DOCUMENT 2

Transportation Master Plan Infrastructure Requirement Study

Review of Alternative LRT Terminus Locations in Riverside South

October 2008







McCORMICK RANKIN CORPORATION



PREFACE

The recommendations and findings presented in this report are one component of a larger study to develop the transit and road infrastructure requirements of the 2008 update to the City of Ottawa's Transportation Master Plan (TMP). This study is being conducted in such a manner as to satisfy Phases 1 and 2 of the Municipal Class Environmental Assessment (October 2000, as amended in 2007) as follows:

Phase 1 – Problem or Opportunity: *The development of a long-term Transportation Vision and associated planning principles, identifying problems and opportunities;*

Phase 2 – Alternative Solutions: A review of transit and road networks. This includes a capacity review of the City's downtown rapid transit network; the development of primary and supplementary transit corridors; identifying potential new and widened arterial roads and bridges, and; associated implementation timelines.

Further documentation will be prepared which describes all of the work undertaken to fulfill Phases 1 and 2, as well as the public and stakeholder consultation carried out.

The Municipal Class Environmental Assessment (EA) recognizes the benefits of long-range infrastructure planning under the Master Planning process and outlines various approaches for Master Plans to fulfill the requirements of the Class EA. The 2008 TMP update is being carried out as part of the City of Ottawa's mandatory 5-year Official Plan Review, and will therefore be planned in accordance with Approach #4 – Integration with the Planning Act.



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1. Introduction

On 28 May 2008, Ottawa City Council approved a **Primary Rapid Transit Network** which incorporated the conversion of the existing diesel-powered O-Train service in the North-South corridor to electrically powered LRT extending south to a terminus at Bowesville Station. This line would continue as a bus transitway corridor from Bowesville Station thorough the Riverside South community and extend west to Barrhaven Town Centre. The approved network is shown in Figure 1.1.

The choice of Bowesville Station as the southern terminus of the LRT service was driven by the following considerations:

- It represented the minimum length extension beyond the Greenbelt that would provide the level of service necessary to meet the City's 2031 transit demands from the southern growth communities of Leitrim, Riverside South and Barrhaven.
- A 3000-spot Park & Ride facility has been planned for at Bowesville Station, which was approved as part of the North-South LRT EA study.
- It extended the corridor to connect to the preferred location for a rail maintenance and storage facility, which was also approved as part of the North-South LRT EA study.

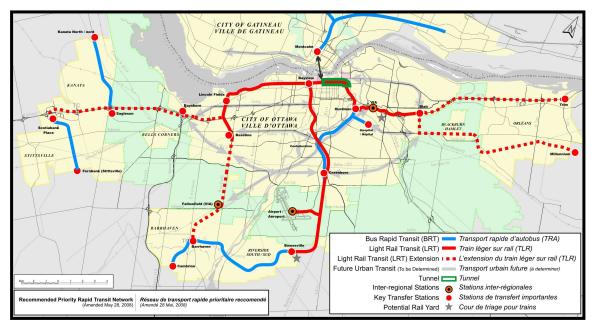


Figure 1.1: Approved Rapid Transit Network



In response to stated concerns that the proposed Bowesville terminus would neither attract a high ridership from Riverside South, nor encourage the transit-oriented development goals for the community as set out in the approved Riverside South Community Design Plan (CDP), Council approved the following motion as a condition of approval of the Primary Transit Network:

1) That staff review the option of an LRT terminus more central to the Riverside South community as part of the staging process and report back to Committee and Council in the fall.

This report responds to the motion.

2. Background

In June 2005, the City approved the Riverside South CDP with a proposed population of 51,500 and a proposed employment figure of 14,690 jobs. The CDP is founded on transit-oriented development (TOD) principles that aim for an efficient use of land by situating higher density forms of development within easy access to rapid transit. A key element of the CDP is the planned location of the proposed rapid transit corridor. The approved CDP is illustrated in Figure 2.1.

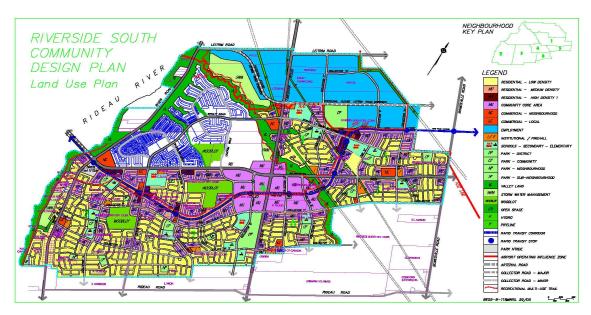
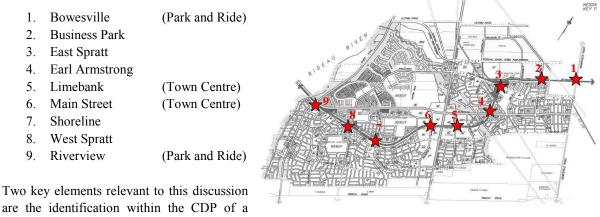


Figure 2.1: Riverside South Community Design Plan

This rapid transit corridor was developed in conjunction with the North-South Corridor LRT EA study, which was approved by Council in July 2005. With input from the CDP team, the EA study developed and confirmed the alignment and geometry for the LRT line, and identified the number and location of the LRT stations and other associated services and facilities. The approved CDP includes a total of nine LRT stations spaced between 500 and 1,400 metres apart to provide the pedestrian-oriented walk-in service desired to support the Riverside South TOD goals.



These stations are as follows:



Community Core that will accommodate a range of institutional, office, retail and residential developments central to the community, adjacent to the rapid transit corridor and containing two transit stations (Limebank & Main Street); and a surface park and ride lot adjacent to Riverview Station to provide parking for commuters. In addition, high to medium development densities, such as apartments, stacked townhouses, and townhouses are located in proximity to transit, while semi-detached and single detached dwellings are generally located further from transit.

3. Attributes of an LRT Terminus Station

Attributes specific to LRT terminus station operations would influence the choice of the proposed terminus location. These include end of line activities such as: loading and unloading of passengers; time stops; change of drivers; temporary storage of disabled trains; storage of trains to be introduced into service; reversing of train direction; and, an interface with bus and park and ride services.

The physical requirements of a terminus station include: two platform tracks to accommodate the anticipated frequency of service: storage of vehicles (in case of malfunctions) and operational staging for peaks (special events); washroom facilities for transit vehicle drivers; and, tail-tracks located beyond the terminus station to accommodate the storage of additional and or disabled vehicles. Bus lay-over space may also be required.

The design vehicles considered for the City's LRT system range from 25 to 30m long. Depending on the service plan and ridership, station platforms on the North-South line segment will likely be designed to accommodate four-car LRT trains resulting in station platforms up to 120m long. Centre-island platforms are preferable at terminus stations.

In order to reverse direction at the end of an LRT line, a "crossover" track is required to switch LRT vehicles onto the returning track. A rail crossover track must intersect the alignment at a relatively flat angle, typically resulting in a crossover approximately 30 m long. A 15 m tangent between the rail crossover and the LRT platform, as shown in the figure below, is required to eliminate the possibility of a vehicle overhang impacting the LRT platform and/or pedestrians.

The required combination of a crossover, tangent, platform and tail track results in a 285m long station, as shown below. The platform must be located on a straight (tangent) portion of track. It is also desirable to have the crossover on straight uninterrupted portions of track. Although desirable it is not necessary for the tail track to be located on a straight section of track.

Figure 1 presented below illustrates the elements of a terminus station.

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Tail Track		Tangent	Crossover	
	Platform		\succ	
60 - 120 m	120 m	15 m	30 m	
	225-285	m		

Figure 3.1: LRT Terminus Elements

4. Alternative Terminus Locations Considered

Four of the nine approved station locations are being considered for LRT terminus operations. These include two locations at the perimeter of the development, one in the town centre and one at Earl Armstrong Road. The four stations identified as possible locations for terminating the LRT are shown on the figure below and are as follows:

- 1. Bowesville Station (per approved Primary Rapid Transit Network)
- 2. Earl Armstrong Station (located east of the Town Centre)
- 3. Main Street Station (located in the Town Centre)
- 4. Riverview Station (located west of the Town Centre)

Bowesville Station was selected as it is the currently approved LRT terminus. The Earl Armstrong Road location was suggested by Mr. Lyon Sachs, President of Urbandale Corporation (the developer of Riverside South) as it is situated adjacent to the principal East-West arterial road crossing the community. Of the two approved stations located in the Town Centre, Main Street Station is being considered because it provides the best penetration into the Town Centre. Finally, Riverview Station was selected as it would provide LRT service to the entire Riverside South community, connect to the approved Park and Ride lot capturing commuters from Manotick and points south, and provide a closer link to LRT service for residents of Barrhaven via the Strandherd-Armstrong Bridge.



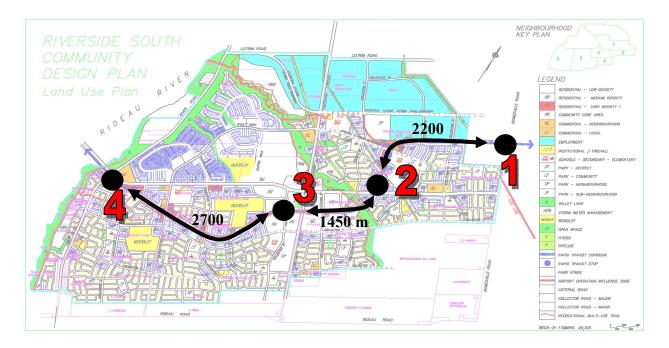


Figure 4.1: Terminus Locations Considered

5. Evaluation Criteria

Each of the 4 alternative terminus locations identified above has their associated advantages and disadvantages. The following evaluation criteria were used to assess the merits of each alternative.

Land Use	Proposed density / Type of land use adjacent to site		
	Proposed Key facilities (e.g. park and ride lot) adjacent to site		
	Geometrics (physical constraints)		
Ridership	Serves existing travelers		
	Ridership Potential		
	Access / Integration with transportation facilities		
Costs	Capital Costs		
	Additional LRT vehicles required to maintain service		
	Bus transit service operations		



6. Analysis of Alternative Terminus Locations

Note: For comparison purposes, the capital costs indicated below are for the total length of the rapid transit corridor from Bowesville Station to Riverview Station. The costs reflect the different lengths of LRT and BRT implementation that result for each alternative considered.

6.1. Bowesville Station:

This station is located 400m east of the Riverside South Community boundary.

Type of Adjacent Land use

Low-density rural. This location is outside of the urban area.

Key Facilities:

A 3,000 spot Park & Ride lot is planned at this station. Sufficient land is available for bus lay-over parking. Approved rail yard location adjacent to site.

Geometrics:

There is adequate space on tangent to accommodate all elements of a terminus station.

Serves Existing Riders:

Current transit service includes express bus route 45, which accesses the downtown (LeBreton) via Limebank, Hunt Club and the Southeast Transitway; and route 145, which accesses the Greenboro Transitway Station. With the introduction of an LRT terminating at Bowesville, existing transit riders would take a bus to Bowesville Station where they could transfer to the LRT Network. Despite the transfer, the quality of service would be enhanced as bus service would be more frequent than today and the LRT service would provide a more comfortable ride.

Ridership Potential:

There are very few residential and employment uses surrounding this station as the recent concentration of new development has been in west end of the community, far away from this station. Transfers between bus and rail are required to connect to the community. This station does not provide the walk in potential that is desired for a TOD. The future population and employment within 600m of the station includes 305 residents and 35 jobs.

Access / Integration with Transit Facilities:

A planned Park and Ride Lot is situated at the Bowesville Station, with up to 3,000 spots. Park and Ride Lots are often located at terminus stations so that people driving from beyond the line can drive to the Rapid transit station instead of relying on local bus service or driving into downtown.



Capital Cost:

The approved Rapid Transit Corridor through Riverside South (between Bowesville and Riverview) will be constructed with BRT. The cost for construction would be as follows:

0 km of LRT = 06.4 km of BRT = \$54 M

TOTAL = \$54 M

LRT Vehicles:

No additional LRT vehicles over the approved Primary Rapid Transit Network plan would be needed.

Bus Transit Operations:

Local buses would circulate through community and then travel to Bowesville Station to connect to the LRT. With the majority of development on the west side of the community, there would be higher bus operational costs due to the longer distance to access transfer station than the other alternatives. Also more buses would be required to provide the desired frequency since each bus route is longer.

6.2. Earl Armstrong Station:

This station is located in the east side of the Riverside south community on the north side of Earl Armstrong Road.

Type of Adjacent Land use:

Medium / low density residential is proposed in this area. A High School is to be located 600m north of this station. The mosquito creek natural area is within walking distance from the station.

Key Facilities:

There is no park and ride lot planned for this location, nor is there space designated in the CDP for this type of land use adjacent to this location

Geometry:

Being located immediately north of Earl Armstrong Road, a terminus station in this location will result in the required tail track crossing the major arterial causing potential delays to both transit and general traffic. The Earl Armstrong station can be relocated further north in order to provide space for the tail track but road access to the station would be reduced and the proposed spacing of stations would be affected.

Serves Existing Riders:

Current transit service includes express bus route 45, which accesses the downtown (LeBreton) via Limebank, Hunt Club and the Southeast Transitway; and route 145, which accesses the Greenboro Transitway Station. With the LRT terminating at Earl Armstrong, transit users would take a bus to the station where they would transfer to the LRT network. The station is too far east from the currently developed lands for existing transit passengers to walk in to the LRT. Despite the transfer, the quality of service would be enhanced as bus service would be more frequent than today and the LRT would provide a more comfortable ride.



Ridership Potential:

There is potential to capture additional riders from the east end of community. Having the LRT terminate at Earl Armstrong will encourage new development to be located near the rapid transit station. This would increase the potential for the LRT to capture additional passengers. These passengers would be able to directly access the downtown with no transfers. The future population and employment within 600m of the station includes 915 residents and 53 jobs.

Access / Integration with Transit Facilities:

There are no transit facilities currently planned around the Earl Armstrong Station. In order for this station to accommodate the transfers between bus and LRT, development space would need to be provided for bus platforms and bus lay-ups.

Capital Cost:

The approved Rapid Transit Corridor through Riverside South (between Bowesville and Riverview) will be constructed with BRT and LRT. The cost for construction would be as follows:

2.2 km of LRT	= \$39 M
4.15 km of BRT	=\$44 M

TOTAL = \$83 M

LRT Vehicles:

The additional 2.2 km of LRT would require an additional 5 LRT vehicles to provide the same service frequency as if it terminated at Bowesville. At \$5M per LRT vehicle, this would add an additional \$25M.

Bus Transit Operations:

Buses can operate on Earl Armstrong to access the terminus. Some buses from the west would likely still travel to Bowesville station to serve the residential and employment lands to the north and east, leading to additional costs due to the extra trip length for buses. This would also create a duplication of transit services between Earl Armstrong and Bowesville stations.

6.3. Main Street Station:

This station is located within the Community Core Area, 250m west of the Limebank Road intersection. This station was identified as a potential terminus because it provides a direct connection from the suburban town centre to Ottawa's CBD. This alternative conforms to the principals of a transit-oriented development; to concentrate the transit services as a focal point in the community in order to promote the development of a thriving town centre.

Type of Adjacent Land use:

Community Core Area (medium density employment and retail). This station is also located within walking distance to a large woodlot (environmental area), and a future high school.

Key Facilities:

A potential interim Park & Ride lot is possible at this station, which could be replaced when development intensifies. There is no space planned for a transit terminus in the current land-use plan, however local bus service could operate in a loop along the adjacent collector roads thus avoiding the need for a major bus terminus.



Geometry:

This station is located on a straight section of track through the town centre. The tail track would be located west of the station on a curve. The proposed 350m long block spacing is enough to accommodate all elements of the terminus station.

Serves Existing Riders

Transit services would circulate through the existing community and take passengers to the Town Centre to access the LRT. Existing passengers will experience a high quality transit trip using the LRT for the majority of their commute. Approximately 9,000 persons live in the existing residential development, situated between 500m and 1,200m north-west from this station. The existing development also currently incorporates 630 jobs.

Ridership Potential:

There is significant ridership potential due to the planned mixed use development surrounding this station. The 600m walking radius around the station captures the majority of the town centre, part of the Armstrong road south woodlot as well as a future high school. There is therefore potential to capture riders from the community core area and in the east end of the community without any transfer from bus to LRT. The future population and employment within 600m of the station include 1056 residents and 516 jobs.

Access / Integration with Transit Facilities:

A potential interim park and ride site could be located in the town centre. This site would eventually be replaced with appropriate development once the town centre has become established. Parking could then be integrated into the future development. This station location is central to the entire Riverside South community and provides a key centralized transit node. There is opportunity to design the LRT terminus station as a positive feature for the community.

Capital Cost:

3.7 km LRT	= \$ 63 M
3.2 km BRT	= \$ 28 M
TOTAL	= \$ 91 M

LRT Vehicles:

The additional 3.7 km of LRT compared with alternative 1 would require an additional 7 LRT vehicle to provide the required service frequency. These additional vehicles would cost \$35M.

Bus Transit Operations:

Local buses would circulate through the all sectors of the community to bring passengers to the town centre as their final destination, or to transfer to the LRT service. That said, residents living east of the town centre wanting to connect to the North-South service would get off at an LRT transfer point in the eastern portion of the community. Therefore, without the need for local bus service from the west to travel to the east to connect to the LRT, bus operational costs are reduced due to their shorter trip lengths.

6.4. River Road Station:

This station is located east of the River Road intersection, near a commercial area and residential development. There is also a Park and Ride Lot at his location.



Land Use:

There a variety of land uses surrounding this station including low, medium and high density residential, and commercial designation. A 1,000 spot Park and Ride lot is planned at this station. There is an elementary school within 500m of the station as well as the Rideau River natural environmental area.

Key Facilities:

A Park and Ride lot is located at this location. Sufficient space is available for bus transfer operations.

Geometry:

The station is situated on a straight section of track with over 500m between intersections. The Land use plan shows the station abutting River Road which may complicate the operations of a terminus station but the station can be shifted east to provide sufficient additional space for the tail track.

Serves Existing Riders

This station is located closest to the existing residential development in the west end of the community. Buses would circulate through the community and take passengers to the Riverview station as well as the town centre.

Ridership Potential:

The potential walk-in ridership gained at this station is limited as it located next to the Rideau River where there is no population or employment. There is a high-density residential parcel of land within 600m of the station, which will generate some riders. The LRT may draw passengers from Barrhaven who would otherwise use the Southwest Transitway to access the downtown; and the Park and Ride Lot may attract riders from Manotick and points south. The future population and employment within 600m of the station includes 715 residents and 243 jobs.

Access / Integration with Transit Facilities:

A park and ride lot is located at this location. This station is located at the intersection of 2 major road arterials which is a key location to intercept commuters and attract them to take transit.

Cost:

6.4 km LRT = \$120M0 km BRT = 0

TOTAL = \$120M

LRT Vehicles:

The additional 6.4 km m of LRT compared with alternative 1 would require an additional 11 LRT vehicles to provide the required service frequency. These vehicles would cost an additional \$55M.

Bus Transit Operations:

Most local buses would circulate through the community similar to alternative 3 taking passengers to the town centre to access the commercial development and the LRT station. The focus of transit services in the Riverside TOD would still be located in the town centre. Some bus routes would service the Riverview station and Park and Ride lot but would likely still travel to the town centre. There are therefore higher total operational costs compared to alternative 3 due to the longer length of LRT operation as well as the duplication of transit services between Riverview and the Town centre.



7. Evaluation Summary

	Bowesville	Earl Armstrong	Main Street	Riverview				
LAND USE								
Type of Land Use	 low density rural Outside of urban area 	Medium density residential	Community Core area (medium density employment and retail) encourages residential and commercial development	 Located within mixed density development but provides service throughout community Development potential constrained by proximity to Rideau River 				
Key Facilities	• A Park and Ride Lot & rail maintenance and storage yard is proposed at site. Site is large enough to accommodate bus transfer station.	 A Park and Ride lot is not compatible with the adjacent residential development. The site is not large enough to accommodate a bus transfer station, nor are side street arrangements conducive to a transfer operation. A Kiss and Ride is possible on Earl Armstrong. 	An interim Park and Ride lot is possible on commercial lands as interim or integrated into development.	• A Park and Ride Lot is proposed at this location. There is space within the lot to accommodate a BRT terminus.				
Geometry	Station on tangent, tail track on tangent, no conflicts with crossing streets	Station on tangent, tail track on curve, conflict with Earl Armstrong crossing	Station on Tangent, tail track on curve, no conflict with crossing streets	Station on tangent, tail track on tangent, conflict with River Road crossing				



	Bowesville	Earl Armstrong	Main Street	Riverview
RIDERSHIP				
Services existing riders	Existing buses rerouted 4 km across community	Existing buses rerouted 3 km across community	Adjacent existing development; will require less service routes	Adjacent existing development; will require less service routes
Ridership Potential	• Ridership transfers from bus or car to LRT, no adjacent development thus no walk in service is anticipated.	Ridership from adjacent medium and low density development east of Limebank. Walk in and Kiss and Ride and bus transfer	• Ridership transfers from bus or car to LRT, walk in anticipated from adjacent commercial sites	• Ridership transfers from bus, car and walk in from adjacent mixed use development to the LRT.
	 Population within 600m: 305 Employment within 600m: 35 	 from Earl Armstrong. Population within 600m: 915 Employment within 600m: 53 	 Population within 600m: 1056 Employment within 600m: 516 	 Population within 600m: 715 Employment within 600m: 243
Access / integration with transit facilities	 Space planned for a transit terminus and a Park & Ride lot at this location. Also the rail yard is desired at the terminus Road access from Lester, Bowesville and Earl Armstrong 	No space planned for a transit terminus at this location.	 No space planned for a transit terminus at this location, but space is available within the corridor and Park and Ride could be integrated into future development. Road access from Limebank, Earl Armstrong and side streets 	 Space planned for a transit terminus and a Park & Ride lot at this location, providing convenient Park and Ride facilities for riders from Manotick. Road access from River Road and Earl Armstrong



	Bowesville	Earl Armstrong	Main Street	Riverview		
COST						
Capital Cost	 Base for comparison Outside community, minimal impact on roadways \$54M (BRT only) 	 Requires additional 2.2 km of LRT track Requires 3 at grade road crossings \$83M (\$39M LRT/ \$44M BRT) 	 Requires an additional 3.7 km of LRT track Requires 5 at grade road crossings \$91M (\$63M LRT / \$28M BRT) 	 Requires an additional 6.4 km of LRT track Requires 12 at grade road crossings \$120M (LRT only) 		
Additional Vehicle Costs	 Base case for LRT vehicles required Highest number of local buses required due to length of service to Bowesville 	 5 additional LRT required over base case to account for increased length of service = \$25M Fewer number of local buses required compared to Bowesville alternative 	 7 additional LRT required over base case to account for increased length of service = \$35M Fewest number of local buses required compared to other alternatives 	 11 additional LRT required over base case to account for increased service length = \$55M Fewer buses required compared to Bowesville alternative; More buses than Main street alternative 		
Bus Transit Operations	Highest operating costs due to length of local bus routes to service station	• Second highest operating costs due to reduced length of local bus routes to service station compared to Bowesville alternative.	Least operating costs for local service routes to service station compared to other alternatives	Similar operating costs for local service routes to service station to Main Street alternative		
Rank	3	4	1	2		
	Legend Best	Middle	Worst			



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8. Conclusion

The main issue with the selection of an alternative terminus location relates to the impact of the permanent facility on the planned development of the site and the impact on transit services. Specifically, a major transfer station with a Park and Ride lot will be difficult to accommodate at either Earl Armstrong or Main Street Stations within the approved land use plan, but the Main Street option has the potential to incorporate a shared parking facility with the proposed commercial development as an interim or permanent measure.

Currently, development is located in the west of the community, which favours the Riverview and Main Street station as appropriate for the LRT terminus. They can serve existing riders while helping to shape future development.

In the end, Main Street Station is identified as the preferred location for the LRT terminus, as it provides the best opportunity to attract additional riders and promote transit-oriented development within the Riverside South community at a comparatively reasonable cost.

