Document 2 Evaluation of Alternative Designs

1.0 ALTERNATIVE DESIGN CONSIDERATIONS

This section provides a summary of the overall principles and design criteria that guided the roadway design for the extension of Earl Armstrong Road. This analysis is sensitive to the site-specific conditions within the study area, drawing on the findings of existing conditions documented as part of the Environmental Assessment (EA) study.

1.1 Road Network Interconnectivity Alternatives

The extension of Earl Armstrong Road as an Arterial Road will serve as a new east-west route in the south-east sector of the city south of the Leitrim community. The roadway will intersect with Albion Road and Bank Street, which are north-south arterials; with Kelly Farm Drive, which is a designated collector road in the City's urban road network, and with Hawthorne Road that is currently designated as a collector road (south of Leitrim Road) in the City's rural road network. There are two alternative means to provide roadway inter-connectivity, including:

1. Signalized Intersections, or
2. Roundabouts

Each intersection has its own characteristics and site-specific intersection choices as appropriate to the context and anticipated future use and demand of the connecting roadways. The following considerations influenced the evaluation and eventual selection for each proposed intersection:

a. Road function within the network
b. Direction and balance of traffic flow
c. Number of intersecting roads (i.e. T-intersection versus four-way intersection)
d. Intersection spacing
e. Adjacent land use and access requirements
f. Intersection footprint and land requirements
g. Community Design Plan vision and choice for neighbourhood connectivity
h. Visual environment, intersecting with Bank Street, a designated Scenic Entry Route to the City

Using these criteria, the following recommendations for the extension of Earl Armstrong Road for intersection control are summarized in Table 1-1.

Table 1-1: Recommendations for Road Network Inter-Connectivity

Intersection	Control Recommendation	Rationale

Intersection	Control Recommendation	Rationale
Extended Earl Armstrong at Albion Road	Signalized Intersection	The intersection of Earl Armstrong Road extension up to Albion Road (as per the approved Limebank EA study, 2003) indicated signalization. This location is constrained by an existing cemetery in the southeast corner, and a compact footprint is preferred to minimize intersection skew and land requirements. Further, Albion Road along its length is currently controlled by signalized intersections. Also, transit priority measures are recommended at this location, and they can only be provided at a signalized intersection.
Extended Earl Armstrong Road at Kelly Farm Drive	Signalized Intersection	The extension of Earl Armstrong Road is currently located on lands designated within the Rural Area, and a T-intersection is recommended at this time at the Kelly Farm Drive extension to serve the Findlay Creek community, with the potential for a fourth leg providing access to rural lands.
Extended Earl Armstrong Road at Bank Street	Roundabout	Bank Street is a designated Scenic Entry Route and through previous EA studies, roundabouts are recommended at intersections north and south of this location. Further, the roundabout design facilitates some left-turn movements to/from adjacent lands which would otherwise be prevented with a signalized intersection design. The roundabout also has a positive traffic calming effect.
Extended Earl Armstrong Road at Hawthorne Road	Signalized Intersection	This intersection serves as the termination point of the Earl Armstrong Extension to Hawthorne Road as indicated in the 2013 TMP. Hawthorne Road is currently controlled by signalized intersections to the north and a stop control intersection at Rideau Road. Without an intensive rural land use on the eastern leg of this intersection, a T-intersection design is recommended at this time.

The decision to use traffic signals or roundabouts is based on the current context but can be revisited during detailed design and evaluated against current practices and adjacent land uses.

1.2 Rural Versus Urban Cross Sections

The road edge design of urban roads is influenced by adjacent land uses, buildings, pedestrian activity, and public space functions, whereas in the rural area the road edge design is more

influenced by its integration with the drainage patterns, landscapes, and natural processes. In the future, as communities continue to develop in the southeast sector of the city, the extension of Earl Armstrong may take on different road characteristics within its life cycle. The two main options for road cross-sections that have been evaluated include:

1. **Rural Cross-Section**, consisting of asphalt travel lanes, partially paved shoulders, gravel rounding, vegetated gently-sloping fore slope, vegetated, flat-bottomed drainage channel, and vegetated back slope with stormwater primarily managed within the right-of-way and out letting to watercourses following in-corridor treatment (i.e. ditches, enhanced grass swales, stormwater management facility, etc.).
2. **Urban Cross-Section**, consisting of asphalt travel lanes, curbs, catchbasins, with stormwater out letting to existing piped municipal drainage systems, or to new road-edge facilities, or

As both cross-section types are anticipated over the life cycle of the road, the environmental benefits of these cross-sections have been evaluated with the results provided in Table 1-2. The road edge treatment assumes that in both contexts, the extension of Earl Armstrong is a two-lane roadway for its length.

Table 1-2 Urban versus Rural Cross-Section Considerations

	Road Edge Treatment	
Criteria	**Rural Cross-Section**	**Urban Cross-Section**
Land Implications	Considerable width of land required to construct gently sloping drainage ditch due to road safety considerations and need for some in-corridor treatment to stormwater. Can be partially mitigated by barrier solutions to allow for steeper side slopes that come with additional cost.	More compact design and less width of land required to construct. An end of pipe solution may be associated with additional land requirements but can be located where land exists or can be considered for incorporation into community stormwater management approaches.
Community Interface and Access	Can cut off mid-block access to sidewalks, cycle tracks and multi-use pathways, and the roadway (users would need to traverse grassy slopes and cross swale).	Provides for direct and at-grade mid-block access to sidewalks, cycle tracks or multi-use pathways, and the roadway.
Road and Pathway Lighting	In-corridor pathways are typically located behind the road-edge drainage system, and ability to illuminate with the roadway lighting will be challenging. Additional pathway lighting will likely be required.	In-corridor pathways and sidewalks can be located near the roadway to benefit, and be lit, by roadway lighting.
Stormwater Management	Stormwater can typically be managed within the system including quality and quantity controls. Roadway edge treatment	Stormwater is managed within the ROW (such as filter, storage systems) and at urban drainage outlets (where available) including

	Road Edge Treatment	
Criteria	**Rural Cross-Section**	**Urban Cross-Section**
	facilities may be required in some circumstances.	measures for water quality and quantity. Stormwater retention facilities may be required in some circumstances.
Natural Heritage	Drainage features can be incorporated into the surrounding natural heritage system and could enhance adjacent features.	With a more compact design, impact on surrounding natural heritage features could be minimized or avoided although offers no real habitat either than for urban species.
Visual Environment	A more natural design features which can be complementary in an open space environment.	Can be designed to include landscape elements to soften the edge treatment, however requires additional land.
Life Cycle Cost	Less expensive to construct and maintain due to open/surface drainage solutions and use of low maintenance vegetation.	More expensive to construct and maintain due to piped/below-grade infrastructure and in-corridor or end of line requirements for quality and quantity control.

With context specific benefits related to both road-edge treatments, the Recommended Plan includes options for a rural two-lane and an urban four-lane cross section, requiring the same right-of-way, to be selected according to travel demand and adjacent land uses. The Recommended cross-sections are illustrated in Figure 1-1 and Figure 1-2.

Figure 1-1: Typical Two-Lane Rural Cross-Section for the Extension of Earl Armstrong Road

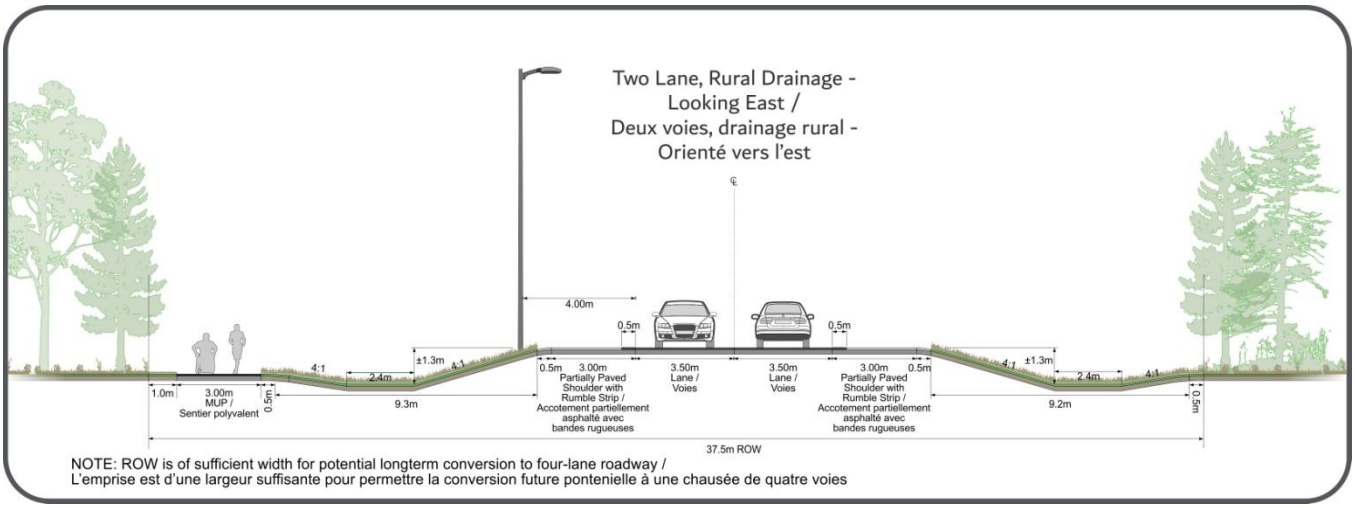
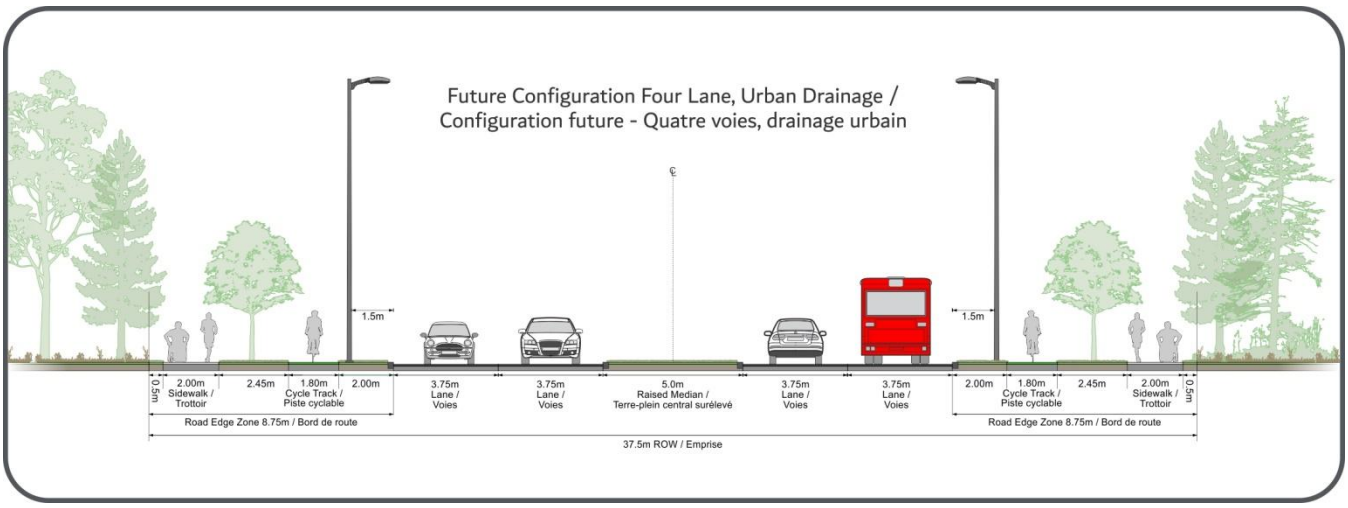


Figure 1-2: Typical Four-Lane Rural Cross-Section for the Extension of Earl Armstrong Road



1.3 **Roadway Division Alternatives**

Potential median types considered include:

- Narrow raised – not recommended: barrier curbs are known to contribute to vaulting and loss of control when hit at high speeds, and narrow width does not allow sufficient room for recovery before entering opposing traffic lanes.
- Wide raised – provides sufficient width for recovery after crossing the curb before entering opposing traffic lanes. There are many examples of this configuration operating well in Ottawa, for example various segments of Hunt Club Road.
- Flush asphalt with rumble strips – provides obvious warning to drivers that they've deviated from their lane and provides a modest width for recovery. Example: proposed safety improvements for Greenbank Road from Hunt Club to Fallowfield, Autoroute 50 from Masson-Angers westwards.
- Depressed/rural ditch – provides safe traversable area for vehicles to recover or stop before entering opposing traffic. Examples: Blackburn Hamlet Bypass, numerous 400 series highways in Ontario.

The narrow raised option was screened out for the identified safety reasons. The flush median with rumble strips was screened out on the basis that its safety benefit is more limited, and that it's better suited for retrofit situations. While the depressed median ditch has excellent safety characteristics, it increases the property requirements considerably. This increases project costs, increases impacts on the natural environment and increases impacts on adjacent land uses. The wide raised median is the recommended solution for the urban cross-section as it has a good balance of proven safety characteristics and property requirements (see Figure 1-2).

Median division for the two-lane rural cross-section was considered, but screened out. Medians are not typically provided on two-lane roads for several reasons. The lower traffic volumes result in reduced probability of collision and the generous outside shoulders give a good recovery area for vehicles to take evasive action to avoid an oncoming vehicle encroaching into their lane. The addition of a median would preclude passing, which would be expected to increase driver

frustration when caught behind slow vehicles for the full length of the segment. Frustrated drivers are known to be more likely to make aggressive moves and engage in unsafe driving behaviour.

1.4 **Pedestrian and Cyclist Alternatives**

The construction of new and renewed transportation infrastructure provides the opportunity to accommodate pedestrians and cyclists in accordance with the policies and objectives in the City's OP and TMP in supporting active transportation alternatives and complete streets.

For pedestrians, alternatives that have been evaluated include:

1. No walking facility
2. 2m sidewalks along one or both sides of the corridor
3. 3m multi-use pathway along one or both sides of the corridor

For cyclists, alternatives that have been evaluated include:

1. No cycling facility
2. Wide paved shoulders along the outer edges of rural cross-sections, in each direction
3. On-road painted bike lanes along the outer edges of urban cross-sections
4. Uni-directional cycle tracks along the edge of urban cross-sections
5. Bi-directional bike-one facility along one or both sides of the corridor

The following considerations influenced the evaluation of alternative designs for pedestrian and cyclists:

- Traffic speed and volume
- Anticipated pedestrian and cyclist demand
- Presence of existing facilities within the corridor that can fulfill the need
- Abutting land use
- Access for pedestrians and cyclists to the lands along the road edge
- Opportunities for route illumination
- Opportunities to provide safe crossings
- The requirement for universal accessibility
- Cost to construct and maintain the facilities

On the basis of the evaluation, and in consideration of the surrounding existing and planned use contexts, it is recommended that a multi-use pathway be provided on the north side of the corridor, nearer to the urban boundary, under a rural cross-section configuration. When the roadway is widened, and converted to an urban cross-section, the recommended facility is 2m sidewalk and a 1.8m cycle track on each side of the roadway. These facilities are also illustrated in Figures 1-2 and 1-3.

1.5 **Corridor Lighting Alternatives**

The extension of Earl Armstrong Road is an Arterial Road within the City's road network, and lighting is to be provided in accordance with the City's Right-of-Way Lighting Policy (City of Ottawa, 2016), that may be updated from time to time. Providing for proposed pedestrian and

cycling facilities is also an important consideration. The following considerations have been reviewed in determining an appropriate lighting strategy for the corridor:

1. Locations and offsets of lighting poles, having regard for roadway safety;
2. Opportunities for corridor lighting to be dual-purpose, serving the needs of the roadway as well as illuminating adjacent sidewalks and/or multi-use pathways
3. Symmetry of the lighting solution
4. Visual environment
5. Nighttime environment for wildlife
6. Cost to construct and maintain the system including impacts related to climate change (extreme wind, heat and cold, and snow and precipitation).

On this basis, the following performance standards are recommended to be part of the design for the extension of Earl Armstrong Road:

- For phases or segments that are designed as rural cross-sections
  - Install a new road-edge roadway lighting system on the north side of the roadway
  - During the detailed design phase, evaluate whether the “back lighting” effect of the roadway lighting is an appropriate level of illumination for the multi-use pathway.
- For phases or segments that are designed as urban cross-sections
  - Install a new road-edge lighting system on both sides of the roadway
  - Design the new road-edge lighting system to have sufficient “back lighting” to illuminate the cycle track and sidewalk.

1.6 **Noise Attenuation**

The extension of Earl Armstrong Road is an Arterial Road within the City’s road network. As an Arterial Road, it is designated to accommodate the highest volumes of traffic travelling over the highest distances and a relatively high speed. The corridor will be a source of noise and it is important to consider the impacts on adjacent noise sensitive receivers including the outdoor living spaces of residential and institutional uses. A preliminary noise and vibration impact assessment has been completed**.** The assessment aligns with the municipal and provincial guidelines that apply to transportation projects.

Future vibrations associated with the long-term operation of the roadway are expected to fall below perceptible levels for existing sensitive receivers by the project area.

For noise, key criteria include:

- Noise sensitive receivers are identified as the rear or exposed side yard amenity areas of residential dwellings and other sensitive land uses; and
- For residential dwellings, the noise sensitive location of concern is the outdoor amenity area located 3.0m behind the rear wall of the dwelling, and 1.5m above the ground.

Where the forecasted noise levels at sensitive receivers are higher than 60 dBA from the resulting ultimate build out condition for the project, noise attenuation is investigated. Where technically, administratively, and economically feasible, noise attenuation will be provided as part of the project. However, this 60 dBA threshold is not met for this project.

Based on the distance from the proposed roadway to existing sensitive receivers and the forecasted noise levels, noise attenuation is not required as part of this project.

1.7 **Design Parameters for the Extension of Earl Armstrong Road**

Table 1-3 Detailed Design Parameters for the Earl Armstrong Road Extension

Design Parameter	Proposed Standard	Technical Reference
Classification	Rural Arterial	City Transportation Master Plan (TMP)
No. Lanes	4 (Albion to Bank) 2 (Bank to Hawthorne)	Environmental Study Report
Truck Route	Yes, full loads	City Transportation Master Plan (TMP)
Requirement for Median Division (Urban)	Yes, 5.0m raised median with curbs and grass surface	Design choice, TAC Synthesis of Practices for Median Design Section 9.1, safety history of Ottawa roads
Requirement for Median Division (Rural)	No	Design choice, TAC Synthesis of Practices for Median Design Section 9.1, safety history of Ottawa roads
Posted Speed	80 km/h	Typical posted speed for rural arterials
Design Speed	90 km/h	Selected based on posted speed and desire to discourage excessive operating speeds
Driving Lane Width (Rural)	3.50m	TAC Geometric Design Guide for Canadian Roads (GDG) Table 4.2.2
Driving Lane Width (Urban)	3.50m + 0.25m curb offset	TAC GDG Table 4.2.3 Match rural lane widths to respect the principles of TAC GDG Section 2.7.2
Shoulder Width (Rural)	3.0m partially paved shoulder with rumble strip and beveled safety edge (plus 0.5m granular rounding)	TAC GDG Table 4.4.1
Clear Zone	8.0m - 10.0m	TAC GDG Table 7.3.1
Rural Ditch Fore Slope	4:1	TAC GDG Table 7.4.1.1 – provide a recoverable foreslope while minimizing ROW requirements
Rural Ditch Flat Bottom Width	2.4m	TAC GDG Figure 7.4.3 – minimum width to assist with slope change criteria

Design Parameter	Proposed Standard	Technical Reference
		Allow for stormwater management BMP
Rural Ditch Back Slope	4:1	TAC GDG Figure 7.4.3 – meet criteria for traversable slope change at bottom of ditch
Sidewalk Width	2m (including 0.2m tactile warning strip if adjacent to cycle track)	Various
Cycle Track Width	1.8m	OTM Book 18
Crossride Offset at Intersections	5m	Emerging Ottawa standard
Multi-Use Pathway Width	3.0m	OTM Book 18, Table 4.7, emerging Ottawa standard
Maximum Superelevation	4%	TAC GDG Section 3.2.2.4, considering likely future intersections
Minimum Horizontal Radius	380m (at 4.0% superelevation) 1500m (reverse crown) 3000m (normal crown)	TAC GDG Table 3.2.3 TAC GDG Table 3.2.5 TAC GDG Table 3.2.5
Minimum Tangent Runout	56m	TAC GDG Section 3.2.4.5
Minimum Vertical Curve – Crest "K" (stopping sight distance)	39	TAC GDG Table 3.3.2
Minimum Vertical Curve – Sag "K" (stopping sight distance)	38 (non-illuminated) 20 (illuminated)	TAC GDG Table 3.3.4 TAC GDG Table 3.3.5
Minimum Gradient	0.5 %	TAC GDG Section 3.3.2.5
Maximum Gradient	4%	TAC GDG Table 3.3.1
Surface Type	Hot Mix Asphalt	Design choice, standard City of Ottawa practice
Traffic volumes	See table 1-4	Environmental Study Report
% Commercial Vehicles	10%	Environmental Study Report
Roundabout Diameter	46m – 67m	TAC Canadian Roundabout Design Guide

Table 1-4 Traffic Volumes for the Earl Armstrong Road Extension

Segment	*Estimated for year 2048*		
	Directional PHV	**Two-way AADT***	**Commercial Vehicles (estimated)**
Albion to Bank	1,000 veh/h	15,000 veh/day	10%
Bank to Hawthorne	800 veh/h	10,000 veh/day	10%

**estimated using standard factor for reference in determining design criteria only*