Evaluation of Alternative Designs

Schedule 'C' Municipal Class Environmental Assessment for
Regional Road 37 (Merritt Road) and Regional Road 54 (Rice Road) in the
Town of Pelham, City of Thorold, and City of Welland, Ontario

Prepared for:

Niagara Region

25 November 2021

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Prepared for:

Niagara Region

Prepared by:

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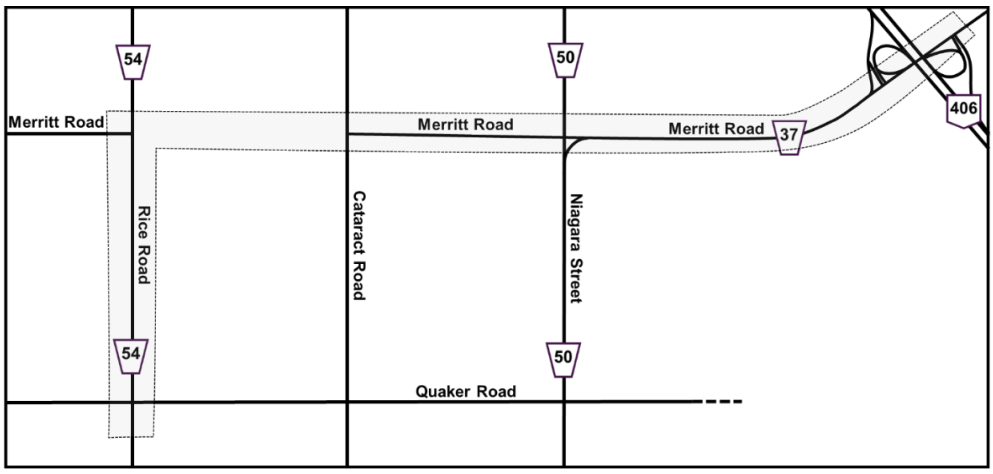
1.0 Introduction

The Regional Municipality of Niagara (Niagara Region) has retained Wood Environment & Infrastructure (Wood) to undertake a Schedule 'C' Municipal Class Environmental Assessment (MCEA) Study for improvements to Regional Road 37 (Merritt Road) and Regional Road 54 (Rice Road), in the Town of Pelham, City of Thorold, and City of Welland, Ontario. The Study Area includes the following four road segments (Figure 1-1):

- Segment 1 – Merritt Road between Rice Road and Cataract Road
- Segment 2 – Merritt Road between Cataract Road and Merrittville Highway / Niagara Street
- Segment 3 – Merritt Road between Merrittville Highway / Niagara Street and Highway 406
- Segment 4 – Rice Road between Merritt Road and Quaker Road

Figure 1-1: Study Area



Building on the recommendations of the Niagara Region's Transportation Master Plan (IBI Group et al., 2017), this Study is being carried out in accordance with the requirements of Phases 1 to 4 outlined in Municipal Class Environmental Assessment document (Municipal Engineers Association, October 2000, as amended in 2007, 2011 & 2015).

This document was prepared to document Municipal Class EA Phase 3 (Alternative Design Concepts) for this project. Municipal Class EA Phases 1 and 2 (Problem and Opportunity Statement and Identification and Evaluation of Alternative Solutions) for this project were addressed under a separate cover.

2.0 Alternative Design Concepts

2.1 Approach to Identification and Evaluation of Alternative Design Concepts

Phase 3 of the Municipal Class EA process involves development and evaluation of alternative design concepts for the Preferred Solution. For this project, Alternative 5 – Improve Merritt Road and Rice Road was identified as the preferred solution. This would involve the following:

- Extension of Merritt Road between Rice Road and Cataract Road;
- Improvements to Merritt Road between Cataract Road and Highway 406;
- Improvements to Rice Road between 200m north of Merritt Road and Quaker Road;
- Localized intersection improvements, such as addition of dedicated turn lanes, and traffic signals/roundabouts and/or improvement of the timing of the existing traffic signal at Merritt Road and Niagara Street intersection to improve traffic operations; and
- Providing active transportation facilities on both Merritt Road and Rice Road.

Accordingly, in accordance with the Phase 3 of the Municipal Class EA process, alternative design concepts were identified and evaluated to identify a preliminary preferred design. This process was generally comprised of the following four steps:

- Step 1: Identification of constraints
- Step 2: Identification of alternative design concepts
- Step 3: Identification of evaluation criteria
- Step 4: Evaluation of alternative design concepts to identify a preliminary preferred design

The alternative design concepts were developed using direction from the Niagara Region's Complete Street Design Manual, that were being developed at the time of this exercise. The following sections discuss the design constraints, alternative design concepts, their evaluation process and the preliminary preferred design concept for this project.

2.1.1 Constraints Identification

At the commencement of Municipal Class EA Phase 3, constraints were identified that may pose challenges from a design perspective. These constraints were identified through a review of various information sources, including, but not limited to:

- Make A Map: Natural Heritage Areas (Ministry of Northern Development, Mines, Natural Resources and Forestry, 2021)
- Niagara Region Official Plan (Niagara Region, 2015)
- Niagara Navigator (Niagara Region, 2021a)
- Niagara Open Data (Niagara Region, 2021b)
- Niagara Peninsula Conservation Authority Open Data and Watershed Explorer (Niagara Peninsula Conservation Authority, 2021)
- Draft Northwest Welland Secondary Plan (City of Welland, 2020)

Constraints identified for each segment are outlined in Table 2-1.

Table 2-1: Design Constraints Identification of Alternative Designs

Road Segment	Design Constraint
Segment 1: Merritt Road (Rice Road to Cataract Road)	**Utilities:** There are utility poles located along the north side of Segment 1. Relocation of these poles will pose additional costs to the project. **Natural Environment:** The Segment 1 crosses various natural environment features related to the Niagara Region's Core Natural Heritage as identified in the Schedule C of the Niagara Region's Official Plan (Niagara Region, 2015). Impacts on the natural environment features will be documented and mitigation to offset impacts will be proposed. **Private Properties:** There are private properties located to the north and south of the Segment 1. Impacts on adjacent private properties will be minimized through the alternative design identification process. **Future Road Cross-section:** The Niagara Region is in the process of developing a Complete Streets Design Manual. Based on this forthcoming document, the future road cross-section for Segment 1 is classified as Rural Scenic typology with 20-26 metres right of way width. **Active Transportation:** Guidance in the forthcoming Complete Street Design Manual is to separate bicycle lanes from the vehicular traffic lanes to provide safety to cyclists. This will be considered in the alternative design identification process.
Segment 2: Merritt Road (Cataract Road to Merrittville Highway / Niagara Street)	**Utilities:** There are utility poles located along the north side of Segment 2. Relocation of these poles will pose additional costs to the project. **Natural Environment:** There are natural environment features (Core Natural Heritage) located to the north (further to the east) and south of Segment 2 (Niagara Region, 2015). Impacts on the natural environment features will be documented and mitigation to offset impacts will be proposed. **Private Properties:** There are private properties located to the north and south of the Segment 2. Impacts on adjacent private properties will be minimized through the alternative design identification process. **Existing and Future Road Cross-section:** The existing right of way width for Segment 2 is 20 metres. Based on the forthcoming Complete Streets Design Manual, the future road cross-section for Segment 2 is classified as Urban General (Narrow) typology, with 20-26 metres right of way width (see note below on Stormwater Management). **Active Transportation:** Guidance in the forthcoming Complete Street Design Manual is to separate bicycle lanes from the vehicular traffic lanes to provide safety to cyclists. This will be considered in the alternative design identification process. **Stormwater Management:** Analysis of this segment identified that a storm sewer system would not be feasible due to the flat terrain and lack of depth of cover (for a storm sewer system). Ditches will be required along this segment. In addition, the south ditch will need to be a minimum of 4.0 m to adequately convey stormwater.

Road Segment	Design Constraint
Segment 3: Merritt Road (Merrittville Highway / Niagara Street to Highway 406)	**Utilities:** There are utility poles located along the north side of Segment 3. Relocation of these poles will pose additional cost to the project. **Natural Environment:** There are natural environment features (Core Natural Heritage) located to the north and south of Segment 3 (Niagara Region, 2015). Impacts on the natural environment features will be documented and mitigation to offset impacts will be proposed. **Private Properties:** There are private properties located to the north and south of the Segment 3. Impacts on adjacent private properties will be minimized through alternative design identification process. **Existing and Future Road Cross-section:** The existing right of way width for Segment 3 is 30 metres. Based on the forthcoming Complete Streets Design Manual, the future road cross-section for Segment 3 is classified as Urban General (Wide) typology, with 26-36 metres right of way width. **Active Transportation:** Guidance in the forthcoming Complete Street Design Manual is to separate bicycle lanes from the vehicular traffic lanes to provide safety to cyclists. This will be considered in the alternative design identification process. **Pedestrian and Cyclist Safety:** Provision of active transportation facility along the north side of Segment 3 may cause pedestrian and cyclist safety concerns due to traffic coming off Highway 406 and going onto Merritt Road westbound. **Highway 406 Bridge:** The existing Highway 406 bridge structure cannot be widened. Provision of active transportation facilities at this location will be constrained by the existing width.
Segment 4: Rice Road (200m north of Merritt Road to Quaker Road)	**Utilities:** There are utility poles located along the east and west side of Segment 4. Relocation of these poles will pose additional costs to the project. **Natural Environment:** A Natural Environment Area is located along Rice Rd (Niagara Region, 2015). The natural environment will be assessed, and presence determined. Impacts on the natural environment features will be documented and mitigation to offset impacts will be proposed. **Private Properties:** There are private properties located on the east and west side of the Segment 4. Impacts on adjacent private properties will be minimized through alternative design identification process. **Existing and Future Road Cross-section:** The existing right of way width for Segment 4 is 20 metres. Based on the forthcoming Complete Streets Design Manual, the future road cross-section for Segment 4 is classified as Urban General (Wide) typology, with 26-36 metres right of way width (see note below on Stormwater Management). **Active Transportation:** Guidance in the forthcoming Complete Street Design Manual is to separate bicycle lanes from the vehicular traffic lanes to provide safety to cyclists. This will be considered in the alternative design identification process. **Stormwater Management:** Analysis of this segment identified that a storm sewer system would not be feasible due to the flat terrain and lack of depth of cover (for a storm sewer system). Ditches will be required along this segment.

2.1.2 Identification and Evaluation of Alternative Design Concepts

Alternative design concepts were identified for the following:

- Road Alignment Alternatives
- Road Cross-Section Alternatives
- Road Intersection Alternatives

To identify the impacts and advantages of each alternative design concept, evaluation criteria were developed related to transportation, socio-economic, natural, and cultural environments and technical and cost considerations. These criteria were chosen based on their ability to identify potential positive and negative effects of each alternative and distinguish the advantages and disadvantages between them. The evaluation criteria that were used for the evaluation of alternative design concepts is presented in sub-sections below. The alternatives were assigned a score based on the scoring system presented below:

○	◔	◑	◕	●
Highest negative impacts or lowest benefits	Higher negative impacts or lower benefits	Moderate negative impacts and benefits	Lower negative impacts or greater benefits	Lowest negative impacts or greatest benefits

Alternatives represented by a full dark circle symbol were given the highest score where the evaluation criteria resulted in the lowest anticipated impacts, or highest benefits from the alternative. In cases where the alternative had the highest anticipated impact or lowest benefit according to the evaluation criteria, a lowest score respresented by white circle with black outline was assigned.

Accordingly, circles shaded one-quarter, half, or three-quarters, represented a range between higher negative impacts or lower benefits, moderate negative impacts and benefits and lower negative impacts or greater benefits.

2.2 Road Alignment Alternatives

2.2.1 Identification of Road Alignment Alternatives

Table 2-2 lists the road alignment alternatives that were identified as part of Phase 3 of the Class EA process for this project. These alternatives and their evaluation process are discussed in further detail in subsections below.

Table 2-2: Road Alignment Alternatives

Road Segment	Alternatives for Cross-Sections
Segment 1: Merritt Road (Rice Road to Cataract Road)	Alternative A: Centre Alignment Alternative B: Hybrid Alignment
Segment 2: Merritt Road (Cataract Road to Merrittville Highway / Niagara Street)	Alternative A: Centre Alignment Alternative B: South Alignment Alternative C: Hybrid Alignment
Segment 3: Merritt Road (Merrittville Highway / Niagara Street to Highway 406)	Alternative A: Centre Alignment Alternative B: North Alignment Alternative C: North Alignment with Adjusted Curve
Segment 4: Rice Road (200m north of Merritt Road to Quaker Road)	Alternative A: Centre Alignment Alternative B: Hybrid Alignment

2.2.2 Evaluation Criteria for Road Alignment Alternatives

Following evaluation criteria was identified to evaluate the road alignment alternatives:

Table 2-3: Evaluation Criteria for Alternative Alignments

Factor	Evaluation Criteria
Transportation	**Safety/Road Geometry:** Ability to improve sightlines and horizontal alignment and ability to provide safe access to driveways and properties along the corridor
Socio-economic Environment	**Private Property Impacts:** Private property taking **Lifestyle Disruption:** Potential for lifestyle disruption effects to residents such as noise or visual impacts **Agricultural Land:** Potential for loss of agricultural land
Natural Environment	**Terrestrial Environment:** Impacts on terrestrial resources (vegetation, wetlands, trees and wildlife) **Aquatic Environment:** Impacts to fish and fish habitats
Cultural / Archaeological Environment	**Archaeological Resources:** Impacts on lands identified to retain potential archaeological resources **Built Heritage and Cultural Resources:** Impacts on built heritage and cultural heritage landscapes
Engineering/Constructability	**Utilities:** Impacts on utilities **Drainage:** Impacts on existing culverts and ditches and ability to facilitate drainage systems

2.2.3 Evaluation of Road Alignment Alternatives for Segment 1

The following two alignment alternatives were identified for Road Segment 1: Merritt Road (Rice Road to Cataract Road). Both alignment alternatives are comprised of a 26 m wide road right of way based on the Rural Scenic typology according to the Region's Complete Streets Design Guidelines.

- **Alternative A: Centre Alignment:** This alternative would involve a 26 m wide road right of way alignment along the centreline of the unopened road allowance. This alternative is shown in Figure 2-1.
- **Alternative B: Hybrid Alignment:** This alternative would involve a 26 m wide road right of way alignment with the eastern section to be shifted slightly southward to align with the road alignment in Segment 2. This alternative is shown in Figure 2-2.

The evaluation of road alignment alternatives for Segment 1 is provided in Table 2-4.

Figure 2-1: Segment 1 - Alternative A: Centre Alignment

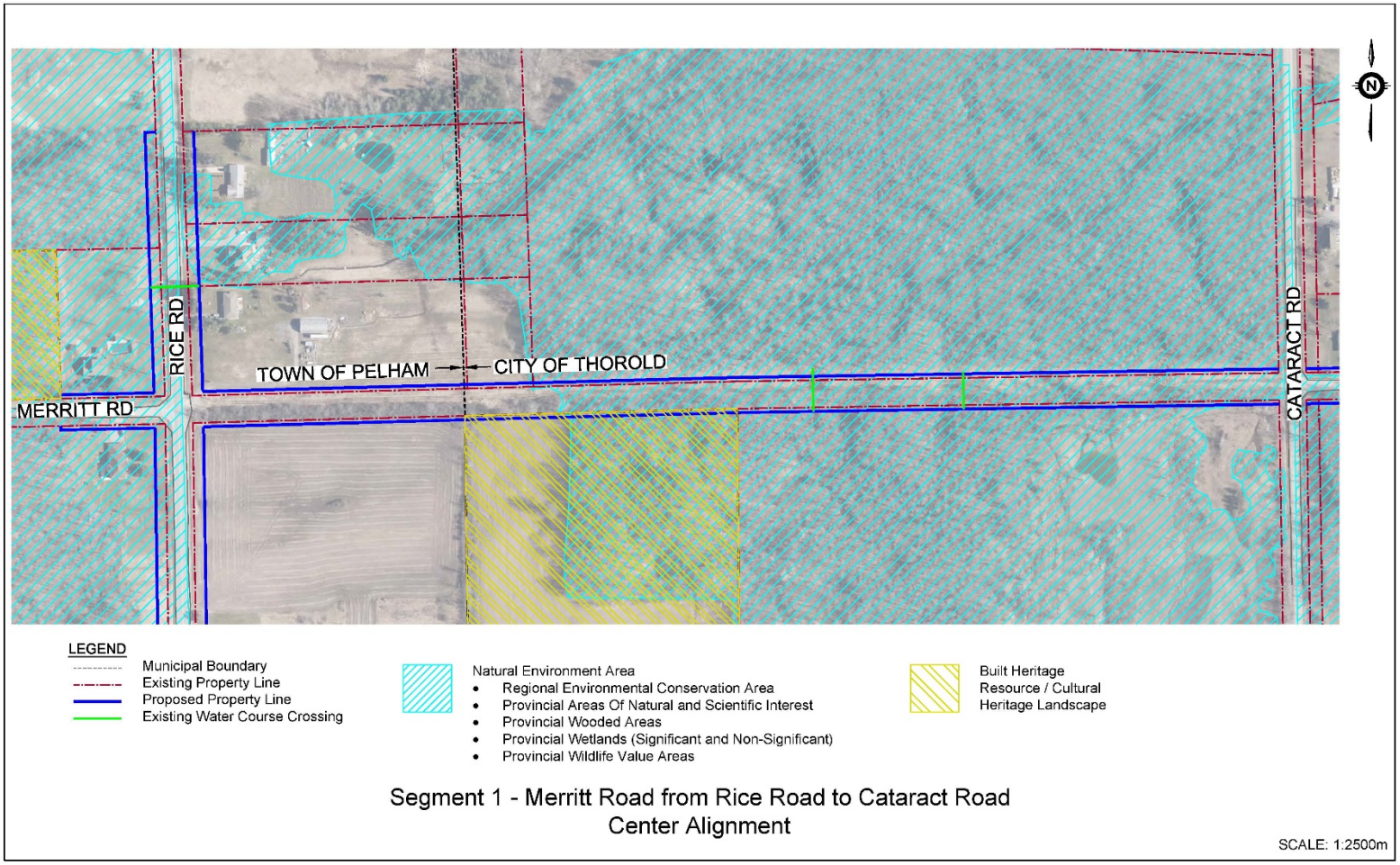


Figure 2-2: Segment 1 - Alternative B: Hybrid Alignment

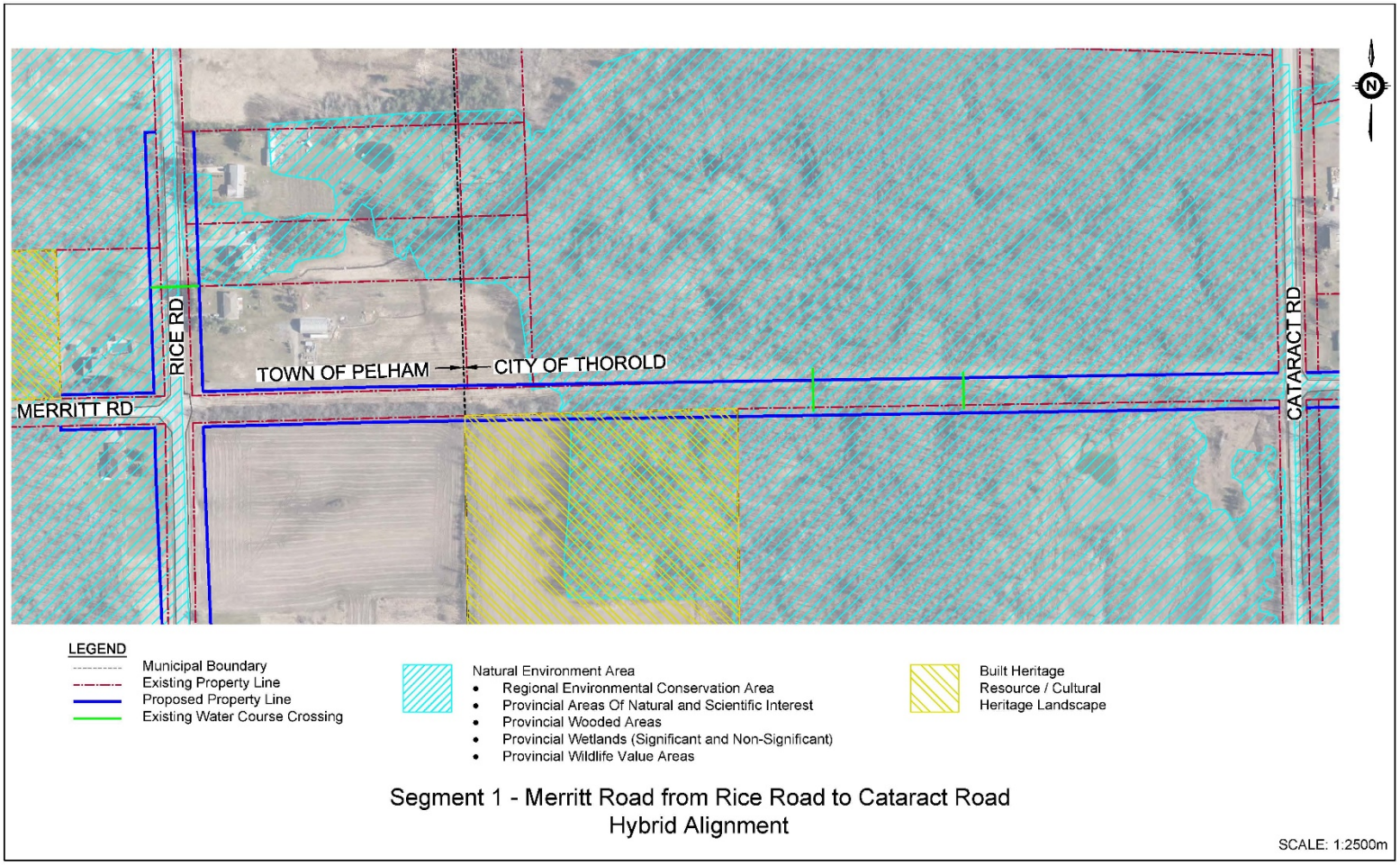


Table 2-4: Evaluation of Road Alignment Alternatives for Segment 1

Evaluation Criteria	Alternative A: Centre Alignment	Score	Alternative B: Hybrid Alignment	Score
Transportation				
Safety/Road Alignment: Ability to improve sightlines and horizontal alignment and ability to provide safe access to driveways and properties along the corridor	This option would result in a straight alignment. If the intersections on the either end are signalized, the centreline will match the centreline on the adjoining road section (Merritt Road to the west). The preferred alignment on Merritt Road east of the segment (Segment 2) would be shifted to the south and would result in the intersection of Merritt Road and Cataract Road being slightly offset at the intersection and is considered less desirable. Sightlines will be unlimited. Straight alignment may encourage higher operating speeds. There is an existing access to a property at the corner of Rice Road and Merritt Road. This access will be shifted such that an appropriate access is provided either along Merritt Road or along Rice Road.	●	This option would result in a slight curvature of the roadway. If the intersections on the either end are signalized, the centreline will match the centreline on both ends of the segment (Merritt Road west of the study area and Segment 2). Sightlines will be essentially unlimited. Essentially straight alignment may encourage higher operating speeds. There is an existing access to a property at the corner of Rice Road and Merritt Road. This access will be shifted such that an appropriate access is provided either along Merritt Road or along Rice Road.	●
Socio-economic Environment				
Private Property Impacts: Private property taking	Around 0.47 ha of private property area will be required. No complete private property buyouts will be required.	◕	Around 0.49 ha of private property area will be required. No complete private property buyouts will be required.	◕
Lifestyle Disruption: Potential for lifestyle disruption effects to residents such as noise or visual impacts	No residential development on either side of the roadway. No difference in noise and visual impacts between the two alignment options.	●	No residential development on either side of the roadway. No difference in noise and visual impacts between the two alignment options.	●
Agricultural Land: Potential for loss of agricultural land	Minor loss of agricultural land.	◕	Minor loss of agricultural land.	◕
Natural Environment				
Terrestrial Environment: Impacts on terrestrial resources (vegetation, wetlands, trees and wildlife)	Removal of 1.38 ha of natural area will be required. This natural area is comprised of Regional Environmental Conservation Area; Provincial Areas of Natural and Scientific Interest; Provincial Wooded Areas; Provincial Wetlands (significant and non-significant); and Provincial Wildlife Value Areas. Where possible, the impacts will be offset or minimized through mitigation measures and design refinements (e.g., removing vegetation outside of the general migratory bird nesting period (April 1 to August 31)). In addition, this alternative will impact White Wood Aster, a species at risk plant, with "Endangered" status under the Endangered Species Act. Consultation will be completed with the Ministry of the Environment, Conservation and Parks to identify permitting requirements associated with impacts to species at risk.	○	Removal of 1.36 ha of natural area will be required. This natural area is comprised of Regional Environmental Conservation Area; Provincial Areas of Natural and Scientific Interest; Provincial Wooded Areas; Provincial Wetlands (significant and non-significant); and Provincial Wildlife Value Areas. Where possible, the impacts will be offset or minimized through mitigation measures and design refinements (e.g., removing vegetation outside of the general migratory bird nesting period (April 1 to August 31)). In addition, this alternative will impact White Wood Aster, a species at risk plant, with "Endangered" status under the Endangered Species Act. Consultation will be completed with the Ministry of the Environment, Conservation and Parks to identify permitting requirements associated with impacts to species at risk.	○
Aquatic Environment: Impacts to fish and fish habitats	This road alignment alternative crosses two watercourses, one of which provides for fish habitat, and the other provides potential seasonal fish habitat. In order to minimize impacts on fish and fish habitat, mitigation measures will be carried out (e.g., completing construction during prescribed in-water works timing windows, and installing erosion and sediment control). Watercourse connectivity will be retained.	◑	This road alignment alternative crosses two watercourses, one of which provides for fish habitat, and the other provides potential seasonal fish habitat. In order to minimize impacts on fish and fish habitat, mitigation measures will be carried out (e.g., completing construction during prescribed in-water works timing windows, and installing erosion and sediment control). Watercourse connectivity will be retained.	◑
Cultural Environment				
Archaeological Resources: Impacts on lands identified to retain potential archaeological resources	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required during detailed design to identify any archaeological resources and associated mitigation measures.	◑	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required during detailed design to identify any archaeological resources and associated mitigation measures.	◑
Built Heritage and Cultural Resources: Impacts on built heritage and cultural heritage landscapes	Minor impacts to one property identified as potential cultural heritage landscape. A Heritage Impact Assessment may be required during detailed design to confirm cultural significance of this property and appropriate measures.	◕	Moderate impacts to one property identified as potential cultural heritage landscape. A Heritage Impact Assessment will be required during detailed design to confirm cultural significance of this property and mitigation measures.	◑

Evaluation Criteria	Alternative A: Centre Alignment	Score	Alternative B: Hybrid Alignment	Score
Engineering				
Utilities: Impacts on utilities	Utility relocation will be required for one utility. Coordination will be required with utility company to relocate utilities.	◕	Utility relocation will be required for one utility. Coordination will be required with utility company to relocate utilities.	◕
Drainage: Impacts on existing culverts and ditches and ability to facilitate drainage systems	This roadway segment is currently undeveloped and therefore would not impact any existing infrastructure. This proposed roadway alignment alternative would require two (2) new hydraulic structures to ensure watercourse connectivity both north and south of the proposed roadway is maintained.	◑	This roadway segment is currently undeveloped and therefore would not impact any existing infrastructure. This proposed roadway alignment alternative would require two (2) new hydraulic structures to ensure watercourse connectivity both north and south of the proposed roadway is maintained.	◑
Overall Recommendation	**Recommended**		**Not Recommended**	

2.2.3.1 Preliminary Preferred Road Alignment for Segment 1

Based on the evaluation presented in Table 2-4, **Alternative A: Centre Alignment** was identified as the preliminary preferred design for Segment 1. This alternative would involve a 26 m wide road right of way alignment along the centreline of the unopened road allowance. The preliminary preferred road alignment for Segment 1 is shown in Figure 2-1.

2.2.4 Evaluation of Road Alignment Alternatives for Segment 2

The following three alignment alternatives were identified for Road Segment 2: Merritt Road (Cataract Road to Merrittville Highway / Niagara Street). All three alignment alternatives are comprised of a 26 m wide road right of way based on Urban General Narrow typology.

- **Alternative A: Centre Alignment:** This alternative would involve widening the existing road to 26 m road right of way equally about the existing road centreline. This alternative is shown in Figure 2-3.
- **Alternative B: South Alignment:** This alternative would involve widening the existing road to 26 m road right of way to the south. This alternative is shown in Figure 2-4.
- **Alternative C: Hybrid Alignment:** This alternative would involve widening the existing road to 26 m wide road right of way alignment with the eastern section to be shifted slightly northward to align with road alignment in Road Segment 3. This alternative is shown in Figure 2-5.

The evaluation of road alignment alternatives for Segment 2 is provided in Table 2-5.

Figure 2-3: Segment 2 - Alternative A: Centre Alignment (Widen to the north and south equally about centreline)

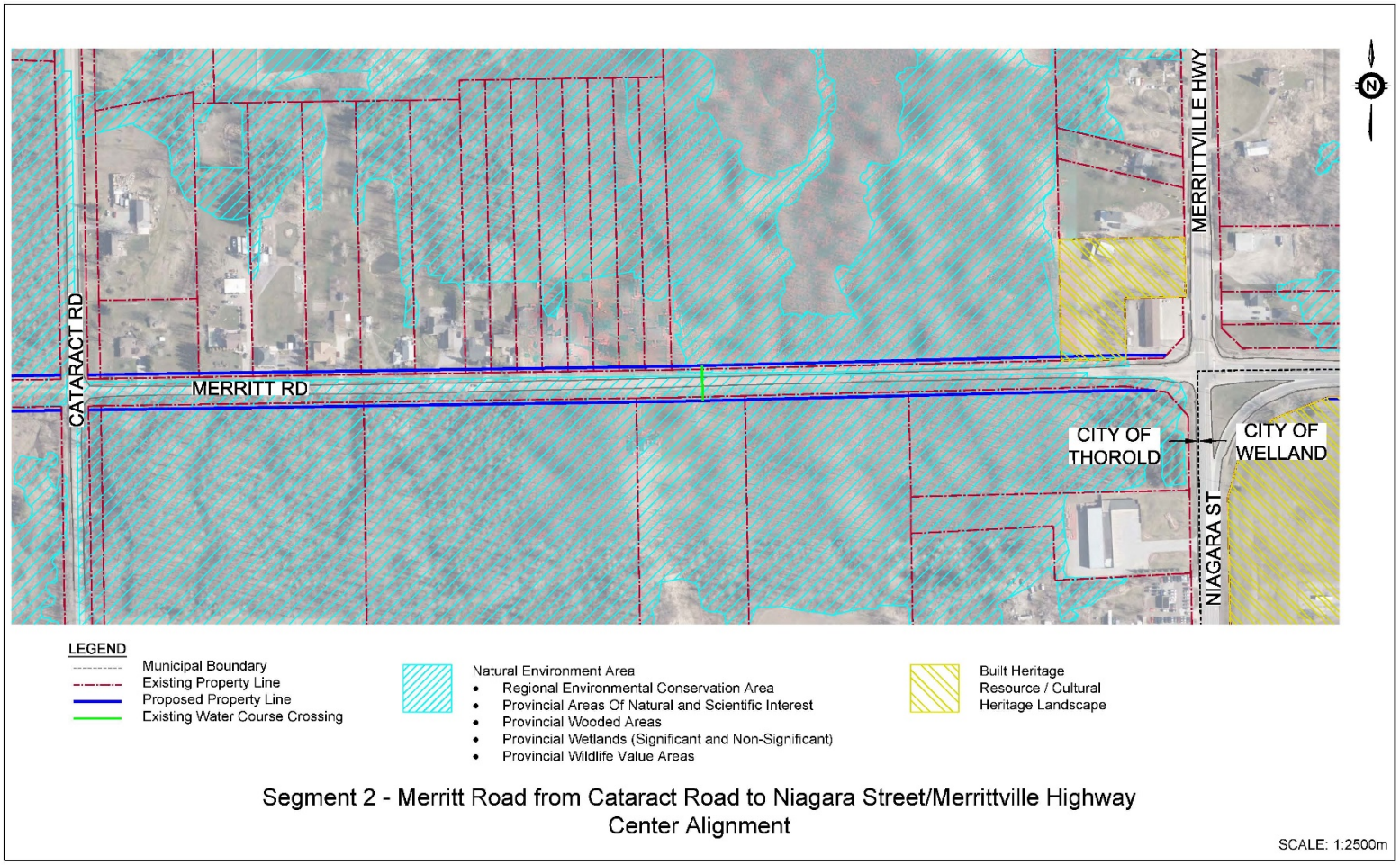


Figure 2-4: Segment 2 - Alternative B: South Alignment (Widen to the south)

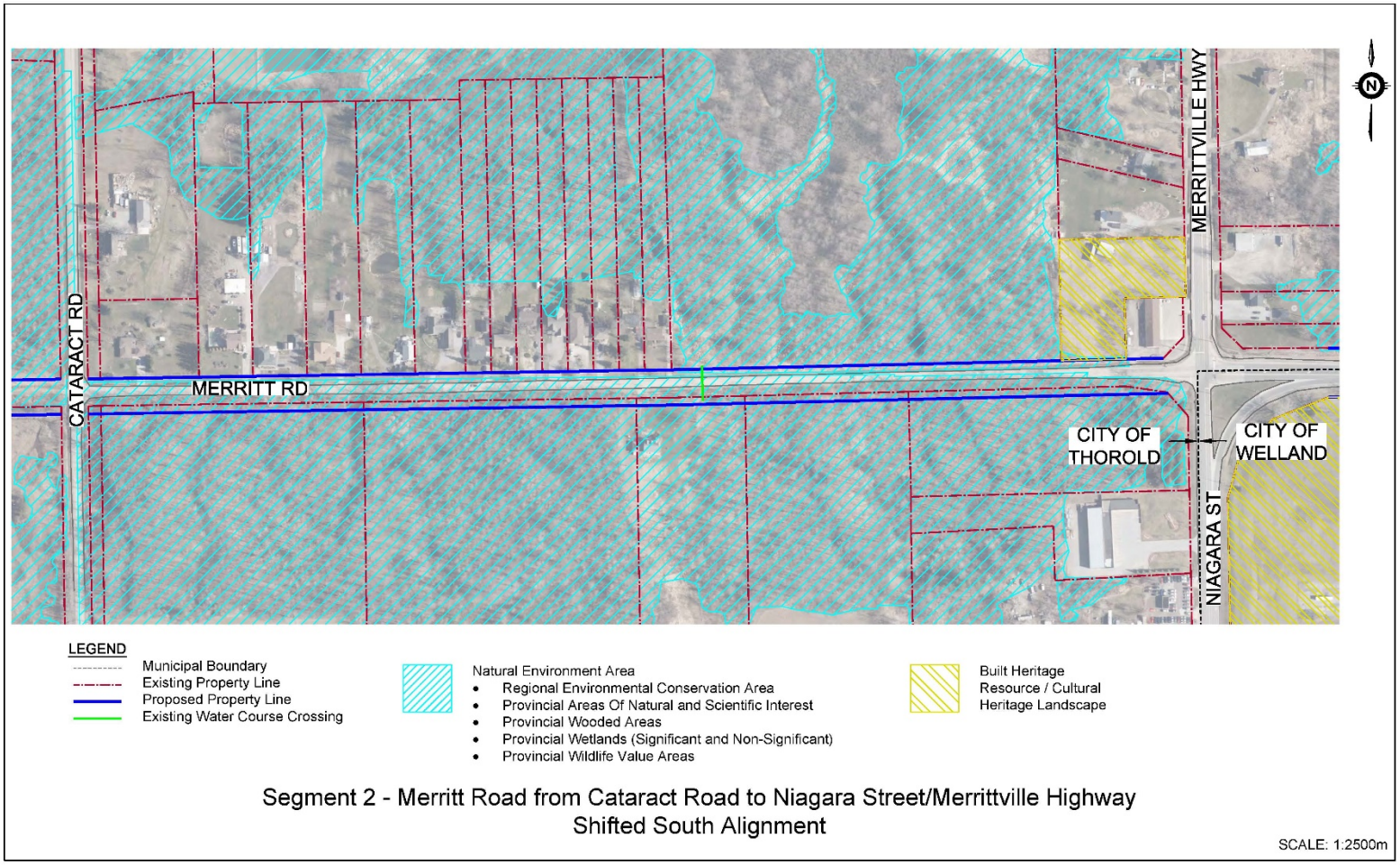


Figure 2-5: Segment 2 - Alternative C: Hybrid Alignment

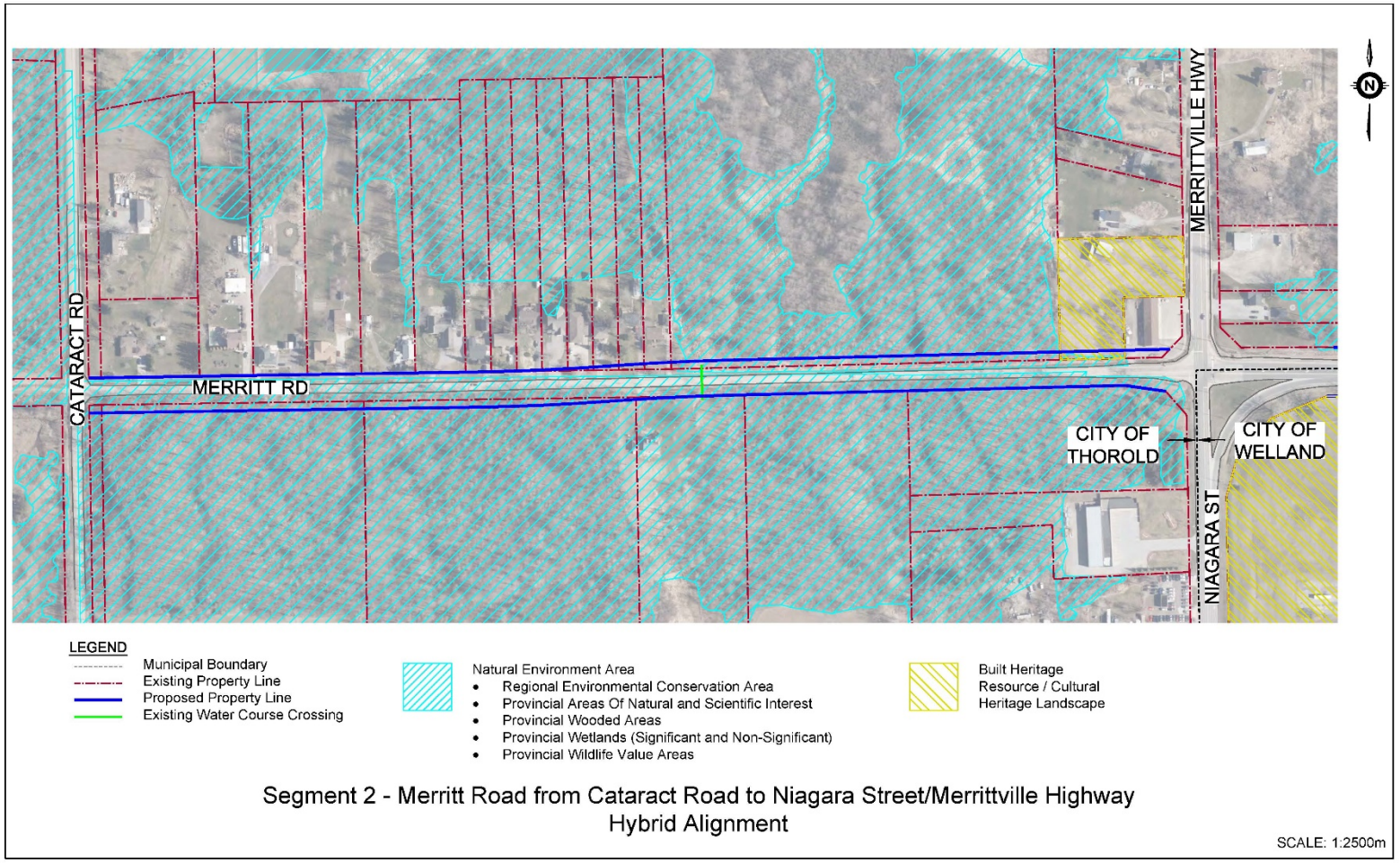


Table 2-5: Evaluation of Road Alignment Alternatives for Segment 2

Evaluation Criteria	Alternative A: Central Alignment	Score	Alternative B: South Alignment	Score	Alternative C: Hybrid Alignment	Score
Transportation						
Safety/Road Alignment: Ability to improve sightlines and horizontal alignment and ability to provide safe access to driveways and properties along the corridor	This option would result in a straight alignment. This alignment would limit options for Segment 3 (flattening the horizontal curve on east approach to Merrittville Highway/Niagara Street. Sightlines will be unlimited. A straight alignment may encourage higher operating speeds. The proposed improvements will provide safe access to properties.	◑	This option would result in a straight alignment. If the traffic signal at Merrittville Highway / Niagara Street remains, this alignment would match the preferred option considered for Segment 3 (flattening the horizontal curve on east approach to Merrittville Highway/Niagara Street. Sightlines will be unlimited. Straight alignment may encourage higher operating speeds. The proposed improvements will provide safe access to properties.	◕	This option would result in a gentle horizontal curve midway through the segment, the curve meets TAC Geometric Design Guidelines for a 60 km/h design speed and may result in an increase in run off the road collisions. If the traffic signal at Merrittville Highway / Niagara Street remains, this alignment would not match the preferred option considered for Segment 3 (flattening the horizontal curve on east approach to Merrittville Highway/Niagara Street, resulting in a poorly aligned intersection. Sightlines will be reduced due to the introduction of the horizontal curve. The curved alignment may 'calm' traffic through this segment. The proposed improvements will provide safe access to properties.	◔
Socio-economic Environment						
Private Property Impacts: Private property taking	There will be loss of aesthetic and financial value to three residences because of the road right of way limit being closer to them. In addition, approximately 0.45 ha of private property area will be required. No complete private property buyouts will be required.	○	Approximately 0.45 ha of private property area will be required. No impacts to aesthetic or financial values of residences, as the road right of way limit matches the existing right of way/property limit to the north. No complete private property buyouts will be required.	◕	Approximately 0.46 ha of private property area will be required. No impacts to aesthetic or financial values of residences, as the road right of way limit matches the existing right of way/property limit to the north. In addition, complete buyout will be required for one private commercial property.	○
Lifestyle Disruption: Potential for lifestyle disruption effects to residents such as noise or visual impacts	In the short-term, the residents along this segment will be temporarily impacted due to construction related activities, however, those impacts can be reduced. In the long-term, while the proposed improvements will improve the aesthetics along the corridor by providing landscaping and active transportation facilities, the proposed sidewalk and cycle track will be very close to the residences on the north side.	◔	In the short-term, the residents along this segment will be temporarily impacted due to construction related activities, however, those impacts can be reduced. In the long-term, the proposed improvements will improve the aesthetics along the corridor by providing landscaping and active transportation facilities.	◕	In the short-term, the residents along this segment will be temporarily impacted due to construction related activities, however, those impacts can be reduced. In the long-term, the proposed improvements will improve the aesthetics along the corridor by providing landscaping and active transportation facilities.	◕
Agricultural Land: Potential for loss of agricultural land	There are no agricultural lands along Segment 2. As such, no impacts are anticipated.	●	There are no agricultural lands along Segment 2. As such, no impacts are anticipated.	●	There are no agricultural lands along Segment 2. As such, no impacts are anticipated.	●

Evaluation Criteria	Alternative A: Central Alignment	Score	Alternative B: South Alignment	Score	Alternative C: Hybrid Alignment	Score
Natural Environment						
Terrestrial Environment: Impacts on terrestrial resources (vegetation, wetlands, trees and wildlife)	Removal of 1.16 ha of natural area will be required. This natural area is comprised of Regional Environmental Conservation Area, Provincial Areas of Natural and Scientific Interest, Provincial Wooded Areas, Provincial Wetlands (significant and non-significant), and Provincial Wildlife Value Areas. Where possible, the impacts will be offset or minimized through mitigation measures and design refinements (e.g., removing vegetation outside of the general migratory bird nesting period (April 1 to August 31)). In addition, this alternative will impact White Wood Aster, a species at risk plant, with "Endangered" status under the Endangered Species Act. Consultation will be completed with the Ministry of the Environment, Conservation and Parks to identify permitting requirements.	○	Removal of 1.30 ha of natural area will be required. This natural area is comprised of Regional Environmental Conservation Area, Provincial Areas of Natural and Scientific Interest, Provincial Wooded Areas, Provincial Wetlands (significant and non-significant), and Provincial Wildlife Value Areas. Where possible, the impacts will be offset or minimized through mitigation measures and design refinements (e.g., removing vegetation outside of the general migratory bird nesting period (April 1 to August 31)). In addition, this alternative will impact White Wood Aster, a species at risk plant, with "Endangered" status under the Endangered Species Act. Consultation will be completed with the Ministry of the Environment, Conservation and Parks to identify permitting requirements.	○	Removal of 1.24 ha of natural area will be required. This natural area is comprised of Regional Environmental Conservation Area, Provincial Areas of Natural and Scientific Interest, Provincial Wooded Areas, Provincial Wetlands (significant and non-significant), and Provincial Wildlife Value Areas. Where possible, the impacts will be offset or minimized through mitigation measures and design refinements (e.g., removing vegetation outside of the general migratory bird nesting period (April 1 to August 31)). In addition, this alternative will impact White Wood Aster, a species at risk plant, with "Endangered" status under the Endangered Species Act. Consultation will be completed with the Ministry of the Environment, Conservation and Parks to identify permitting requirements.	○
Aquatic Environment: Impacts to fish and fish habitats	There is a large pond located on private property south of Merritt Road which was not assessed due to the property being fenced and gated. No watercourse crossing was observed along this road segment. Two Corrugated Steel Pipe (CSP) culverts were identified within vicinity of this road segment, providing for roadside drainage conveyance only and do not provide for fish habitat. No connection to any watercourses along Merritt Road was observed. This alignment will disturb the moderate amount of area of the pond which may provide for fish and fish habitat.	◑	There is a large pond located on private property south of Merritt Road which was not assessed due to the property being fenced and gated. No watercourse crossing was observed along this road segment. Two Corrugated Steel Pipe (CSP) culverts were identified within vicinity of this road segment, providing for roadside drainage conveyance only and do not provide for fish habitat. No connection to any watercourses along Merritt Road was observed. This alignment will disturb the highest amount of area of the pond which may provide for fish and fish habitat.	◔	There is a large pond located on private property south of Merritt Road which was not assessed due to the property being fenced and gated. No watercourse crossing was observed along this road segment. Two Corrugated Steel Pipe (CSP) culverts were identified within vicinity of this road segment, providing for roadside drainage conveyance only and do not provide for fish habitat. No connection to any watercourses along Merritt Road was observed. This alignment will disturb the least amount of area of the pond which may provide for fish and fish habitat.	◕
Cultural Environment						
Archaeological Resources: Impacts on lands identified to retain potential archaeological resources	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required during detailed design to identify any archaeological resources and associated mitigation measures.	◑	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required during detailed design to identify any archaeological resources and associated mitigation measures.	◑	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required during detailed design to identify any archaeological resources and associated mitigation measures.	◑
Built Heritage and Cultural Resources: Impacts on built heritage and cultural heritage landscapes	Moderate impacts to one property that may have historical and/or contextual value. A Heritage Impact Assessment will be required during detailed design to confirm cultural significance of this property and appropriate mitigation measures.	◑	Minor impacts to one property that may have historical and/or contextual value. A Heritage Impact Assessment may be required during detailed design to confirm cultural significance of this property and appropriate mitigation measures.	◕	Slightly higher impacts to one property that may have historical and/or contextual value. A Heritage Impact Assessment will be required during detailed design to confirm cultural significance of this property and appropriate mitigation measures.	◔

Evaluation Criteria	Alternative A: Central Alignment	Score	Alternative B: South Alignment	Score	Alternative C: Hybrid Alignment	Score
Engineering						
Utilities: Impacts on utilities	Utility relocation will be required for four utilities. Coordination will be required with utility company to relocate hydro poles.	◑	Utility relocation will be required for four utilities. Coordination will be required with utility company to relocate utilities.	◑	Utility relocation will be required for four utilities. Coordination will be required with utility company to relocate hydro poles.	◑
Drainage: Impacts on existing culverts and ditches and ability to facilitate drainage systems	There are numerous existing culverts located along this roadway segment, primarily including driveway culverts facilitating local roadway drainage, as well as one (1) cross culvert located approximately 110 m (+/-) west of Niagara Street. There are also three (3) observed depressions in the landscape located south of Merritt Road, including an identified pond located on private property. The central alignment may generate moderate impacts to private property drainage infrastructure (i.e., driveway culverts) on both the north and south sides of the proposed roadway, as well as present moderate impacts to the existing drainage features.	◑	There are numerous existing culverts located along this roadway segment, primarily including driveway culverts facilitating local roadway drainage, as well as one (1) cross culvert located approximately 110 m (+/-) west of Niagara Street. There are also three (3) observed depressions in the landscape located south of Merritt Road, including an identified pond located on private property. The south alignment would generate minor impacts to private property drainage infrastructure (i.e., driveway culverts) on the north side of the proposed roadway. However, this alignment would result in slightly higher impacts to the existing pond and/or local depressions south of Merritt Road potentially impacting the local drainage patterns and drainage design along the south of the right-of-way.	◔	There are numerous existing culverts located along this roadway segment, primarily including driveway culverts facilitating local roadway drainage, as well as one (1) cross culvert located approximately 110 m (+/-) west of Niagara Street. There are also three (3) observed depressions in the landscape located south of Merritt Road, including an identified pond located on private property. The hybrid alignment would generate minor impacts to private property drainage infrastructure (i.e., driveway culverts) on majority of the north side of the proposed roadway. However, this alignment would still maintain the slightly higher impacts to the local depressions located south of the right-of-way (west), while also minimizing the impacts on the existing pond located south of Merritt Road.	◕
Overall Recommendation	**Not Recommended**		**Recommended**		**Not Recommended**	

2.2.4.1 Preliminary Preferred Road Alignment for Segment 2

Based on the evaluation presented in Table 2-5, **Alternative B: South Alignment** was identified as the preliminary preferred alignment for Segment 2. This alternative would involve widening the existing Merritt Road to a 26 m road right of way and shifting the centreline to the south. This alternative is shown in Figure 2-4.

2.2.5 Evaluation of Road Alignment Alternatives for Segment 3

Following three alignment alternatives were identified for Road Segment 3: Merritt Road (Merrittville Highway / Niagara Street to Highway 406). All three alignment alternatives are comprised of a 36 m wide road right of way based on Urban General Wide typology based on the Complete Streets Design Guidelines.

- **Alternative A: Centre Alignment:** This alternative would involve widening the existing road to 36 m road right of way equally about the existing road centreline. This alternative is shown in Figure 2-6.

- **Alternative B: North Alignment:** This alternative would involve widening the existing road to 36 m to the north. This alternative is shown in Figure 2-7.

- **Alternative C: North Alignment with Adjusted Curve:** This alternative would involve widening the existing road to 36 m road right of way to the north with adjusting the road curve west of Highway 406 ramp. This alternative is shown in Figure 2-8.

The evaluation of road alignment alternatives for Segment 3 is provided in Table 2-6.

Figure 2-6: Segment 3 - Alternative A: Centre Alignment (Widen to the north and south equally about centreline)

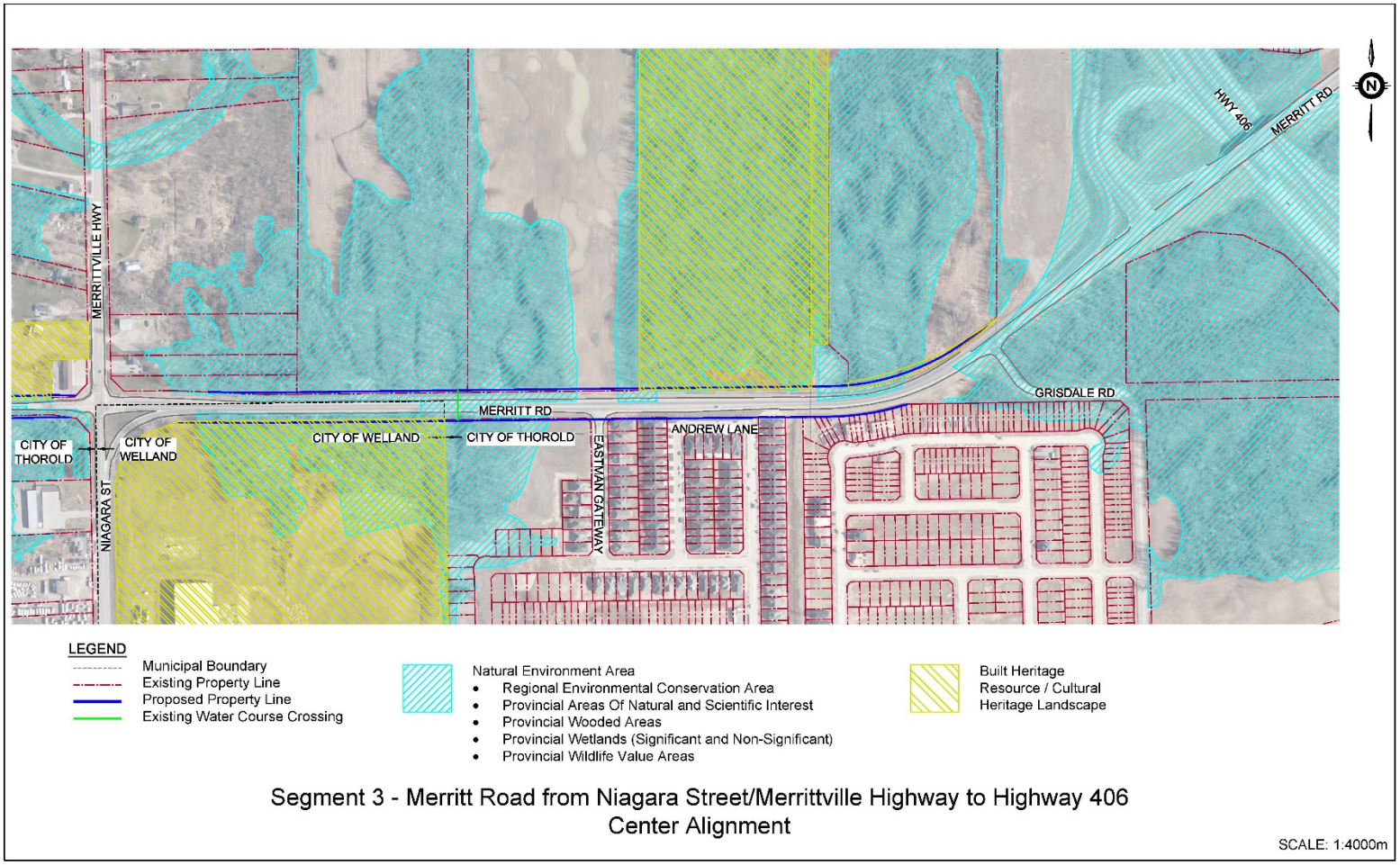


Figure 2-7: Segment 3 - Alternative B: North Alignment (Widen to the north)

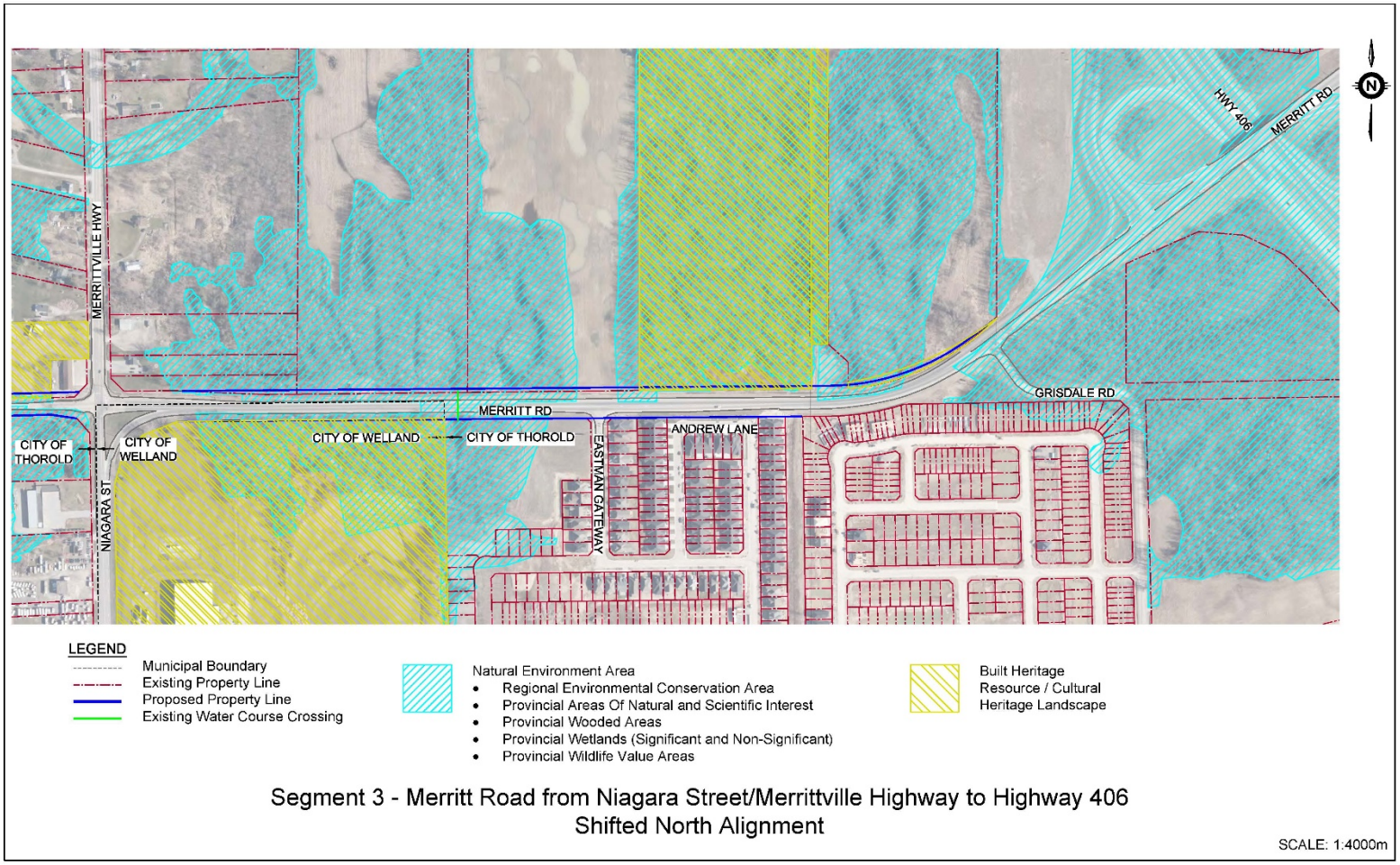


Figure 2-8: Segment 3 - Alternative C: North Alignment with Adjusted Road Curve

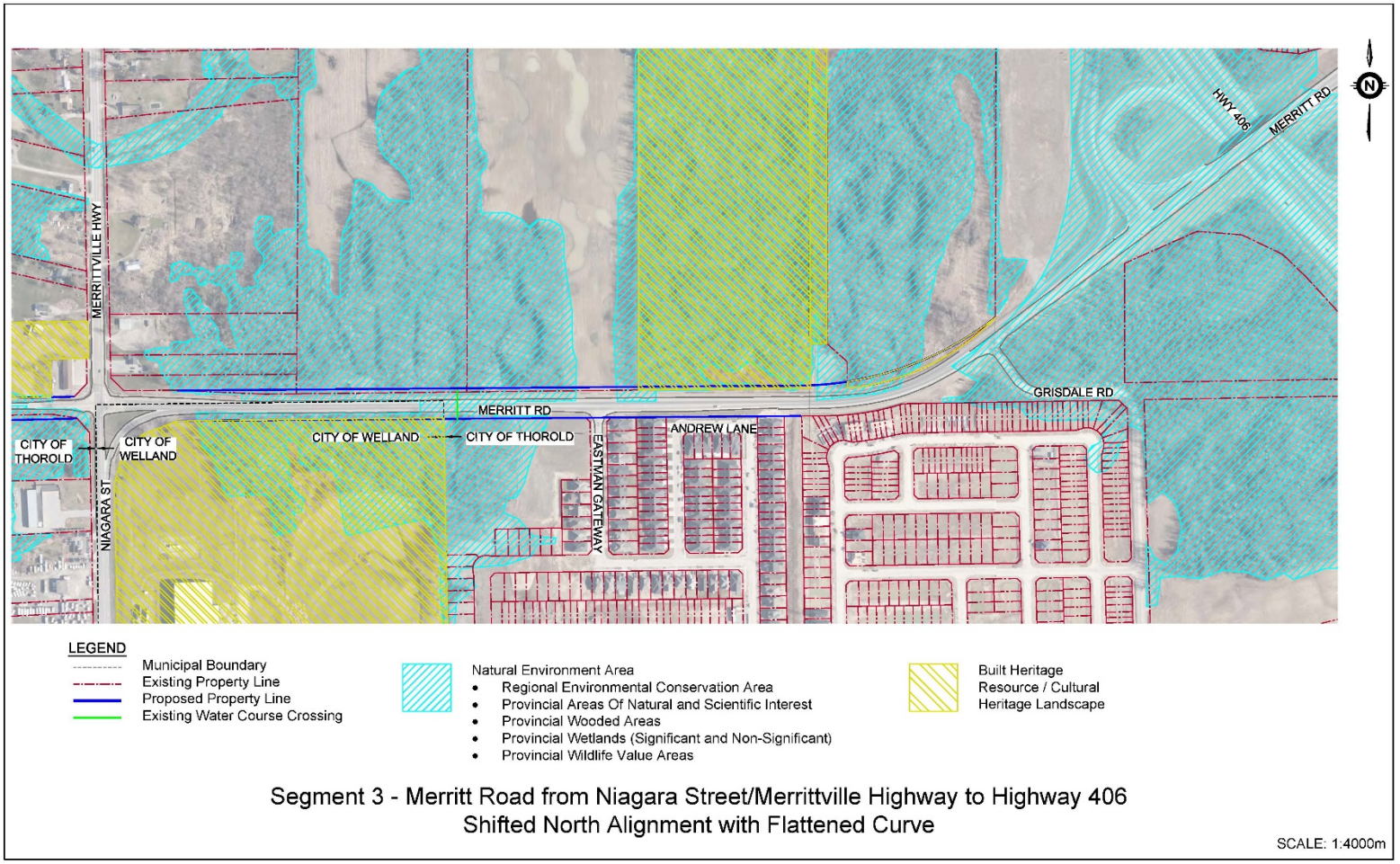


Table 2-6: Evaluation of Road Alignment Alternatives for Segment 3

Evaluation Criteria	Alternative A: Centre Alignment	Score	Alternative B: North Alignment	Score	Alternative C: North Alignment with Adjusted Road Curve	Score
Transportation						
Safety/Road Alignment: Ability to improve sightlines and horizontal alignment and ability to provide safe access to driveways and properties along the corridor	No modifications to horizontal curve west of Grisdale Road. Limited sightlines through this horizontal curve (roughly 130 metres). Sightlines would be improved to approximately 190 metres if the trees are cut back to the road right of way. The proposed improvements will provide safe access to the Merritt Meadows subdivision.	◔	No modifications to horizontal curve west of Grisdale Road. Sightlines through right of way would 210 metres. The proposed improvements will provide safe access to the Merritt Meadows subdivision.	◕	Horizontal curve west of Grisdale Road will be flattened. Sightlines will be improved to 230 metres; however, the flattened curve may increase operating speeds. Methods to mitigate this will need to be investigated (i.e., landscaping). The proposed improvements will provide safe access to the Merritt Meadows subdivision.	◑
Socio-economic Environment						
Private Property Impacts: Private property taking	Approximately 0.35 ha of private property area will be required. In addition, complete buyout will be required for three private residential properties.	○	Approximately 0.36 ha of private property area will be required. No complete private property buyouts will be required.	◕	Approximately 0.44 ha of private property area will be required. No complete private property buyouts will be required.	◑
Lifestyle Disruption: Potential for lifestyle disruption effects to residents such as noise or visual impacts	In the short-term, the residents within the Merritt Meadows subdivision will be temporarily impacted due to construction related activities, however, those impacts can be reduced. In the long-term, the proposed improvements will improve the aesthetics along the corridor by providing landscaping and active transportation facilities.	◕	In the short-term, the residents within the Merritt Meadows subdivision will be temporarily impacted due to construction related activities, however, those impacts can be reduced. In the long-term, the proposed improvements will improve the aesthetics along the corridor by providing landscaping and active transportation facilities.	◕	In the short-term, the residents within the Merritt Meadows subdivision will be temporarily impacted due to construction related activities, however, those impacts can be reduced. In the long-term, the proposed improvements will improve the aesthetics along the corridor by providing landscaping and active transportation facilities.	◕
Agricultural Land: Potential for loss of agricultural land	Minor loss of agricultural lands is anticipated.	◕	Minor loss of agricultural lands is anticipated.	◕	Minor loss of agricultural lands is anticipated.	◕
Natural Environment						
Terrestrial Environment: Impacts on terrestrial resources (vegetation, wetlands, trees and wildlife)	Removal of 1.12 ha of natural area will be required. This natural area is comprised of Regional Environmental Conservation Area; Provincial Areas of Natural and Scientific Interest; Provincial Wooded Areas; Provincial Wetlands (significant and non-significant); and Provincial Wildlife Value Areas. Where possible, the impacts will be offset or minimized through mitigation measures and design refinements (e.g., removing vegetation outside of the general migratory bird nesting period (April 1 to August 31)). In addition, this alternative will impact two species at risk plants: White Wood Aster and Round-leaved Greenbrier. White Wood Aster has “Endangered” status and Round-leaved Greenbrier has “Threatened” status under the Endangered Species Act. Consultation will be completed with the Ministry of the Environment,	○	Removal of 1.21 ha of natural area will be required. This natural area is comprised of Regional Environmental Conservation Area; Provincial Areas of Natural and Scientific Interest; Provincial Wooded Areas; Provincial Wetlands (significant and non-significant); and Provincial Wildlife Value Areas. Where possible, the impacts will be offset or minimized through mitigation measures and design refinements (e.g., removing vegetation outside of the general migratory bird nesting period (April 1 to August 31)). In addition, this alternative will impact two species at risk plants: White Wood Aster and Round-leaved Greenbrier. White Wood Aster has “Endangered” status and Round-leaved Greenbrier has “Threatened” status under the Endangered Species Act. Consultation will be completed with the Ministry of the	○	Removal of 1.16 ha of natural area will be required. This natural area is comprised of Regional Environmental Conservation Area; Provincial Areas of Natural and Scientific Interest; Provincial Wooded Areas; Provincial Wetlands (significant and non-significant); and Provincial Wildlife Value Areas. Where possible, the impacts will be offset or minimized through mitigation measures and design refinements (e.g., removing vegetation outside of the general migratory bird nesting period (April 1 to August 31)). In addition, this alternative will impact two species at risk plants: White Wood Aster and Round-leaved Greenbrier. White Wood Aster has “Endangered” status and Round-leaved Greenbrier has “Threatened” status under the Endangered Species Act. Consultation will be completed with the Ministry of the Environment, Conservation and Parks to identify permitting requirements associated with impacts to species at risk.	○

Evaluation Criteria	Alternative A: Centre Alignment	Score	Alternative B: North Alignment	Score	Alternative C: North Alignment with Adjusted Road Curve	Score
	Conservation and Parks to identify permitting requirements associated with impacts to species at risk.		Environment, Conservation and Parks to identify permitting requirements associated with impacts to species at risk.			
Aquatic Environment: Impacts to fish and fish habitats	This road alignment alternative crosses one watercourse with potential for seasonal fish habitat. In order to minimize impacts on fish and fish habitat, mitigation measures will be carried out (e.g., completing construction during prescribed in-water works timing windows, and installing erosion and sediment control).	◑	This road alignment alternative crosses one watercourse with potential for seasonal fish habitat. In order to minimize impacts on fish and fish habitat, mitigation measures will be carried out (e.g., completing construction during prescribed in-water works timing windows, and installing erosion and sediment control).	◑	This road alignment alternative crosses one watercourse with potential for seasonal fish habitat. In order to minimize impacts on fish and fish habitat, mitigation measures will be carried out (e.g., completing construction during prescribed in-water works timing windows, and installing erosion and sediment control).	◑
Cultural Environment						
Archaeological Resources: Impacts on lands identified to retain potential archaeological resources	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required during detailed design to identify any archaeological resources and associated mitigation measures.	◑	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required during detailed design to identify any archaeological resources and associated mitigation measures.	◑	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required during detailed design to identify any archaeological resources and associated mitigation measures.	◑
Built Heritage and Cultural Resources: Impacts on built heritage and cultural heritage landscapes	Moderate impacts to two properties that may have historical and/or contextual values. A Heritage Impact Assessment will be required during detailed design to confirm cultural significance of this property and appropriate mitigation measures.	◑	Moderate impacts to two properties that may have historical and/or contextual values. A Heritage Impact Assessment will be required during detailed design to confirm cultural significance of this property and appropriate mitigation measures.	◑	Moderate impacts to two properties that may have historical and/or contextual values. A Heritage Impact Assessment will be required during detailed design to confirm cultural significance of this property and appropriate mitigation measures.	◑
Engineering						
Utilities: Impacts on utilities	Utility relocation will be required for four utilities. Coordination will be required with utility companies to relocate utilities.	◑	Utility relocation will be required for four utilities. Coordination will be required with utility companies to relocate utilities.	◑	Utility relocation will be required for four utilities. Coordination will be required with utility companies to relocate utilities.	◑
Drainage: Impacts on existing culverts and ditches and ability to facilitate drainage systems	The southern portion of the Merritt Road right-of-way along the Merritt Meadows development consists of an urban cross-section with curb/gutters collecting drainage and discharging south of the right-of-way to the storm sewer along Eastman Gateway. There are also two (2) CSP cross culverts identified within this roadway segment, located west of the Merritt Meadows development. This road alignment would result in moderate impacts to the watercourse / culvert crossings, likely requiring work on both sides of the right-of-way.	◑	The southern portion of the Merritt Road right-of-way along the Merritt Meadows development consists of an urban cross-section with curb/gutters collecting drainage and discharging south of the right-of-way to the storm sewer along Eastman Gateway. There are also two (2) CSP cross culverts identified within this roadway segment, located west of the Merritt Meadows development. This road alignment would potentially result in limited impacts to the watercourse / culvert crossings, should the in-water work be scoped to a single side of the right-of-way (i.e. widening to the north only).	◕	The southern portion of the Merritt Road right-of-way along the Merritt Meadows development consists of an urban cross-section with curb/gutters collecting drainage and discharging south of the right-of-way to the storm sewer along Eastman Gateway. There are also two (2) CSP cross culverts identified within this roadway segment, located west of the Merritt Meadows development. This road alignment would potentially result in limited impacts to the watercourse / culvert crossings, should the in-water work be scoped to a single side of the right-of-way (i.e., widening to the north only). The adjusted road curve in the eastern side of this segment is not expected to impact the culvert crossings located in the west.	◕
Overall Recommendation	**Not Recommended**		**Recommended**		**Not Recommended**	

2.2.5.1 Preliminary Preferred Road Alignment for Segment 3

Based on the evaluation presented in Table 2-6, **Alternative B: North Alignment** was identified as the preliminary preferred alignment for Segment 3. This alternative would involve widening the existing Merritt Road to 36 m wide road right of way between Merrittville Highway and Grisdale Road. The preliminary preferred alignment for Segment 3 is shown in Figure 2-7.

2.2.6 Evaluation of Road Alignment Alternatives for Segment 4

Following two alignment alternatives were identified for Road Segment 4: Rice Road (200m north of Merritt Road to Quaker Road). Both alignment alternatives are comprised of a 36 m wide road right of way based on Urban General Wide typology

- **Alternative A: Centre Alignment:** This alternative would involve widening the existing road to 36 m road right of way equally about the existing road centreline. This alternative is shown in Figure 2-9.
- **Alternative B: Hybrid Alignment:** This alternative would involve widening the existing road to 36 m road right of way with the north section to be shifted slightly to the east. This alternative is shown in Figure 2-10.

The evaluation of road alignment alternatives for Segment 4 is provided in Table 2-7.

Figure 2-9: Segment 4 - Alternative A: Centre Alignment (Widen to the east and west equally about centreline)

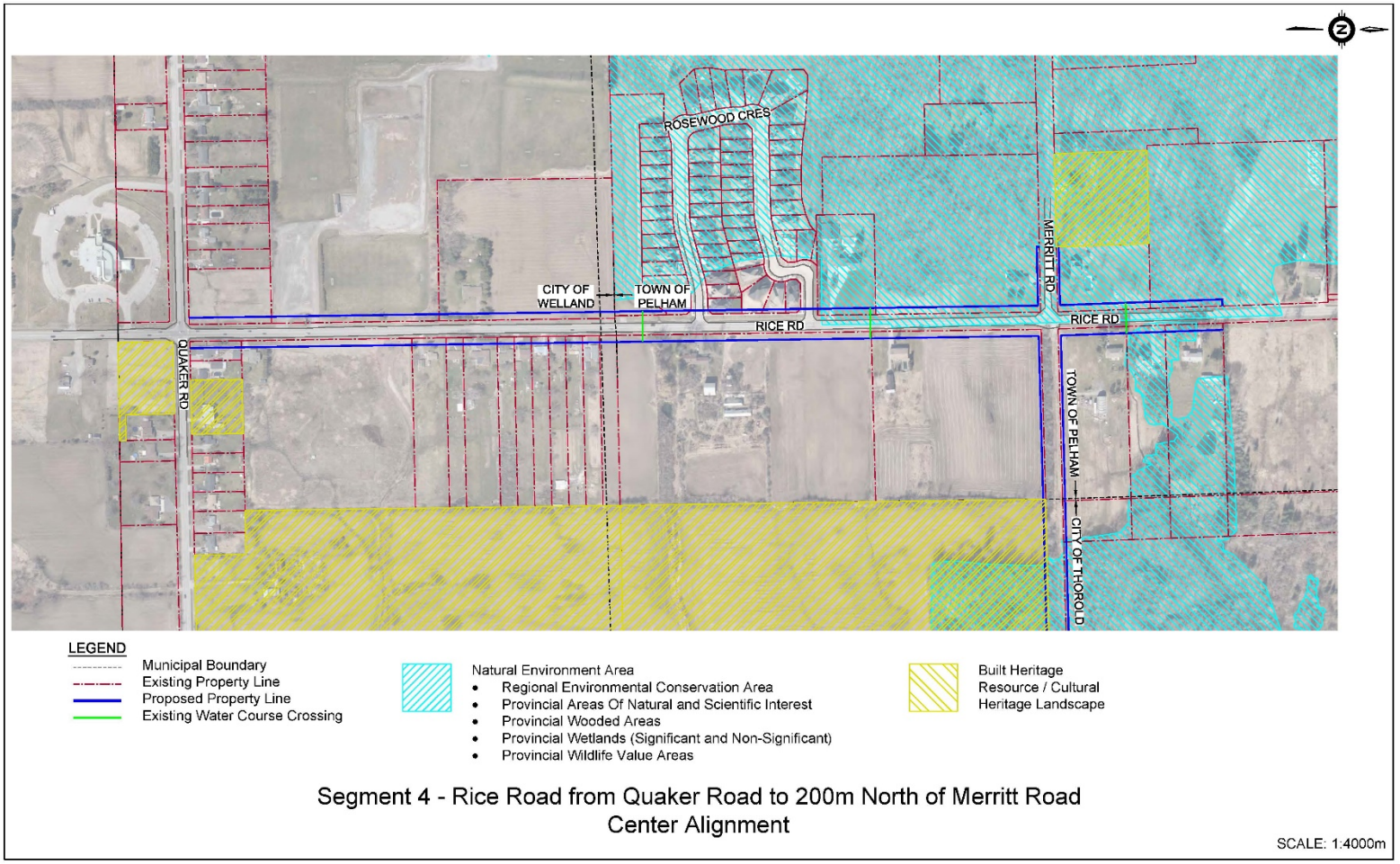


Figure 2-10: Segment 4 - Alternative B: Hybrid Alignment

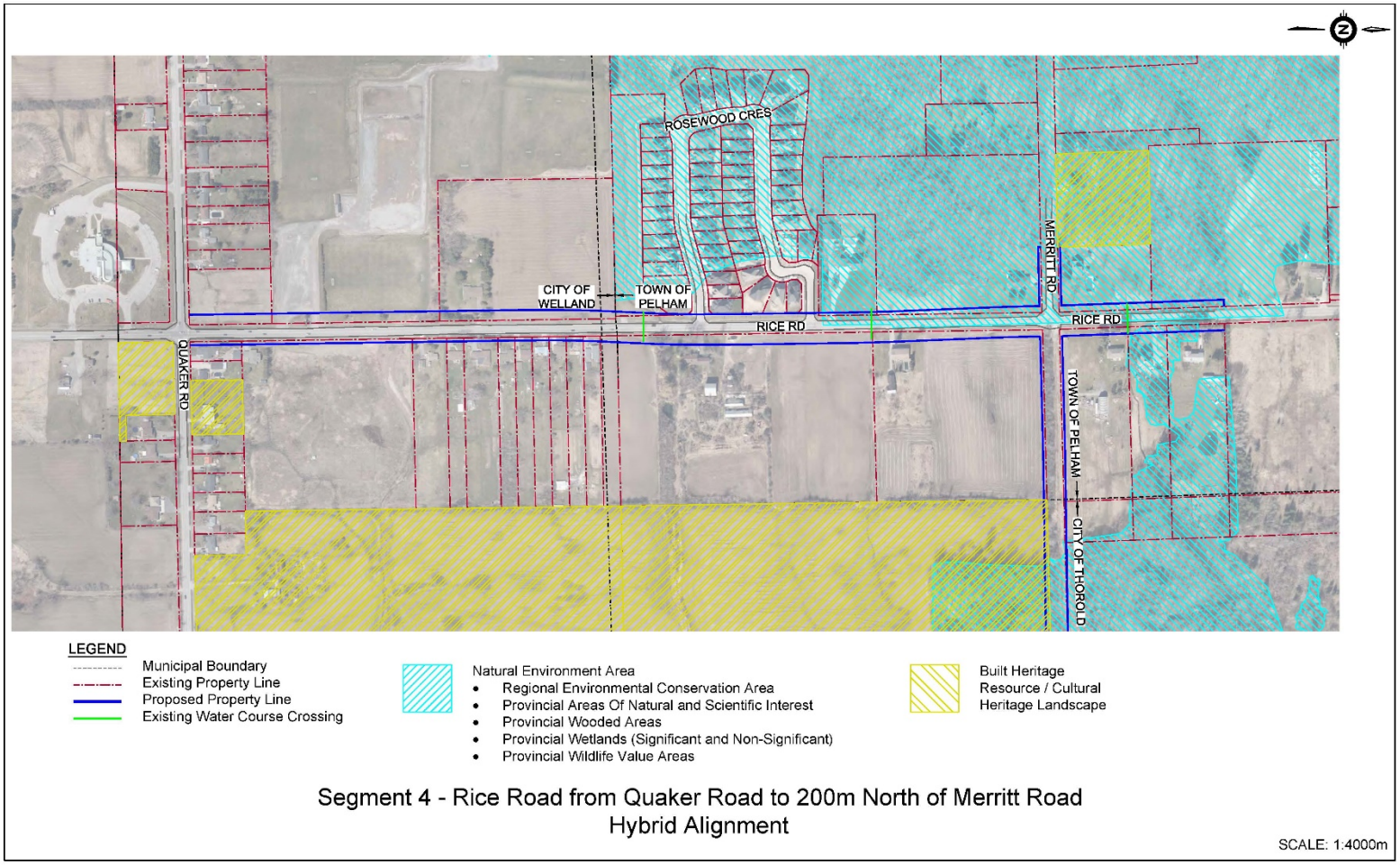


Table 2-7: Evaluation of Road Alignment Alternatives for Segment 4

Evaluation Criteria	Alternative A: Central Alignment	Score	Alternative B: Hybrid Alignment	Score
Transportation				
Safety/Road Alignment: Ability to improve sightlines and horizontal alignment and ability to provide safe access to driveways and properties along the corridor	Straight alignment that matches alignment to the north and the south. May encourage higher operating speeds. Landscaping should be considered to visually narrow the roadway. The proposed improvements will provide safe access to properties.	◕	This option would result in a gentle horizontal curve midway through the segment; however the curve meets TAC Geometric Design Guidelines for a 60 km/h design speed. Sightlines will be reduced due to the introduction of the horizontal curve and may increase run-off the road collisions. The curved alignment may 'calm' traffic through this segment. The proposed improvements will provide safe access to properties.	◑
Socio-economic Environment				
Private Property Impacts: Private property taking	Approximately 1.55 ha of private property area will be required. In addition, complete buyout will be required for four private residential properties.	○	Approximately 1.83 ha of private property area will be required. No complete private property buyouts will be required.	◑
Lifestyle Disruption: Potential for lifestyle disruption effects to residents such as noise or visual impacts	In the short-term, the residents along this segment will be temporarily impacted due to construction related activities, however, those impacts can be reduced. This alignment will significantly impact properties in the Rosewood Crescent subdivision. For the remaining properties, the proposed improvements will improve the aesthetics along the corridor by providing landscaping and active transportation facilities.	◑	In the short-term, the residents along this segment will be temporarily impacted due to construction related activities, however, those impacts can be reduced. The proposed alignment will shift closer to some properties along this segment, resulting in noise and visual impacts. However, in the long-term, the proposed improvements will improve the aesthetics along the corridor by providing landscaping and active transportation facilities.	◕
Agricultural Land: Potential for loss of agricultural land	Northwest Welland Secondary Plan (OPA 29) identifies the existing agricultural lands along Rice Road to be redesignated as residential lands (City of Welland, 2020). Accordingly, these lands will likely be developed in future for residential development. No loss of agricultural lands is anticipated.	●	Northwest Welland Secondary Plan (OPA 29) identifies the existing agricultural lands along Rice Road to be redesignated as residential lands (City of Welland, 2020). Accordingly, these lands will likely be developed in future for residential development. No loss of agricultural lands is anticipated.	●
Natural Environment				
Terrestrial Environment: Impacts on terrestrial resources (vegetation, wetlands, trees and wildlife)	Removal of 0.68 ha of natural area will be required. This natural area is comprised of Regional Environmental Conservation Area; Provincial Areas of Natural and Scientific Interest; Provincial Wooded Areas Provincial Wetlands (significant and non-significant); and Provincial Wildlife Value Areas. No potential impacts to species at risk are identified. Where possible, the impacts will be minimized through mitigation measures and design refinements (e.g., removing vegetation outside of the general migratory bird nesting period (April 1 to August 31)).	○	Removal of 0.61 ha of natural area will be required. This natural area is comprised of Regional Environmental Conservation Area; Provincial Areas of Natural and Scientific Interest; Provincial Wooded Areas Provincial Wetlands (significant and non-significant); and Provincial Wildlife Value Areas. No potential impacts to species at risk are identified. Where possible, the impacts will be minimized through mitigation measures and design refinements (e.g., removing vegetation outside of the general migratory bird nesting period (April 1 to August 31)).	○
Aquatic Environment: Impacts to fish and fish habitats	This road alignment alternative crosses two watercourses that have the potential to provide for seasonal fish habitat. In order to minimize impacts on fish and fish habitat, mitigation measures will be carried out (e.g., completing construction during prescribed in-water works timing windows, and installing erosion and sediment control).	◑	This road alignment alternative crosses two watercourses that have the potential to provide for seasonal fish habitat in order to minimize impacts on fish and fish habitat, mitigation measures will be carried out (e.g., completing construction during prescribed in-water works timing windows, and installing erosion and sediment control).	◑
Cultural / Archaeological Environment				
Archaeological Resources: Impacts on lands identified to retain potential archaeological resources	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required during detailed design to identify any archaeological resources and associated mitigation measures.	◑	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required during detailed design to identify any archaeological resources and associated mitigation measures.	◑
Built Heritage and Cultural Resources: Impacts on built heritage and cultural heritage landscapes	Minor impacts to one property that may have historical and/or contextual value. A Heritage Impact Assessment may be required during detailed design to confirm cultural significance of this property and appropriate mitigation measures.	◕	No impacts to properties of historical and/or contextual value.	●

Evaluation Criteria	Alternative A: Central Alignment	Score	Alternative B: Hybrid Alignment	Score
Engineering/Constructability				
Utilities: Impacts on utilities	Utility relocation will be required for six utilities. Coordination will be required with utility companies to relocate utilities.	◑	Utility relocation will be required for six utilities. Coordination will be required with utility companies to relocate utilities.	◑
Drainage: Impacts on existing culverts and ditches and ability to facilitate drainage systems	There are five (5) cross culverts located within this roadway segment, of which three (3) are watercourse crossings. In addition, there are three (3) culverts within the right-of-way facilitating roadway drainage beneath Merritt Road and Rosewood Crescent (as part of the Rosewood Estates development dated 2014). The watercourse located south of Rosewood Crescent was realigned to the south of the existing stormwater management facility (SWMF), as part of the Rosewood Estates development. The central alignment alternative would generate moderate impacts to the watercourses on both sides of the right-of-way (relative to culvert works), as well as moderate impacts to the existing SWMF and private driveway culverts along this roadway segment.	◑	There are five (5) cross culverts located within this roadway segment, of which three (3) are watercourse crossings. In addition, there are three (3) culverts within the right-of-way facilitating roadway drainage beneath Merritt Road and Rosewood Crescent (as part of the Rosewood Estates development dated 2014). The watercourse located south of Rosewood Crescent was realigned to the south of the existing stormwater management facility (SWMF), as part of the Rosewood Estates development. The hybrid alignment would limit the impact to the watercourse crossings by potentially scoping the in-watercourse work to a single side of the right-of-way, as well as limit the impacts to the existing SWMF associated with the Rosewood Estates development, and minor impacts to the private driveway culverts along this roadway segment.	◕
Overall Recommendation	**Not Recommended**		**Recommended**	

2.2.6.1 Preliminary Preferred Road Alignment for Segment 4

Based on the evaluation presented in Table 2-7, **Alternative B: Hybrid Alignment** was identified as preliminary preferred alignment for Segment 4. This alternative would involve widening the existing road to 36 m road right of way with the north section shifted slightly to the east. The widening would occur on Rice Road from Quaker Road to 200 m north of Merritt Road. The preliminary preferred alignment for Segment 4 is shown in Figure 2-10.

2.3 Road Cross-Section Alternatives

2.3.1 Identification of Road Cross Section Alternatives

Once the preliminary preferred alignments were identified for the road segments, the next step was to identify and evaluate alternative cross-sections for the road segments. Two cross-section alternatives were identified and evaluated for each road segment.

Cross section alternatives were designed in accordance with the Region's Complete Street Guidelines (currently being developed). In addition, input was obtained on the cross-section alternatives from the staff from the Niagara Region, the Town of Pelham, the City of Thorold, and the City of Welland. The cross sections also consider design recommendations of the Health Impact Assessment being completed by the Niagara Region's staff. These recommendations include provision of physically separated and continuous active transportation facilities. On-road bike lanes were not included in the cross-section alternatives as they are less safe compared to off road facilities (e.g., cycle tracks, multi-use paths). As such, off-road cycle tracks and multi-use paths were considered as they are a safer option than on-road bike lanes.

The following are the definitions of rural, urban and hybrid cross sections, which are referenced throughout the following sub-sections:

- Rural Cross Section: A cross-section with partially paved shoulders with no curbs and ditches.
- Urban Cross Section: A cross-section with curbs with a storm sewer system.
- Hybrid Cross Section: A cross-section with curbs and ditches.

Table 2-8 below briefly identifies the cross-section alternatives. Additional cross sections were identified but were ruled out due to the design constraints presented at the beginning of this memo. The alternatives listed below represent those cross sections that were short listed based on discussions with Regional staff. The alternatives, including their key design features and their evaluation process are discussed in further detail in subsections below.

Table 2-8: Road Cross-Sections Alternatives

Road Segment	Alternatives for Cross-Sections
Segment 1: Merritt Road (Rice Road to Cataract Road)	Alternative A: Rural Cross-section: Two travel lanes with shoulders, ditches, sidewalk on north side and cycle track on south side Alternative B: Hybrid (Rural-Urban) Cross-section: Two travel lanes with curbs and ditches, sidewalk and cycle track on north side
Segment 2: Merritt Road (Cataract Road to Merrittville Highway / Niagara Street)	Alternative A: Rural Cross-section: Two travel lanes with shoulder, ditches, sidewalk on north side and cycle track on south side. Alternative B: Hybrid (Rural-Urban) Cross-section: Two travel lanes with curbs and ditches, sidewalk and cycle track on north side
Segment 3: Merritt Road (Merrittville Highway / Niagara Street to Highway 406)	Alternative A: Urban Cross-section: Four travel lanes, sidewalk and cycle track on south side Alternative B: Urban Cross-section: Four travel lanes with curbs and sidewalk and cycle track on both sides
Segment 4: Rice Road (200m north of Merritt Road to Quaker Road)	Alternative A: Rural Cross-section: Four drive lanes with ditches, sidewalk on both sides and cycle track on west side Alternative B: Hybrid (Rural-Urban) Cross-section: Four drive lanes with curbs and ditches, sidewalk on both sides and cycle track on west side

2.3.2 Evaluation Criteria for Road Cross-Section Alternatives

Table 2-9: Evaluation Criteria for Road Cross-Section Alternatives

Factor	Evaluation Criteria
Transportation	**Active Transportation:** Potential to incorporate active transportation facilities for walking and cycling **Road Safety:** Potential to improve road safety and pedestrian and cyclists' safety
Engineering/Constructability	**Operation and Maintenance:** Feasibility of operation and maintenance **Stormwater Management:** Ability to provide opportunities to reduce stormwater quantity and/or improve stormwater quality
Cost	**Construction Cost:** Cost to construct **Operations and Maintenance Cost:** Cost to operate and maintain

2.3.3 Evaluation of Road Cross-Section Alternatives for Segment 1

The following two cross-section alternatives were identified for Road Segment 1: Merritt Road (Rice Road to Cataract Road).

Road Cross-Section Alternative A: Key design features of this Rural Cross-section Alternative include:

- Two 3.3 m drive lanes with 1.5 m paved shoulders and 1.5 m gravel shoulders with rounding on both sides
- Two 3.0 m ditches (one on each side)
- 1.8 m sidewalk to the north side
- 3.6 m two-way cycle track on the south side.

This alternative is shown in Figure 2-11.

Road Cross-Section Alternative B: Key design features of this Hybrid (Rural-Urban) Cross-section alternative include:

- Two 3.3 m drive lanes with curbs and ditches (no shoulders)
- Two 3.0 m ditches (one on each side)
- 3.6 m two-way track and 1.8 m sidewalk on the north side.

This alternative is shown in Figure 2-12.

The evaluation of road cross-section alternatives for Segment 1 is provided in Table 2-10.

Figure 2-11: Segment 1 – Road Cross-Section Alternative A

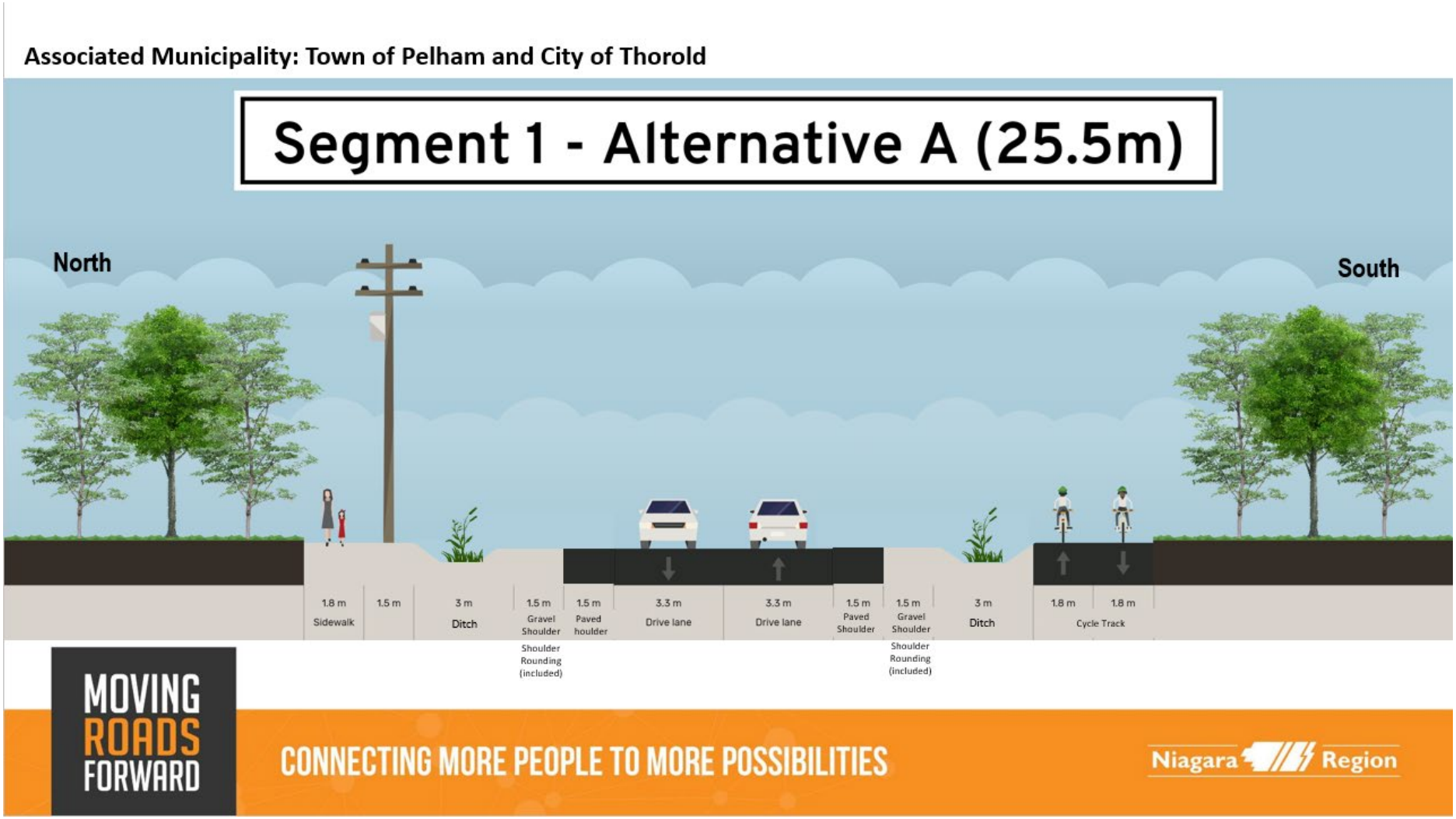


Figure 2-12: Segment 1 – Road Cross-Section Alternative B

Associated Municipality: Town of Pelham and City of Thorold

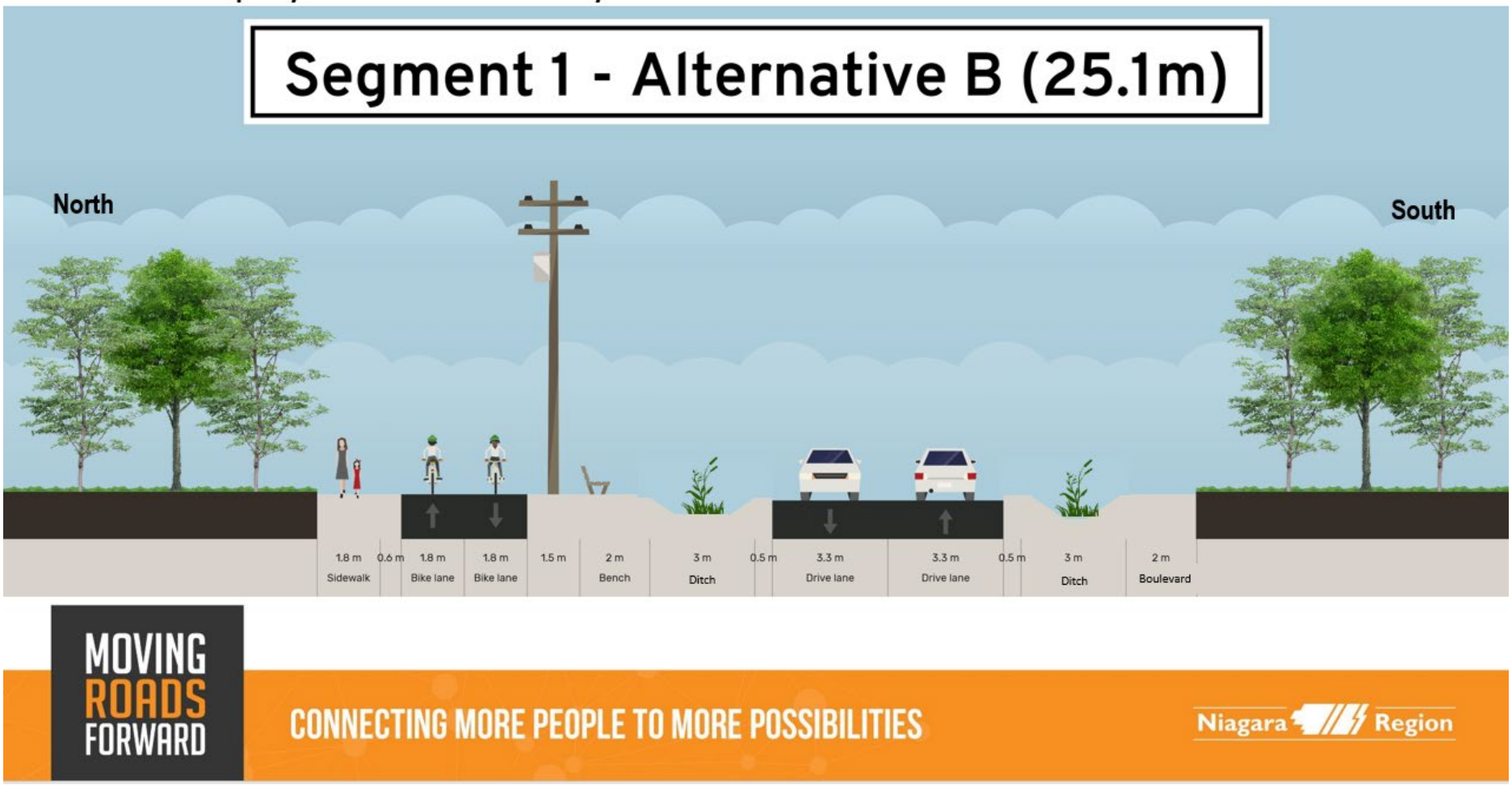


Table 2-10: Evaluation of Road Cross-Section Alternatives for Segment 1

Evaluation Criteria	Alternative A: Rural Cross-section	Score	Alternative B: Hybrid (Rural-Urban) Cross-section	Score
Transportation				
Active Transportation: Potential to incorporate active transportation facilities for walking and cycling	This cross-section provides a separate sidewalk and a separate bi-directional cycle track.	●	This cross-section provides a separate sidewalk and a separate bi-directional cycle track.	●
Road Safety: Potential to improve road safety and pedestrian and cyclists' safety	Provision of separate facilities for pedestrians, cyclists and drivers will result in less conflicts and will be safer. Potential for safety concerns due to no barrier curbs between travel lanes and ditches.	◕	Provision of separate facilities for pedestrians, cyclists and drivers will result in less conflicts and will be safer. Potential for improved safety due to curbs between travel lanes and ditches.	●
Engineering/Constructability				
Flexibility in Design: Ability to reduce right of way requirements to accommodate desired features	This cross-section provides less opportunities to further refine the design and reduce the overall width of the alignment for Segment 1 (25.5 m width).	◑	This cross-section provides opportunity to further refine the design and reduce the overall width of the alignment for Segment 1. The overall width of the right-of-way is 25.1 m in Segment 1. This reduces impacts on private properties, natural environment, and cultural environment.	●
Operation and Maintenance: Feasibility of operation and maintenance	Because of two separate active transportation facilities on either side of the road, the maintenance requirements for this alternative would be comparatively higher. However, ditches can be used to store snow in winter.	◕	Because of the active transportation facilities being on one side of the road, the maintenance requirements for this alternative would be comparatively lower. However, ditches can be used to store snow in winter.	●
Stormwater Management: Ability to provide opportunities to reduce stormwater quantity and/or improve stormwater quality	This cross-section proposes two 3.0 m wide ditches (one on each side). Ditches would provide stormwater quantity and quality control.	●	This cross-section proposes two 3.0 m wide ditches (one on each side). Ditches would provide stormwater quantity and quality control.	●
Cost				
Construction Cost: Cost to construct	As this cross-section proposes two different type of active transportation facilities (i.e., sidewalk and bi-directional cycle track), and a partially paved shoulder, the cost to construct will be comparatively higher.	◕	As this cross-section proposes no shoulders, the cost to construct will be comparatively lower.	●
Operations and Maintenance Cost: Cost to operate and maintain	Both options have two active transportation facilities, operation and maintenance costs are similar.	●	Both options have two active transportation facilities, operation and maintenance costs are similar.	●
Overall Recommendation	**Not Recommended**		**Recommended**	

2.3.3.1 Preliminary Preferred Road Cross-Section for Segment 1

Based on the evaluation presented in Table 2-10, **Alternative B - Hybrid (Rural-Urban) Cross-section** was identified as the preliminary preferred cross-section for Segment 1.

Key design features of the preliminary preferred cross-section for Segment 1 include:

- Two 3.3 m drive lanes with curbs and ditches (no shoulders)
- Two 3.0 m ditches (one on each side)
- 3.6 m two-way cycle track and 1.8 m sidewalk on the north side.

This hybrid cross-section provides opportunity to further refine the design and reduce the overall width of the alignment for Segment 1. The overall width of the proposed road has been reduced from 26 m to 25.1 m in Segment 1. This reduces impacts on private properties, natural environment, and cultural environment. The preliminary preferred cross-section for Segment 1 is shown in Figure 2-12.

2.3.4 Evaluation of Road Cross-Section Alternatives for Segment 2

The following two cross-section alternatives were identified for Road Segment 2: Merritt Road (Cataract Road to Merrittville Highway/Niagara Street). The original intent was to base the cross sections on an Urban Narrow typology, however due to stormwater management constraints, ditches needed to be included in the cross section. In addition, the ditch on the south side needed to be 4.0 m wide to adequately drain run-off.

Road Cross-Section Alternative A: Key design features of this Rural Cross-section Alternative include:

- Two 3.3 m drive lanes with 1.5 m paved shoulders and 1.5 m gravel shoulders with rounding
- A 3.0 m ditch on the north side and a 4.0 m ditch on the south side
- 1.8 m sidewalk to the north side
- 3.6 m two-way cycle track on the south side

This alternative is shown in Figure 2-13.

Road Cross-Section Alternative B: Key design features of this Hybrid (Rural-Urban) Cross-section Alternative include:

- Two 3.3 m drive lanes with 0.5 m curbs
- One 3.0 m ditch on the north side and a 4.0 m ditch on the south side
- 1.8 m sidewalk to the north side
- 3.6 m two-way cycle track on the north side

This alternative is shown in Figure 2-14.

The evaluation of road cross-section alternatives for Segment 2 is provided in Table 2-11.

Figure 2-13: Segment 2 – Road Cross-Section Alternative A

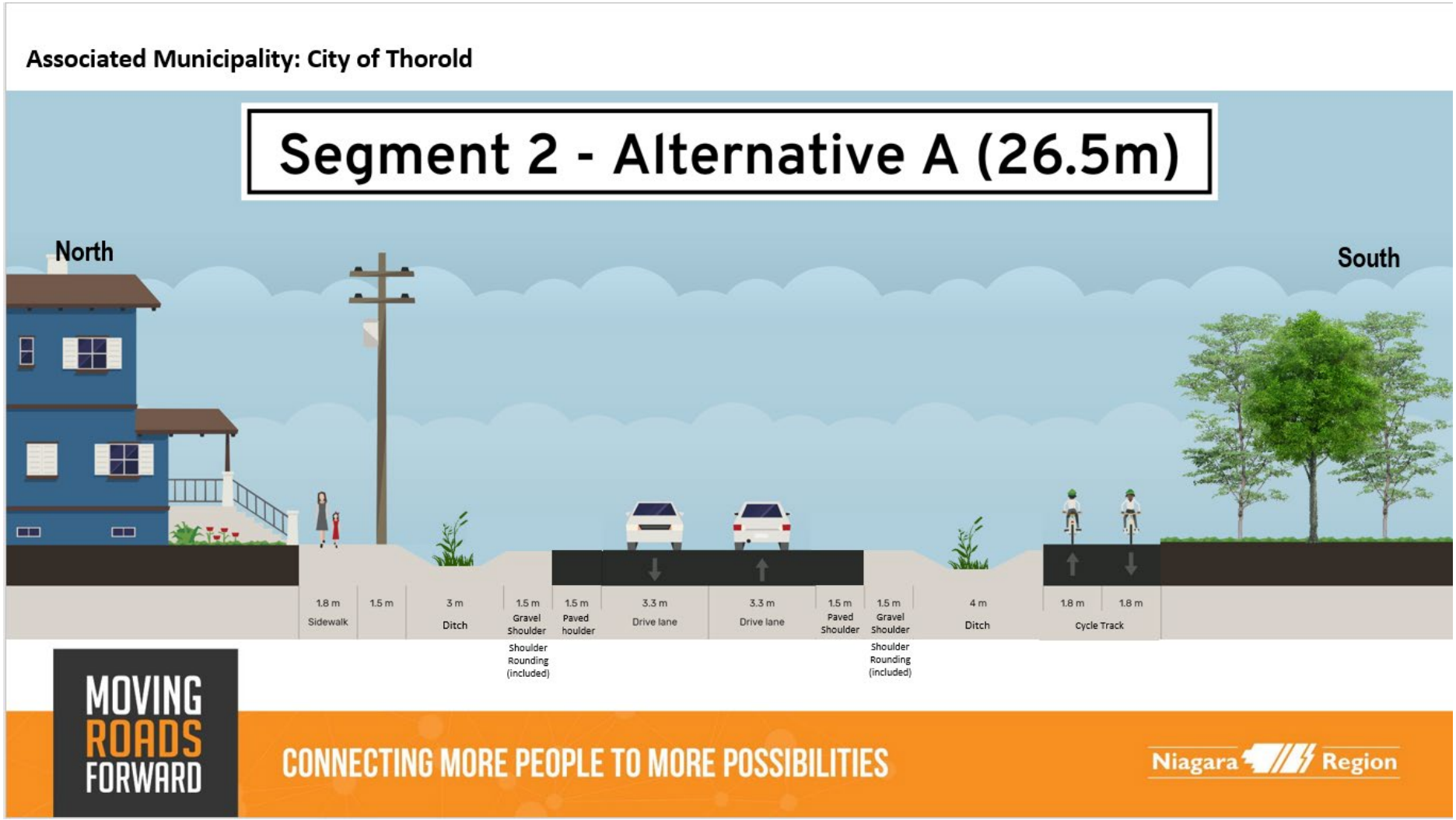


Figure 2-14: Segment 2 – Road Cross-Section Alternative B

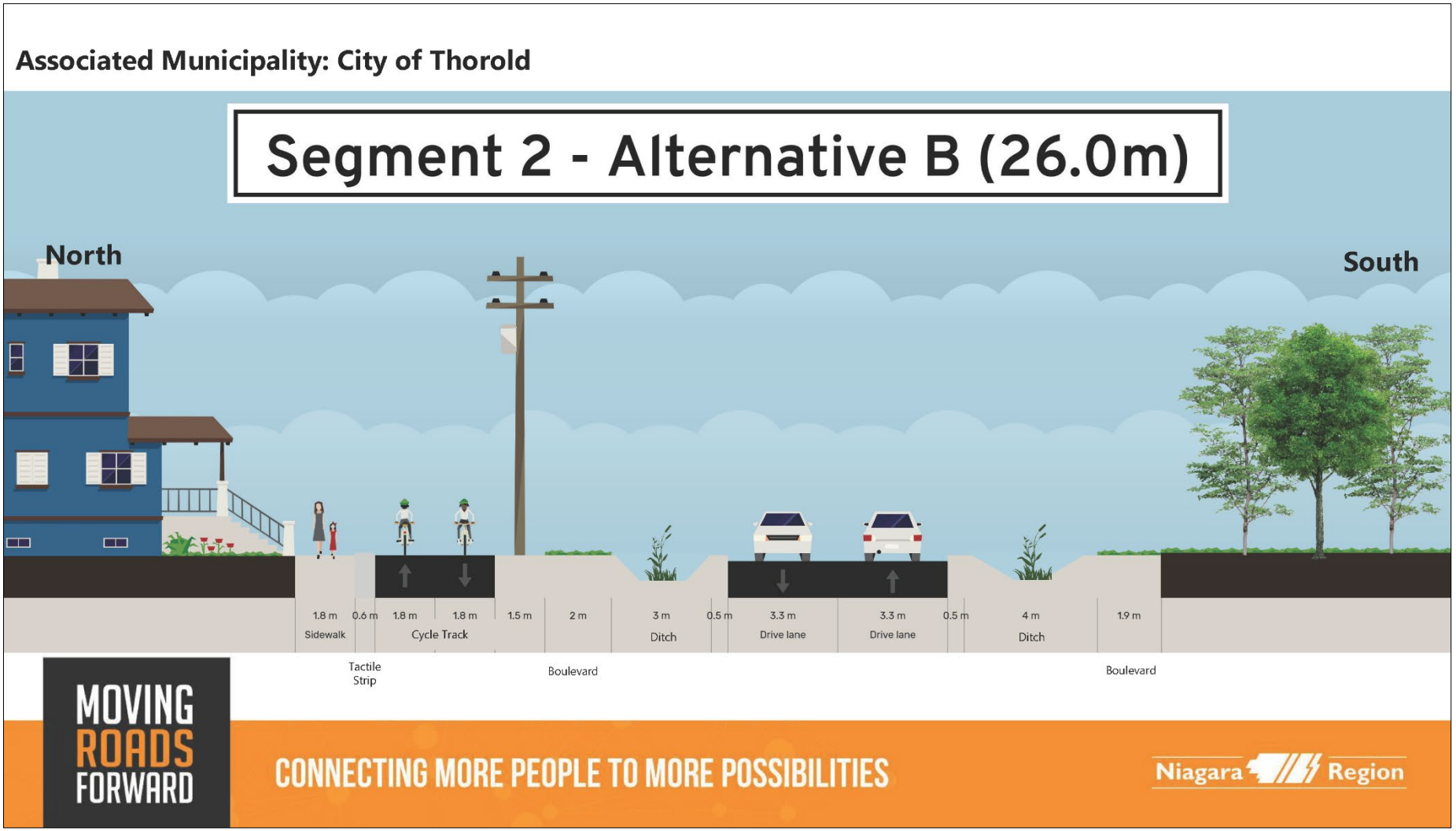


Table 2-11: Evaluation of Road Cross-Section Alternatives for Segment 2

Evaluation Criteria	Alternative A: Rural Cross-section	Score	Alternative B: Hybrid (Rural-Urban) Cross-section	Score
Transportation				
Active Transportation: Potential to incorporate active transportation facilities for walking and cycling	This cross-section provides a separate sidewalk and a separate bi-directional cycle track.	●	This cross-section provides a separate sidewalk and a separate bi-directional cycle track.	●
Road Safety: Potential to improve road safety and pedestrian and cyclists' safety	Provision of separate facilities for pedestrians, cyclists and drivers will result in less conflicts and will be safer. Provision of cycle track to the south side will reduce conflicts with vehicles entering or existing the residential properties along the north side. Potential for safety concerns due to no barrier curbs between travel lanes and ditches.	◕	Provision of separate facilities for pedestrians, cyclists and drivers will result in less conflicts and will be safer. Provision of cycle track to the north side will introduce conflicts with vehicles entering or exiting the residential properties along the north side. Removal of sight obstructions and/or signing recommended. Potential for improved safety due to curbs between travel lanes and ditches.	◕
Engineering/Constructability				
Flexibility in Design: Ability to reduce right of way requirements to accommodate desired features	This cross-section would have limited opportunity to further refine the design and reduce the overall width of the alignment for Segment 2, given the width (26.5m)	◔	This cross section would be narrower (26.0m), providing more opportunity to further refine the design in the detailed design stage.	◑
Operation and Maintenance: Feasibility of operation and maintenance	The maintenance requirements would be more involved with separate facilities on both sides of the roadway. Ditches can be used to store snow in winter.	◕	The maintenance requirements would be slightly less (facilities on one side of the roadway). Ditches can be used to store snow in winter.	●
Stormwater Management: Ability to provide opportunities to reduce stormwater quantity and/or improve stormwater quality	This cross-section proposes a wider ditch on the south side. This should be adequate to convey stormwater. The wider ditch would provide a higher level of stormwater quantity and quality control.	●	This cross-section proposes a wider ditch on the south side. This should be adequate to convey stormwater. The wider ditch would provide a higher level of stormwater quantity and quality control.	●
Cost				
Construction Cost: Cost to construct	The key design elements that differentiate this alternative from Alternative B, are the provision of paved and gravel shoulders for this cross-section. The cost to construct for this cross-section will be comparatively higher.	◕	The key design element that differentiates this alternative from Alternative A, is the provision of curbs for this cross-section. The cost to construct for this cross-section will be comparatively lower.	●
Operations and Maintenance Cost: Cost to operate and maintain	The maintenance cost for both alternatives would generally be similar.	●	The maintenance cost for both alternatives would generally be similar.	●
Overall Recommendation	**Not Recommended**		**Recommended**	

2.3.4.1 Preliminary Preferred Road Cross-Section for Segment 2

Based on the evaluation presented in Table 2-11, **Alternative B - Hybrid (Rural-Urban) Cross-section** was identified as the preliminary preferred cross-section for Segment 2.

Key design features of the preliminary preferred cross-section for Segment 2 include:

- Two 3.3 m drive lanes with 0.5 m curbs
- One 3.0 m ditch on the north side and a 4.0 m ditch on the south side
- 1.8 m sidewalk to the north side
- 3.6 m two-way cycle track and sidewalk on the north side.

Preliminary preferred cross-section for Segment 2 is shown in Figure 2-14.

2.3.5 Evaluation of Road Cross-Section Alternatives for Segment 3

The following two cross-section alternatives were identified for Road Segment 3: Merritt Road (Merrittville Highway/Niagara Street to Highway 406).

Road Cross-Section Alternative A: Key design features of this Urban Cross-section Alternative include:

- Four 3.3 m drive lanes separated by a 2.5 median
- 1.8 m sidewalk to the south side
- 3.6 m two-way cycle track on the south side

This alternative is shown in Figure 2-15.

Road Cross-Section Alternative B: Key design features of this Urban Cross-section Alternative include:

- Four 3.5 m drive lanes separated by a 2.5 median
- Two 1.8 m sidewalks (one on each side)
- Two 1.8 m one-way cycle tracks (one on each side)

This alternative is shown in Figure 2-16.

The evaluation of road cross-section alternatives for Segment 1 is provided in Table 2-12**.**

Figure 2-15: Segment 3 – Road Cross-Section Alternative A

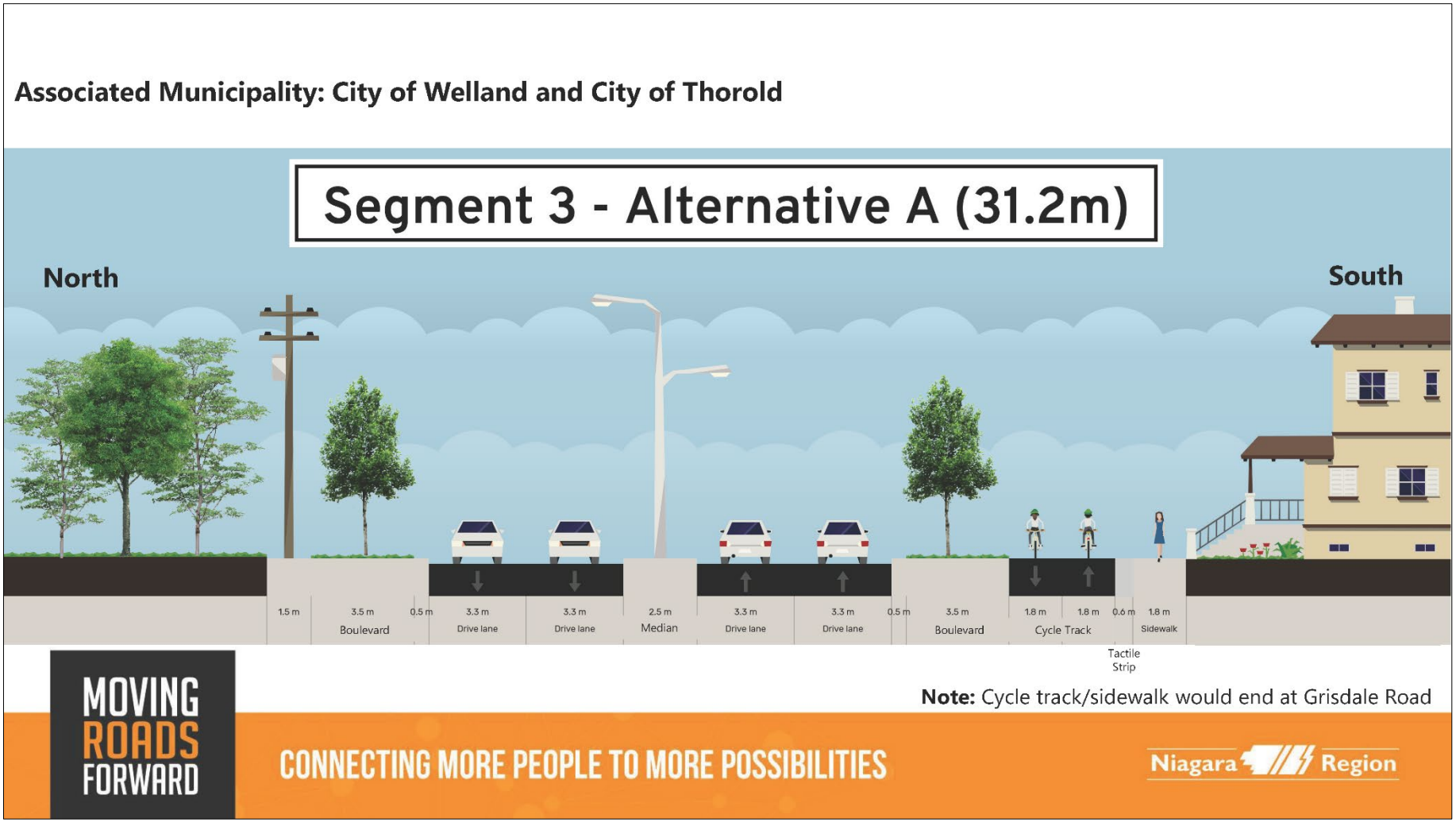


Figure 2-16: Segment 3 – Road Cross-Section Alternative B

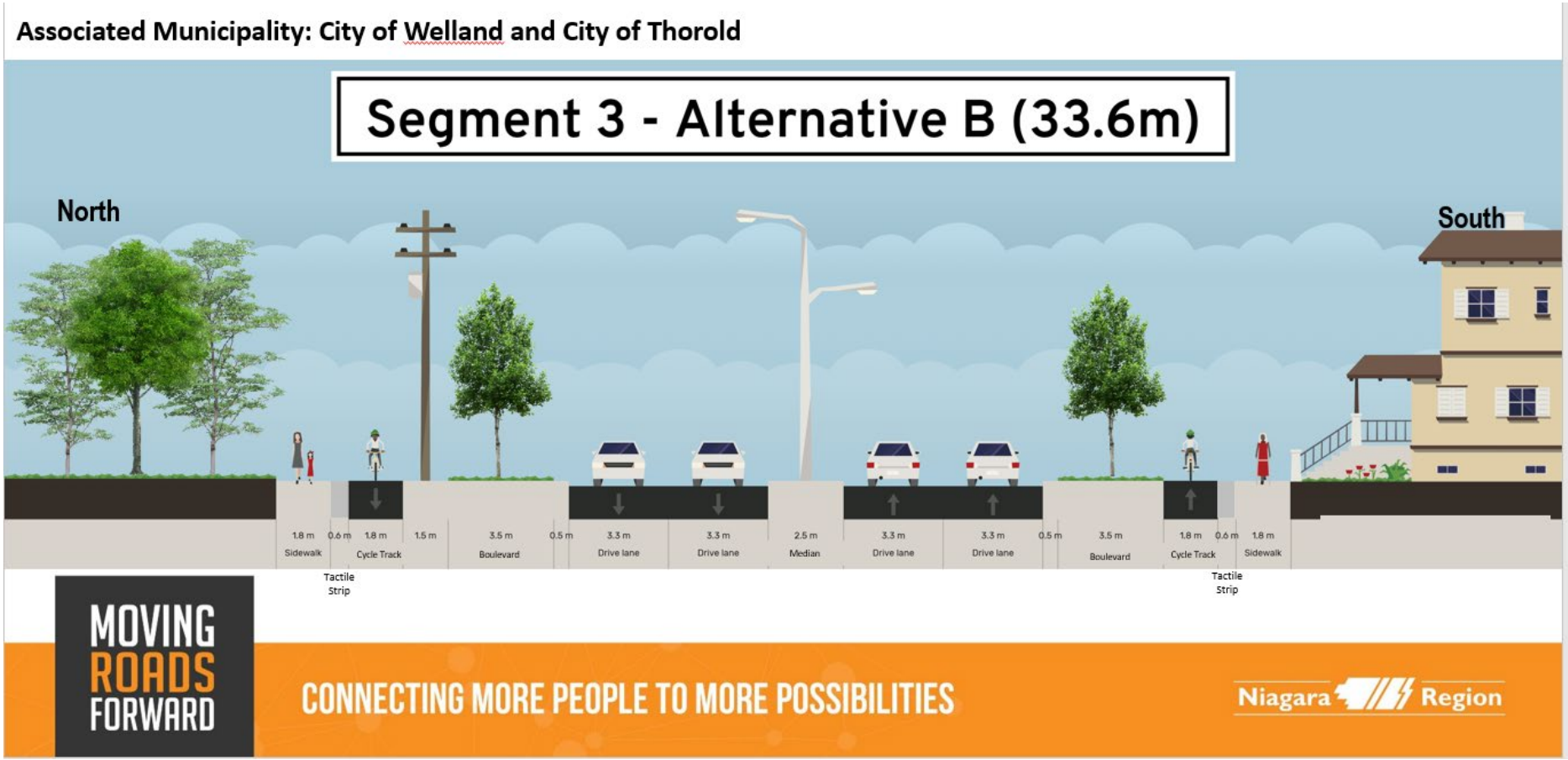


Table 2-12: Evaluation of Road Cross-Section Alternatives for Segment 3

Evaluation Criteria	Alternative A: Urban Cross-section (Active Transportation on South Side)	Score	Alternative B: Urban Cross-section (Active Transportation on Both Sides)	Score
Transportation				
Active Transportation: Potential to incorporate active transportation facilities for walking and cycling	This cross-section provides a separate sidewalk and a separate bi-directional cycle track on the south side.	●	This cross-section provides two separate sidewalks and two separate unidirectional cycle tracks.	●
Road Safety: Potential to improve road safety and pedestrian and cyclists' safety	Provision of separate facilities for pedestrians, cyclists and drivers will result in less conflicts and will be safer. Provision of active transportation facilities on the south side only will avoid conflicts/safety concerns associated with vehicular traffic from Highway 406 merging on to Merritt Road westbound.	●	Provision of separate facilities for pedestrians, cyclists and drivers will result in less conflicts and will be safer. Provision of active transportation facilities to the north side will result in potential conflicts/safety concerns associated with vehicular traffic from Highway 406 merging on to Merritt Road westbound.	◑
Engineering/Constructability				
Flexibility in Design: Ability to reduce right of way requirements to accommodate desired features	The width of the proposed cross section is 31.2 m This will reduce impacts on private properties, natural environment, and cultural environment.	●	The width of the proposed cross section is 33.6 m. This cross-section provides less opportunity to further refine the design and reduce the overall width of the alignment for Segment 3. There will be a greater impact on private properties, natural environment, and cultural environment.	◕
Operation and Maintenance: Feasibility of operation and maintenance	Because of active transportation facilities being proposed on one side, the maintenance requirements will generally be lower.	●	Because of active transportation facilities being proposed on both sides, the maintenance requirements will generally be higher.	◕
Stormwater Management: Ability to provide opportunities to reduce stormwater quantity and/or improve stormwater quality	This cross-section proposes to urbanize this road segment with curb and gutter, which would provide stormwater quantity and quality control.	●	This cross-section proposes to urbanize this road segment with curb and gutter, which would provide stormwater quantity and quality control.	●
Cost				
Construction Cost: Cost to construct	As this cross-section proposes sidewalk and bi-directional cycle track only on one side, the cost to construct will be comparatively lower.	●	As this cross-section proposes sidewalk and bi-directional cycle track on both sides, the cost to construct will be comparatively higher.	◕
Operations and Maintenance Cost: Cost to operate and maintain	Because of active transportation facilities being proposed on one side, the maintenance cost would be comparatively lower.	●	Because of active transportation facilities being proposed on both sides, the maintenance cost would be comparatively higher.	◕
Overall Recommendation	**Recommended**		**Not Recommended**	

2.3.5.1 Preliminary Preferred Road Cross-Section for Segment 3

Based on the evaluation presented in Table 2-12, **Alternative A - Urban Cross-section** was identified as preliminary preferred cross-section for Road Segment 3.

Key design features of the preliminary preferred cross-section for Segment 3 include:

- Four 3.3 m drive lanes separated by a 2.5 m median
- 1.8 m sidewalk to the south side
- 3.6 m separated two-way cycle track on the south side

This cross-section provides opportunity to further refine the design and reduce the overall width of the alignment for road Segment 3. The width of the proposed road widening has been reduced from 36 m to 31.2 m in Segment 3. This reduces impacts on private properties, natural environment, and cultural environment. The preliminary preferred cross-section for Segment 3 is shown in Figure 2-15.

2.3.6 Evaluation of Road Cross-Section Alternatives for Segment 4

The following two cross-section alternatives were identified for Road Segment 4: Rice Road (200 m north of Merritt Road to Quaker Road). Both alternatives are 36 m wide based on the Urban Wide typology, however due to stormwater management constraints, ditches needed to be included in the cross section.

Road Cross-Section Alternative A: Key design features of this Rural Cross-section Alternative include:

- Four 3.3 m drive lanes with paved and gravel shoulders
- Oncoming traffic lanes separated by a 2.5 m median
- Two 1.8 m sidewalks (one on each side)
- 3.0 m two-way cycle track on the west side
- Two 3.0 m ditches (one on each side)

This alternative is shown in Figure 2-17.

Road Cross-Section Alternative B: Key design features of this Hybrid (Rural-Urban) Cross-section Alternative include:

- Four 3.3 m drive lanes with curbs
- Oncoming traffic lanes separated by a 2.5 m median
- Two 1.8 m sidewalks (one on each side)
- 3.6 m two-way cycle track on the west side
- Two 3.0 m ditches (one on each side)

This alternative is shown in Figure 2-18.

The evaluation of road cross-section alternatives for Segment 4 is provided in Table 2-13.

Figure 2-17: Segment 4 – Road Cross-Section Alternative A

Associated Municipality: City of Welland and Town of Pelham

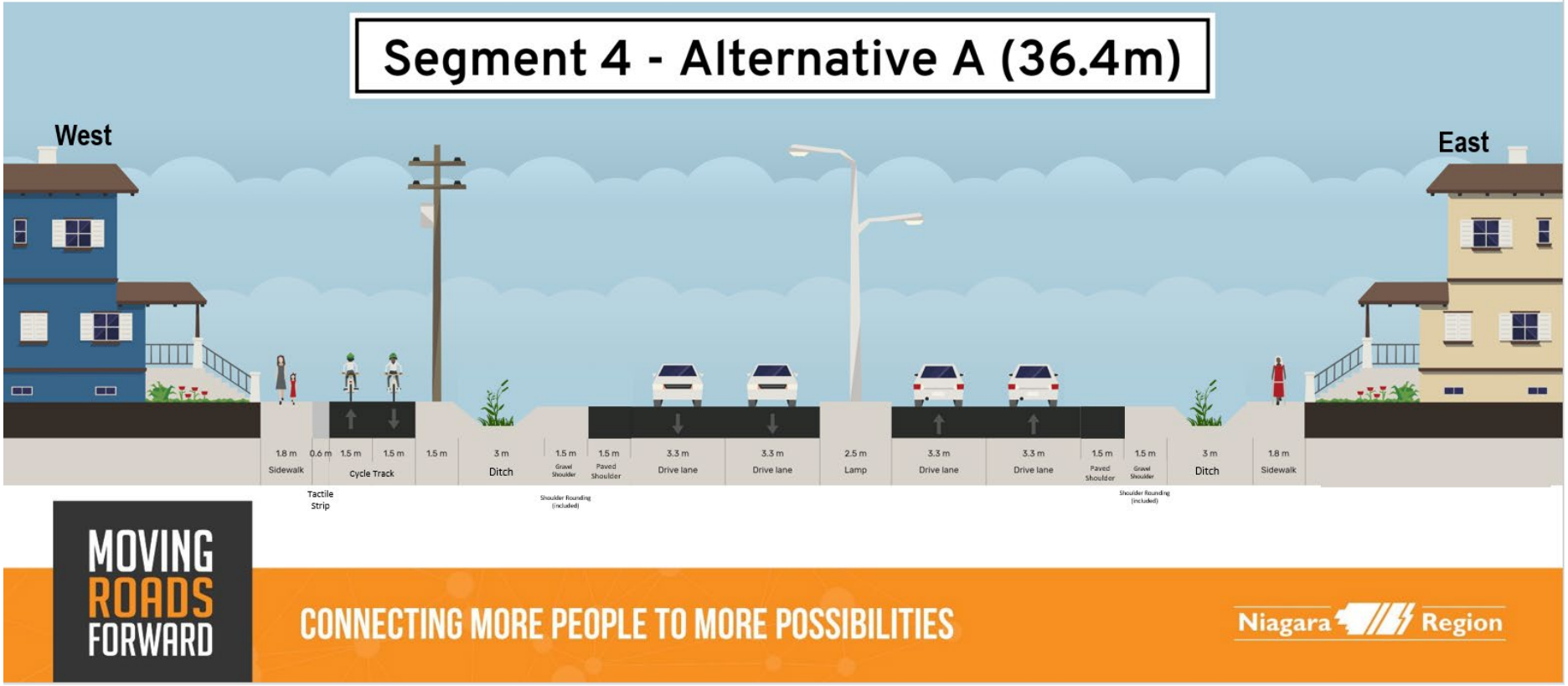


Figure 2-18: Segment 4 – Road Cross-Section Alternative B

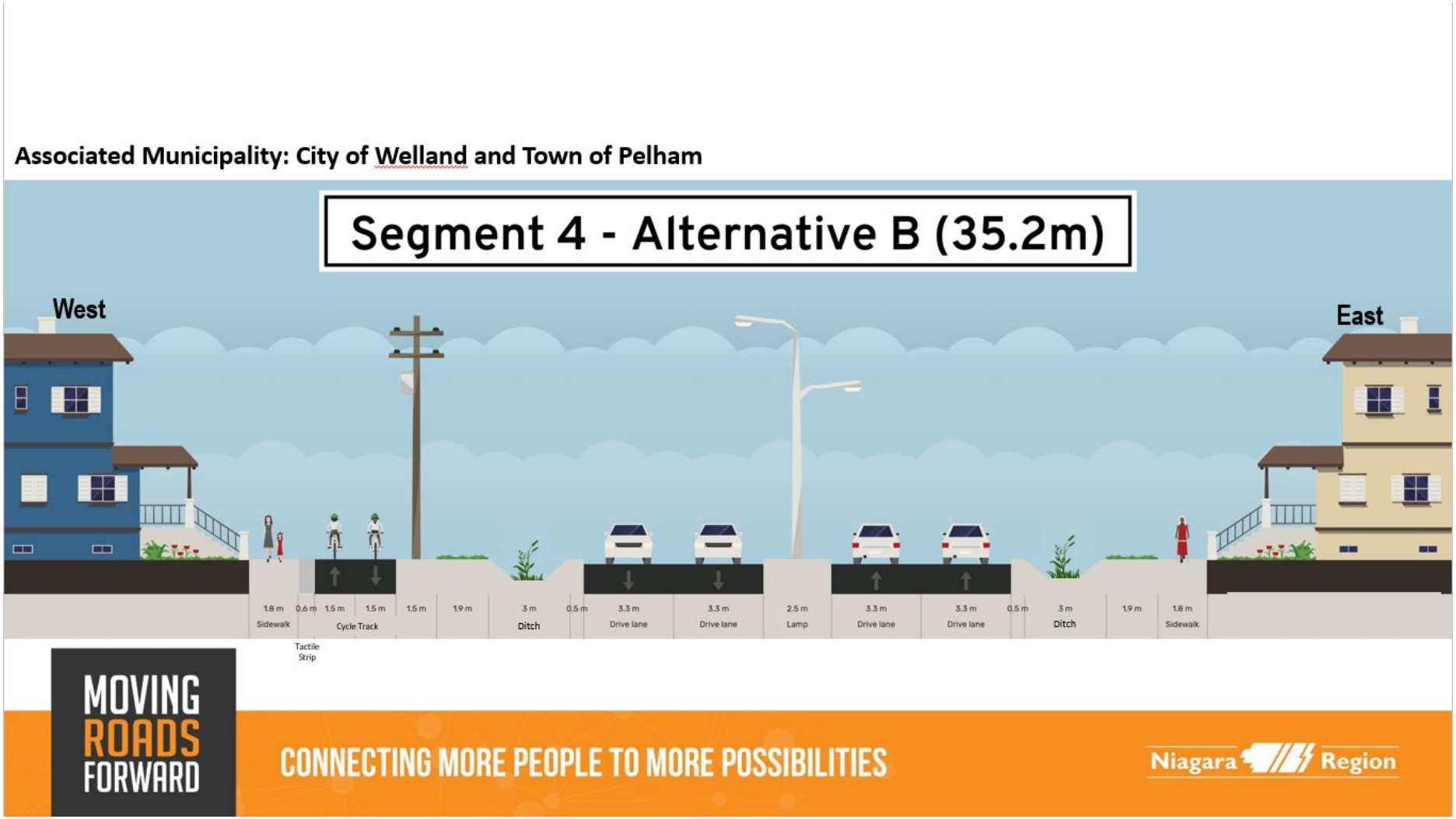


Table 2-13: Evaluation of Road Cross-Section Alternatives for Segment 4

Evaluation Criteria	Alternative A: Rural Cross-Section	Score	Alternative B: Hybrid (Rural-Urban) Cross-section	Score
Transportation				
Active Transportation: Potential to incorporate active transportation facilities for walking and cycling	This cross-section provides separate sidewalks and a separate bi-directional cycle track.	●	This cross-section provides separate sidewalks and a separate bi-directional cycle track.	●
Road Safety: Potential to improve road safety and pedestrian and cyclists' safety	Provision of separate facilities for pedestrians, cyclists and drivers will result in less conflicts and will be safer. Potential for safety concerns due to no barrier curbs between travel lanes and ditches.	◕	Provision of separate facilities for pedestrians, cyclists and drivers will result in less conflicts and will be safer. Potential for improved safety due to curbs between travel lanes and ditches.	●
Engineering/Constructability				
Flexibility in Design: Ability to reduce right of way requirements to accommodate desired features	This cross section is 36.4 m wide. The cross section would provide limited opportunities to further refine the design and reduce the overall width of the alignment for Segment 4.	◔	This cross-section (35.2 m wide) would provide opportunity to further refine the design and reduce the overall width of the alignment for Segment 4.	◑
Operation and Maintenance: Feasibility of operation and maintenance	Operation and maintenance requirements for both alternatives will generally be similar. Ditches can be used to store snow in winter.	●	Operation and maintenance requirements for both alternatives will generally be similar. Ditches can be used to store snow in winter.	●
Stormwater Management: Ability to provide opportunities to reduce stormwater quantity and/or improve stormwater quality	This cross-section proposes two 3.0 m wide ditches (one on each side). Ditches would provide stormwater quantity and quality control.	●	This cross-section proposes two 3.0 m wide ditches (one on each side). Ditches would provide stormwater quantity and quality control.	●
Cost				
Construction Cost: Cost to construct	The key design elements that differentiate this alternative from Alternative B, are the provision of paved and gravel shoulders for this cross-section. The cost to construct for this cross-section will be comparatively higher.	◕	The key design element that differentiates this alternative from Alternative A, is the provision of curbs for this cross-section. The cost to construct for this cross-section will be comparatively lower.	●
Operations and Maintenance Cost: Cost to operate and maintain	The maintenance cost for both alternatives would generally be similar.	●	The maintenance cost for both alternatives would generally be similar.	●
Overall Recommendation	**Not Recommended**		**Recommended**	

2.3.6.1 Preliminary Preferred Road Cross-Section for Segment 4

Based on the evaluation presented in Table 2-13, **Alternative B - Hybrid (Rural-Urban) Cross-section** was identified as preliminary preferred cross-section for Segment 4.

Key design features of the preliminary preferred cross-section for Segment 4 include:

- Four 3.3 m drive lanes with curbs
- Oncoming traffic lanes separated by a 2.5 m median
- Two 1.8 m sidewalks (one on each side)
- 3.6 m bi-directional cycle track on the north side
- Two 3.0 m ditches (one on each side)

This alternative is shown in Figure 2-18. To facilitate access into driveways, gaps in the median or a centre

2.4 Road Intersection Alternatives

The following sections outlines a review of intersection alternatives at four key intersections along the study corridor, Merritt Road and Rice Road, Merritt Road and Cataract Road, Merritt Road and Merrittville Highway/Niagara Street and Rice Road and Quaker Road.

2.4.1 Identification of Road Intersection Alternatives

Alternative road intersection alternatives are identified in Table 2-14. As noted in the Transportation Report submitted to the Region, based on future traffic conditions, either a traffic signal or a roundabout would be required to accommodate future traffic conditions at Merritt Road and Rice Road, Merritt Road and Cataract Road and Rice Road and Quaker Road. A traffic signal is already in place at the intersection of Merritt Road and Merrittville Highway/Niagara Street.

Table 2-14: Road Intersection Alternatives

Road Intersection	Alternatives for Intersections
Merritt Road and Rice Road	Alternative A: Traffic Signal Alternative B: Roundabout
Merritt Road and Cataract Road	Alternative A: Traffic Signal Alternative B: Roundabout
Merritt Road and Merrittville Highway / Niagara Street	Alternative A: Maintain Existing Traffic Signal and Remove Northbound Right-turn Channel Alternative B: Roundabout
Rice Road and Quaker Road	Alternative A: Traffic Signal Alternative B: Roundabout

2.4.2 Evaluation Criteria for Road Intersection Alternatives

Table 2-15 shows the evaluation criteria used to evaluate the road intersection alternatives.

Table 2-15: Evaluation Criteria for Intersections

Factor	Evaluation Criteria
Transportation	**Road Safety:** Potential to improve road safety and pedestrian and cyclists' safety **Operations:** Potential to improve traffic operations **Road Corridor Consistency:** Consistency with upstream and downstream intersections
Socio-economic Environment	**Private Property Impacts:** Private property taking **Public Realm:** Ability to provide opportunities to enhance streetscaping, landscaping, and public realm along Merritt Road and Rice Road
Natural Environment	**Terrestrial Environment:** Impacts on terrestrial resources (vegetation, wetlands, trees and wildlife) **Aquatic Environment:** Impacts to fish and fish habitats
Cultural / Archaeological Environment	**Archaeological Resources:** Impacts on lands identified to retain potential archaeological resources **Built Heritage and Cultural Resources:** Impacts on built heritage and cultural heritage landscapes
Engineering/Constructability	**Feasibility:** Feasibility of access to local properties
Cost	**Construction Cost:** Cost to construct **Operation and Maintenance Cost:** Cost to operate and maintain

In addition to the evaluation criteria, the safety considerations for traffic signals and roundabouts are outlined on the following page:

Road Safety Considerations for Traffic Signals:

- May encourage motorists to speed up during the amber phase
- Longer crossing distances for pedestrians and cyclists; thus, increasing the potential for turning movement collisions due to increased exposure to traffic and high-speed vehicles
- More conflict points than a roundabout; thus, increasing the potential for crashes
- Installing a traffic signal at a stop-controlled intersection results in 44% reduction in all types of crashes (Harkey et al., 2008)

Road Safety Considerations for Roundabouts:

- Considered the safest type of intersection for all road users due to lower vehicle speeds, fewer conflict points, and reduced crash angles
- Safer for pedestrians due to shorter crossing distances, slower-moving traffic that is only approaching from one direction at a time, and good sightlines between motorists and pedestrians
- Reduced conflict points between road users which ultimately reduces crashes
- Provides easy u-turn opportunities, thus improving safety by reducing conflict and full access points
- Roundabouts are considered a safer option for intersections with heavy left turn movements
- Converting an all-way stop-controlled intersection to a roundabout result in 45.6% reduction in all type of crashes (Qin et al., 2013)
- Roundabouts tend to increase the frequency of bicycle crashes. This will be mitigated by providing separated cycle paths at the roundabout

2.4.3 Evaluation of Alternatives for Merritt Road and Rice Road Intersection

The following two alternatives were identified for the Merritt Road and Rice Road intersection:

Alternative A - Traffic Signal: This alternative would involve installing a traffic signal at the Merritt Road and Rice Road intersection.

Alternative B - Roundabout: This alternative would involve installing a roundabout at the Merritt Road and Rice Road intersection.

The evaluation of the road intersection alternatives for Merritt Road and Rice Road intersection is presented in Table 2-16.

Table 2-16: Evaluation of Road Intersection Alternatives for Merritt Road and Rice Road Intersection

Evaluation Criteria	Alternative A: Traffic Signal	Score	Alternative B: Roundabout	Score
Transportation				
Road Safety: Potential to improve road safety and pedestrian and cyclists' safety	As noted earlier, as a whole traffic signals are a less safe choice	◔	As noted earlier, as a whole roundabouts are a safer choice	◕
Operations: Potential to improve traffic operations	No issues with intersection operating under traffic signal with additional northbound-southbound through lane, dedicated left turn lanes and northbound right turn lane up to 2041	●	Roundabouts will improve traffic operations at this intersection. A roundabout will be sufficient to accommodate future traffic to 2041	●
Road Corridor Consistency: Consistency with upstream and downstream intersections	Traffic signal at Rice Rd / Merritt Rd will be consistent with the upstream (Rice Rd / Port Robinson Rd) and downstream (Rice Rd / Woodlawn Rd) signal-controlled intersections	●	A roundabout will be inconsistent with upstream and downstream signalized intersections	◔
Socio-economic Environment				
Private Property Impacts: Private property taking	Comparatively less private property taking will be required	◕	Comparatively higher private property taking will be required. Significant property impacts to three properties.	◔
Public Realm: Ability to provide opportunities to enhance streetscaping, landscaping, and public realm	Some opportunities for streetscaping	◑	More opportunities for landscaping within the roundabout, and gateway treatments and landscaping	●
Natural Environment				
Terrestrial Environment: Impacts on terrestrial resources (vegetation, wetlands, trees, and wildlife)	Some impacts are anticipated to the natural environment area (comparatively less removal of natural area). Idling vehicles at the traffic signal will impact the air quality	◑	More natural environment area is impacted compared to the implementation of traffic signal at this intersection (comparatively higher removal of natural area). Fewer delays and smooth traffic flow at the roundabout reduce emissions	◑
Aquatic Environment: Impacts to fish and fish habitat	No impacts are anticipated to fish and fish habitat	●	No impacts are anticipated to fish and fish habitat	●
Cultural / Archaeological Environment				
Archaeological Resources: Impacts on lands identified to retain potential archaeological resources	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required to identify any potential impacts and associated mitigation measures	◑	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required to identify any potential impacts and associated mitigation measures	◑
Built Heritage and Cultural Resources: Impacts on built heritage and cultural heritage landscapes	No impacts are anticipated to heritage property	●	No impacts are anticipated to heritage property	●
Engineering / Constructability				
Feasibility: Feasibility of access to local properties	Driveways are farther away from the traffic signal. Queuing at the traffic signal due to delays could block access to nearby driveways	◑	Close proximity to nearby driveways due to larger footprint compared to a traffic signal	◔
Implementation: Impacts associated with project implementation / construction	Complete reconstruction of the intersection will be required.	◑	Complete reconstruction of the intersection will be required.	◑
Utilities: Impacts on utilities	Utility relocation will be required within the right-of-way	◑	Utility relocation will be required within the right-of-way	◑
Cost				
Construction Cost: Cost to construct	Lower construction cost compared to roundabout	◕	Higher construction cost because of more road structure in total, and more concrete for curbs, splitter islands and the central island	○
Operation and Maintenance Cost: Cost to operate and maintain	Higher electricity costs associated with operating traffic signals. Will require signal maintenance	◔	Lower life cycle cost because of less need for ongoing maintenance.	◕
Overall Recommendation	**Recommended**		**Not Recommended**	

2.4.3.1 Preliminary Preferred Improvement for Merritt Road and Rice Road Intersection

Based on the evaluation presented in Table 2-16, **Alternative A: Traffic Signal** was identified as the preliminary preferred improvement for Merritt Road and Rice Road intersection.

2.4.4 Evaluation of Alternatives for Merritt Road and Cataract Road Intersection

Following two alternatives were identified for the Merritt Road and Cataract Road intersection:

Alternative A - Traffic Signal: This alternative would involve installing a traffic signal at the Merritt Road and Cataract Road intersection.

Alternative B - Roundabout: This alternative would involve installing a roundabout at the Merritt Road and Cataract Road intersection.

The evaluation of the road intersection alternatives for Merritt Road and Cataract Road intersection is presented in Table 2-17.

Table 2-17: Evaluation of Road Intersection Alternatives for Merritt Road and Cataract Road Intersection

Evaluation Criteria	Alternative A: Traffic Signal	Score	Alternative B: Roundabout	Score
Transportation				
Road Safety: Potential to improve road safety and pedestrian and cyclists' safety	As noted earlier, as a whole traffic signals are a less safe choice	◔	As noted earlier, as a whole roundabouts are a safer choice	◕
Operations: Potential to improve traffic operations	No issues with intersection operating under traffic signal with dedicated left turn lanes	●	Roundabouts will improve traffic operations at this intersection. A roundabout will be sufficient to accommodate future traffic to 2041	●
Road Corridor Consistency: Consistency with upstream and downstream intersections	A traffic signal will be inconsistent with upstream and downstream stop-controlled intersections	◔	A roundabout will be inconsistent with upstream and downstream stop-controlled intersections	◔
Socio-economic Environment				
Private Property Impacts: Private property taking	Comparatively less private property taking will be required.	◕	Comparatively higher private property taking will be required – significant impacts to residential property on northeast corner of intersection.	◔
Public Realm: Ability to provide opportunities to enhance streetscaping, landscaping, and public realm	Some opportunities for streetscaping	◑	More opportunities for landscaping within the roundabout, and gateway treatments and landscaping	●
Natural Environment				
Terrestrial Environment: Impacts on terrestrial resources (vegetation, wetlands, trees, and wildlife)	Some impacts are anticipated to the natural environment area (comparatively less removal of natural area). Idling vehicles at the traffic signal will impact the air quality	◔	More natural environment area is impacted compared to the implementation of traffic signal at this intersection (comparatively higher removal of natural area). Fewer delays and smooth traffic flow at the roundabout reduce emissions	◔
Aquatic Environment: Impacts to fish and fish habitat	No impacts are anticipated to fish and fish habitat	●	No impacts are anticipated to fish and fish habitat	●
Cultural / Archaeological Environment				
Archaeological Resources: Impacts on lands identified to retain potential archaeological resources	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required to identify any potential impacts and associated mitigation measures	◑	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required to identify any potential impacts and associated mitigation measures	◑
Built Heritage and Cultural Resources: Impacts on built heritage and cultural heritage landscapes	No impacts are anticipated to heritage property	●	No impacts are anticipated to heritage property	●
Engineering / Constructability				
Feasibility: Feasibility of access to local properties	Driveway to the east of the intersection is farther away from the traffic signal. Queuing at the traffic signal due to delays could block access to nearby driveways	◑	Close proximity to nearby driveway to the east of intersection due to larger roundabout footprint compared to a traffic signal	◔
Implementation: Impacts associated with project implementation / construction	Complete reconstruction of the intersection will be required.	◑	Complete reconstruction of the intersection will be required.	◑
Utilities: Impacts on utilities	Utility relocation will be required within the right-of-way	◑	Utility relocation will be required within the right-of-way	◑
Cost				
Construction Cost: Cost to construct	Lower construction cost compared to roundabout	◕	Higher construction cost because of more road structure in total, and more concrete for curbs, splitter islands and the central island	○
Operation and Maintenance Cost: Cost to operate and maintain	Higher electricity costs associated with operating traffic signals. Will require signal maintenance	◔	Lower life cycle cost because of less need for ongoing maintenance.	◕
Overall Recommendation	**Recommended**		**Not Recommended**	

2.4.4.1 Preliminary Preferred Improvement for Merritt Road and Cataract Road Intersection

Based on the evaluation presented in Table 2-17, **Alternative A: Traffic Signal** was identified as the preliminary preferred improvement for Merritt Road and Cataract Road intersection.

2.4.5 Evaluation of Alternatives for Merritt Road and Merrittville Highway / Niagara Street Intersection

Following two alternatives were identified for the Merritt Road and Merrittville Highway / Niagara Street intersection:

Alternative A - Maintain Existing Traffic Signal and Remove Northbound Right-turn Channel: This alternative would involve maintaining the existing traffic signal and removing the northbound right-turn channel at the Merritt Road and Merrittville Highway / Niagara Street intersection.

Alternative B – Two-lane Roundabout: This alternative would involve replacing the existing traffic signal and the northbound right-turn channel at the Merritt Road and Merrittville Highway / Niagara Street intersection with a roundabout.

The evaluation of the road intersection alternatives for Merritt Road and Merrittville Highway/Niagara Street intersection is presented in Table 2-18.

Table 2-18: Evaluation of Road Intersection Alternatives for Merritt Road and Merrittville Highway / Niagara Street Intersection

Evaluation Criteria	Alternative 1: Maintain Existing Traffic Signal and Remove Northbound Right-turn Channel	Score	Alternative 2: Roundabout	Score
Transportation				
Road Safety: Potential to improve road safety and pedestrian and cyclists' safety	Longer crossing distances for pedestrians and cyclists at the intersection increases the potential for crashes due to increased exposure to vehicular traffic. Removing the northbound right-turn channel will improve safety for pedestrians and cyclists	◔	As noted earlier, as a whole roundabouts are a safer choice	◕
Operations: Potential to improve traffic operations	Under continued signal control, with the addition of the eastbound left turn lane and the additional through lane, this intersection will still experience critical movements (WBL and SBLT-TR), approaching capacity in 2041	◑	Roundabout will improve traffic operations at this intersection and will benefit the heavy westbound left movement on Niagara Street – Merrittville Highway at Merritt Road. A roundabout should operate acceptably.	●
Road Corridor Consistency: Consistency with upstream and downstream intersections	Traffic signal is consistent with the downstream (Quaker Rd/Niagara St) signal-controlled intersections	●	A roundabout will be inconsistent with upstream and downstream stop-controlled and signalized intersections	◔
Socio-economic Environment				
Private Property Impacts: Private property taking	Comparatively less private property taking will be required.	◕	Comparatively higher private property taking will be required. Property expropriation required on northeast corner.	○
Public Realm: Ability to provide opportunities to enhance streetscaping, landscaping, and public realm	Removing the northbound right-turn channel will allow for significant opportunities for landscaping	●	Opportunities for landscaping within the roundabout including opportunities for gateway treatments	◕
Natural Environment				
Terrestrial Environment: Impacts on terrestrial resources (vegetation, wetlands, trees, and wildlife)	Some impacts are anticipated to the natural environment area (comparatively less removal of natural area). Idling vehicles at the traffic signal will impact the air quality	◕	More natural environment area is impacted compared to the implementation of traffic signal at this intersection (comparatively higher removal of natural area). Fewer delays and smooth traffic flow at the roundabout reduce emissions	◑
Aquatic Environment: Impacts to fish and fish habitat	No impacts are anticipated to fish and fish habitat	●	No impacts are anticipated to fish and fish habitat	●
Cultural / Archaeological Environment				
Archaeological Resources: Impacts on lands identified to retain potential archaeological resources	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required to identify any potential impacts and associated mitigation measures	◑	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required to identify any potential impacts and associated mitigation measures	◑
Built Heritage and Cultural Resources: Impacts on built heritage and cultural heritage landscapes	No impacts are anticipated to heritage property	●	No impacts are anticipated to heritage property	●
Engineering / Constructability				
Feasibility: Feasibility of access to local properties	Driveways are farther away from the traffic signal. Queuing at the traffic signal due to delays blocks access to nearby driveways	◑	Close proximity to nearby driveway to the east of intersection due to larger roundabout footprint compared to a traffic signal	◔
Implementation: Impacts associated with project implementation / construction	Complete reconstruction of the intersection will be required.	◑	Complete reconstruction of the intersection will be required.	◑
Utilities: Impacts on utilities	Utility relocation will be required within the right-of-way	◑	Utility relocation will be required within the right-of-way	◑
Cost				
Construction Cost: Cost to construct	Lower construction cost compared to roundabout	◕	Higher construction cost because of more road structure in total, and more concrete for curbs, splitter islands and the central island	○
Operation and Maintenance Cost: Cost to operate and maintain	Higher electricity costs associated with operation and maintenance of traffic signals	◔	Lower life cycle cost because of less need for ongoing maintenance.	◕
Overall Recommendation	**Recommended**		**Not Recommended**	

2.4.5.1 Preliminary Preferred Improvement for Merritt Road and Merrittville Highway / Niagara Street Intersection

Based on the evaluation presented in Table 2-18, **Alternative A: Traffic Signal (Remove Northbound Right Turn Channel)** was identified as the preliminary preferred improvement for Merritt Road and Merrittville Highway / Niagara Street intersection.

2.4.6 Evaluation of Alternatives for Rice Road and Quaker Road Intersection

Following two alternatives were identified for the Rice Road and Quaker Road intersection:

Alternative A - Traffic Signal: This alternative would involve installing a traffic signal at the Rice Road and Quaker Road intersection.

Alternative B - Two-lane Roundabout: This alternative would involve installing a roundabout at the Rice Road and Quaker Road intersection.

The evaluation of the road intersection alternatives for Rice Road and Quaker Road intersection is presented in Table 2-19.

Table 2-19: Evaluation of Road Intersection Alternatives for Rice Road and Quaker Road Intersection

Evaluation Criteria	Alternative A: Traffic Signal	Score	Alternative B: Roundabout	Score
Transportation				
Road Safety: Potential to improve road safety and pedestrian and cyclists' safety	As noted earlier, as a whole traffic signals are a less safe choice	◔	As noted earlier, as a whole roundabouts are a safer choice	◕
Operations: Potential to improve traffic operations	No issues with intersection operating under traffic signal with an additional northbound-southbound through lane and with dedicated left turn lanes up to 2041	●	Roundabouts will improve traffic operations at this intersection and will particularly benefit the heavy left turns. A roundabout should be sufficient to accommodate future traffic to 2041	●
Road Corridor Consistency: Consistency with upstream and downstream intersections	Traffic signal at Rice Rd / Quaker Rd will be consistent with the upstream (Rice Rd / Port Robinson Rd) and downstream (Rice Rd / Woodlawn Rd) signal-controlled intersections	●	A roundabout will be inconsistent with upstream and downstream signalized intersections	◔
Socio-economic Environment				
Private Property Impacts: Private property taking	Complete buy-out of property on northeast corner of intersection.	◔	Comparatively higher private property taking will be required. Significant impacts to properties on all four corners of intersection. Complete buy-out of property on northeast corner of intersection.	○
Public Realm: Ability to provide opportunities to enhance streetscaping, landscaping, and public realm	Some opportunities for streetscaping	◑	More opportunities for landscaping within the roundabout, and gateway treatments and landscaping	●
Natural Environment				
Terrestrial Environment: Impacts on terrestrial resources (vegetation, wetlands, trees, and wildlife)	No impacts are anticipated on terrestrial resources. Idling vehicles at the traffic signal will impact the air quality	◕	No impacts are anticipated on terrestrial resources. Fewer delays and smooth traffic flow at the roundabout reduce emissions	●
Aquatic Environment: Impacts to fish and fish habitat	No impacts are anticipated to fish and fish habitat	●	No impacts are anticipated to fish and fish habitat	●
Cultural / Archaeological Environment				
Archaeological Resources: Impacts on lands identified to retain potential archaeological resources	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required to identify any potential impacts and associated mitigation measures	◑	Potential impacts to lands identified to retain potential archaeological resources. Stage 2 archaeological assessment will be required to identify any potential impacts and associated mitigation measures	◑
Built Heritage and Cultural Resources: Impacts on built heritage and cultural heritage landscapes	Lower impacts to heritage property	◕	Slightly higher impacts to heritage property compared to a traffic signal	◑
Engineering / Constructability				
Feasibility: Feasibility of access to local properties	Driveways are farther away from the traffic signal. Queuing at the traffic signal due to delays could block access to nearby driveways	◑	Close proximity to nearby driveways due to larger footprint compared to a traffic signal	◔
Implementation: Impacts associated with project implementation / construction	Complete reconstruction of the intersection will be required.	◑	Complete reconstruction of the intersection will be required.	◑
Utilities: Impacts on utilities	Utility relocation will be required within the right-of-way	◑	Utility relocation will be required within the right-of-way	◑
Cost				
Construction Cost: Cost to construct	Lower construction cost compared to roundabout	◕	Higher construction cost because of more road structure in total, and more concrete for curbs, splitter islands and the central island	○
Operation and Maintenance Cost: Cost to operate and maintain	Higher electricity costs associated with operating traffic signals. Will require signal maintenance	◔	Lower life cycle cost because of less need for ongoing maintenance.	◕
Overall Recommendation	**Recommended**		**Not Recommended**	

2.4.6.1 Preliminary Preferred Improvement for Rice Road and Quaker Road Intersection

Based on the evaluation presented in Table 2-19, **Alternative A: Traffic Signal** was identified as the preliminary preferred improvement for Rice Road and Quaker Road intersection.

3.0 Next Steps

As required by the Municipal Class EA process, the results of the evaluation of alternative designs must be shared with the public, Indigenous Nations, review agencies and key stakeholders for review and input. Accordingly, the results of the evaluation of alternatives (i.e., the preliminary preferred design) presented in this document will be shared with the public, Indigenous Nations, review agencies and key stakeholders for review and input. Meetings will be held with the relevant government agencies and stakeholders to present the preliminary preferred design. A Public Information Centre #3 will be hosted to share the preliminary preferred design with the public.

Following the Public Information Centre #3, the project will proceed to Phase 4 of the Municipal Class EA process, where an Environmental Study Report will be developed to document the planning, decision making and consultation process. A Notice of Study Completion will be issued to inform interested parties where and when they access the Environmental Study Report for review.

4.0 References

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