

# ANNEX C

## Review of Urbandale Rapid Transit Proposal

### Detailed Report

# City of Ottawa

## Review of Urbandale Rapid Transit Proposal

DETAILED REPORT



*Ottawa*



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## 1. General

<b>1.1. Introduction</b>
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The City of Ottawa retained the MMM Group to carry out a technical review of the proposal “An Affordable Solution for Rapid Transit in Ottawa” dated August 2007 (“Urbandale proposal”), to compare it with the former N-S LRT project and to review the feasibility of the implementation of Phase 1 of the Urbandale proposal, together with any suggested improvements. This is one of a number of reports that will support the staff response to the City Council motion requesting that staff review the proposal from Urbandale and report back to a joint meeting of Transportation and Transit Committees on:

- a. The appropriateness of the corridors;
- b. Recommendations on modifications of the corridors including expansion to Kanata and across the Strandherd Bridge to Barrhaven Town Centre (TC); and
- c. A timetable to undertake any additional or modification studies to implement such a network.

This Detailed Report provides details of the analysis undertaken to support the conclusions and recommendations as set out in the Summary Report. The Report is essentially a compendium of technical issues including a brief description of the issue, comments on how the issue was to be managed in the context of the former N-S LRT project, a review of the possible implications of the variation or modification proposed by Urbandale and, where applicable, the suggestion of an alternative arrangement. An importance index is also presented to give an indication of the relative influence the issue will have on the success of an LRT project.

**1.2. Glossary**

BTC	Barrhaven Town Centre
DLT	Dows Lake Tunnel
DBO	Design, Build, Operate
EA	Environmental Assessment
HPTM	High Pressure Transmission Main
LPTM	Low Pressure Transmission Main
LRV	Light Rail Vehicle
LRT	Light Rail Transit
MC	Maintenance Centre
N-S	North-South
OLC	Ottawa Light Rail Corporation (Siemens-PCL/Dufferin)
OP	Official Plan
O/P	Overpass
RFP	Request for Proposal
RR	River Road
SN	Structure Number
TC	Town Centre
TMP	Transportation Master Plan
U/P	Underpass

### 1.3. Project Staging

**Importance: High**

#### Description

The implementation of the LRT system can be staged to coincide with increases in ridership demands and available funding. This section discusses some of the options available for consideration.

#### Former N-S LRT

##### Description

The City of Ottawa had selected OLC as the proponent to design, build and maintain (15 years) the former N-S LRT system from the Mackenzie King Bridge to Barrhaven Town Centre with a probable extension to the University of Ottawa, pending E.A. approval.

##### Commentary

- The implementation timetable met the timing expectations of Council for the commencement of in-service operation in 2010 for the initial stage of the LRT system.
- The implementation timetable met the schedule expectations of the Federal and Provincial funding agencies.
- Project construction was timed to slightly lead the majority of development in Riverside South, thereby providing an incentive to those moving into the development to become more transit oriented and less reliant on automobile transportation.
- The project cost had been reviewed and value for money had been confirmed.

#### Urbandale

##### Description

The Urbandale proposal includes the following key elements, which are illustrated in more detail in Annex A, Exhibits 1-7 appended to this Summary Report:

##### Phase 1A

- Connect River Road and Bayview stations (Ex.1);
- From River Road to east of Mosquito Creek, move the LRT alignment from within the Town Centre of the Riverside South community to follow Earl Armstrong Road (Ex.2 and 3);
- Reduce the size of the Maintenance Centre (MC) (Ex.2);
- Delete Greenboro Station (Ex.4);

- Dow's Lake Tunnel to remain as a single track with signal-controlled two-way operation (Ex.5); and
- Bayview Station to be a system hub (Ex.6).

#### Phase 1B

- Extend across LeBreton Flats without a LeBreton Station (Ex.7);
- The LRT to run in a tunnel across the downtown core area. The tunnel to extend to south of the University of Ottawa (Ex.7);
- Provide a transfer station at Hurdman (Ex.7); and
- Terminate at the VIA Train station (Ex.7)

#### Phase 2

- Extend west to Barrhaven TC when passenger demand increases (Ex.2); and,
- Extend to the East and to the West.

#### Commentary

- Phase 1A is proposed for initial implementation. The Urbandale proposal has assumed funding is available, ridership will justify the business case and that only minor E.A. amendments will be required, if any.
- Urbandale recognizes that Phase 1B implementation is pending EA approval, and funding availability.
- The extension of Phase 1A, west to Barrhaven TC, is seen by Urbandale as dependent upon the development of ridership demand.
- Timetables for implementation of the Phase 2 extensions west to the 416/417 interchange, and east to Blackburn Hamlet and Trim Road have not been developed in the Urbandale proposal.

#### Alternative

##### Description

Subject to funding availability, and business case justification, construct the alignment of the Phase 1 LRT project from Bayview to either of:

- Bowesville Park-and-Ride.
- River Road Park-and-Ride.
- Barrhaven Town Centre.

Proceed with the E.A. for the downtown tunnel with east and west limits as appropriate.

Proceed with E.A for west and east extensions pending review/completion of TMP update.



### Commentary

- In order to allocate funding for the project, the Federal and Provincial funding agencies will require that the E.A approvals be in place and that the business case supports the project between the limits identified.

### Analysis

The E.A. is approved for the former N-S LRT project, thus the portion from Bayview Station south to River Road Station is eligible to proceed on the former alignment if funds are available. If this is the only portion to proceed at this time, then the ridership and business case for that section should be confirmed in support of the funding request for this undertaking.

Likewise, the E.A. for the portion of the former N-S LRT project from River Road to BTC is approved, thus that portion is eligible to proceed if funds are available. If this is added to the Bayview Station to River Road segment, then the ridership and business case for that section should be confirmed to support the funding request for this undertaking and the timing of the implementation.

If funds are not available to proceed with the entire LRT line from Bayview Station south to River Road, then following the rationale used by Urbandale for the timing of implementation of the LRT in South Nepean, the section of LRT line passing through Riverside South could be considered for deferral until ridership demand increases in Riverside South. In this case, it is suggested that an interim termination point could be established at the Bowesville Park-and-Ride station, thereby providing a collection point for Riverside South patrons pending the extension into Riverside South. In this case the ridership demand for an LRT service running from Bowesville Park-and-Ride to Bayview Station should be prepared, and a business case put forward that will support the funding request of this interim project.

The alignment for the project through Riverside South should be the former N-S LRT alignment. (See Section 3.1)

## 1.4. System Parameters Affecting Ridership - Train Frequency and Train Length

**Importance: High**

### Description

The capacity of a LRT system is a function of the number of trains per hour (frequency of train arrival), and the passenger capacity of each train. These are two of the principal parameters that combine with reliability, safety and cleanliness to affect ridership.

Train frequency is measured by the headway that is the elapsed time between two trains traveling in the same direction. A train headway that is too long will result in people having to wait longer which may result in a longer overall trip time compared to other travel choices, thus causing them to consider another form of transport. Increasing train frequency while retaining existing train length increases system capacity.

Train length is the number of "cars" that are coupled together to constitute a full train. Increasing the length of the train while retaining the same train frequency would increase capacity proportionately in relation to the number of cars in the train.

### Former N-S LRT

#### Description

The former N-S LRT was planned for variable headways to correspond to the predicted ridership. Initially, the former N-S LRT would operate with one-car trains, and add capacity when required in the future by using two-car trains. However, the downtown constraints of short block lengths and numerous driveways that could not be blocked, dictated that on-street platform lengths could not exceed 55-60m, thereby limiting ultimate train length to two-cars. When future passenger demand increases beyond the capacity of two-car trains operating at five-minute headways, more two-car trains would be placed in service thereby decreasing the headway below five minutes. The system design was based on providing for headways as low as three minutes to accommodate projected future demands. If service demand grew beyond the ability of the system to service it, it was proposed that system/network changes would be reviewed, including a tunnel option for downtown.

The former N-S LRT had a second tunnel at Dow's Lake to accommodate future headways less than five minutes, and also to allow for schedule variability due to trains operating on-street, downtown, where traffic conditions could add un-scheduled travel time.

#### Commentary

- The longer interval of 10 minutes between trains on the Leitrim - Barrhaven segment reflected the lower passenger demand, which could be served by fewer trains at up to 15-minute headways.
- The on-street design of the former N-S LRT constrained the train length to two cars, thus ultimately constraining the system flexibility. The twin tunnel at Dow's Lake allows shorter headways and any requirement for further capacity would have been met by shorter headways.

- The initial peak service period would provide five-minute frequencies north of Leirim station, where every second train would turn back to return to downtown.
- The on-street design of the former N-S LRT meant that trains would operate in a mixed street traffic environment. Interaction with the traffic flow, particularly at intersections would introduce variability in the headways between trains thereby affecting reliability of service.

## Urbandale

### Description

The Urbandale Phase 1A would have single car trains on opening day running at five minute headways between the River Road station and a terminal station at Bayview. As ridership demand increases, the train frequency would remain as five minutes and more cars would be added to the trains as necessary in order to service that demand.

### Commentary

- By stopping all trains at Bayview until a downtown tunnel was ready for service, the Urbandale proposal would avoid having LRT trains operate across downtown on the surface in mixed on-street traffic. This is an important distinction that removes the limit on train lengths in the downtown, thereby allowing train lengths to increase as passenger demand increases in the future, subject to station lengths elsewhere in the system. The Urbandale proposal would use single car trains on opening day. Urbandale asserts that the future projected ridership demands could be accommodated by utilizing longer trains without decreasing the headways to less than five minutes.
- The removal of on-street running in the downtown core means that the headways between trains could remain more constant and predictable, influenced only by street crossings in South Nepean and Riverside South.
- The Urbandale proposal further asserts that maintaining headways at no less than five minutes allows for a single-track operation at the Dow's Lake tunnel, thereby avoiding the need to twin the Dow's Lake tunnel.
- The impact that train length may have on station length and current E.A. approvals needs to be reviewed. While stations in the downtown tunnel may accommodate longer trains, the stations in the rest of the system need to be reviewed for the local impacts and costs of lengthening platforms.

## Alternative

### Description

Train Frequency (peak period): Subject to ridership and simulation studies, initial peak hour service at five-minute intervals or more frequently, based on expected ridership.

With a downtown tunnel, train length can be increased beyond the two-car train length used for the former N-S LRT project. Stations in the rest of the system would be reviewed to maximize possible length while minimizing costs

### Commentary

- This solution provides the most flexibility to the system capacity. By allowing different headways in different sections of the system, train capacity can be best matched to ridership demand, thereby minimizing operating costs. More frequent service can be achieved thereby increasing capacity and reducing total travel time. If train station lengths can be increased outside the downtown core, increased capacity can be achieved by adding more cars to a train without increasing the number of operators.

### Analysis

The former N-S LRT station platform length was constrained by the physical conditions associated with on-street operation of the downtown core and the designs in Riverside South and South Nepean. As a result the train length was limited to two cars.

There may also have been a practical limit to shortening the headway. The former N-S LRT project was planned to start up with peak period five-minute headways (north of Leirim) and 10-minute headways (south of Leirim), which could be reduced to less than three minutes as passenger demand increases. These two factors combined were expected to allow the LRT capacity to ultimately be adjusted to meet the forecasted 2031 ridership demand.

Urbandale proposes a train frequency of five minutes with single-car trains throughout the system and has a tunnel in the downtown core, which would allow the platform and train length to be increased in the future to longer than two cars. Also due to the removal of a turn back at Leirim, headways would remain the same throughout the system.

With the former N-S LRT station design, train lengths were limited to two cars.

The Alternative plan would keep the flexibility of different headways in different sections of the system to save on operating costs.

The Alternative plan would also attempt to maximize train length throughout the system. The actual length allowed would have to be studied. The maximum capacity of the former N-S LRT project (two-car trains every three minutes) was 6,000 passengers per hour per direction (pphpd). The capacity of the Urbandale proposal is constrained only by the maximum train length (e.g. a four-car train every five minutes is 7,200 pphpd). Note that the capability to operate four-car trains in the rest of the system still needs to be verified, particularly for the sections in Riverside South and South Nepean.

## 1.5. Single Track vs. Two Tracks

**Importance: Med**

### Description

Single-track operation requires the operation of trains running in both directions on the same track. This requires the coordination of schedules and appropriately placed passing tracks to allow trains to maintain their schedules to the stations. It reduces the flexibility of the system to recover from unscheduled events and to increase capacity by increasing train frequency. The benefit of single-track operation is that it can defer costs in the initial construction phase when train headways are less frequent.

### Former N-S LRT

#### Description

Two Tracks: Downtown to MC (including DLT).

Single Track: MC to BTC (with passing sections).

#### Commentary

- The former N-S LRT project added a second tunnel to provide two tracks at Dow's Lake. This was required to accommodate three-minute headways in the future, and allowed for flexibility of the system to recover from unscheduled events. This was an important requirement with a surface operation in the downtown core.
- Single track with strategically located two-track sections was proposed between the MC and BTC as a means to substantially reduce some of the initial capital investment. During the initial phase of operation, 10-minute headways could be serviced by some strategically located single-track sections.

### Urbandale

#### Description

Although the Urbandale proposal does not specifically address track requirements throughout the corridor the proposal states that the basic N-S alignment (as per the former N-S LRT above) is used for Phase 1A. However, discussions with the Urbandale system designer confirmed that the intent was to "Twin Track" throughout from Bayview to RR, with the sole exception being the single track at the DLT.

## Commentary

- Urbandale has stated that the reduction of the DLT to a single track will not impact operations. This is claimed to be possible as a result of less variability in the headways of trains due to a (future) tunnel operation for downtown rather than surface operation.
- Urbandale has also proposed two tracks from the MC to RR, with five-minute headways.

## Alternative

### Description

Two Tracks: Downtown to MC (DLT to be reviewed).

Single Track: DLT and MC to River Road (with passing sections); To be simulated and reviewed for cost with the possibility of adding two tracks now based on business case.

Single Track: River Road to BTC (with passing sections).

### Commentary

- See the foregoing discussion regarding the DLT. With further simulation it can be determined whether single track from the MC to River Road would meet business case requirements. It is expected that there should be no requirement to provide two tracks west of River Road at this time, but this also needs to be simulated.

## Analysis

The number of tracks proposed in the former N-S LRT and the Urbandale proposal are similar, with the exception of the DLT (see the discussion under that factor) and the single versus the two tracks between the MC and RR. Single track does introduce a constraint into the system. A delay to a train in one direction will create a delay for a train in the other direction. This can impact on system reliability. Thus when compared to the former N-S LRT project, the Urbandale proposal may be somewhat constrained as a result of trying to run five-minute headways on single track through the DLT.

Simulation will also assist in the determination of the influence the system operation will have on the variability of train headway and thus the ability/requirement to operate single-track grade crossings and intersections along the LRT system in either a "pre-empt" mode (LRT has absolute exclusive priority), or "priority" mode (LRT receives an exclusive window within the programmed schedule of intersection traffic control signal indications). The impacts on the operation and overall capacity of the subject intersections need to be included in the assessment of the simulation results.

To assist making decisions, the simulation should include consideration of the extension to BTC to confirm the impact single track versus two-track operation would have on this section, and conversely, its impact on the rest of the system operation.

Ridership is one of the principal factors in determining the need for two tracks. On the basis of the ridership forecasts for the former N-S LRT project, neither the section between the MC and RR, nor from RR to BTC appear likely to require two tracks for some time.

Two tracks add an element of reliability over single track, providing redundancy that can minimize the effects of ongoing maintenance work on LRT operation, and providing an increased ability to deal with catastrophic events such as a collision or vehicle breakdown on one track.

Another factor for consideration is that when a single-track section is later twinned, there are operational restrictions during the construction period (typically “go slow” orders). This will have a temporary detrimental impact on LRT operations.

The Urbandale proposal for twinning the track between the MC and RR introduces service improvements at added cost over the single track proposed in the former N-S LRT. The previous assessment as part of the former N-S LRT project indicated that adequate service could be achieved using single track at 10-minute headways, so the combination of two tracks and five-minute headways as proposed by Urbandale would most certainly provide service levels in excess of those required at the initial system start up. Even two tracks with an increase in headways from five minutes to 10 minutes would be ample service, and would provide redundancy in the event of breakdowns, maintenance, etc. which the single track does not provide.

Regardless of the plan selected, a business plan analysis should take into account options for single versus two tracks (the cost of adding a second track is less than double the cost of a single track) to assist with the final decision as to the preferred alternative.

## 1.6. O-Train Shutdown

**Importance: Med**

### Description

During the construction of any of the alternatives suggested, the existing O-Train would have to be shutdown.

### Former N-S LRT

#### Description

The O-Train operation was to be shut down in the spring of the first construction season. Train service would resume with the in-service operation of the new LRT system three years later.

#### Commentary

- Due to the amount of construction in the corridor and especially at the Dow's Lake Tunnel and nearby rock-cut it was planned that the O-Train would be shut down for the entire construction period.
- OC Transpo had prepared a contingency plan that was to be put into place to provide a bus service in place of the current O-Train service until commencement of the LRT service.

### Urbandale

#### Description

The Urbandale proposal says that the O-Train shutdown interval is expected to be considerably reduced due to the elimination of the second tunnel construction under Dow's Lake.

#### Commentary

- The Urbandale proposal for a short duration shutdown of the existing O-Train service relies on the assumption that the existing tunnel could be quickly waterproofed using injection-grouting techniques, and no new tunnel would be constructed under Dow's Lake. There are however, other factors that would constrain the continued operation of the existing O-Train.
- The Rideau River Bridge at Carleton University requires major maintenance work, which involves the removal of the deck and piers and their reconstruction, complete with two new electric LRT tracks. An active rail line cannot be operated while this work is undertaken. The civil works will require two construction seasons to complete. If the desire is to maintain O-Train operation, then a study is required to look at construction options or alternate alignments for a new bridge. The south end of the existing structure connects to a very narrow corridor through the NCC's adjacent Vincent Massey Park, making alternate alignments impossible to attain without impacting the Park.



- From time to time it has been suggested that the O-Train could continue to operate between Bayview Station and the Carleton University Station while the construction takes place on the Rideau River structure. The existing maintenance facility for the O-Train is currently located at the former Walkley Rail Yard. The Rideau River structure is between Carleton University and the Walkley Yard, so when the bridge is under construction the existing O-Train would not be able to access the maintenance yard from north of the Rideau River. Alternate maintenance facilities would be required. None currently exist along the balance of the existing O-Train line. Potential alternate maintenance services elsewhere would require service agreements, and construction of temporary track work to access an alternate facility from the existing O-Train line.
- The rock cut immediately north of the existing Dow's Lake Tunnel needs to be widened in order to accommodate twinning of the track. Drilling and blasting would be the quickest and most efficient way to remove the rock. The fractured rock will fall on the existing rail lines. That work would take at least one construction season to carry out. This work is incompatible with active train operations.
- New grade separations are to be built at the two locations where the existing O-Train line crosses other active railway lines (VIA and Ottawa Central). This will eliminate the interference to LRT and rail timetables created by the passage of freight and passenger trains. The existing diamond crossings will be decommissioned and the O-Train track through them removed. This work is on and adjacent to the existing O-Train corridor, and will require shutting down the O-Train and/or slow order running rules for the approximately two year duration of construction of these bridges.
- Commissioning of the new operating system with the new trains on the new track will take approximately 9 months. Operation of the existing O-Train on the new tracks while trying to implement the new system creates safety concerns and added liability issues for the system installers and operators. These issues translate into time and dollar costs to pay for the increased risks that the contractor would be responsible to handle in this situation.
- There would also be additional costs to keep the O-Train available during the two to three years of construction prior to the commissioning of the new operating system. Protection measures and flag persons would be standard requirements through the areas of active construction.

## Alternative

### Description

The O-Train shutdown period would be the same as with the former N-S LRT project. At the start of construction the O-Train would have to be taken out of service and would be replaced by the LRT. Interim bus service during construction would be provided by OC Transpo bus service.

### Commentary

- The actual timing of this shutdown will depend on the full construction schedule, but there is unlikely to be any significant improvement on the originally planned shutdown.

## Analysis

The Urbandale proposal focused on the construction activity in the Dow's Lake Tunnel only. There is a significant amount of work that has to be done elsewhere in the O-Train corridor during this same period. As a result there are no apparent practical alternatives except for shutting down the O-Train from the start of construction to the end of commissioning of the new LRT.

There are other construction activities that will require the O-Train to be shutdown for the duration of the project to be able to cost effectively build the system. These include:

- Rideau River bridge construction and therefore access to the maintenance facility;
- Widening of the rock-cut north of the DLT;
- Grade separation at two separate active railway crossings (VIA, Ottawa Central);
- Testing and commissioning of the new operating LRT;
- Track replacement from single track to two tracks (outside of DLT) and related switches, traction power signals and communications systems.

## 1.7. Fleet Size (Number of Trains)

**Importance: High**

### Description

For the sake of this description a car is the smallest indivisible self-functioning unit. A train is a combination of cars hooked together in one assembly. For the purpose of this analysis it will be assumed that trains have only one car unless otherwise stated.

### Former N-S LRT

#### Description

BTC to Ottawa University;

TOTAL TRAINS; 22.

18 in peak period service;

4 spares to allow for Maintenance/Crash/Hot Standby.

#### Commentary

- The downtown surface operation required an adequate number of trains due to variability of service in the downtown core, the length of travel time in the downtown core and the requirement to have standbys available to replace trains that may be disabled due to incidents or malfunction. There would be a higher risk of traffic collisions in the downtown, compared to the exclusive LRT track elsewhere in the N-S corridor.

### Urbandale

#### Description

Phase 1A; River Road to Bayview;

TOTAL TRAINS; 18.

17 in peak period service;

1 spare to allow for Maintenance/Crash/Hot Standby.

Phase 1B - River Road – VIA Station

TOTAL TRAINS; 23.

22 in peak period service;  
1 spare to allow for Maintenance/Crash/Hot Standby.

### Commentary

- When compared to the former N-S LRT project, Phase 1A of the Urbandale proposal has reduced the number of trains by four to 18, by removing one due to system length and headways, and making provision for only one spare train to allow for maintenance/crash/hot standby.
- In Phase 1B the Urbandale proposal has increased the number of trains by five to 23 to provide the extended service through downtown to the VIA Train station.
- As one vehicle will likely be in maintenance at any given time, having no hot standby or crash spare gives no flexibility to respond to unscheduled events. The occurrence of such an event would immediately impact system availability.
- The possibility of collisions would be reduced with tunnel operation in the downtown core, but the possibility still exists due to the number of at-grade crossings in the rest of the system.
- The 22 trains identified to service the operation at five-minute headways appear to be higher than required. A simulation study is needed to verify the number of trains required for this length of system.

### Alternative

#### Description

##### Phase 1A; River Road to Bayview;

TOTAL TRAINS; 16.  
13 in peak period service;  
3 spares to allow for Maintenance/Crash/Hot Standby.

##### Phase 1B; River Road to VIA Station;

TOTAL TRAINS; 22.  
19 in peak period service;  
3 spares to allow for Maintenance/Crash/Hot Standby.

##### BTC to Bayview

TOTAL TRAINS; 18.  
15 in peak period service;

3 spares to allow for Maintenance/Crash/Hot Standby.

### **Commentary**

Similar to the Urbandale proposal, the Alternative proposal would reduce the number of standby units compared to the former N-S LRT project. However, the Alternative plan follows a more cautious approach. Discussion with other Transit Authorities has reinforced concern about such a reduction. A decision in this regard should not be taken until there has been a thorough analysis of the technology being provided, the project requirements, and a comparison to similar operations elsewhere.

### **Analysis**

The former N-S LRT project required an increased fleet size to allow for downtown operation. The Urbandale proposal removed the hot standby and crash spares and made minor reductions for transit spares.

The Urbandale system designer stated that the assumptions for the number of trains was likely greater than needed as he did not have access to the OLC simulation.

The alternative proposal estimates 6 fewer trains for the River Road to Bayview service as compared to the former N-S LRT service from BTC to the University of Ottawa. Once a detailed simulation analysis can be performed, the fleet size for various alternatives can be verified. .

## 1.8. Structures

**Importance: Low**

### Description

This section identifies major City structures along the LRT corridor which are currently undergoing maintenance, are scheduled for maintenance, or may be of interest for future maintenance depending on the detailed designs for the selected LRT line.

### Former N-S LRT

#### Description

The City of Ottawa had selected OLC to design, build and maintain (15 years) the N-S LRT project from the Mackenzie King Bridge to Barrhaven Town Centre with a probable extension to the University of Ottawa, pending E.A. approval. Detailed structural designs would have been prepared for all structural work as part of the project.

#### Commentary

- The supplementary structure renewals, incorporated into the 2006 budget and intended to proceed with the former NS LRT project are now proceeding through design and construction and will be completed by 2007 and 2008.
- Reconstruction of the O-Train bridge over the Rideau River at Carleton University (SN 015290) is not proceeding. A major renewal investment is required and the plans for the O-Train need to be better articulated prior to making a major structure renewal investment now that the Project Agreement for the N-S LRT project has been terminated.
- The Booth St O/P Open Aqueduct (SN 017030) is not currently proceeding beyond scoping work, for the same reason as the O-Train bridge at Carleton University. The former N-S LRT project had the Booth St O/P Open Aqueduct and Booth St O/P LRT/West Transitway bridges as part of the scope, with the existing Booth Street stone masonry bridge over the Aqueduct being converted to pedestrian-only use. The structure renewal scope of work would be much less costly as part of a conversion to pedestrian use, than if road traffic needs to be accommodated during structure renewal and continued use as a road bridge.
- Rideau River Bridge – see relevant section in this report.

### Urbandale

#### Description

The Urbandale proposal for Phase 1A would interface with the same structures as the former N-S LRT project, plus the existing crossing of Earl Armstrong over Mosquito Creek. For Phase 1B (the downtown

tunnel and extension to the Via Station) as well as Phase 2 (the extensions west and east) the proposal needs to be identified at least to a preliminary design level in order to determine interaction with existing structures.

### Commentary

- The existing bridge over Mosquito Creek on Earl Armstrong Road between Limebank Road and Bowesville Road would be affected by the Urbandale submission.
- Impacts on existing structures in the West Transitway and Central Area Transitway / East Transitway/South East Transitway will be limited if the buses and the LRT vehicles run on the same existing lanes. All structures supporting the buses have been designed to support LRT vehicles. Should another set of lanes be added to the structures to allow independent side-by-side lanes, and then all structures will need to be widened. That applies to structures supporting the rails and those passing over them.
- The drawings for the SE Transitway O/P Rideau River (SN 013010) and the Single & Twin Box Culverts under the West Transitway (SN 018230-1&2) were examined. The former N-S LRT project information indicates that the structures were designed for future asphalt wear surface with waterproofing, concrete pads & rails, & Transitway loading [Rail] TD-C-09. The box culverts were designed for future rails in each direction.
- Existing and planned structure renewal work in the Mann Ave. to the VIA Train Station transitway corridor are as follows;
  - - SN 016950 - Mann Ave. - Expansion joint renewal;
  - - SN 014010 - CA Transitway U/P Queensway - no work planned in next five yrs.;
  - - SN 016050 - CA Transitway U/P Lees Avenue. - Renewal scheduled for 2013;
  - - SN 013010 - CA Transitway O/P Rideau River - no work planned in next five yrs.;
  - - SN 056650 - E Transitway O/P Riverside Dr. - no work planned in next five yrs.;
  - - SN 056660 - E Transitway U/P Train Station Access Road - renewal contract in progress;
  - - SN 059850 - Train Station Pedestrian Bridge - renewal contract in progress;
  - - SN 056670 - E Transitway U/P Train Station Access Road - renewal contract in progress.

### Alternative

#### Description

Structural design work should be included as a part of any design that goes forward for an LRT project.

### **Commentary**

- Structural work will be required subject to alignment and traffic loading for whichever LRT project moves forward. That work should be incorporated in the LRT project in order to maximize cost savings and optimize scheduling.

### **Analysis**

Analysis will be undertaken for the selected alignment.



## 1.9. Utilities

**Importance: Med**

### Description

Significant effort is required to relocate the existing underground utilities that are installed along the existing rail corridor from Bayview to Bowesville in order to make way for the installation of the second track. Relocation work from design through to completion is expected to take approximately a year to accomplish, subject to readily available replacement plant materials and qualified labour. The conduits are mounted on the walls of the existing Dow's Lake tunnel, and are attached to the existing Rideau River Bridge.

### Former N-S LRT

#### Description

The former N-S LRT project team was in the process of negotiations with all of the utilities along the corridor in order to prepare for the relocations.

#### Commentary

- It had not been resolved if the cost of these relocations would be shared between the City and the utilities or if the potential legal action by the utilities would result in the City paying all costs. After the former N-S LRT project was terminated, the City paid the utilities for all their planning and coordination costs, without prejudice, up to the point of the termination of the project agreement.

### Urbandale

The Urbandale design does not allow for the cost of changes to existing underground utility conduits, primarily communications plant, running along parts of the rail corridor.

#### Commentary

- The Urbandale report gives the impression that there will be no remaining utility relocation costs. This is not the case as there may be utility costs for the following areas: downtown tunnel portal accesses, downtown station access, changes in LeBreton Flats, in the corridor from Bayview to Bowesville, at the Maintenance Centre and other utility crossings beyond Bowesville. A sample listing of the types of utility issues that need to be checked in detail is as follows:
  - Sewer issues at Prince of Wales;
  - Overland storm drainage routes;
  - Mosquito Creek Crossing at Earl Armstrong Road;

- Storm drainage at Sawmill Creek.
- Bayview station:
  - HPTM watermain crossing of LRT corridor is scheduled to begin this fall (tender closes Friday Sept 07th – completion 15th of May 2008);
  - Crossing of the Mooney's Bay Collector at old Wellington Street. There is a dip in the Mooney's Bay Collector at the LRT crossing that needs to be addressed;
  - Overall there is a master servicing study being undertaken for this area.
- LeBreton Flats – There is large infrastructure crossing LeBreton Flats including:
  - The Low Pressure Transmission Main (LPTM);
  - High Pressure Transmission Main (HPTM);
  - The Cave Creek Collector;
  - West Nepean collector;
  - Preston Street Trunk Sewer;
  - Ottawa Interceptor Outfall Sewer;
  - Aqueduct;
  - Fleet Street Pumping Station;
  - Telecommunications Joint Use Trench;
  - Bell Canada has duct system within the Albert St. right-of-way;
  - Enbridge Gas crosses at the Booth Street Bridge;
  - Hydro Ottawa/Hydro One.
- The potential portal location identified in the Urbandale proposal raises concern due to the proximity to the Ottawa Interceptor Outfall Sewer. This sewer is at a depth of approximately 14 m at Fleet Street. There is a large ventilation stack at the intersection of the extension of Bronson and Sparks Street that would be potentially impacted.
- Across the downtown core there are major infrastructure installations in the public right-of-way. A detailed review of the infrastructure impacts due to the tunnel construction and the shaft locations will have to be undertaken once more detailed information is available. The deepest infrastructure will be the sewers that may be impacted by the tunnel depth; other infrastructure may only be impacted when the tunnel comes to surface.
- The Rideau Canal Interceptor (1950mm) sewer runs along the west side of the Rideau Canal. It is at a depth of approximately 15m;
- There is a 400mm watermain running along Colonel By Drive which crosses the canal as a 762mm feeder main just south of the Laurier Bridge;
- There is a 508mm watermain crossing the canal at Somerset;
- There is a 1800mm brick combined sewer at the extension of Lewis St.;

- The 1220 feedermain which feeds Orleans crosses the transitway just north of Lees Avenue;
- The Rideau River Interceptor Combined Sewer crosses the Transitway just north of the Rideau River;
- The Rideau River Trunk Sanitary Collector crosses the Transitway at Hurdman Station;
- There is a 914mm watermain running along the Transitway east from Hurdman that crosses the Transitway just west of Riverside;
- A 750mm sanitary sewer crosses the Transitway west of Riverside.

### **Alternative**

Proceed with negotiations with utility companies to carry out relocations as appropriate once the selected alignment is identified.

### **Analysis**

Full consideration was not given to the remaining utility costs in the Urbandale proposal.

## 1.10. Property

**Importance: Low**

### Description

In order to complete the LRT project, all property rights must be obtained by the City for the complete corridor, stations and Maintenance Centre. There are also additional requirements to obtain easements for property required for construction access.

### Former N-S LRT

#### Description

All property requirements had been identified and were in the process of being acquired.

#### Commentary

- There are some parcels that have yet to be purchased or leased, notably those under the control of Federal agencies. In order to proceed with any project along this corridor, negotiations would have to recommence, and each agency would have to proceed with their respective processes for release/use of the Federal lands. Typically this will take approximately one year of processing before consent can be obtained to occupy the land. Except for the lease required for the Maintenance Centre and adjacent track in the corridor through the Airport lands owned by Transport Canada, all of the properties have been acquired for the former N-S LRT alignment through Riverside South.
- Property negotiations remain to be completed for the extension of the LRT from Woodroffe Station to Barrhaven Town Centre.

### Urbandale

#### Description

The Urbandale proposal would require less land to be acquired for the Dow's Lake Tunnel, but may increase the requirements for acquisition in the LeBreton area and Riverside South.

#### Commentary

- The full property impacts of the Urbandale proposal would have to be addressed once the exact alignment was determined. If a single track within the Dow's Lake Tunnel is adequate, reduction in the land use impact during construction at the Arboretum at the Experimental Farm may be realized. A significant concern was the required relocation of many "dedicated" trees.

- The impact in the LeBreton area can only be evaluated after the alignment is confirmed. That matter may be influenced by the track alignment at Bayview Station and the tunnel portal location for a downtown tunnel. Thus the Downtown Tunnel Study has to be completed so that the actual land use requirements across LeBreton Flats can be identified.
- Land requirements along Earl Armstrong Road can only be determined after a preliminary design is completed. Some consideration may have to be made for space for stations and the support facilities.
- A consideration when assessing the tunnel option downtown is the required property. If the tunnel strays outside of the vertical projection of a street right of way, then property may be required either through acquisition or an easement as appropriate. This would apply to the tunnel, the stations, the access points to the stations, etc.

## Alternative

### Description

Proceed with negotiations with property owners to acquire ownership or easements as applicable once the selected alignment is identified.

### Analysis

The former N-S LRT had an acquisition plan for all of the required properties. The Urbandale proposal would likely require some extra property in the Riverside South area for the LRT line and stations, and might require extra property in the LeBreton area and downtown. As the LeBreton area is suggested to be part of the Downtown Study, this is not expected to affect the schedule. However, any acquisition required along Earl Armstrong Road might affect the project schedule.

If the Earl Armstrong Road alignment becomes the selected option, there may be an opportunity to exchange the former N-S LRT corridor for lands required along the Earl Armstrong Road alignment.

## 1.11. Approvals

**Importance: Low**

### Description

Prior to commencement of construction there are many approvals required from a variety of agencies.

### Former N-S LRT

#### Description

Approval requirements had been identified and some were in the process of being obtained while others were pending further details of the design by OLC before processing of an application could commence.

#### Commentary

- The former N-S LRT project had received Provincial and Federal E.A. approvals (except for the extension to the University of Ottawa, and the site for the Maintenance Centre, both of which were in progress), and applications for the design and construction approvals had commenced. These latter approvals from the governing agencies would have to recommence, and each agency would have to re-establish their review teams and familiarize themselves with the proposal. It is estimated that the initial review processes required prior to commencement of construction would take approximately one year.
- An overview of the types of approvals that remain and the extent of agency involvement is as follows;
  - Federal land use approval would be required for the federal lands associated with the project;
  - The E.A. addenda currently on file with the Ontario Ministry of the Environment as it applies to the extension to the University of Ottawa and the site for the Maintenance Centre need to be processed.
  - The archaeological investigations within the corridor need to be recommenced and completed;
  - Various environmental investigations – fish, wildlife, flora, etc. need to be finalized;
  - Several Federal Agencies require detailed plans for review and sign-off prior to commencement of construction;
  - Detailed design decisions (such as those for traffic control signal integration for pre-empt versus priority intersection control), and circulations need to be undertaken at the City for review and sign-off prior to commencement of construction;

- A regulatory regime (federal or self-regulated) must be established for the operation of the LRT system. Resolution of this issue within a one-year horizon may be optimistic;
- Railway regulatory agencies require design review and sign-off, or agreements put in place to delegate that approval authority to the City;
- Agreements need to be enacted with the railway companies to arrange for changes to the existing railway crossings. This includes rescinding existing Board Orders and preparing new Board Orders with Transport Canada;
- An agreement needs to be put in place to address rail service to the NRC facility via the LRT line from the Walkley Yard to just south of Lester Road;
- A new business case would need to be prepared and submitted for Funding Agencies to confirm value for money;
- The “design-build” aspect of the former North-South LRT project foresaw a staged approval process with some construction, for example clearing and grubbing, proceeding while the approval process for the final detailed design, of say a structure, was being carried out. This is feasible; however, it appears that some agencies may be reluctant to proceed in this manner. They may insist on final design plans prior to granting their approval. In this case additional time may be required before construction may commence.

## Urbandale

### Description

The Urbandale proposal does not address the matter of approvals directly, although it is mentioned that for Phase 1A the, "...preliminary design and field work (are) already completed."

### Commentary

- It is anticipated that the Urbandale proposal would require the same design and construction approvals and approval processes as those for the former N-S LRT project, as well as an E.A. approval for the downtown tunnel, the extension to the VIA Station and the East and West LRT extensions envisioned in Phase 2 of the proposal. Furthermore, either an E.A., or an E.A. Addendum, would be required for the Earl Armstrong Road alignment.
- The Urbandale proposal would probably trigger revisions to the Riverside South Community Design Plan. This would involve amendments to the TMP and OP.

## Alternative

All design, construction and regulatory approvals must be obtained in accordance with agency requirements prior the commencement of construction. Acquisition of these approvals is estimated to take one year. If an LRT project is initiated, all applications for approvals should be re-commenced.

## Analysis

The same basic design and construction approvals are required for either the former N-S LRT project or the Urbandale project. Upon initiation of an LRT project, applications for approvals should commence.

The Urbandale alignment will trigger E.A. or E.A Addendum requirements for alignment options that differ from the former N-S LRT alignment. These requirements could add one to two years to the project schedule.



## 1.12. Development Potential

**Importance: Med**

### Description

Construction of the former N-S LRT project was expected to be a catalyst to generate transit supportive development particularly at station nodes along the alignment.

### Former N-S LRT

#### Description

The development industry showed an active interest in participating in the construction of some of the stations along the N-S LRT corridor.

#### Commentary

- Memoranda of Understanding (MOU) had been signed (but have since lapsed) for construction of integrated developments with the LRT station/platforms at:
  - University of Ottawa;
  - Carleton University; and,
  - Walkley Road.
- Discussions/negotiations were underway (but ceased when the former N-S LRT project was terminated) for undertakings to incorporate development/station/platforms at:
  - Bayview; and,
  - Arts Court.
- Developer interest had been expressed (but no follow-up was carried out after the former N-S LRT project was terminated) to begin discussions regarding potential for development/station/platforms at:
  - Gladstone; and,
  - Carling.

### Urbandale

#### Description

The Urbandale proposal alludes to development only to say, "Incremental growth of the network coverage...will be provided to facilitate urban growth linked to transit availability."

## Commentary

- The alignment of the Urbandale proposal passes through or near the same locations of interest to the development industry as those of the former N-S LRT project. It is expected that there would be the same interest in re-energizing these development proposals if an LRT project was activated.
- The limits of the Urbandale proposal go beyond that of the former N-S LRT project and so have the potential to generate additional developer interest at new locations.
- The alignment of the Urbandale proposal through Riverside South follows Earl Armstrong Road and would not penetrate the town centre area that is intended for high-density development. This would likely result in less opportunities for development particularly for transit-supportive development in Riverside South.

## Alternative

### Description

Upon activation of an LRT project, re-establish contact with all interested developers and renegotiate MOUs for station developments.

## Analysis

Upon initiation of an LRT project, whatever the alignment, active negotiations should be entered into with the development industry to foster development at and around station locations.

The limits of the Urbandale proposal go beyond that of the former N-S LRT project, and so, have the potential to generate additional developer interest at new locations. An anomaly is the Riverside South alignment, which bypasses the town centre area that is intended to be high-density development.

In light of the termination of the former N-S LRT project, it is anticipated that developers may be reluctant to initiate active discussions regarding development plans for stations until after construction has commenced. Any new Project Agreement for should have a provision for a station that has had a development agreement signed, with an appropriate renegotiation for the LRT elements of that station, which remain part of an LRT project.

## 2. Barrhaven

### 2.1. River Road to Barrhaven

**Importance: Med**

#### Description

This discusses the alignment and timing of the section from River Road to Barrhaven Town Centre.

#### Former N-S LRT

##### Description

In the former N-S LRT project, the LRT line in Barrhaven was a single track, with passing tracks appropriately located so that LRT vehicles going in opposite directions could pass each other and timetables could be maintained. Headways were set at 10 minutes. Simulations were used to determine that a 10-minute headway would be feasible. The proposed design would accommodate this and possibly as short as a 7.5-minute headway.

##### Commentary

- By providing LRT service through to the Barrhaven Town Centre, a network link would be made between LRT service and the existing BRT service on the SW Transitway, which will be extended from Fallowfield to the Barrhaven TC, connecting the two communities of Riverside South and Barrhaven so they can share facilities. Also, patrons could easily and conveniently transfer from one mode to the other when traveling to destinations located along either corridor. This would enhance the appeal of public transit leading to increased ridership.
- Upon commencement of the detailed design, an effort may have been made to flatten the curve around Nepean Woodlot to increase operating speed. An added benefit would be to minimize the potential for wheel squeal.
- Previous ridership projections indicated that 10,000 to 15,000 riders/day could be expected by 2011 and 2021 respectively if the headway was reduced to five minutes.

#### Urbandale

##### Description

Note that the Urbandale drawing shows the alignment in a different location than they had intended. The designer has advised that they had intended no change from the former N-S LRT alignment.

The extension from River Road to Barrhaven would be done as part of the Phase 2 work as shown in the Urbandale proposal.

## Commentary

- Transit riders in Barrhaven would use shuttle bus services, or park-and-ride linkages to connect to the LRT at River Station during Phase 1A and 1B of the Urbandale proposal.
- The timing of the installation of the LRT may have an impact on the South Nepean Town Centre Study, and may be guided by recent/ongoing developments such as Chapman Mills.

## Alternative

### Description

City Council could consider the option of constructing from Bayview to Barrhaven Town Centre as part of an initial LRT project, using the single-track design as per the former N-S LRT project.

### Commentary

- The headways should be reviewed, in conjunction with the short turn locations, to see if appropriate service is being given to this area of the system, and to determine the appropriate mode of LRT operation – pre-emption or priority - through the neighbourhood intersections.
- Ridership projections may require revisions if the downtown extension to the VIA Station is factored into the business case.
- A mention has been made of terminating the LRT line at the Woodroffe Park-and-Ride terminal. LRT/BRT transfers between Woodroffe and Barrhaven Town Centre would be via bus service between the two. While this is functionally possible, it is seen as degraded service, introducing undesirable transfers that would lead to lower ridership.
- Another variation would be to build the Woodroffe Park-and-Ride now, without LRT service, and use buses to transfer people across the Strandherd Bridge to the River Road LRT station. This would provide a less attractive service, not likely to interest as many riders as an LRT continuing to Woodroffe.

## Analysis

The only technical difference between the Urbandale and the former N-S LRT plans between Barrhaven Town Centre (TC) and Prince of Wales Drive is the proposed headway - 10 minutes for the N-S LRT and five minutes for the Urbandale proposal. Otherwise the sole difference is in the timing of construction. This section was to be built as part of the initial implementation of the former N-S LRT project, whereas with the Urbandale proposal this would be built at a later date as a Phase 2 of the LRT implementation. It is understood that the Urbandale proposal is to run along the south side of Strandherd Road west of the Strandherd/Armstrong Bridge, as proposed for the former N-S LRT.

As with the former N-S LRT project, the option exists to implement the LRT to BTC to allow for direct LRT service to be extended to this community. The decision to proceed or not can be guided by the results of the simulation and ridership studies which will assist in assessing the cost effectiveness of building this section of the system as part of the base project.

If the LRT does not go to Barrhaven initially, then consideration needs to be given to providing bus service from Barrhaven to the nearest LRT station. The impacts and costs for that operation should be considered in the business case assessment to assist in the decision whether or not to proceed with the construction of the LRT through to BTC.

The timing of the installation of the LRT may have an impact on the South Nepean Town Centre Study, and may be guided by recent/ongoing developments such as Chapman Mills. Coordination with development studies and plans is a necessity.

Funding for the former N-S LRT project was approved with the extension through to BTC. Funding provisions should be verified if a shorter project is considered initially.

## 2.2. Strandherd / Armstrong Bridge and Adjacent Intersections

**Importance: High**

### Description

The transportation network for the southern area in Ottawa relies on the construction of the Strandherd/Armstrong Bridge to link the two communities of Barrhaven and Riverside South in order to service regular day to day traffic demands such as recreational, commuter, commercial, etc. crossing the Rideau River. It will provide needed relief to the over-burdened Manotick Bridge crossing. At the time of the former N-S LRT project, the estimated cost of the Bridge was \$42M, which included \$6M for LRT components on the bridge. Construction of the bridge is currently identified as an individual undertaking with provision for transit-only lanes as part of the City's ongoing capital works program.

The E.A. for the former N-S LRT project envisioned that at some future date the volume of traffic using the Strandherd/Armstrong Bridge and adjacent intersections might increase to the point where it would adversely impact LRT operation. Likewise, general traffic operations will be compromised by the limited capacity. Therefore additional lanes and grade separations of the LRT at the adjacent intersections would be needed. A second future LRT-only bridge was proposed when traffic/transit operations require it, together with LRT grade separations under River Road and over Prince of Wales Drive. The separation of the LRT line from the cross street traffic and intersections at each end of the bridge would provide improved service along this link of the LRT line.

### Former N-S LRT

#### Description

Initial: Integrated bridge, to carry LRT (on south side) and traffic lanes;

Future: Second bridge for LRT only, with LRT tracks removed from first bridge in order to provide two additional general service traffic lanes;

Utilities at River Road: Allow for future bridge (LRT under River Road).

#### Commentary

- The OLC design for the Strandherd/Armstrong Bridge was progressing through the approval process with the NCC and Parks Canada until the former N-S LRT project was terminated. During meetings with those agencies, it was mentioned that a second bridge would require particularly careful attention to the design in order to achieve aesthetic qualities in keeping with the Rideau Canal as a World Heritage Site. Detailed design presentations would be required at that time, just as with the first bridge.
- As part of the development construction in Riverside South, the underground utilities in the vicinity of River Road were to be designed in a manner to accommodate the potential future underpass of the LRT line beneath River Road.

## Urbandale

### Description

Initial: Integrated bridge, with separate LRT lanes (possible in the centre);

Future: No change;

Utilities at River Road: Do not allow for future bridge (LRT under).

### Commentary

- Urbandale has provided no rationale for not needing the second dedicated LRT crossing in the future. As there currently is no future second bridge planned, Urbandale has proposed that the underground utilities in the area of River Road not be designed to accommodate the second bridge.

## Alternative

### Description

Initial: Integrated bridge, shared multi-modal (LRT optional);

Future: One grade separated dedicated LRT crossing; the other shared multi-modal (not LRT);

Utilities at River Road: Review for cost impact and location and likelihood of interference with future crossing. The financial impact of not considering implementing a change to the locations of underground utilities as part of the initial installation needs to be assessed.

### Commentary

- The provision for a future expansion of the capacity of the Strandherd/Armstrong crossing should be retained. This includes the separation of the LRT onto a dedicated, grade separated (from River Road and Prince of Wales) crossing. At the time of requirement the various options should be considered.
- It is proposed that underground utility services beneath River Road be designed to address the current roadway and LRT profiles, and that it be recognized that these utilities may require some alterations/relocations in the distant future if it is decided to proceed with changes to the LRT line. The cost impacts of planning for this work need to be considered against the likelihood of interference with the future Rideau crossing.

## Analysis

The Urbandale proposal does not provide support for the statement that a second future LRT-only bridge will not be required. It would be prudent as approved in the E.A. for the N-S LRT project to maintain the opportunity for capacity expansion of the Strandherd / Armstrong crossing of the Rideau River. The method of accomplishing this will likely be determined at a later date and will be subject to full federal approval. As a result it is proposed that the utility design changes required to protect for a future LRT-only bridge be reviewed

to determine the cost trade-offs of installing the utilities accordingly now versus the likelihood that there will be interference with future construction.

In the initial stage of the Urbandale proposal there would be no LRT service across the Strandherd/Armstrong Bridge. Therefore, the issue of traffic capacity versus LRT priority at the intersections on either side of the bridge at River Road and at Prince of Wales Drive would not be a concern. The introduction of LRT onto the bridge at a later date in order to provide service to BTC will understandably have implications on traffic capacity at that time due to the implementation of either priority or pre-emption traffic control signal operation, and protection gates.



## 3. Riverside South

### 3.1. Riverside South Alignment

**Importance: High**

#### Description

This factor reviews the alignment of the LRT in the Riverside South corridor.

#### Former N-S LRT

##### Description

The former N-S LRT plan followed a route through the Riverside South community, including the Town Centre area with proposed and approved higher-density development patterns, rather than following the planned arterial roads. Initially, the N-S LRT was to operate with two stations, at Spratt Road, and at River Road, the latter including a Park-and-Ride facility. Provision was made in the future for a total of 9 stations from River Road to Bowesville inclusive.

##### Commentary

- The former N-S LRT alignment was planned in conjunction with the Community Design Plan for Riverside South, with the objective of providing stations in the areas of highest planned density. This would allow the greatest number of riders to be able to walk to the stations. This is considered as a great benefit to the community and an incentive that would lead to increased transit ridership.
- Two stations were to be in operation at the start of revenue service (River Road and Spratt West). More station locations were identified for future implementation to provide the "walk-in" service to the people in the fully developed (future) Riverside South community. While this would result in slower speeds with potentially greater variability in travel times on the LRT corridor, it would provide for greater direct access to the line and may reduce the door-to-door travel times for these patrons thereby increasing ridership for the immediate service area. Conversely, slower transit speeds could negatively impact ridership for patrons traveling through this area from elsewhere on the LRT line. It is recommended that this impact be part of the ridership study.
- Situated in a narrow dedicated corridor (20m) through much of Riverside South, the detailed design for the former N-S LRT would have required special consideration and features to address technical issues such as grading and drainage, noise and vibration from trains and crossings, and LRT pre-empt operation.
- The E.A. for the former N-S LRT project identified 15 existing and future road crossings over the 7 km length of the LRT line between River Road and Bowesville Road. From a safety perspective, each crossing introduces a potential point for a LRT vehicle to collide with a

- pedestrian/cyclist/vehicle. A combination of normal safety devices such as crossing gates and / or train and traffic control signals, are required at all crossings.
- The former N-S LRT crosses Mosquito Creek south of Earl Armstrong Road at one of its' narrowest points, thereby minimizing the impact on the sensitive fish spawning areas within the creek.
  - Because E.A. approval exists for the former N-S LRT alignment through Riverside South, there is no impact to the schedule due to E.A. processes.

## Urbandale

### Description

The Urbandale proposal would locate the LRT in the median of the Earl Armstrong roadway between the River Road Station and the point east of Mosquito Creek where Earl Armstrong Road intersects the LRT alignment proposed in the former N-S LRT project. Note that the Urbandale drawing shows the alignment in a different location than they had intended. Clarification from the Urbandale system designer indicates that the intent is to carry the LRT easterly along Earl Armstrong Road to pass over Mosquito Creek then turn to connect with the former N-S LRT alignment.

The Urbandale proposal has three stations (River Road with a park-and-ride, plus two other stations) for both the initial implementation and for the future final operation..

### Commentary

- The Urbandale proposal is to run on a straight alignment down the middle of an arterial roadway, Earl Armstrong Road, with only three stations along the approximately 6.5 km length between River Road and Bowesville Road, thereby traversing a shorter distance than the former N-S LRT, at a claimed shorter travel time due to higher speed and fewer stops when compared to the future ultimate former N-S LRT design. In order to quantify the intuitive assertions of this alignment, a scaled preliminary design and a simulation study are required.
- The Urbandale proposal allowed for no additional future stations in order to maintain a high-speed operation. This would result in more riders having to take an intermediate shuttle service to get to stations. This would increase total trip travel time and may negatively impact ridership. Though the time spent in the train may be shorter, the total travel time for the rider (including intermediate shuttles) may be longer. This impact should be studied as part of the ridership study.
- Technical issues such as grading and drainage, noise and vibration from trains and crossings are more readily addressed with the LRT in the middle of an arterial road right-of-way than in the narrow corridor that was proposed in the former N-S LRT project.
- Due to the high number of vehicles interacting with the LRT at intersections on the arterial roadway, attention is required in the selection of pre-emption or priority operation for the LRT. That in turn will have an impact on the service provided to vehicle movements through the intersections.

- Technical issues are introduced in terms of LRT transition at each end of Earl Armstrong Road from median-running to LRT corridor-running.
- According to the Riverside South Community Design Plan, there will be 8 full four-way intersections and five “T” intersections on the Earl Armstrong/LRT alignment between River Road and Bowesville Road inclusive. Safety precautions such as crossing gates and/or train and traffic control signals will be required at the four-way intersections. “T” intersections may or may not require protection depending on whether or not cross street traffic is permitted to cross the median.
- An LRT alignment along Earl Armstrong Road will also result in operational issues for the new fire station on Earl Armstrong Road near Spratt Road.
- The station configuration at River Road would require review, as would the connection to Strandherd Bridge.
- The Urbandale proposal would have the LRT line cross Mosquito Creek on the alignment of Earl Armstrong Road. In so doing, only one crossing of the creek is needed for the combined road and LRT facility rather than two structures as proposed in the former N-S LRT project.
- The Urbandale proposal would likely allow a further cost savings as the costs of a structure for crossing Mosquito Creek could be shared with the road crossing.
- The change to the alignment from that of the former N-S LRT project would trigger at least an E.A. review. The scope of the change and the impacts would dictate what type of update to the E.A. would be required and thus how long it would likely take. There is no guarantee that the E.A. analysis would find that the Earl Armstrong Road alignment is the preferred choice.
- As the stations have only been suggested in quantity and their actual locations have not been identified, it is not known what the impacts of the final locations will be (station, utilities, parking, bus turning, etc).
- Land requirements along Earl Armstrong Road can only be determined after a preliminary design is created. Some consideration may have to be made for space for stations and the support facilities.
- The CDP for Riverside South should be reviewed if the Urbandale proposal is to be considered further. This would trigger a review of the TMP and the OP to confirm viability/appropriateness of running the LRT on the Earl Armstrong corridor.

## Alternative

### Description

Alignment: The former N-S LRT alignment;

Stations: Initially two (River Road and Spratt West). Future stations are dependent on ridership studies and simulation analysis.

## Commentary

- The former N-S LRT alignment was developed as part of the Community Design Plan for Riverside South, a rigorous design exercise to put Ottawa on the leading edge of development policy. A reassessment of that process is not deemed likely to produce a better plan.
- Current design and road contract preparation activities for roadway projects on Earl Armstrong Road and on Limebank Road are moving forward in step with development. A reassessment of the former N-S LRT alignment would mean that these projects would have to be postponed pending resolution of the LRT corridor selection through Riverside South.

## Analysis

The Urbandale proposal has focused on transit travel time as the main requirement. The original CDP for Riverside South took into consideration many established planning concepts and ideals, including transit travel time. It also considered the Earl Armstrong Road alignment as one of the options. After the full due process for the CDP was completed it was determined that the best result was gained by the alignment as proposed in the former N-S LRT project. There is nothing to indicate that that process has to be revisited.

The Urbandale proposal in essence questions the design philosophy of the Riverside South Community. The Urbandale focus is on the speed of the LRT, which is affected by the length and geometry of the rail alignment, and by the number of stations. In this regard it is noted that the Urbandale proposal is approximately 0.6 km shorter than the former N-S LRT alignment. A detailed plan of the Urbandale alignment would be required in order to ascertain the exact difference in length.

Urbandale has confirmed that in both the initial and final state of the proposal, three stations are proposed between River Road and Bowesville Road while the former N-S LRT had provision for 9. Of note is that either alignment could of course have more or fewer stations in the future.

Train speed does impact ridership, but so does the density of development in the vicinity of LRT stations. For residents located in neighbourhoods beyond walking distance to stations in either plan, feeder buses would be used to shuttle riders to the stations. Otherwise these residents could cycle or go to the park-and-ride lot at River Road to access the LRT.

In the extreme, a corollary to the Urbandale proposal would see a complete revision to the Riverside South Community Design Plan so as to locate higher density along Earl Armstrong Road. The CDP Land Use Plan is based on achievable residential densities, location and extent surrounding all LRT stations. If the Earl Armstrong Road alignment is selected, simply doubling the residential density on the Land Use Plan on two quadrants of the stations would likely not result in the same number of residents having walking distance access. This is because homebuilders do not usually develop large single tracts of medium density housing in a suburban context and this also is not a preferred land use planning approach.

The master servicing, environmental, transportation, commercial market and planning/urban design study costs for Riverside South now are in excess of one million dollars and have been underway since 2003. If the Earl Armstrong Road option were selected, a substantial portion of these studies would have to be redone, potentially including an entire redesign of the CDP, Core Area plan and Implementation Guidelines. This process would require sufficient time for full public and stakeholder participation and City Council approval and would take one to two years to complete. This work would trigger an amendment to the former N-S LRT Environmental Assessment with no guarantee that a better community plan would result.

Any proposed change in the alignment of the LRT corridor through Riverside South should take into consideration established planning concepts and ideals. The following bullets clearly illustrate that the Urbandale proposal does not support the policy base and land use planning and process found in the current Official Plan.

- The Riverside South Rapid Transit Functional Planning Study (McCormick Rankin 2003) recommended an LRT alignment that was subsequently used in the CDP. The study also recommended integration of rapid transit in the mixed use Core Area to support transit-oriented development and to create a walkable urban village in the central part of the community. The same study recommended avoiding the Earl Armstrong corridor as a location for rapid transit to avoid conflicts with vehicle movements.
- The LRT alignment for the former N-S LRT project was selected based on a collaborative community building process with extensive consultation over two years. The central alignment represents an optimum location in the community that balances the policy objectives of the Official Plan. Council approved the central alignment in the CDP without objections from any person or group. The Environmental Assessment for the former N-S LRT, carried out subsequent to the preparation of the CDP, did not recommend any alternative alignments as “improvements” over the central one shown in the CDP.
- Council recently adopted its 2007 – 2010 City Strategic Directions document. Objective “F.1” directs that Ottawa become leading edge in community and urban design. Going back to a business as usual approach to community design by locating the LRT based primarily on the most direct and cheapest route rather than that which embodies optimum transit-oriented design principals would be contrary to that direction.
- For many years the planning, urban design, engineering and transportation professions have stressed the importance of integrating rapid transit in communities through transit-oriented design to promote public transit usage and to improve urban form. The approved central LRT alignment selected by the City through the Riverside South Community Design Plan process integrates rapid transit as a part of the neighbourhood fabric rather than locating it along an existing major transportation corridor at the edge of the new community.
- The former N-S LRT alignment is centrally located in consideration of the existing urban boundary and optimum land-use density and distribution. It provides for superior Core Area urban design context. The approved alignment creates more southerly station locations than that of the Urbandale proposal, to improve proximity to transit for the greatest number of (future) residents in the community. The alignment provides walking distance access (within 800m) for approximately 30,000 residents and 10,000 employees based on the CDP land use as planned. An Earl Armstrong Road alignment would reduce the number of people within walking distance access by approximately 5,000. This is due to the lower density nature of the existing community north of Earl Armstrong Road.
- The CDP Land-Use Plan established the minimum residential and employment density required to meet the objectives of the Official Plan. The CDP is flexible providing opportunity for increased density in proximity to LRT stations to increase transit usage. The central LRT alignment provides for opportunity to increase density on four quadrants abutting each station location. The Earl Armstrong Road alignment would allow for only two quadrants since the existing neighbourhood north of Earl Armstrong Road is developed. The existing neighbourhood was planned before the CDP was approved and is constructed at relatively low residential density of 24 u/ha average compared to minimum 31 u/ha required in the CDP area.

- The Core Area (town centre) was designed with the LRT corridor as the central east-west spine of a pedestrian friendly, higher-density mixed-use area. All proposed land uses in the Core Area are oriented around the LRT “Transit Street.” Parking will be located in the interior of development blocks with buildings abutting surrounding rights-of-way.
- A new and unique to Ottawa design approach in the Core Area is that large format stores are required to be located adjacent to the arterial roads and smaller retail, office and residential buildings must be adjacent to and have functional front doors on internal streets including Transit Street. This transit-oriented design approach would be compromised if the LRT were relocated to Earl Armstrong Road.

## 4. Maintenance Centre

### 4.1. Size of Maintenance Centre

**Importance: High**

#### Description

The main requirements of the maintenance facility were for heavy maintenance, wheel truing/lathing, light maintenance (including daily inspections and cleaning), painting and storage. The original requirements of the RFP required maintenance and stabling for up to 100 trains. After a Value Engineering analysis, the requirement for stabling and light maintenance was reduced.

#### Former N-S LRT

##### Description

Value engineering of the original submission led to a reduction of the maintenance and stabling capacity.

16 tracks provided access to the various bays and stabling area.

##### Commentary

- The Maintenance Centre as designed appears to be much larger than required for the initial fleet size. At the time of the termination of the former N-S LRT project, the project team was negotiating with OLC to reduce the capacity of the facility.

#### Urbandale

##### Description

Urbandale proposed reducing the size of the Maintenance Centre based on the assumption that additional light maintenance facilities would be located in the East and West if/when those expansions are done.

##### Commentary

- The proposal may be acceptable, but details were not given, so the cost savings proposed by Urbandale cannot be verified.



## Alternative

### Description

#### Alternative: Initial Installation.

Stabling and maintenance for 27 trains.

#### Alternative: Final Installation.

Stabling and maintenance for 45 trains.

### Commentary

- At the time of the termination of the former N-S LRT project, the size of the maintenance facility was being reviewed. If a LRT project is activated, consideration should be given to reactivating this review. At question is the provision of a basic facility capable of servicing only the opening day vehicle fleet, versus a larger facility sized to service a larger future fleet, and if so, to what horizon date. Although simple in concept, the details of maintenance operations, shift work, dual usage of maintenance bays and storage facilities complicate the determination of an optimum facility size. The review should address all aspects of maintenance – stabling, painting, daily inspection/cleaning, washing, light maintenance and heavy maintenance.
- Stabling; this is storage for trains that are not in use or undergoing maintenance. If the maintenance bays are not being used then they can also be used for stabling. This determination is a function of fleet size.
- The extent of enclosed protection of the stabling facility could vary. Some daily inspections or light maintenance could take place in a suitably designed and equipped stabling facility. Weather protection is a concern for the operation of the doors and other external devices on a LRV in the transition from the wash bay to stabling in extreme cold.
- The stabling shed should be built so as not to preclude the possibility of converting a track to light maintenance use.
- It is assumed that LRT network expansions to the east and west will come with their own stabling facilities that will include space for light maintenance work and wheel truing.
- Painting; if the LRT does not operate in mixed traffic flow in the downtown core, then the LRVs exposure to salt, sand, debris and potential collisions is lessened, thereby reducing the requirement for painting them. Rather than painting on site, alternate solutions to painting vehicles could be considered, such as contracting out for that service.
- The maintenance building could be built so as not to preclude the possibility of converting light maintenance bays to heavy maintenance bays.
- Possible Track Quantity/Layout.

#### Initial/Future Configuration.

Total - 7 (10).



- Potential use of the straight stretches of track to the east and west of the building may assist in further reductions to track configuration.
- Real Estate Requirements; A reduction in the number of bays in the Maintenance Centre and/or track reductions would reduce the number of switches and the site length required to operate the facility. This in turn may reduce the footprint on the esker at the maintenance site and therefore reduce the cost and lessen the schedule implications of its removal.
- The nature of this building (large building that is relatively low) and the location (out in a rural area), offers a potential for consideration for construction to a high LEED standard (green building) to reduce long term operational costs.

## Analysis

The former N-S LRT plan had generous requirements for the Maintenance Centre. The project team was in the process of negotiating this to be a smaller more efficient facility. If the project was to restart, a "ground-up" approach should be taken in assessing the requirements of the facility.

The Urbandale proposal stated that a significant reduction could be made to the facility but did not state any specifics or give a cost breakdown.

It should be possible to reduce the size of the maintenance facility substantially from what was proposed in the original RFP. The alternative solution proposes building the maintenance facility with full future capacity for both heavy and light maintenance (assuming that LRT network expansions to the west and east will have their own light maintenance facilities).

In the time frame given it was not possible to do a detailed cost estimate and analysis. Further ideas that might be considered for cost reduction for the Maintenance Centre and surrounding areas are:

- Reduce the light and heavy maintenance bays to the minimum required for opening day and review shift use opening day;
- The stabling area could have a roof only, rather than enclosed and heated. If this was the case the vehicles may have to be left with heat on during colder periods;
- The design of the stabling area could be reviewed to determine the minimum required footprint of the MC switches and building and the minimum real estate site requirement;
- The amount of excavation of the nearby esker may be reduced which could significantly reduce the schedule and budget risks associated with this work;
- Methods of outsourcing the painting of LRVs could be investigated until the fleet increases to the point where a paint shed is required;
- Additional consideration should be given for building this facility to a high LEED standard to take advantage of lower operational costs as a result of "green" implementation;

## 5. Maintenance Centre to Dow's Lake Tunnel

### 5.1. Greenboro Station

**Importance: Med**

#### Description

The initial implementation of the former N-S LRT project included LRT stations at Lester and Greenboro, with a future station at South Keys. There is currently an operational O-Train station at Greenboro.

#### Former N-S LRT

##### Description

Stations: South Keys & Greenboro

The first phase of the former N-S LRT as initially approved was to immediately construct South Keys Station instead of Lester Station. The Greenboro Station was going to transition from O-Train service to the LRT.

##### Commentary

- Maintaining the existing Greenboro Station to allow for additional transfer to the BRT and the use of the Park and Ride lot at Greenboro by the LRT users is assumed to maximize the potential ridership in the area. Ridership needs can be verified as part of the updated ridership study.

#### Urbandale

##### Description

Stations: South Keys only

##### Commentary

- Urbandale proposes that the Greenboro Station remain as a BRT only station. There is an existing Park-and-Ride at Greenboro Station. The walk from South Keys to Greenboro is approximately 800m. Urbandale assumes that the BRT / LRT transfer will be happening at the South Keys Station. Ridership would likely be lost due to the reduction in the station's catchment area. Park-and-Ride users will have much further to walk to access to the LRT. The ridership that currently uses the Greenboro Station on the O-Train might also be partially lost.

## **Alternative**

### **Description**

Stations: as per the former N-S LRT (Greenboro and South Keys)

### **Analysis**

It is preferred that the Greenboro Station be retained. It is an existing Park-and-Ride location, thus a benefit to developing additional ridership for the LRT.

## 5.2. Link to Airport

**Importance: Med**

### Description

The approved E.A. design for the former N-S LRT protects a corridor for a two-track link between the former N-S LRT alignment and the passenger terminal at the Ottawa MacDonald-Cartier International Airport.

### Former N-S LRT

#### Description

The former N-S LRT project initial implementation did not include construction of the LRT link to the Ottawa MacDonald-Cartier International Airport.

The project allowed for the addition of the airport link at a future date.

The Airport Authority has reserved a corridor for a future LRT link from the N-S LRT corridor to the airport.

#### Commentary

- Passenger transfer between the airport and the LRT system was to be via the existing airport bus service operated by OC Transpo serving South Keys and Greenboro Stations.
- The forecast ridership at the start of revenue service for the former N-S LRT was projected to be very low. As ridership demands increase, the business case to support the construction of the LRT link to the airport could be reviewed.

### Urbandale

#### Description

The Urbandale proposal shows a shuttle bus link between the airport and the LRT system.

#### Commentary

- Urbandale assumed that the airport bus link would serve the South Keys Station. In discussion with the Urbandale system designer, it was agreed that the OC Transpo airport bus service currently serving both South Keys and Greenboro would equally meet the Urbandale design objectives.

## Alternative

### Description

Operate a bus service between the Ottawa MacDonald-Cartier International Airport and South Keys and Greenboro Stations.

Continue to protect a corridor for the future implementation of a LRT link to the airport.

Reassess the business case for construction of the LRT link to the airport upon completion of the update to the ridership study.

### Commentary

- It is important to protect for the possible future LRT link to the airport. The timing of when that should proceed would be determined as part of the studies to be initiated.

## Analysis

The LRT link to the airport was not supported by the business case for initial implementation as part of the former N-S LRT project. Depending on the outcome of the revised ridership study, based on a tunnel option and new end points for the LRT operation, the business case may support earlier implementation of the LRT airport link

To date, the decision as to whether or not to proceed with the implementation of the airport link has been driven by the business case. Consideration could also be given to the global exposure factors such as the world perception and advertising potential created for Ottawa by having an LRT system connected directly to the international airport. As a G8 Capital City, there is an argument to be made that such a service is evidence of a progressive, environmentally friendly, forward thinking City. These intangibles are beyond the scope of a dollar-oriented business case.

Maintaining the existing bus service linking the airport to both Greenboro and South Keys Stations rather than only to South Keys Station allows not only for transfer to the LRT and BRT, it also gives direct access to a Park and Ride lot.

### 5.3. Short Turn at Leirim

**Importance: Med**

#### **Description**

Short turn locations are provided to allow for some trains to turn back, thereby allowing for different headways (e.g. five-minutes vs. 10-minutes) on either side of the short-turn. This is done to provide different levels of service to suit different ridership demands. The projected ridership for the former N-S LRT project was less in the south end compared to the north end of the LRT system.

#### **Former N-S LRT**

##### **Description**

Location: Leirim

##### **Commentary**

- In the former N-S LRT project, Leirim Station was the “short-turn” location where every second train arriving from downtown would reverse and return to downtown rather than proceed south to the South Urban Community. This provided the capability to have different headways south of Leirim versus north of Leirim. In order for this station to provide for the short turn, another track and a platform would be needed in addition to what is normally required at a standard through-traffic station. This required additional property to accommodate the three track widths and two platforms.

#### **Urbandale**

##### **Description**

Location: None.

##### **Commentary**

- A short turn was not proposed at Leirim. It was intended by Urbandale that five-minute headways would be used throughout the system.

#### **Alternative**

##### **Description**

Location: The short turn at Leirim should be reviewed based on the revised ridership studies once the alignment and project staging have been determined.

### **Commentary**

- It is preferred that a short turn be provided based on expected ridership at different sections of the corridor, which could lead to operating cost savings. The Leirim location would be revisited to ensure an optimal location.

### **Analysis**

It is preferred that a short-turn location be included and that the site for a “short- urn” be reviewed based on revised ridership projections and simulations of a revised project.

## 6. Dow's Lake Tunnel

### 6.1. Twin Track vs. Single Track

**Importance: High**

#### Description

The O-Train currently goes through a single-track tunnel below the Rideau Canal near the south end of Dow's Lake. The need to add a second tunnel and track is a function of the frequency of service, the variability of schedules on either side, the size of the train and the length of the single-track section.

#### Former N-S LRT

##### Description

Two tracks with new second tunnel.

##### Commentary

- Due to the LRT line operating on the surface in a mixed traffic environment on Albert Street and Slater Street, there will be variability in the schedule of arrival time of an LRT vehicle approaching the Dow's Lake tunnel. System variability is also affected by the numerous at-grade road and intersection crossings throughout the system.
- The length of train is limited to two cars due to the downtown on-street limitations. This required the ultimate design headway to be three minutes to achieve the capacity required to satisfy the 2021 passenger forecast. This short headway is also a contributing factor to needing two tracks.
- All remediation work of the existing tunnel would have been completed during the construction of the second tunnel.

#### Urbandale

##### Description

Single Track (existing one-track tunnel only)

##### Commentary

- Due to the Urbandale proposal for a tunnel in the downtown, the mixed-flow traffic implications would be eliminated thereby reducing the variability in the arrival pattern of LRT vehicles approaching the Dow's Lake tunnel. According to Urbandale this, in combination with the change in headway, would negate the need for a two-track tunnel. This does not take into account the headway variability introduced into the system by the at-grade



- crossings throughout the LRT line, and the system operation through the development sections in the Riverside South and Barrhaven/Nepean South town centres.
- Urbandale proposed five-minute headways throughout the length of the system. According to their proposal this would negate the necessity of a twin track tunnel. This type of operation would introduce a constraint in the system operation ultimately limiting the headways between trains. This situation may be offset by the fact that trains could now be composed of more than two cars because the platform lengths may no longer be limited by the requirement for trains to fit within the downtown street geometry (suburban stations need to be reviewed).
  - If the tunnel is ever to be twinned in the future, and that tunnel is to be immediately adjacent to the existing one, then a temporary closure of the existing tunnel may be required in order to install bracing to support the existing structure when the earth adjacent to it is removed for the construction of the second tunnel. Other options for a second tunnel such as offset alignments or tunnel boring could be investigated. Detailed technical analysis is required to determine the viability of options and estimated costs for construction of a second tunnel at a future time.
  - The current tunnel leaks extensively and requires waterproofing. There are various methods to carry this out; the most direct is to expose the structure in an open-cut and apply the restoration works. The feasibility and cost of optional techniques including pressure grouting from inside or outside would have to be investigated. The Urbandale proposal recognizes that this waterproofing must be done, and that the existing O-Train may be shut down during this work. (See O-Train shutdown).
  - A single tunnel could also have negative impacts in the case of maintenance requirements (longer term) and possible emergency conditions.
  - A work zone for construction activity for the waterproofing of the existing tunnel, and construction of a second tunnel requires permanent easements from federal agencies, as well as temporary construction easements.
  - With the remediation of the existing tunnel, there is a significant possibility that the canal in this area would have to be closed for skating during one winter season. Given that this location is near the end of the skating surface on the canal, a closure here is thought to be tolerable.
  - The length of the single-track section would require simulation. It is possible that the single track would have to run approximately from Carleton University in the south, to Gladstone in the north, depending on whether switches (to revert to two tracks) could be installed on the curves near the tunnel.

## Alternative

### Description

A simulation model run needs to be done to verify that the single track can be operated successfully, and when, if ever, the tunnel would have to be twinned. If it is confirmed that single-track operation is feasible,, then the trade-offs between single track and two tracks should be analyzed and documented.

### Commentary

- If the former N-S LRT project is to proceed with two tracks at the Dow's Lake tunnel, consideration should be given to shifting the alignment of the tunnel slightly. In the former N-S LRT option, the second tunnel was to be located on the west side of the existing tunnel, to be built with an open cut construction activity. This was going to have an impact on a significant number of existing trees in the Arboretum. If a second tunnel is contemplated in a revised project, consideration should be given to construction of a second tunnel to the east of the existing tunnel. This would affect fewer trees, but probably require the removal/replacement of the pumping and ventilation equipment room for the current tunnel.

### Analysis

Long-term future maintenance requirements and emergency conditions should be considered when contemplating the single versus twin tunnel option. A second tunnel offers the option to operate one tunnel as a single bi-directional tunnel while maintenance work is carried out in the adjacent tunnel. Likewise, a collision, vehicle breakdown or other catastrophic event in one tunnel could be bypassed via the second tunnel.

The advantage to a single tunnel is a reduction (or at least deferral) of the initial cost. Once the simulation and ridership study are completed, a cost/benefit analysis should be done to determine the recommended option.

## 7. Dow's Lake Tunnel to Bayview

<b>7.1. General</b>
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**Importance: Low**

### **Description**

In the area from the Dows Lake Tunnel to the Bayview Station there are no differences between the Urbandale proposal and the former N-S LRT design.

## 8. Bayview/LeBreton

### 8.1. Bayview Station

**Importance: High**

#### Description

The O-Train currently terminates at Bayview Station where there is a BRT/LRT transfer point. This is a single-track station with a platform designed for the O-Train.

This is also the location where the former track leading to the Prince of Wales Bridge (former railway line from Gatineau, tracks removed) meets the City of Ottawa transit system.

#### Former N-S LRT

##### Description

It was intended to have a station at Bayview approximately in the current location of the O-Train station.

##### Commentary

- The station location was being maintained as per the original O-Train concept to continue to allow flexibility for riders using the area.

#### Urbandale

##### Description

Urbandale has proposed that Bayview Station be the hub for the Bayview/LeBreton area. In Phase 1A it would be an interim terminus for the north-south line. Once the tunnel was finished the Bayview station would become the main hub/transfer point for the area.

\$20M has been included in the Urbandale cost estimate to widen or twin the existing BRT structure and further develop the existing LRT platform to create a major two level station with the LRT stopping beneath the BRT at the Scott Street overpass.

The Urbandale system designer acknowledges that this concept requires further design work.

##### Commentary

- Given the unknown requirements of the downtown tunnel study and potentially a link to Gatineau, spending significant funds on the Bayview Station is not seen as appropriate in the initial stage.

- As part of the Phase 1A proposal, Urbandale proposes to modify the alignment from that proposed in the former N-S LRT project to increase the radius. The details of this design will further determine the feasible permanent location of the station.
- The Urbandale concept as explained by the designer is to flatten the curve of the former N-S LRT line by shifting the alignment to pass through the vacant development lands (DCR Phoenix) southeast of the current O-Train station. This would bypass the existing O-Train Bayview station platform and bus interface facilities. Normally stations are located on tangent or near tangent sections of track so that the train will align with the platform such that the gap between the train and the platform is consistent at each door on the LRT vehicle. Given that a longer train could be accommodated using the Urbandale proposal (see train size) a long tangent length such as 120m could be required for the platform design. The feasibility of construction of a station on or near this new curve would require a detailed study.
- The potential for this location to be a full diamond intersection, in the future, to provide for interconnectivity movements between E-W, N-S LRT and possible inter-provincial connection is not conducive to an efficient station design as a hub station.
- Creation of a hub at this location with significant bus staging facilities is not appropriate land use for an area so close to downtown; rather the area should be developed for intensification.
- Analysis is needed to verify that there is sufficient interim capacity on the downtown street network to accommodate the bus service during the interim period of operation when Bayview is the north termination point of the LRT system from where patrons transfer to buses to go downtown.
- Analysis is required to determine the number of transfers that would take place at this station, and therefore how big a “hub” facility is required.
- The Urbandale proposal does not mention whether or not there would still be a requirement for a significant number of buses from the West Transitway to travel on Albert and Slater Streets.

## Alternative

### Description

Construct an interim station at Bayview to serve as the north terminal of the first phase of the project subject to verification that there is sufficient capacity on the downtown street network to accommodate this interim service. Once a study of the LeBreton / Downtown areas has been completed then the decision as to where (and if) to locate the permanent Bayview station should be made.

### Commentary

- This should allow a minimal amount of expenditure before the details of the impacts of the downtown tunnel are known in this area.

## Analysis

The former N-S LRT project included Bayview as a stop on the way to downtown that would allow for transfers to/from the West Transitway bus routes. The Urbandale proposal suggested an interim northern terminal at Bayview until a downtown tunnel design could be completed, but included significant costs to upgrade the station as a permanent hub for the area.

If a modified N-S LRT were to proceed, Bayview Station would be the preferred interim northerly terminus until the outcome of the tunnel study is known. As the requirements for and impacts to Bayview Station will not be fully understood until after the tunnel study is complete, it would be preferable to minimize the costs for upgrading the station to be able to handle the first phase of the LRT.

## 8.2. LeBreton Station

**Importance: High**

### Description

The LeBreton Station has been designed in cooperation with the NCC and their development plans. It had been envisioned as a central transfer location for the LeBreton Flats area and is central to the highest density planned in the area. NCC has previously indicated that the LeBreton Station is fundamental to the future viability of the new LeBreton community. In addition, it is intended to be a major connection of transit services between Ottawa and Gatineau.

This entire area is very sensitive to the NCC and use of additional land or changes in the plan must go through a rigorous NCC approval process.

### Former N-S LRT

#### Description

The LeBreton Station is included as a main LRT/BRT transfer point and connection with Ottawa transit services to Gatineau.

#### Commentary

- In general, the location and design of the LeBreton Station was acceptable and had been tentatively approved by the NCC. Detailed work was underway at the time of termination of the Project Agreement in regards to coordination of BRT/LRT services and final design concepts of the station configuration.

### Urbandale

#### Description

LeBreton Station removed.

#### Commentary

- The LeBreton Station is eliminated in the Urbandale proposal. However, NCC has previously indicated that LeBreton Station is fundamental to the future viability of the new LeBreton community.

## Analysis

The Urbandale proposal removed the LeBreton Station. This is not compatible with the NCC's development plans in the area, even with a hub at Bayview. There is also significant risk that the Bayview Station will have to change (or be removed) after the tunnel study is complete.

If a modified N-S LRT project is to proceed, It is preferred that the initial system terminate at Bayview Station, but that LeBreton remain as an important station for future implementation. The exact details of the future LeBreton and Bayview Stations are to be determined upon completion of the downtown tunnel study.



### 8.3. Bayview/LeBreton Alignment

**Importance: High**

#### Description

The alignment through LeBreton flats from Bayview to the escarpment has to take into consideration many different requirements including: conflicts with existing and proposed utilities (such as the major HPTM and LPTM watermain lines), integration with the NCC's vision for the LeBreton Flats community, geotechnical constraints, coordination with BRT services, and use of other lands other than NCC and escarpment development.

#### Former N-S LRT

##### Description

The former N-S LRT project had a two-track LRT line passing through a north-south oriented station at Bayview, then turning sharply to the east to merge with the BRT corridor, then running in combined LRT/BRT operation through the LeBreton Station, then eastward to climb the escarpment to connect with the one-way streets of Albert and Slater in the downtown core.

##### Commentary

- The alignment of the former N-S LRT was acceptable and was being updated as part of the detailed design. Some details still needed to be worked on, including maximizing the radius at the corner of Bayview.

#### Urbandale

##### Description

Phase 1A ; Northerly terminus at interim Bayview Station

Phase 1B ; Connect the N-S portion to the downtown tunnel with no station at LeBreton and a flatter curve and relocate station at Bayview.

##### Commentary

- The Urbandale alignment will introduce different property requirements from those identified in the former N-S LRT project.
- The Urbandale alignment would increase the radius in an attempt to reduce the potential for wheel squeal at the Bayview Station.
- The Urbandale alignment east of Booth Street appears to be in conflict with existing facilities at the Fleet Street Pumping Station and the tailrace adjacent to it.

- This proposal needs to be integrated with the NCC's Master Plan for LeBreton Flats, the NCC's Portage/Wellington Node & Escarpment District Urban Design Analysis and Demonstration Plan Project, and, the City of Ottawa's Escarpment Area District Plan, being part of the Downtown Ottawa Urban Design Strategy.
- The tight radius curves that would be introduced on the alignment approaching the escarpment proposed by Urbandale in order to have the alignment of the tunnel in the downtown core below Sparks Street would introduce speed limitations and potentially cause wheel squeal.
- Any proposed changes to the LRT system at the east end of LeBreton Flats, need to be coordinated with the Carling/Bayview Rapid Transit Corridor Community Design Plan.

## Alternative

### Description

The final alignment should be determined only after the Tunnel Study has been completed. The Tunnel Study limits should take into account the impacts of the tunnel portal location on the alignment and design of the LRT west of the escarpment. The extent of the area of influence of the Tunnel Study will be a function of the options that arise as part of the study and could conceivably include all the way to the South and West of Bayview Station.

### Commentary

- It is preferred that the westerly limit of the tunnel study be extended as appropriate for the options the study investigates.
- It is suggested that the ability to maintain an LRT station at the Bayview site in the long term be assessed, given the track geometry in the Urbandale proposal.
- In the meantime, it is preferred that if it is decided to proceed with construction of a LRT line south of Bayview Station, for the interim, the northern terminus point for that line should be at the existing LRT station at Bayview Station, subject to confirmation that the downtown street network can accommodate traffic associated with this interim measure.

## Analysis

The former N-S LRT included a LRT / BRT alignment through LeBreton Flats and into the downtown where it was to operate on-street. The Urbandale proposal has proposed that the alignment be changed in the LeBreton Flats area, including removing the LeBreton Station, and connecting to a tunnel under Sparks Street. The removal of the LeBreton Station and the tunnel below Sparks Street is not recommended at this time.

Council has authorized that the downtown tunnel study proceed. The study should be sufficiently broad to consider all options for portal locations, and include the impacts on the LeBreton Flats area. The alignment through LeBreton Flats should be included in the scope of the Tunnel Study.

The designer for the Urbandale proposal has acknowledged that his alignment from Bayview through LeBreton Flats to the Bronson Escarpment will require a more detailed design in order to assess the ability to merge this with the NCC's plans for the LeBreton community. The idea of improving the radius of the curve at Bayview

has merit as improved performance and ride would result. It is therefore concluded that more functional/preliminary design work should be done as part of the downtown Tunnel Study.

In addition to the alignment for the LRT, there are ancillary matters in LeBreton that may be affected including, widening of Scott Street, Booth Street and Preston Street extensions to Wellington/Ottawa River Parkway, a grade separation of Preston Street at the LRT/BRT, and concepts for the reintroduction of Old Wellington Street near Bayview Station.

## 9. Downtown

### 9.1. Downtown: Surface vs Tunnel

**Importance: High**

#### Description

Connection into the downtown or Central Business District (CBD) is an essential component of the LRT. Doing so with a minimum of interruptions during construction and operation is considered to be very important.

#### Former N-S LRT

##### Description

The plan was for the LRT to operate with buses in exclusive transit lanes adjacent to mixed traffic lanes for trucks, cars, and buses on the one-way pair, Albert Street and Slater Street, between the Bronson escarpment and Mackenzie King Bridge. The LRT would cross the Rideau Canal via the Mackenzie King Bridge and terminate at a station just east of the end of the bridge, on the campus of the University of Ottawa. A total of five stops were planned with three in the downtown core west of the Canal.

##### Commentary

- For many reasons this solution was seen as very challenging to implement. The challenges included the cost and risk of moving/replacing the utilities, interruption to the CBD during construction and operation, impact on traffic on surface streets, and platform length constraints that would limit the system to two car trains.
- The former N-S LRT project had established that the maximum train set length would be composed of two-car trains. There was a need to operate the LRT such that all traffic modes – pedestrian, cyclist, bus, automobile and truck – could be accommodated. This meant taking into consideration a combination of the LRT train size, LRT platform size, intersection locations and block size (200m per block), location of private accesses, loading ramps, parking garages, and, the geometry of the lane configurations required to service bus lanes, turning movements, stopping and loading zones, etc.
- In the former N-S LRT plan, the LRT platforms were situated adjacent to the sidewalks, approximately mid-block in alternate blocks from the BRT platforms.
- Extensive and costly utility relocations were expected on Albert and on Slater Streets as part of the former N-S LRT project.

## Urbandale

### Description

Urbandale proposes a tunnel in the downtown, from the escarpment to the area east of the Rideau Canal near Union Station and then turning south. The intended alignment is under Sparks Street.

### Commentary

- The implementation of a downtown tunnel is seen as much less intrusive than a surface LRT operation, while giving much greater flexibility into the future.
- A tunnel operation would allow trains longer than two cars. Platforms in a tunnel can potentially be as long as the longest expected train.
- In the tunnel alternative, the platforms could be located at any convenient location along the line. Furthermore, tunnel stations may be accessed from various directions thereby providing users with real and perceived direct access. For example, a 120m long platform located beneath the intersection of Kent and Albert Streets could have escalators at each end that lead to access points in buildings near Bank Street to the east, and near Lyon Street to the west, near Slater to the south and Queen Street to the north. The perception would be that the station is not far away from any of these locations.
- With the Urbandale proposal, a careful positioning of the stations and the access stairs/escalators to the surface would dramatically reduce the interference with utilities and significantly reduce the associated costs. As an additional advantage, this solution avoids the cost risk that the City was exposed to pending the settlement of an agreement for cost sharing of utility relocations, particularly in the downtown.
- It should be noted that many of the water and sewer lines on Albert and on Slater Streets are due for replacement or relining (some watermains are over 100 years old), so a complete reconstruction of both Albert Street and Slater Street will result when excavation work proceeds for this undertaking, independent of the LRT construction activity.
- The extensive traffic detour requirements associated with the utility relocation work for the former N-S LRT implementation would be reduced within the tunnel option to those required for station access points, and maintenance and ventilation shafts at the surface. This may be nonexistent if access is via underground portals to existing buildings. Traffic detours will still be required for the extensive water and sewer replacement/re-lining work planned by the City on Albert and Slater Streets that is independent of the LRT project.
- In comparison with surface operation, tunnel operation would result in fewer locations where LRT trains would interact with LRT parallel and cross street traffic, including pedestrians, cyclists and vehicles. There would be less potential for collisions, pedestrian trip hazards or cyclist/motorcycle wheel tracking which could occur when rail tracks are on the street.
- The visual/aesthetic and safety concerns of overhead wires and supports along Albert and Slater Streets are nonexistent with a tunnel option.
- Security concerns may be more prevalent with a tunnel. Security and emergency measures would be an integral part of the design.

- Noise and vibration concerns associated with on-street operation on the Mackenzie King Bridge at NAC and Rideau Canal crossing would not exist with the tunnel option, although the tunnel alignment would have to be planned and designed carefully to avoid similar concerns at the NAC. The streetscape work that was to occur on Albert and on Slater Streets as part of the former N-S LRT project would not be an applicable element of the tunnel option.
- The geotechnical conditions need to be assessed in order to ascertain the viability of constructing and maintaining a tunnel.
- With the tunnel option, the Mackenzie King Bridge can continue to service existing vehicle and cyclist traffic in addition to existing bus traffic. This was a major concern for the merchants in the downtown core and the cycling community respectively.
- A tunnel will require ventilation, and fire safety concerns that will have to be addressed commensurate with the types of vehicles that will be in the tunnel - electric, gas, diesel, hybrid - either public transit vehicles or maintenance vehicles.
- Operating in a downtown tunnel would result in less exposure of the LRT vehicles to salt and sand, and less weather related track maintenance requirements.
- A twin tunnel design offers the option to operate a single bi-directional tunnel while maintenance work is carried out in the adjacent tunnel. Likewise, a collision, vehicle breakdown or other catastrophic event in one tunnel could be bypassed via the second tunnel. The on-surface operation on Albert and Slater proposed in the former N-S LRT project did not support this opportunity.
- The twin tunnel design is also conducive to a central platform design. This makes use of one station platform for trains traveling in both directions. This was not the case in the on-surface operation.
- The tunnel design offers patrons a completely weather protected environment at the stations. The on-street shelters for the former N-S LRT were proposed to provide limited weather protection similar to that of a bus shelter.
- A variety of underground alignments for the tunnel could be considered, not only beneath any of the core east-west streets, but also on diagonal or curvilinear courses, subject to the location of building foundations and geotechnical suitability. Such alignments could be useful to distribute service north-south while traversing the core area east-west.
- The capital cost of a tunnel is expected to be significantly higher than the cost of the on-street plan.
- The Urbandale proposal should be coordinated with the Downtown Ottawa Urban Design Strategy.

## Analysis

As mentioned elsewhere in this report, the Tunnel Study should be undertaken.

The selected LRT plan should be coordinated with the University of Ottawa Master Plan, and University of Ottawa Development Plans.

## 9.2. Downtown: University of Ottawa to VIA Train Station

**Importance: High**

### Description

Connection of the LRT system to feeder commuter rail services is seen as an essential element to support future growth of the City and the surrounding communities.

### Former N-S LRT

#### Description

The connection of the former N-S LRT to the VIA Station was to be provided by the existing bus service running on the transitway between the VIA Train Station and the downtown core in keeping with the BRT/LRT network proposed in the Transportation Master Plan.

#### Commentary

- The existing transitway passes adjacent to the north side of the existing VIA Train Station. There is a bus station on the Transitway at the Train Station.

### Urbandale

#### Description

The Urbandale proposal for Phase 1B has the LRT continuing in a tunnel from the downtown in a southerly direction beneath the existing transitway alignment beside Nicholas Street to emerge at a portal onto the transitway on the north side of the Queensway, thence to follow on/along the transitway to Hurdman Station and then east to the VIA Train Station.

#### Commentary

- The following are a few comments related to the proposed tunnel/at grade alignment of the Urbandale proposal between the University of Ottawa and the VIA Train Station.
  - As with the rest of the downtown corridor, a variety of tunnel alignments could be examined. Subject to building foundations and geotechnical considerations, a sweeping curve could pass beneath the University of Ottawa such that a station could be located within the heart of the campus.
  - An LRT station located at the existing transitway station at the University of Ottawa would benefit not only the University and nearby Sandy Hill, but also the Centre Town community on the west side of the Rideau Canal whose residents could access the station via the new pedestrian bridge over the canal at Somerset St.

- Utility conflicts need to be ascertained.
- Property requirements need to be identified.
- Special attention needs to be paid when passing through the Lees Ave area, a site known in the past to have underground coal tar deposits. Coal tar is a carcinogen.
- Subject to the alignment proposed for the LRT line south of the Rideau River to Hurdman, track stability may be a concern. This site is a former garbage/landfill location that continues to decompose with time.
- The configuration at Hurdman Station requires attention. Tight approach curves could generate wheel squeal. At-grade pedestrian crossings introduce safety concerns; while grade separated pedestrian crossings introduce aesthetic issues for the residents of adjacent high-rise buildings. Grade separation of the LRT over/under the transitway is of concern. An overpass introduces aesthetic issues of concern to residents of adjacent high-rise buildings. An underpass on the other hand would have to be designed in consideration of the sub-grade materials (garbage), and the potential for methane containment.
- The alignment of the section of the LRT corridor between Hurdman Station and the Train Station will depend to some extent on the layout of the connection to Hurdman Station. Since the Urbandale proposal calls for the LRT line to be on the south side of the existing rail line at the Train Station, a LRT crossing of the rail line is required at some point along this link. Details need to be developed.
- Detailed designs are required to show the integration of the LRT line with the train station and the BRT station.

## Alternative

### Description

This portion of the Urbandale alignment should be the subject of an E.A. process in conjunction with the Downtown Tunnel Study.

### Commentary

- The selected LRT plan should be coordinated with the Nicholas / Mann - Gateway, Mann to Queensway Study.

## Analysis

N/A.