 7:

- **North Point to 160 Avenue N – lengthen BRT Route.**  
The existing BRT route has a northern terminus of the North Pointe Park and Ride. With significant residential growth occurring north of Stoney Trail, consideration should be given to the timing of extending the BRT into the new communities north of Stoney Trail.
- **Harvest Hills Boulevard N & Coventry Hills Drive NE/Panatella Boulevard NW – Intersection Improvement.**  
The City of Calgary Roads is expected to implement intersection improvements at this intersection this year to provide a northbound dual left turn to address a queue spillback issue that occurs in the northbound left turn during the PM peak period. This spill back issue currently impacts the operation of the Route 123.
- **North Pointe – Shorten the bus loop around the park and ride lot.**  
Route 301 busses currently do an approximately 1km loop around the block when they reach the North Pointe park and ride lot (Harvest Hills Boulevard N to Country Village Road NE to Country Village Link NE to Country Village Way NE) before traveling back south on Harvest Hills Boulevard N. Consideration should be given to shortening this loop.

- **Harvest Hills Boulevard N & Country Hills Boulevard N – Add queue jump.**  
Country Hills Boulevard was identified as a location for future grade separation as part of the Green Line North Functional Planning Study. In advance of the grade separation, consideration should be given to the provision of a queue jump at this location.
- **Harvest Hills Boulevard N & Country Hills Road NW /96 Avenue NE – Add queue jump**  
We recommend that additional study be conducted on this intersection. We have received comments from both bus operators and Calgary Transit staff that there are operational issues through this section of the corridor. Additional study will be required to determine if queue jumps or modifications to the left turn lane(s) will best address the operational issues at this location.
- **Bus Trap (South of Beddington Boulevard) – Add a traffic signal and a northbound acceleration lane.**  
As noted in the review of the existing transit priority measures through the corridor, the bus trap requires northbound busses to stop and wait for vehicles that are traveling southbound on Harvest Hills Boulevard. Consideration could be given to the provision of a traffic signal that would stop southbound traffic at this location to prioritize the northbound bus movements. Additionally, consideration for a longer northbound acceleration lane for the busses should also be reviewed.
- **Beddington Boulevard N to 64 Avenue N – Dedicated bus lanes & overall bus operation review.**  
As noted in the review of the existing bus operations along the corridor, this section of Centre Street has the highest daily volume of busses in the corridor. This 1.8 km section of Centre Street also generally has a wider right of way than much of the southern portions of Centre Street N.  
  
We recommend reviewing the bus operations through this section of Centre Street in more detail to determine the benefit of providing dedicated bus lanes or if other improvements would be more appropriate. One of the key considerations that will need to be taken into account is the operation of the 78 Avenue Bus Terminal and how these operations would or would not benefit from the provision of dedicated bus lanes through this area.
- **Centre Street N & McKnight Boulevard N – Review operation of existing queue jump.**  
As noted earlier in this memo, queue jumps have been provided on both northbound and southbound approaches to this intersection. However, there is a need to review the operation of these queue jumps to see if any improvements can be made to address the issue of right turning traffic blocking buses from being able to continue through this intersection.

- **McKnight Boulevard N to 16 Avenue N – dedicated bus lanes.**

The provision of bus only lanes would enhance the bus operations along the Centre Street N corridor. There are several different ways that this could be accomplished. One way would be by dedicating the curb lanes for exclusive bus use throughout the day. A red color is often used to designate these lanes for bus use as illustrated in Figure 6 below.

Similar to the HOV lanes that currently exist on Centre Street south of 20 Avenue N, compliance is one of the main challenges associated with any curbside configuration is that this lane is required to be shared with right turning vehicles. Right turning vehicles are usually allowed to enter the turn lane one block prior to the locations where they would be turning right. However, there are no physical barriers preventing through traffic from traveling in the curb lane. Another option would be to only designate these lanes as bus only lanes during the peak periods. This type of approach allows the curb lane to be utilized for parking in the off-peak periods. This again can pose compliance issues because in addition to the issues highlighted above, towing would be required to clear the lane at the start of service if any vehicles were still parked in the curb lane.

One consideration with the provision of bus only lanes through this portion of the corridor is that it will result in a significant displacement of peak hour vehicular traffic. This displacement will be considered as part of the broader network study that is planned to be completed for the area north of the Bow River.

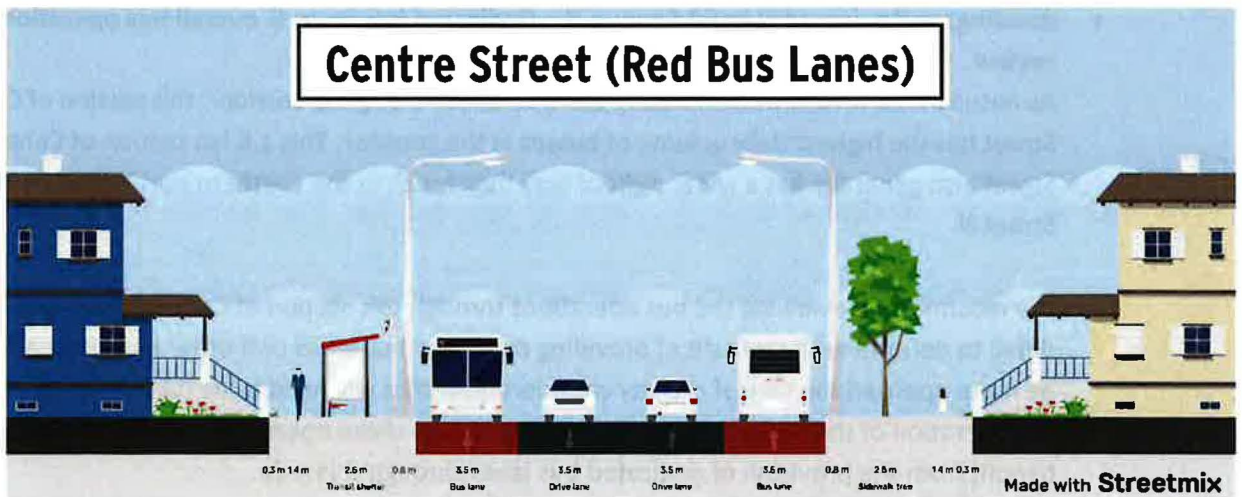


Figure 6 Curbside Bus Lanes

- **BusSES Sharing the LRT ROW:** The LRT guideway on Centre Street N will be designed to allow BRT and Express buses to operate within the guideway south of 13 Avenue N to the north end of the new LRT bridge. Permitting BRT and express buses in the guideway will help improve transit travel time reliability along this stretch of Centre Street N, which is currently prone to congestion and delays bus movement.



- **Centre Street bridge - dedicated bus lanes.**

There are currently four vehicular travel lanes on the Centre Street bridge. With the construction of a middle-running at-grade LRT on Centre Street north of the bridge, the section of the corridor just north of the bridge will be reduced to two travel lanes. As a result, two of the bridge lanes could be designated for bus only use. Other items that will need to be considered when making this determination is the lane configuration that will be required when entering downtown. If it is ultimately determined that only a single lane can be provided, it will be used to accommodate busses in the peak direction of flow (southbound in the AM and northbound in the PM).
- **Downtown – bus operations review.**

The operation of busses on the loop through downtown is an area that requires further study. As noted in the description of the existing conditions, the bus operations through downtown are quite slow. In some locations, bus operations may benefit significantly from the provision of a dedicated peak hour bus lane adjacent to the curbside stop locations.
- **Corridor Wide - improved customer amenities.**

In addition to the above noted operational improvements, we are also recommending that improved customer amenities be provided. This would include amenities such as MAX BRT stations which include elements such as near-level boarding, real time information, enclosed heated shelters and improved lighting and security.
- **Corridor Wide - transit signal priority.**

It is recommended that transit signal priority be installed at all remaining intersections where it is not currently present (under 40% of the signals in the north corridor). In addition, in the locations where transit signal priority has already been provided, it should be reviewed to see if any additional improvements can be made to its operation.
- **Corridor Wide - off-board fare payment.**

Calgary Transit has identified the desire to provide off-board fare payment throughout the MAX BRT system in the future. As noted in the review of the existing conditions, it can sometimes take 45 seconds or more to board the bus at certain stop locations due to passengers having to board through the front door to pay or prove payment to the bus operator. Off-Board fare payment would allow customers to board by both the front and back doors of the bus and would substantially reduce the boarding time. While this may seem like a minor improvement, this could reduce the overall travel time by as much if not more than many of the improvements listed above.

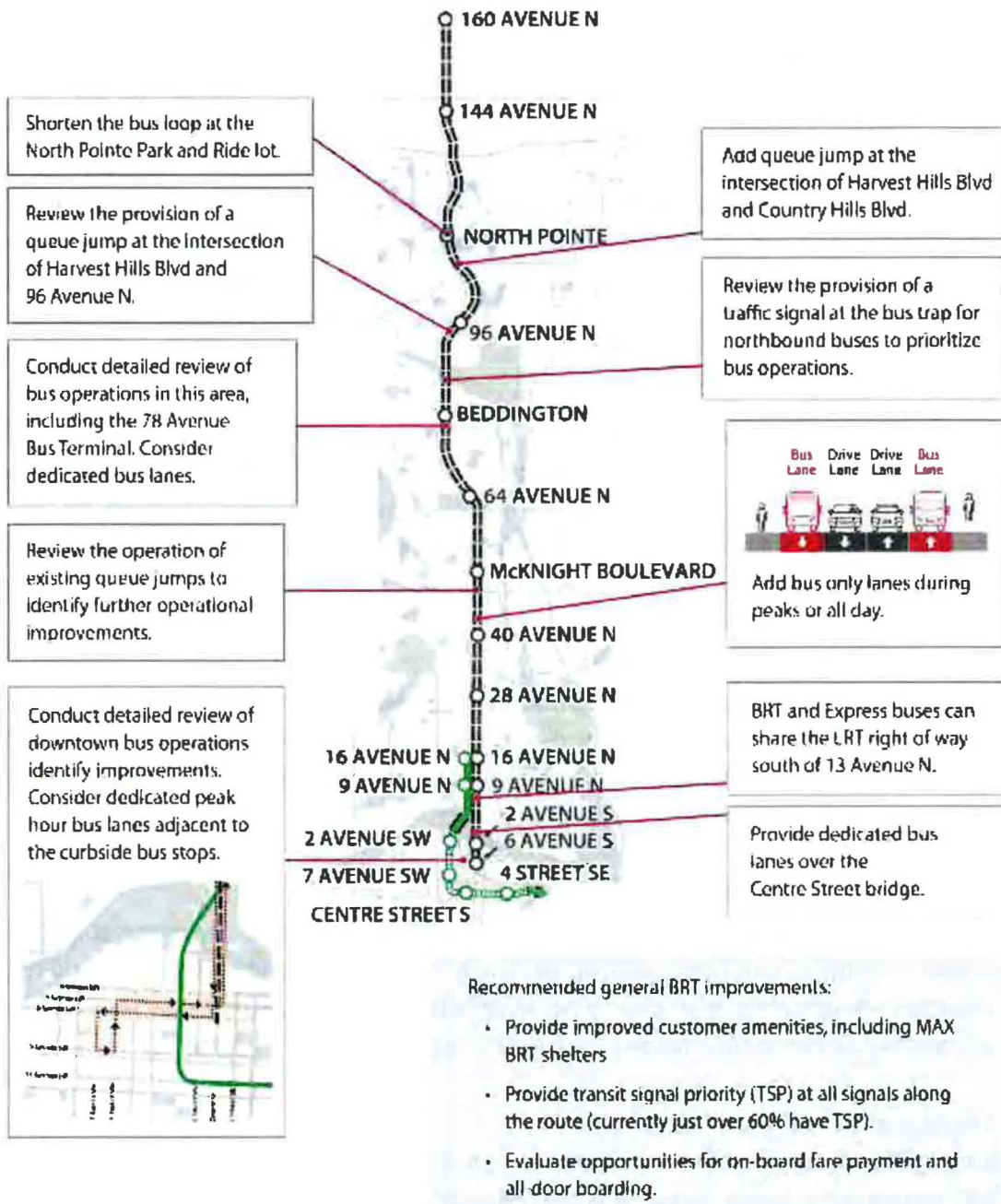


FIGURE 7 BRT IMPROVEMENTS

## 4 CONCLUSIONS

This memo has presented a series of bus operation improvements and infrastructure modifications that could strengthen bus operations in north central Calgary. For purposes of this review, we have considered what modifications would be most beneficial when paired with the Green Line updated Stage 1 alignment recommendation. As part of the next steps for this work, it is recommended that The City advance a more detailed study of the improvements and prepare a functional plan that will be used to advance the improvements to implementation.

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