

Appendix P – Design Alternatives Evaluation Tables

*Kennedy Road Environmental Assessment between
Steeles Avenue and Major Mackenzie Drive*



Table 1: Kennedy Road Evaluation of Alternative Designs (Steeles Avenue to 14th Avenue)

CRITERIA	ALTERNATIVE 1: Widening About the Centreline	ALTERNATIVE 2: Widening to the West	ALTERNATIVE 3: Widening to the East
Transportation Service			
Improve Public Transit Service	<ul style="list-style-type: none">Transit service on Kennedy Road would be enhanced and delays minimized, with a reduction in traffic congestion due to the provision of Transit/HOV lanes to minimize transit interactions with automobiles		
Reduce Traffic Congestion and Delays	<ul style="list-style-type: none">Reduced traffic congestion and delays by increasing capacity to meet future demandsCongestion mitigation provided by active transportation improvements and the provision of Transit/HOV lanes to reduce dependence on single-occupant vehicles		
Create a Pedestrian-Friendly Environment	<ul style="list-style-type: none">Potential to improve pedestrian environment at locations where there are currently deficiencies with level of service		
Create a Cyclist-Friendly Environment	<ul style="list-style-type: none">Improved environment for cyclists through the provision of continuous, dedicated cycling facilities		
Improve Safety for All Travel Modes	<ul style="list-style-type: none">Reduced collision potential with management of potential conflicts, reduced traffic congestion, and reduced driver frustrationHigh potential for improved cyclist and pedestrian safety due to provision of dedicated active transportation facilities, reducing conflict with motorists		
Improve Mode Choice	<ul style="list-style-type: none">Enhanced transit service with dedicated Transit/HOV lanes andProvision of active transportation facilities will reduce dependence on single-occupant vehicles		
Summary of Transportation Service	Most Preferred	Most Preferred	Most Preferred
Natural Environment			
Protect Designated Natural Areas	<ul style="list-style-type: none">There are no Areas of Natural and Scientific Interest (ANSIs)There are no Provincially Significant Wetlands (PSWs)		
Protect Vegetation	<ul style="list-style-type: none">Vegetation communities identified within the study area consist primarily of manicured areas with amenity trees planted		
	<ul style="list-style-type: none">Potential impacts to Kentucky Coffee Trees in east boulevard, regulated as Threatened under ESA but are non-native to the corridor and not treated as protected under the ESA, as confirmed by MNRFPotential impacts to 2 trees of >50cm DBHPotential impacts to meadow and wetland vegetation north of the GO Rail tracksMinor impacts to vegetation communities and mature tree growth due to wider roadway platform and widening to both sidesThe study area is dominated by vegetation that is manicured and regularly maintained, including plant species that are well adapted to persist in areas that are regularly disturbed	<ul style="list-style-type: none">No Kentucky Coffee Trees identified in west boulevardNo impacts to trees of >50cm DBH in the west boulevardPotential impacts to meadow vegetation north of the GO Rail tracks in the west boulevardModerate impacts to vegetation communities and mature tree growth due to wider roadway platform and widening to one side onlyThe study area is dominated by vegetation that is manicured and regularly maintained, including plant species that are well adapted to persist in areas that are regularly disturbed	<ul style="list-style-type: none">Significant impacts to Kentucky Coffee Trees in east boulevard, regulated as Threatened under ESA but are non-native to the corridor and not treated as protected under the ESA, as confirmed by MNRFPotential impacts to 2 trees of >50cm DBHPotential impacts to meadow and wetland vegetation north of the GO Rail tracks in the east boulevardModerate impacts to vegetation communities and mature tree growth due to wider roadway platform and widening to one side onlyThe study area is dominated by vegetation that is manicured and regularly maintained, including plant species that are well adapted to persist in areas that are regularly disturbed
Protect Wildlife	<ul style="list-style-type: none">Potential for minor impacts on wildlife due to a wider roadway platformWhile highly disturbed, vegetative communities yielding wildlife habitat are generally sparse on both sides of study corridor due to existing land-useNo structures were identified as suitable for the nesting of threatened bird species were identified within the study area		
Protect Aquatic Habitat	<ul style="list-style-type: none">Potential impacts to frog and turtle species as frog and turtle habitats are located in the wetland north of the GO Rail tracks	<ul style="list-style-type: none">No impact to aquatic habitat on west side of Kennedy Road	<ul style="list-style-type: none">Potential impacts to frog and turtle species as frog and turtle habitats are located in the wetland north of the GO Rail tracks
Storm and Groundwater Management	<ul style="list-style-type: none">Moderate impact with increased roadway width and hard surface area to accommodate additional Transit/HOV lanes and active transportation facilities, stormwater quantity will increase and quality mitigation may be required; however, can be addressed through designModerate impact to shallow groundwater system due to potential increase in contaminants related to increased roadway width (i.e. road salt, etc.)		
Improve Air Quality	<ul style="list-style-type: none">Moderate improvement to air quality through increased high-occupancy vehicles and transit use, and reduced congestionActive transportation and transit service improvements can reduce dependence on automobile and provide air quality improvements		

CRITERIA	ALTERNATIVE 1: Widening About the Centreline	ALTERNATIVE 2: Widening to the West	ALTERNATIVE 3: Widening to the East
	<ul style="list-style-type: none">• Minor improvement in air quality on adjacent streets due to reduction in traffic diversion		
Minimize Effects on Climate Change	<ul style="list-style-type: none">• Less reliance on automobiles through increased mode choice and decreased congestion can minimize effects on climate change (i.e. by reducing greenhouse gas emissions)• Opportunities for implementation of tree plantings and Low Impact Development stormwater management strategies as part of road improvements can improve the study corridor resiliency to climate change		
<i>Summary of Natural Environment</i>	Less Preferred	Most Preferred	Least Preferred
Social Environment			
Minimize Impacts on Existing Residential, Institutional and Recreational Dwellings / Properties	<ul style="list-style-type: none">• Minor impacts to residential properties• No required displacement of residential properties; potential for property acquisition of residential properties	<ul style="list-style-type: none">• Minor impacts to residential properties as travel lanes are in closer proximity to residents on the west side• No required displacement of residential properties; potential for property acquisition of back lots	<ul style="list-style-type: none">• Moderate impacts to residential properties as travel lanes are in closer proximity to residents on the east side• Significant potential impact to condo tower on west boulevard south of Denison Street• No required displacement of residential properties; potential for property acquisition of front lots
Improve Access to Residential Areas, Institutional and Recreational Facilities	<ul style="list-style-type: none">• Reduced traffic congestion will improve access to residential areas and intersections• Moderate temporary impacts during construction to driveways/access points as there are residential and commercial properties fronting the corridor at this section		
Minimize Traffic Noise	<ul style="list-style-type: none">• Noise levels are anticipated to increase with future traffic growth and lanes in closer proximity to properties• York Region's Retrofit Program for noise mitigation would need to satisfy retrofit criteria		
Preserve Archaeological and Cultural Heritage Features	<ul style="list-style-type: none">• Minor Impacts to 7543 Kennedy Road property but not building feature inventoried on Markham's Heritage Buildings geospatial database• Minor Impacts to 7703 Kennedy Road property but not building feature listed on Markham's Register of Property of CHVI• No impacts to areas of previous disturbance with low archaeological potential	<ul style="list-style-type: none">• No impacts to cultural heritage feature properties• No impacts to areas of previous disturbance with low archaeological potential	<ul style="list-style-type: none">• Significant impacts to 7507 Kennedy Road (Smith House) building and property listed on Markham's Register of Property of Cultural Heritage Value or Interest (CHVI)• Moderate Impacts to 7543 Kennedy Road property but not building feature, inventoried on Markham's Heritage Buildings geospatial database• Moderate Impacts to 7703 Kennedy Road property but not building feature, listed on Markham's Register of Property of CHVI• No impacts to areas of previous disturbance with low archaeological potential
Minimize Impacts to Cemeteries and Burial Grounds	<ul style="list-style-type: none">• Not applicable	<ul style="list-style-type: none">• Not applicable	<ul style="list-style-type: none">• Not applicable
Improve Visual Aesthetics	<ul style="list-style-type: none">• Visual aesthetics will be moderately reduced due to increased pavement width for Transit/HOV lanes and active transportation facilities• Visual aesthetics can be improved through localized tree plantings and other boulevard treatments wherever possible within ROW		
Improve Community Character	<ul style="list-style-type: none">• Community character will be moderately improved through the provision of improved transit, cycling, and pedestrian facilities• Community connectivity will be moderately improved due to improved traffic flow and reduction of transit service delays		
<i>Summary of Social Environment</i>	Less Preferred	Most Preferred	Least Preferred
Infrastructure Design			
Minimize Utility Relocation	<ul style="list-style-type: none">• Moderate to significant utility relocation anticipated to accommodate additional lanes and active transportation improvements• 		
Minimize Disruption due to Construction	<ul style="list-style-type: none">• Significant impacts to roadway users and surrounding property owners to construct additional lanes and active transportation facilities; construction staging to be reviewed in detail at a later stage of the study to minimize impacts as feasible• Potential for temporary disruptions to driveways• Mitigation strategies such as Smart Work Zones can be implemented during construction		
Minimize Constructability Complexity	<ul style="list-style-type: none">• High complexity at-grade separation at Stouffville GO crossing to be reviewed in a separate evaluation		

CRITERIA	ALTERNATIVE 1: Widening About the Centreline	ALTERNATIVE 2: Widening to the West	ALTERNATIVE 3: Widening to the East
	<ul style="list-style-type: none">Similar construction complexity to widen and grade-separate		
Summary of Infrastructure Design	Most Preferred	Most Preferred	Most Preferred
Economic Environment and Cost Effectiveness			
Accommodate Planned Development and Growth	<ul style="list-style-type: none">Supports approved development in the study area by providing adequate capacity and transportation choices to accommodate planned growth		
Minimize Impacts on Business Properties	<ul style="list-style-type: none">Minor impacts on business properties located on east side, i.e., shopping centre, commercial plazas, and grocery storeNo displacement of business properties required	<ul style="list-style-type: none">Moderate impacts on business properties located on west side, i.e., shopping centre, commercial plazas, and grocery storeSignificant potential impact to undeveloped land parcel on west boulevard north of Steeles AvenueNo displacement of business properties required	<ul style="list-style-type: none">Significant impacts on business properties located on both sides, i.e., shopping centre, commercial plazas, and grocery storeNo displacement of business properties required
Improve Access to Businesses and Key Employment Areas	<ul style="list-style-type: none">Improved access at commercial driveways, employment areas and cross-streets due to reduced traffic congestionImproved transit, pedestrian, and cycling access		
Maximize Construction Value	<ul style="list-style-type: none">Provides improvement for all travel modes		
Minimize Property Requirements	<ul style="list-style-type: none">Reduced potential for property acquisition along the study corridor, as impacts are balanced on both sides	<ul style="list-style-type: none">Potential for property acquisition on the west side of the study corridor	<ul style="list-style-type: none">Potential for property acquisition on the east side of the study corridor
Minimize Operating Costs	<ul style="list-style-type: none">Moderate increase in operating costs with additional roadway width (additional lanes) to maintainModerate increase in operating costs to maintain active transportation facilities		
Summary of Economic Environment and Cost Effectiveness	Most Preferred	Least Preferred	Least Preferred
Overall Summary			
Recommendation	This option achieves the transportation, social, and economic objectives of the study. Balancing impacts on both sides of Kennedy Road will minimize impacts on either side of the street. The potential for property acquisition will be minimized as impacts are balanced on both sides as opposed to exclusively widening to the east or west.	This option achieves the transportation objectives of the study, but results in impacts to the social, and economic environment. Property acquisition would be required due to the business and residential properties located on the west side of Kennedy Road. There are several residential properties on the west side at this section which would require driveway shortening to accommodate the proposed improvements.	This option achieves the transportation objectives of the study, but results in impacts to the natural, social, and economic environment. Property acquisition would be required due to the business and residential properties located on the east side of Kennedy Road. Widening to the east poses significant impacts to the heritage properties located on the east side along this section. This option also results in significant impacts to trees on the east side of the road.
	RECOMMENDED		

Table 2: Kennedy Road Evaluation of Alternative Designs (Highway 7 to 16th Avenue)

CRITERIA	ALTERNATIVE 1: Widening About the Centreline	ALTERNATIVE 2: Widen to the West	ALTERNATIVE 3: Widen to the East
Transportation Service			
Improve Public Transit Service	<ul style="list-style-type: none">Transit service on Kennedy Road would be enhanced and delays minimized, with a reduction in traffic congestion due to the provision of Transit/HOV lanes to minimize transit interactions with automobiles		
Reduce Traffic Congestion and Delays	<ul style="list-style-type: none">Reduced traffic congestion and delays by increasing future capacity to meet future demandsCongestion mitigation provided by active transportation improvements and the provision of Transit/HOV lanes to reduce dependence on single-occupant vehicles		
Create a Pedestrian-Friendly Environment	<ul style="list-style-type: none">Potential to improve pedestrian environment at locations where there are currently deficiencies with level of service		
Create a Cyclist-Friendly Environment	<ul style="list-style-type: none">Improved environment for cyclists through the provision of continuous, dedicated cycling facilities		
Improve Safety for All Travel Modes	<ul style="list-style-type: none">Reduced collision potential with management of potential conflicts, reduced traffic congestion, and reduced driver frustrationHigh potential for improved cyclist and pedestrian safety due to provision of dedicated active transportation facilities, reducing conflict with motorists		
Improve Mode Choice	<ul style="list-style-type: none">Enhanced transit service with dedicated Transit/HOV lanes andProvision of active transportation facilities will reduce dependence on single-occupant vehicles		
Summary of Transportation Service	Most Preferred	Most Preferred	Most Preferred
Natural Environment			
Protect Designated Natural Areas	<ul style="list-style-type: none">There are no Areas of Natural and Scientific Interest (ANSIs)There are no Provincially Significant Wetlands (PSWs)		
Protect Vegetation	<ul style="list-style-type: none">Potential impacts to Kentucky Coffee Trees, regulated as Threatened under ESA but are non-native to the corridor and not treated as protected under the ESA, as confirmed by MNRFPotential impacts to trees of >50cm DBHPotential impacts to forest and meadow vegetation near Rouge River, between Denby Court and Go Rail trackMinor impacts to vegetation communities and mature tree growth on both sides of study corridor due to wider roadway platform widening to both sidesThe study area is dominated by vegetation that is manicured and regularly maintained, including plant species that are well adapted to persist in areas that are regularly disturbed	<ul style="list-style-type: none">Moderate impacts to Kentucky Coffee Trees in west boulevard, regulated as Threatened under ESA but are non-native to the corridor and not treated as protected under the ESA, as confirmed by MNRFPotential impacts to 15 trees of >50cm DBHPotential impacts to forest and meadow vegetation to the west, near Rouge River, between Denby Court and Go Rail trackModerate impacts to vegetation communities and mature tree growth due to wider roadway platform and widening to one side onlyThe study area is dominated by vegetation that is manicured and regularly maintained, including plant species that are well adapted to persist in areas that are regularly disturbed	<ul style="list-style-type: none">Minor impacts to Kentucky Coffee Trees in east boulevard, regulated as Threatened under ESA but are non-native to the corridor and not treated as protected under the ESA, as confirmed by MNRFPotential impacts to 9 trees of >50cm DBHPotential impacts to forest and meadow vegetation to the east, near Rouge River, between Denby Court and Austin DriveModerate impacts to vegetation communities and mature tree growth due to wider roadway platform and widening to one side onlyThe study area is dominated by vegetation that is manicured and regularly maintained, including plant species that are well adapted to persist in areas that are regularly disturbed
Protect Wildlife	<ul style="list-style-type: none">Potential for moderate impacts on wildlife due to a wider roadway platform and the likelihood of wildlife using Rouge River crossings as a movement corridorWhile highly disturbed, vegetative communities yielding wildlife habitat are generally sparse on both sides of study corridor due to existing land-use, with the exception of the watercourse crossing where more significant wildlife habitat is presentNo structures were identified as suitable for the nesting of threatened bird species were identified within the study area		
Protect Aquatic Habitat	<ul style="list-style-type: none">Potential for moderate impacts to aquatic habitat at Rouge River crossing, which supports permanent fish, frog, and turtle habitatNo SAR habitat identified for aquatic species at Rouge River crossing	<ul style="list-style-type: none">Potential for significant impacts to aquatic habitat at Rouge River crossing, which supports permanent fish, frog, and turtle habitatNo SAR habitat identified for aquatic species at Rouge River crossingBridge modification / replacement is anticipated to support the improvements. Widening to one side may result in disturbing established fish habitat	

CRITERIA	ALTERNATIVE 1: Widening About the Centreline	ALTERNATIVE 2: Widen to the West	ALTERNATIVE 3: Widen to the East
	<ul style="list-style-type: none">Bridge modification / replacement is anticipated to support the improvements. Widening to both sides may result in disturbing established fish habitat		
Storm and Groundwater Management	<ul style="list-style-type: none">Moderate impact with increased roadway width and hard surface area to accommodate additional Transit/HOV lanes and active transportation facilities, stormwater quantity will increase and quality mitigation may be required; however, can be addressed through designModerate impact to shallow groundwater system due to potential increase in contaminants related to increased roadway width (i.e. road salt, etc.)		
Improve Air Quality	<ul style="list-style-type: none">Moderate improvement to air quality through increased high-occupancy vehicles and transit use, and reduced congestionActive transportation and transit service improvements can reduce dependence on automobile and provide air quality improvementsMinor improvement in air quality on adjacent streets due to reduction in traffic diversion		
Minimize Effects on Climate Change	<ul style="list-style-type: none">Less reliance on automobiles through increased mode choice and decreased congestion can minimize effects on climate change (i.e. by reducing greenhouse gas emissions)Opportunities for implementation of tree plantings and Low Impact Development stormwater management strategies as part of road improvements can improve the study corridor resiliency to climate change		
Summary of Natural Environment	Most Preferred	Less Preferred	Least Preferred
Social Environment			
Minimize Impacts on Existing Residential, Institutional and Recreational Dwellings / Properties	<ul style="list-style-type: none">No direct impacts on residential propertiesNo displacement of residential properties required	<ul style="list-style-type: none">Moderate impacts to residential properties as travel lanes are in closer proximity to residents on the west sideNo required displacement of residential properties; potential for property acquisition of back lots on west side between Highway 7 and 16th Avenue	<ul style="list-style-type: none">Moderate impacts to residential properties as travel lanes are in closer proximity to residents on the east sideNo required displacement of residential properties; potential for property acquisition of back lots on east side between Highway 7 and 16th Avenue
Improve Access to Residential Areas, Institutional and Recreational Facilities	<ul style="list-style-type: none">Reduced traffic congestion will improve access to residential areas and intersectionsMinor temporary impacts during construction to driveways/access points as there are limited residential or commercial properties fronting the corridor at this section		
Minimize Traffic Noise	<ul style="list-style-type: none">Noise levels are anticipated to increase with future traffic growth and lanes in closer proximity to propertiesYork Region’s Retrofit Program for noise mitigation would need to satisfy retrofit criteria		
Preserve Archaeological and Cultural Heritage Features	<ul style="list-style-type: none">Minimized impacts to properties of cultural heritage value or interest due to wider roadway platform and widening to both sidesNo impacts to areas of archaeological potential	<ul style="list-style-type: none">Moderate impacts to 215 Austin Drive property inventoried on Markham’s Register of Property of CHVINo impacts to areas of archaeological potential	<ul style="list-style-type: none">Moderate impacts to 9227 Kennedy Road property but not building feature listed on Markham’s Register of Property of Cultural Heritage Value or Interest (CHVI)No impacts to areas of archaeological potential
Minimize Impacts to Cemeteries and Burial Grounds	<ul style="list-style-type: none">Not applicable	<ul style="list-style-type: none">Not applicable	<ul style="list-style-type: none">Not applicable
Improve Visual Aesthetics	<ul style="list-style-type: none">Visual aesthetics will be moderately reduced due to increased pavement width for Transit/HOV lanes and active transportation facilitiesVisual aesthetics can be improved through localized tree plantings and other boulevard treatments wherever possible within ROW		
Improve Community Character	<ul style="list-style-type: none">Community character will be moderately improved through the provision of improved transit, cycling, and pedestrian facilitiesCommunity connectivity will be moderately improved due to improved traffic flow and reduction of transit service delays		
Summary of Social Environment	Most Preferred	Least Preferred	Least Preferred
Infrastructure Design			
Minimize Utility Relocation	<ul style="list-style-type: none">Moderate to significant utility relocation anticipated to accommodate additional lanes and active transportation improvements on both sides as utilities run on both sides of the study corridor in this segment		
Minimize Disruption due to Construction	<ul style="list-style-type: none">Significant impacts to roadway users and surrounding property owners to construct additional lanes and active transportation facilities; construction staging to be reviewed in detail at a later stage of the study to minimize impacts as feasible		

CRITERIA	ALTERNATIVE 1: Widening About the Centreline	ALTERNATIVE 2: Widen to the West	ALTERNATIVE 3: Widen to the East
	• Mitigation strategies such as Smart Work Zones can be implemented during construction		
Minimize Constructability Complexity	<ul style="list-style-type: none">• Significant construction complexity as cross-section footprint cannot be accommodated on existing Rouge River structure• Low construction complexity as the road alignment will generally remain the same for Kennedy Road	<ul style="list-style-type: none">• Significant construction complexity as cross-section footprint cannot be accommodated on existing Rouge River structure• Moderate to significant construction complexity due to the realignment of Kennedy Road to the east or west	
Summary of Infrastructure Design	Most Preferred	Least Preferred	Least Preferred
Economic Environment and Cost Effectiveness			
Accommodate Planned Development and Growth	• Supports approved development in the study area by providing adequate capacity and transportation choices to accommodate planned growth		
Minimize Impacts on Business Properties	• Minor impacts on business properties on both sides		
Improve Access to Businesses and Key Employment Areas	<ul style="list-style-type: none">• Improved access at commercial driveways, employment areas and cross-streets due to reduced traffic congestion• Improved transit, pedestrian and cycling access		
Maximize Construction Value	<ul style="list-style-type: none">• Significant capital cost at Rouge River crossing due to structural replacement and road realignment to the east or west• Provides improvement for all travel modes	<ul style="list-style-type: none">• Moderate capital cost at Rouge River crossing due to structural replacement; realignment is not necessary• Provides improvement for all travel modes	
Minimize Property Requirements	<ul style="list-style-type: none">• Reduced potential for property acquisition along the study corridor, as impacts are balanced on both sides	<ul style="list-style-type: none">• Potential for property acquisition on the west side of the study corridor	<ul style="list-style-type: none">• Potential for property acquisition on the east side of the study corridor
Minimize Operating Costs	<ul style="list-style-type: none">• Moderate increase in operating costs with additional roadway width (additional lanes) to maintain• Moderate increase in operating costs to maintain active transportation facilities		
Summary of Economic Environment and Cost Effectiveness	Most Preferred	Least Preferred	Least Preferred
Overall Summary			
Recommendation	This option achieves the transportation objectives of the study, but results in impacts to the natural, social, and economic environment. Widening to the east has moderate impacts on a property of CHVI and residential properties in close proximity to the right-of-way.	This option achieves the transportation objectives of the study, but results in impacts to the natural, social, and economic environment. Widening to the west results in moderate impacts to Kentucky Coffee trees as well as trees >50 DBH. Widening to the west also has moderate impacts on a property of CHVI and residential properties in close proximity to the right-of-way...	This option achieves the transportation, social, and economic environment objectives of the study. Balancing the impacts on both sides of Kennedy Road will minimize impacts on either side of the road, especially near the Rouge River crossing that results in minimized impacts to the adjacent natural environment. The potential for property acquisition will be minimized as impacts are balanced on both sides of Kennedy Road as opposed to exclusively widening to the east or west.
	RECOMMENDED		

Table 3: Kennedy Road Evaluation of Alternative Designs (16th Avenue to Major Mackenzie Drive)

CRITERIA	ALTERNATIVE 1: Widen About the Centreline	ALTERNATIVE 2: Widen to the West	ALTERNATIVE 3: Widen to the East
Transportation Service			
Improve Public Transit Service	<ul style="list-style-type: none">Transit service on Kennedy Road would be enhanced and delays minimized, with a reduction in traffic congestion due to the provision of Transit/HOV lanes to minimize transit interactions with automobiles		
Reduce Traffic Congestion and Delays	<ul style="list-style-type: none">Reduced traffic congestion and delays by increasing capacity to meet future demandsCongestion mitigation provided by active transportation improvements and the provision of Transit/HOV lanes to reduce dependence on single-occupant vehicles		
Create a Pedestrian-Friendly Environment	<ul style="list-style-type: none">Potential to improve pedestrian environment at locations where there are currently deficiencies with level of service		
Create a Cyclist-Friendly Environment	<ul style="list-style-type: none">Improved environment for cyclists through the provision of continuous, dedicated cycling facilities		
Improve Safety for All Travel Modes	<ul style="list-style-type: none">Reduced collision potential with management of potential conflicts, reduced traffic congestion, and reduced driver frustrationHigh potential for improved cyclist and pedestrian safety due to provision of dedicated active transportation facilities, reducing conflict with motorists		
Improve Mode Choice	<ul style="list-style-type: none">Enhanced transit service with dedicated Transit/HOV lanes andProvision of active transportation facilities will reduce dependence on single-occupant vehicles		
Summary of Transportation Service	Most Preferred	Most Preferred	Most Preferred
Natural Environment			
Protect Designated Natural Areas	<ul style="list-style-type: none">There are no Areas of Natural and Scientific Interest (ANSIs)There are no Provincially Significant Wetlands (PSWs)		
Protect Vegetation	<ul style="list-style-type: none">Potential impacts to Kentucky Coffee Trees in east boulevard, regulated as Threatened under ESA but are non-native to the corridor and not treated as protected under the ESA, as confirmed by MNRFPotential impacts to trees of >50cm DBHPotential impacts to meadow and agricultural vegetation within this road segmentPotential impacts to vegetation communities and mature tree growth due to wider roadway platform and widening to one side onlyThe study area is dominated by vegetation that is manicured and regularly maintained, as well as vegetation communities that are culturally influenced, including plant species that are well adapted to persist in areas that are regularly disturbed	<ul style="list-style-type: none">No Kentucky Coffee Trees identified in west boulevardPotential impacts to 2 trees of >50cm DBHPotential impacts to meadow vegetation to the east, south of Major Mackenzie DrivePotential impacts to meadow and agricultural vegetation to the west, between Angus Glen Boulevard and Wilfred Murison AvenueModerate impacts to vegetation communities and mature tree growth due to wider roadway platform and widening to one side onlyThe study area is dominated by vegetation that is manicured and regularly maintained, including plant species that are well adapted to persist in areas that are regularly disturbed	<ul style="list-style-type: none">Moderate impacts to Kentucky Coffee Trees in east boulevard, regulated as Threatened under ESA but are non-native to the corridor and not treated as protected under the ESA, as confirmed by MNRFPotential impacts to 5 trees of >50cm DBHPotential impacts to meadow vegetation to the east, south of Major Mackenzie DriveModerate impacts to vegetation communities and mature tree growth due to wider roadway platform and widening to one side onlyThe study area is dominated by vegetation that is manicured and regularly maintained, including plant species that are well adapted to persist in areas that are regularly disturbed
Protect Wildlife	<ul style="list-style-type: none">Potential for moderate impacts on wildlife due to a wider roadway platformWhile highly disturbed, vegetative communities yielding wildlife habitat are generally sparse on both sides of study corridor due to existing land-use, with the exception of the watercourse crossing where more significant wildlife habitat is presentPotential impacts to bird species as bird habitats are located throughout the corridorNo habitats considered suitable for the nesting of Threatened bird species were identified within the study area		
Protect Aquatic Habitat	<ul style="list-style-type: none">Potential impacts to frog and turtle species as frog and turtle habitats are located in the stormwater ponds north of 16th Avenue and south on Major Mackenzie Drive	<ul style="list-style-type: none">No impact to aquatic habitat on west side of Kennedy Road	<ul style="list-style-type: none">Potential impacts to frog and turtle species as frog and turtle habitats are located in the stormwater ponds north of 16th Avenue and south on Major Mackenzie Drive
Storm and Groundwater Management	<ul style="list-style-type: none">Moderate impact with increased roadway width and hard surface area to accommodate additional Transit/HOV lanes and active transportation facilities, stormwater quantity will increase and quality mitigation may be required; however, can be addressed through design		

CRITERIA	ALTERNATIVE 1: Widen About the Centreline	ALTERNATIVE 2: Widen to the West	ALTERNATIVE 3: Widen to the East
	<ul style="list-style-type: none">• Moderate impact to shallow groundwater system due to potential increase in contaminants related to increased roadway width (i.e. road salt, etc.)		
Improve Air Quality	<ul style="list-style-type: none">• Moderate improvement to air quality through increased high-occupancy vehicles and transit use, and reduced congestion• Active transportation and transit service improvements can reduce dependence on automobile and provide air quality improvements• Minor improvement in air quality on adjacent streets due to reduction in traffic diversion		
Minimize Effects on Climate Change	<ul style="list-style-type: none">• Less reliance on automobiles through increased mode choice and decreased congestion can minimize effects on climate change (i.e. by reducing greenhouse gas emissions)• Opportunities for implementation of tree plantings and Low Impact Development stormwater management strategies as part of road improvements can improve the study corridor resiliency to climate change		
Summary of Natural Environment	Most Preferred	Less Preferred	Least Preferred
Social Environment			
Minimize Impacts on Existing Residential, Institutional and Recreational Dwellings / Properties	<ul style="list-style-type: none">• No direct impacts to residential properties• Potential displacement of 2 residential; 9286 Kennedy Road (George Hunter House) and 9392 Kennedy Road (Thomas Lownsborough House)• 	<ul style="list-style-type: none">• Minor impacts to residential properties as travel lanes are in closer proximity to residents on the west side• Significant impacts due to displacement of 2 properties; 9286 Kennedy Road (George Hunter House) and 9392 Kennedy Road (Thomas Lownsborough House)• Potential for property acquisition of front lots between 16th Avenue and Major Mackenzie Drive. Encroachment onto window streets.	<ul style="list-style-type: none">• Minor impacts to residential properties as travel lanes are in closer proximity to residents on the east side• No required displacement of residential properties; potential for property acquisition of front lots on east side between 16th Avenue and Bur Oak Avenue. Encroachment onto window streets.
Improve Access to Residential Areas, Institutional and Recreational Facilities	<ul style="list-style-type: none">• Reduced traffic congestion will improve access to residential areas and intersections• Minor temporary impacts during construction to driveways/access points as there are limited residential properties fronting the corridor at this section		
Minimize Traffic Noise	<ul style="list-style-type: none">• Noise levels are anticipated to increase with future traffic growth and lanes in closer proximity to properties• York Region's Retrofit Program for noise mitigation would need to satisfy retrofit criteria		
Preserve Archaeological and Cultural Heritage Features	<ul style="list-style-type: none">• Moderate-Significant impacts to designated and CHVI properties located on both sides of Kennedy Road with balanced impacts due to even widening on each side• Moderate impacts to an area of archaeological potential	<ul style="list-style-type: none">• Significant impacts to 9286 Kennedy Road (George Hunter House) property and building feature designated under Part IV of the <i>OHA, by-law 14-96</i>, requiring relocation / demolition• Significant impacts to 9392 Kennedy Road (Thomas Lownsborough House) property and building feature listed on Markham's Register of Property of CHVI requiring relocation• Significant impacts to 9400 Kennedy Road (St. Philip's Cemetery) listed on Markham's Register of Property of CHVI• Minor impacts to 9418 Kennedy Road (St. Philip's Anglican Church Manse) listed on Markham's Register of Property of CHVI• Minor impacts to 10000 Kennedy Road (S.S. #11 Colty Corners School House) designated under Part IV of the <i>OHA, by-law 307-83</i>• No anticipated impacts to an area of archaeological potential	<ul style="list-style-type: none">• • Significant impacts to 9423 Kennedy Road (Bethesda Lutheran Cemetery) listed on Markham's Register of Property of CHVI• Significant impacts to an area of archaeological potential•
Minimize Impacts to Cemeteries and Burial Grounds	<ul style="list-style-type: none">• To be assessed in a separate evaluation	<ul style="list-style-type: none">• To be assessed in a separate evaluation	<ul style="list-style-type: none">• To be assessed in a separate evaluation
Improve Visual Aesthetics	<ul style="list-style-type: none">• Visual aesthetics will be moderately reduced due to increased pavement width for Transit/HOV lanes and active transportation facilities• Visual aesthetics can be improved through localized tree plantings and other boulevard treatments wherever possible within ROW		
Improve Community Character	<ul style="list-style-type: none">• Community character will be moderately improved through the provision of improved transit, cycling, and pedestrian facilities		

CRITERIA	ALTERNATIVE 1: Widen About the Centreline	ALTERNATIVE 2: Widen to the West	ALTERNATIVE 3: Widen to the East
	• Community connectivity will be moderately improved due to improved traffic flow and reduction of transit service delays		
Summary of Social Environment	Most Preferred	Least Preferred	Less Preferred
Infrastructure Design			
Minimize Utility Relocation	• Moderate to significant utility relocation anticipated to accommodate additional lanes and active transportation improvements as utilities run on both sides of the study corridor in this segment		
Minimize Disruption due to Construction	• Significant impacts to roadway users and surrounding property owners to construct additional lanes and active transportation facilities; construction staging to be reviewed in detail at a later stage of the study to minimize impacts as feasible • Potential for temporary disruptions to driveways • Mitigation strategies such as Smart Work Zones can be implemented during construction		
Minimize Constructability Complexity	• Minor construction complexity as the road alignment will generally remain the same for Kennedy Road	• Moderate construction complexity due to the realignment of Kennedy Road to the east or west	
Summary of Infrastructure Design	Most Preferred	Least Preferred	Least Preferred
Economic Environment and Cost Effectiveness			
Accommodate Planned Development and Growth	• Supports approved development in the study area by providing adequate capacity and transportation choices to accommodate planned growth		
Minimize Impacts on Business Properties	• Minor impacts on business properties on both sides		
Improve Access to Businesses and Key Employment Areas	• Improved access at commercial driveways, employment areas and cross-streets due to reduced traffic congestion • Improved transit, pedestrian and cycling access		
Maximize Construction Value	• Provides improvement for all travel modes		
Minimize Property Requirements	• Reduced potential for property acquisition along the study corridor, as impacts are balanced on both sides	• Potential for property acquisition on the east side of the study corridor	• Potential for property acquisition on the east side of the study corridor
Minimize Operating Costs	• Moderate increase in operating costs with additional roadway width (additional lanes) to maintain • Moderate increase in operating costs to maintain active transportation facilities		
Summary of Economic Environment and Cost Effectiveness	Most Preferred	Least Preferred	Least Preferred
Overall Summary			
Recommendation	This option achieves the transportation, natural, social, and economic environment objectives of the study. Balancing the impacts on both sides of Kennedy Road will minimize impacts on either side of the road. The potential for property acquisition and impact on designated and CHVI properties will be minimized as impacts are balanced on both sides of Kennedy Road as opposed to exclusively widening to the east or west.	This option achieves the transportation objectives of the study, but results in impacts to the natural, social, and economic environment. Widening to the west causes potential impacts to of trees >50 DBH. This option also has significant impacts on designated and CHVI properties along the west side of this segment, and residential properties in close proximity to the right-of-way.t.	This option achieves the transportation objectives of the study, but results in impacts to the natural, social and economic environment. Widening to the east causes potential impacts to Kentucky Coffee trees as well as trees of >50 DBH. This option significantly impacts a CHVI property, an area of archaeological potential and residential properties in close proximity to the right-of-way.
	RECOMMENDED		

Typical Cross-Section

Typical cross-sections for the corridor and at constrained locations were developed based on the recommended element widths outlined in **Table 1**. These widths were referenced using established guidelines and standards.

Where applicable, the design elements were based on design speed of 60km/h with posted speed of 60km/h, which is consistent with the Region's Towards Great Regional Streets Guidelines, 2008 for six-lane roads.

Table 1: Cross-Section Design Parameters

Element	Width / Clearance	Source/Notes
Right-of-Way (existing)	<36 m (14 th Avenue to CN Rail Crossing, 16 th Avenue to Wilfred Murison Avenue) >36 m and < 43m (Steeles Avenue to 14 th Avenue, CN Rail Crossing to 407 ETR, Castan Avenue to Highway 7, Carlton Road to 16 th Avenue, Wilfred Murison Avenue to Castlemore Avenue) >43 m (407 ETR to Castan Avenue, Highway 7 to Carlton Road, Castlemore Avenue to Major Mackenzie Drive)	Legal Survey for Kennedy Road EA
Right-of-Way (designated)	Up to 43 m between Steeles Avenue and YMCA Boulevard, and between Highway 7 and Major Mackenzie Drive Up to 45 m between YMCA Boulevard and Highway 7	Map 12 of the Region's Official Plan, 2010
Lane Width (through lane)	3.3 m	Section 5.1 of Towards Great Regional Streets, 2008
Lane Width (Transit/HOV lane)	3.5 m	Section 5.1 of Towards Great Regional Streets, 2008
Two-Way Centre Left-Turn Lane	3.3 m	Transportation Association of Canada (TAC) – Geometric Design Guide for Canadian Roads, 2017
Left-Turn Lane at Intersections	5.0 m (3.3m lane with 1.7 m median)	TAC – Geometric Design Guide for Canadian Roads, 2017
Centre Median	5.0 m (minimum 1.5 m at constrained locations)	TAC – Geometric Design Guide for Canadian Roads, 2017
Sidewalk	Minimum 1.5 m (additional 0.5 m if adjacent to curb)	Section 5.6 of Towards Great Regional Streets, 2008

Element	Width / Clearance	Source/Notes
Cycle Track (off-street)	2.0 m (ideal) – 1.8 m if adjacent to sidewalk	Ontario Traffic Manual – Book 18, 2013
Multi-Use Path	3.0 m (ideal) – Minimum 2.4 m at constrained locations (additional 0.5 m if adjacent to curb)	Ontario Traffic Manual – Book 18, 2013
Utility Line Clearance	<p>2.0 m (1.0 m from back of curb to edge of pole; 0.7 m maximum pole diameter; 0.3 m minimum buffer from edge of pole to edge of AT facility)</p> <p>2.0 m (1.0 m from property line to edge of pole; 0.7 m maximum pole diameter; 0.3 m minimum buffer from edge of pole to edge of AT facility)</p>	Discussions with York Region Internal Team
Grading Buffer	0.5 m from edge of AT facility to property line	Transportation Association of Canada (TAC) – Geometric Design Guide for Canadian Roads, 2017
Tree Planting clearance (short and tall trees)	<p>Absolute Minimum 2.9 m; Ideal =>3.5m [0.6 m from edge of AT Facility (ideally 1 m); 2.3 m from back of curb (2.5 m from centreline of tree to face of curb)]. Full-form trees may be planted near streetlights if above clearances are met.</p> <p>5.0 m from centerline of hydro pole to centerline of tree; 2.3 m from back of curb; 0.6 m from edge of AT Facility. Tall trees cannot be planted along the same alignment as hydro poles.</p>	<p>York Region Street Tree Preservation and Planting Design Guidelines, 2013</p> <p>Discussions with York Region Forestry</p>

Screening of Active Transportation Facilities

A high-level screening of the active transportation facility type for the corridor was undertaken as presented in **Table 2**. Consideration was given to the Region's Transportation Master Plan recommendation which identified Separated Facilities (see Map 9 of the YR-TMP) for the Kennedy Road corridor. Separated Facilities are defined in the YR-TMP as:

"...facilities that provide physically separate space for cyclists. Types of facilities can include cycle tracks, raised bike lanes or multi-use trails. These facilities improve the comfort for cyclists along higher-speed, busy roadways."

Table 2: High Level Screening of Active Transportation Facilities

Facility Type	Discussion	Recommendation
Sidewalk, on one or both sides	<ul style="list-style-type: none"> Provides dedicated pedestrian facility Opportunities to provide new sidewalks and connect to existing sidewalks 	Carry forward
Multi-use Path (two-way shared facility), on one or both sides	<ul style="list-style-type: none"> Provides grade separation and adequate horizontal distance from vehicular traffic Minimizes potential conflicts with transit Does not provide separation between cyclists and pedestrians Consistent with Transportation Master Plan recommendation Opportunities to provide active transportation connections in constrained locations 	Carry forward
On-road facility (conventional bike lanes and separated bike lanes with marked buffers)	<ul style="list-style-type: none"> Does not provide grade separation from vehicular traffic Higher potential for conflicts with transit Separation from pedestrians Not consistent with Transportation Master Plan recommendation 	Screened out – Do not carry forward
One-way off-road cycle track	<ul style="list-style-type: none"> Provides grade separation and adequate horizontal distance from vehicular traffic Minimizes potential conflicts with transit Separation from pedestrians Consistent with Transportation Master Plan recommendation Fewer conflict points as pedestrians and turning drivers expect one directional bicycle traffic 	Carry forward

Combinations of the AT facilities that were carried forward, listed from greatest separation between modes to least separation, are:

- Sidewalk and one-way off-road cycle track, in each boulevard
- Multi-Use Path, one in each boulevard
- One side sidewalk and other side Multi-Use Path

Table 3 outlines the assessment undertaken to determine the preferred combination of Active Transportation facilities along Kennedy Road.

Table 3: Active Transportation Facilities Evaluation Table

CRITERIA	ALTERNATIVE 1: Cycle Track and Sidewalk on Both Sides	ALTERNATIVE 2: Multi-Use Path on Both Sides	ALTERNATIVE 3: Multi-Use Path one side and sidewalk one side
Compatible with Adjacent Land Uses			
Mostly residential with some commercial and institutional areas. Key pedestrian / cyclist generators include Pacific Mall, Milliken Mills High School, Milliken Mills Community Centre, and Commercial uses south of Highway 7	<ul style="list-style-type: none"> Pedestrian / cyclist destinations exist along both the east and west sides of the corridor. Cycle tracks and sidewalks provide access to destinations for pedestrians and cyclists on both boulevards Cycle tracks are one-directional resulting in potentially longer travel distance (depending on origin and destination) due to the inability to travel southbound in the east boulevard and northbound in the west boulevard 	<ul style="list-style-type: none"> Pedestrian / cyclist destinations exist along both the east and west sides of the corridor. MUPs provide access to destinations for pedestrians and cyclists on both boulevards MUPs allow for two-way travel which minimize cyclist travel distance to destination, on both sides 	<ul style="list-style-type: none"> Pedestrian / cyclist destinations exist along both the east and west sides of the corridor. MUP on one side and sidewalk on the other provides pedestrian access to destinations on both boulevards, and cyclist access to destinations on one boulevard only MUP allows for two-way travel which minimize cyclist travel distance to destination, on one side only
Compatible with Access			
Some commercial access points and properties that front onto the corridor. However, there are more rear lots than driveways.	<ul style="list-style-type: none"> One-directional cycling facilities minimize potential conflicts with adjacent driveways, based on driver expectation of one-way cyclist travel 	<ul style="list-style-type: none"> Bi-directional facilities for cyclists increases potential conflicts with adjacent driveways, based on driver expectation of two-way cyclist travel, on both boulevards 	<ul style="list-style-type: none"> Bi-directional facility for cyclists increases potential conflicts with adjacent driveways, based on driver expectation of two-way cyclist travel, on one boulevard
Direct, Continuous, and Convenient Connections			
<p>Opportunity to provide direct connections to residential developments, schools, Malls, shopping plazas</p> <p>Potential for connections to downtown Markham at Enterprise Boulevard with the Rapidway</p>	<ul style="list-style-type: none"> Separated pedestrian and cycling facilities provide direct and convenient connections along the corridor, on both sides. Separated pedestrian and cycling facilities will be discontinuous at highly constrained areas due to limited available property and recommended configuration at the 407 interchange as follows: <ul style="list-style-type: none"> 14th to Duffield (limited available ROW with cemeteries) CN to 407 (two separate bridges for MUP recommended over the 407) Bridle Trail to 16th Avenue (limited available ROW) Beckett Avenue to Wilfred Murison Drive (limited available ROW with cemeteries) 	<ul style="list-style-type: none"> Shared pedestrian and cycling facilities provide direct, continuous, and convenient connections along the corridor, on both sides. Shared pedestrian and cyclist facilities will be continuous in the corridor through the implementation of minimum 2.4m MUP, designated 'narrow path' and configuration at the 407 interchange as follows: <ul style="list-style-type: none"> 14th to Duffield (cemeteries) – dual min 2.4m MUP (with some locations identified as a 'narrow path' where less than 2.4m is available) CN to 407 (two separate bridges for MUP recommended over the 407) Bridle Trail to 16th Avenue (dual min 2.4m MUP) Beckett Avenue to Wilfred Murison Drive (cemeteries) – dual min 2.4m MUP (with some locations identified as a 'narrow path' where less than 2.4m is available) 	<ul style="list-style-type: none"> Shared pedestrian and cycling facility provides direct, continuous, and convenient connections along the corridor, on both sides for pedestrians, but on one side only for cyclists
Separated / Protected From Vehicular Lanes			
Opportunity to provide separated / protected facilities on either side to promote safety	<ul style="list-style-type: none"> No difference in options - all options will be separated/ protected from vehicular lanes 		

and comfort for pedestrians and cyclists			
Separated / Protected from Pedestrians			
Opportunity to provide separated / protected facilities on either side to promote safety and comfort for pedestrians.	<ul style="list-style-type: none"> Dedicated one-way cycle tracks with sidewalks eliminates conflict between pedestrians and cyclists 	<ul style="list-style-type: none"> MUPs have potential conflicts between pedestrians and cyclists due to shared facilities, on both sides 	<ul style="list-style-type: none"> MUP has potential conflict between pedestrians and cyclists due to shared facilities, on one side Sidewalk on other side eliminates conflict between pedestrian and cyclists, on one side
Safe and Accommodates Different Cyclist Users (recreational, commuter, cyclists of different ages)			
Opportunity to provide safe facilities that accommodates different cyclist users	<ul style="list-style-type: none"> Dedicated one-way cycle tracks with sidewalks eliminate conflict between pedestrians and cyclists, and cyclists travelling in opposing directions Potential conflict between cyclists and transit riders boarding/alighting at transit shelters/pads due to limited available right-of-way at intersections, on both sides 	<ul style="list-style-type: none"> MUPs have potential conflicts between pedestrians and cyclists due to shared facilities, and between cyclists traveling in opposing directions, on both sides Potential conflict between cyclists and transit riders boarding/alighting at transit shelters/pads due to limited available right-of-way at intersections, on both sides 	<ul style="list-style-type: none"> MUP has potential conflicts between pedestrians and cyclists due to shared facilities, and between cyclists traveling in opposing directions, on one side Potential conflict between cyclists and transit riders boarding/alighting at transit shelters/pads due to limited available right-of-way at intersections, on one side
Economic Impacts and Property Requirements			
Ability to Implement within Proposed Right-of-Way and at Constrained Locations (i.e. Sections with Narrow ROW)	<ul style="list-style-type: none"> AT facility requires greatest amount of space, typical right-of-way not constrained Some opportunity for streetscaping in both boulevards May require additional space at intersections to accommodate cross-rides on both approaches, if required Not able to implement proposed right-of-way at constrained locations because cycle track and sidewalk has the greatest width 	<ul style="list-style-type: none"> AT facility requires less amount of space, typical right-of-way not constrained Greater opportunity for streetscaping in both boulevards May require additional space at intersections to accommodate cross-rides on both approaches, if required Able to implement proposed right-of-way at constrained locations using minimum width. At highly constrained locations (cemeteries) select portions of MUP facility will require warning signage to indicate narrow path 	<ul style="list-style-type: none"> AT facility requires least amount of space, typical right-of-way not constrained Greatest opportunity for streetscaping in both boulevards May require additional space at intersections to accommodate cross-rides on one approach, if required Able to implement proposed right-of-way at constrained locations
Capital, Operations, and Maintenance Costs			
Minimize costs associated with construction, operations, and maintenance	<ul style="list-style-type: none"> Highest capital cost for structure modification to accommodate sidewalks and cycle tracks on both boulevards through structure widening/ replacement/ extension Additional maintenance and operations agreements required to address cycle tracks 	<ul style="list-style-type: none"> Similar capital cost to Alternative 1 for structure modification to accommodate MUP on both boulevards through structure widening/ replacement/ extension Additional maintenance and operations agreements required to address MUPs 	<ul style="list-style-type: none"> Least capital cost for structures to accommodate sidewalk and MUP through structure widening/ replacement/ extension. Additional maintenance and operations agreements required to address MUP on one side
RECOMMENDATION	This solution is not recommended given the facility type will alternate at various locations throughout the corridor.	RECOMMENDED SOLUTION This AT facility alternative and vehicles, while maintaining continuity through	This solution is not recommended as it does not provide for cycling facilities and connectivity on both sides of the corridor.

Best Fit Approach Design - Boulevard Widths

Based on the evaluation of alternative Active Transportation facilities, the best fit approach design protects for a multi-use path on both boulevards. In order to achieve the recommended alternative solution for continuous AT facilities, transit/HOV lanes, and streetscaping within the available and protected Right-of-Way, the corridor design resulted in the following boulevard width options with the objective to minimize property takings. Each boulevard option allows for a 0.3m curb & gutter, 1.0m clearance from back to curb to face of pole, 0.7m hydro pole/light standard, multi-use path (either 3.0m ideal width, or 2.4m absolute minimum), and 0.6m grading buffer. Opportunities for streetscaping are identified considering absolute minimum 2.9m space and ideal minimum 3.5m space. The boulevard options are applied for both east and west boulevards as presented in the best fit approach plan drawing. As per existing conditions, hydro poles are assumed to be accommodated in the east boulevard.

Option 1



Figure 1: Boulevard width for 5.3m

Option 2



Figure 2: Boulevard Width for 6.2m

Option 3



Figure 3: Boulevard Width for 6.8-7.7m

Table 1: Kennedy Road Evaluation of Clayton Drive GO Crossing – Clayton Drive to Gorvette Road

CRITERIA	ALTERNATIVE 1: Modified Typical Section – At-Grade Crossing with AT Improvements	ALTERNATIVE 2: UNDERPASS – Modified Typical Section with AT Improvements	ALTERNATIVE 3: OVERPASS – Modified Typical Section with AT Improvements
TRANSPORTATION SERVICES			
Improve Public Transit Service	<ul style="list-style-type: none"> • Improved transit service by providing dedicated transit/HOV lanes • Increased delays to transit service caused by requirement to stop at all rail crossings, and with increased train crossing frequency at at-grade crossing 	<ul style="list-style-type: none"> • Improved transit service by providing dedicated transit/HOV lanes • Significant reduction in delays to transit service with elimination of at-grade rail crossing • Relocation of transit stops on Kennedy Road, north of Market Village Plaza access, may result in increased walking distances for transit riders to access residential communities on west side and commercial uses on east and west sides 	
Reduce Traffic Congestion and Delays	<ul style="list-style-type: none"> • Increased delay due to frequent gate closures from increased GO Train service • Maintain right-in-right-out access on Kennedy Road to Hollywood Square Plaza • Maintain right-out access on Kennedy Road from Market Village Plaza 	<ul style="list-style-type: none"> • Moderate improvement to traffic operations by reducing delays caused by at-grade train crossings • Maintain right-in-right-out access on Kennedy Road to Hollywood Square Plaza • Maintain right-out access on Kennedy Road from Market Village Plaza 	<ul style="list-style-type: none"> • Moderate improvement to traffic operations by reducing delays caused by at-grade train crossings • Closure of right-in-right-out access on Kennedy Road to Hollywood Square Plaza • Closure of right-out access on Kennedy Road from Market Village Plaza
Create a Pedestrian-Friendly Environment	<ul style="list-style-type: none"> • No change to pedestrian environment; pedestrians cross rail at-grade • Maintains direct pedestrian access to adjacent land use, including residential communities on west side and commercial uses on east and west sides • Reduction in perceived safety due to at-grade rail crossing with six lanes of traffic and increased rail frequency 	<ul style="list-style-type: none"> • Moderate impact to pedestrian environment due to increased travel distance for pedestrians traveling along moderate incline • Moderate improvement to pedestrian environment through elevated structure for AT facilities that are continuous and provide separation from rail crossing with reduced incline • Significant improvement to perceived safety with elimination of at-grade crossing • Moderate reduction to perceived safety due to reduced visibility of pedestrian passage and likely to be noisy • Moderate reduction in direct pedestrian access to adjacent land uses including residential communities on west side and commercial uses on east and west sides 	<ul style="list-style-type: none"> • Significant impact to pedestrian environment due to increased travel distance for pedestrians travelling along a substantial incline with wind exposure • Moderate improvement to pedestrian environment with continuous AT facilities and separation from rail crossing • Significant improvement to perceived safety with elimination of at-grade crossing and with clear visibility of pedestrian passage • Moderate Reduction in direct pedestrian access to adjacent land use including residential communities on west side and commercial uses on east and west sides
Create a Cyclist-Friendly Environment	<ul style="list-style-type: none"> • Significant improvement to cyclist environment due to construction of dedicated cycling infrastructure. Cyclists cross rail at-grade • Potential to provide direct cyclist access to adjacent land use, including residential communities on west side and commercial uses on east and west sides through existing connections 	<ul style="list-style-type: none"> • Moderate impact to cyclist environment due to increased travel distance for cyclist traveling along moderate incline • Moderate improvement to cyclist environment through elevated structure for AT that are continuous and provide separation from rail crossing with reduced incline • Moderate reduction to perceived safety due to reduced visibility of cyclist passage and likely to be noisy • Moderate reduction in direct cyclist access to adjacent land use including residential communities on west side and commercial uses on east and west sides 	<ul style="list-style-type: none"> • Significant impact to cyclist environment due to increased travel distance for cyclist travelling along a substantial incline with wind exposure • Moderate improvement to cyclist environment with continuous AT facilities and separation from rail crossing • Significant improvement to perceived safety with clear visibility of pedestrian passage • Moderate Reduction in direct cyclist access to adjacent land uses including residential communities on west side and commercial uses on east and west sides
Improve Safety for all Travel Modes	<ul style="list-style-type: none"> • Potential reduction in safety for motorists and vulnerable users (pedestrians and cyclists), with increased exposure to train crossings at-grade with increased train service • Improved safety for cyclists and pedestrians with dedicated infrastructure providing greater separation on both sides of Kennedy Road 	<ul style="list-style-type: none"> • Improved safety with separation of conflict points and road users with grade-separation • Improved safety for cyclists and pedestrians with dedicated infrastructure providing greater separation on both sides of Kennedy Road 	
Improve Mode Choice	<ul style="list-style-type: none"> • Moderate improvement in mode choice with provision of dedicated transit/HOV lanes and dedicated continuous AT facilities 		

CRITERIA	ALTERNATIVE 1: Modified Typical Section – At-Grade Crossing with AT Improvements	ALTERNATIVE 2: UNDERPASS – Modified Typical Section with AT Improvements	ALTERNATIVE 3: OVERPASS – Modified Typical Section with AT Improvements
Summary of Transportation Service	Least Preferred	Most Preferred	Less Preferred
NATURAL ENVIRONMENT			
Protect Designated Natural Areas	<ul style="list-style-type: none"> • No impact to designated natural areas as no Areas of Natural And Scientific Interest (ANSI), Provincially Significant Wetlands (PSWs), or Environmentally Sensitive Area (ESA) are located within the study area segment 		
Protect Vegetation	<ul style="list-style-type: none"> • Moderate impacts to vegetation due to construction of road widening; adjacent vegetation communities consist of manicured areas with landscaped trees on west side and marsh and swamp wetland on the east side • Potential displacement of Honey Locust trees in west boulevard, and White Oak and Trembling Aspen trees in east boulevard • No impact to trees with 50dbh or higher. • No impact to rare, threatened, or endangered species 	<ul style="list-style-type: none"> • Significant impacts to vegetation due to construction of widening with larger footprint and excavation; adjacent vegetation communities consist of manicured areas with landscaped trees on west side and marsh and swamp wetland on east side • Potential displacement of Honey Locust trees in west boulevard, and White Oak and Trembling Aspen trees in east boulevard • No impact to trees with 50dbh or higher • No impact to rare, threatened, or endangered species 	<ul style="list-style-type: none"> • Significant impacts to vegetation due to construction of widening; adjacent vegetation communities consist of manicured areas with landscaped trees on west side and marsh and swamp wetland on east side • Potential displacement of Honey Locust trees in west boulevard, and White Oak and Trembling Aspen trees in east boulevard • No impact to trees with 50dbh or higher • No impact to rare, threatened, or endangered species
Protect Wildlife	<ul style="list-style-type: none"> • Minimal impact to vegetative communities yielding wildlife habitat, as they are generally sparse on both sides of the study corridor at this section due to existing land-use. Ground flora within wetland area north of the rail tracks on east side of Kennedy Road is sparse and much of the ground is bare. • Small and medium sized mammals will be displaced 		
Protect Aquatic Habitat	<ul style="list-style-type: none"> • No anticipated impact to aquatic habitat 		
Surface Water and Ground Water Management	<ul style="list-style-type: none"> • Moderate impact with increased roadway width and hard surface area; stormwater quantity will increase and quality mitigation must be implemented • Minor impact to shallow groundwater system due to potential increase in contaminants (for ex. road salt) resulting from increased roadway width. Stormwater quality mitigation required. • No excavation-based impacts to groundwater are anticipated • Permit to take water not anticipated to be required for construction or to support long-term improvements 	<ul style="list-style-type: none"> • Significant impact with increased roadway width and hard surface area; stormwater quantity will increase and quality mitigation must be implemented • Moderate impact to shallow groundwater system due to potential increase in contaminants (for ex. road salt) resulting from increased roadway width. Stormwater quality mitigation required. • Significant excavation-based impacts to groundwater are anticipated • Significant dewatering will be required. A multi-level dewatering systems will be required during construction. An internal drainage and pumping system, or a long-term drawdown pumping system will be required in the long-term • Category 3 Permit to take water anticipated to be required for construction and to support long-term improvements 	<ul style="list-style-type: none"> • Moderate impact with increased roadway width and hard surface area; stormwater quantity will increase and quality mitigation must be implemented • Moderate impact to shallow groundwater system due to potential increase in contaminants (for ex. road salt) resulting from increased roadway width. Stormwater quality mitigation required. • No excavation-based impacts to groundwater are anticipated • Permanent dewatering is not required • Permit to take water not anticipated to be required for construction or to support long-term improvements
Improve Air Quality	<ul style="list-style-type: none"> • Potential to reduce air quality due to frequent vehicle queuing caused by increased GO Train service • Improved air quality through frequent transit service, high-occupancy vehicle lanes, and continuous active transportation facilities that will encourage people to divert from cars • No improvement in air quality on adjacent streets due to traffic diversion 	<ul style="list-style-type: none"> • Potential to improve air quality from elimination of vehicle idling caused by the closing of the gates at the rail crossing • Improved air quality through frequent transit service, high-occupancy vehicle lanes, and continuous active that will encourage people to divert from cars • Minor improvement in air quality on adjacent streets due to reduction in traffic diversion 	

CRITERIA	ALTERNATIVE 1: Modified Typical Section – At-Grade Crossing with AT Improvements	ALTERNATIVE 2: UNDERPASS – Modified Typical Section with AT Improvements	ALTERNATIVE 3: OVERPASS – Modified Typical Section with AT Improvements
Minimize Effects of Climate Change	<ul style="list-style-type: none"> Lower reliance on automobiles through increased non-auto mode share can reduce vehicle emissions and reduce effects on climate change Increased congestion due to frequent vehicle queuing caused by increased GO Train service can increase vehicle emissions and negative associated effects on climate change if grade separation is not provided 	<ul style="list-style-type: none"> Lower reliance on automobiles through increased non-auto mode share can reduce vehicle emissions and reduce effects on climate change Decreased congestion resulting from elimination of vehicle queuing caused by gate closures at the rail crossing can decrease vehicle emissions and negative associated effects on climate change 	
Summary of Natural Environment	Less Preferred	Least Preferred	Most Preferred
SOCIAL ENVIRONMENT			
Minimize Impacts on Existing Residential, Institutional and Recreational Dwellings / Properties	<ul style="list-style-type: none"> No direct impacts to residential properties immediately adjacent to the at-grade crossing 	<ul style="list-style-type: none"> No direct impacts to residential properties immediately adjacent to the at-grade crossing Permanent underpass design in proximity to residential properties on west and commercial uses on east side Potential temporary encroachment on Market Village parking lot as a result of the construction of the underpass Reduced level of connectivity for pedestrians/cyclists from properties adjacent to Kennedy Road 	<ul style="list-style-type: none"> No direct impacts to residential properties immediately adjacent to the at-grade crossing Potential temporary encroachment on Market Village parking lot as a result of the construction of the overpass, as well as permanent closure of Market Village and Hollywood Square Plaza accesses Potential temporary encroachment on 1-2 properties on Kennedy Road (Market Village and Milliken Wesleyan Methodist Church) Reduced privacy for residential properties located west of Kennedy Road as an overpass would allow drivers to have a view into backyards of properties Reduced level of connectivity for pedestrians/ cyclists from properties adjacent to Kennedy Road
Improve Access to Residential Areas, Institutional and Recreational Facilities	<ul style="list-style-type: none"> Reduction in access to residential areas, institutional and commercial facilities and cross-streets due to increased traffic congestion with at-grade crossing and resultant delays for transit and vehicles No impact to any residential driveways 	<ul style="list-style-type: none"> Significant improvement to access to residential areas, institutional and commercial facilities and cross-streets due to reduced traffic congestion No impact to any residential driveways 	<ul style="list-style-type: none"> Significant improvement to access to residential areas, institutional and commercial facilities and cross-streets due to reduced traffic congestion No impact to any residential driveways
Mitigate Traffic on Local Streets	<ul style="list-style-type: none"> No improvement to traffic infiltration on local streets with increased congestion 	<ul style="list-style-type: none"> Reduces traffic infiltration by easing congestion and delay at the rail crossing Congestion during construction not expected to result in traffic infiltration, as there are no collector streets within the vicinity that provide an alternate means of crossing the GO rail tracks, and detour will provide same road capacity as what exists today 	
Minimize Traffic Noise	<ul style="list-style-type: none"> Minor increase in level of traffic noise when compared to existing conditions Potential increase in train whistles from increased GO Train service; subject to compliance with City's Anti-Whistle policy Temporary noise impact due to construction 	<ul style="list-style-type: none"> Noise level associated with an underpass is anticipated to be higher than that associated with an overpass dependent on design of underpass walls Elimination of train whistles at the crossing with grade separation Significant temporary noise impact due to construction expected as a result of proximity between detour roadway to homes adjacent to Kennedy Road 	<ul style="list-style-type: none"> Noise level associated with an overpass is anticipated to be lower than that associated with an underpass Elimination of train whistles at the crossing with grade separation Significant temporary noise impact due to construction expected as a result of proximity between detour roadway to homes adjacent to Kennedy Road
Preserve Archaeological and Cultural Heritage Features	<ul style="list-style-type: none"> No areas of Cultural Heritage Value or Interest (CHVI) at this section No areas with archaeological potential at this section 		

CRITERIA	ALTERNATIVE 1: Modified Typical Section – At-Grade Crossing with AT Improvements	ALTERNATIVE 2: UNDERPASS – Modified Typical Section with AT Improvements	ALTERNATIVE 3: OVERPASS – Modified Typical Section with AT Improvements
Improve Visual Aesthetics	<ul style="list-style-type: none"> • No measurable change to existing aesthetics for residences • Temporary reduction to visual aesthetics during construction • Opportunity for tree planting or landscaping 	<ul style="list-style-type: none"> • No measurable change to existing aesthetics for residences. • Moderate reduction to visual aesthetics for the travelling public on Kennedy Road with all road users crossing under the rail; potential for public art and illumination to mitigate aesthetic impacts • Opportunity for tree planting or landscaping in screening buffer and beyond limits of underpass walls • Temporary reduction in aesthetics on east and west boulevards with detour roads 	<ul style="list-style-type: none"> • Significant reduction to visual aesthetics for residences to the east and west of the crossing due to visual obstruction of new overpass structure anticipated to be 9.7m in height, including potential parapet walls • Opportunity for tree planting or landscaping in embankment or by retaining walls • Temporary reduction in aesthetics on east and west boulevards with detour roads
Improve Community Character	<ul style="list-style-type: none"> • No Change to community character. Kennedy Road is a barrier to east and west sides as there is no midblock connection in this section 	<ul style="list-style-type: none"> • Impacts community character by introducing a physical barrier into the neighbourhood 	
Summary of Social Environment	Less Preferred	Most Preferred	Least Preferred
INFRASTRUCTURE DESIGN			
Minimize Utility Relocation	<ul style="list-style-type: none"> • Minor utility conflicts and impacts • Anticipated relocation of above ground and underground facilities, including Bell lines, Telus fiber optic lines, watermain, and gas main within the east and west boulevard. As well as possible relocation of streetlight cables within the east and west boulevard. 	<ul style="list-style-type: none"> • Significant utility conflicts and impacts • Anticipated relocation of above ground and underground facilities, including Bell lines, Telus fiber optic lines, watermain, and gas main within the east and west boulevard. As well as possible relocation of streetlight cables within the east and west boulevard. Underground utility relocation includes buried facilities. 	<ul style="list-style-type: none"> • Moderate utility conflicts and impacts • Anticipated relocation of above ground and underground facilities, including Bell lines, Telus fiber optic lines, watermain, and gas main within the east and west boulevard. As well as possible relocation of streetlight cables within the east and west boulevard.
Minimize Disruption due to Construction	<ul style="list-style-type: none"> • Potential minor disruption to rail corridor users due to construction of widening and implementation of enhanced crossing gates • Moderate delays to road corridor users due to potential lane closures; four lane detour roadway provided to maintain access through construction • Shorter construction duration, with lesser impact to through traffic and residents • No change to risk of flooding 	<ul style="list-style-type: none"> • Potential moderate disruption to rail corridor users due to tunneling, support for rail lines and construction of underpass • Moderate delays to road corridor users due to potential lane closures, construction of at-grade and grade-separated detour roads, and AT facilities to maintain access throughout construction • Longer construction duration - anticipated to be 3 to 4 years • Significant constructability concerns: <ul style="list-style-type: none"> ○ Construction staging and requirement for grade separated and at-grade detour roads ○ Multi-level dewatering system required during construction ○ Internal drainage and pumping system, or long-term groundwater drawdown pumping system required for long-term ○ Second track is already in place but not currently in use. Track modifications, if required, will require scheduled short duration track outages ○ Need for construction of concrete base slab and contiguous caisson walls along east and west sides of Kennedy Road 	<ul style="list-style-type: none"> • Potential minor disruption to rail corridor users due to construction of overpass structure • Moderate delays to road corridor users due to potential lane closures, construction of at-grade and grade-separated detour roads, and AT facilities to maintain access throughout • Short construction duration - anticipated to be 2 year • Moderate constructability concerns: <ul style="list-style-type: none"> ○ Construction staging and requirement for grade separated and at-grade detour roads ○ Approach embankment north and south of the rail line can be constructed with sideslopes, or Retained Soil System walls could be constructed to retain the approach embankment • No change to risk of flooding

CRITERIA	ALTERNATIVE 1: Modified Typical Section – At-Grade Crossing with AT Improvements	ALTERNATIVE 2: UNDERPASS – Modified Typical Section with AT Improvements	ALTERNATIVE 3: OVERPASS – Modified Typical Section with AT Improvements
		<ul style="list-style-type: none"> Risk of flooding if long-term groundwater drawdown system shuts down; however, retaining walls should be designed for full hydrostatic pressure 	
Minimize Constructability Complexity	<ul style="list-style-type: none"> Minor Construction Complexity due to construction of detour route / construction staging 	<ul style="list-style-type: none"> Higher risk associated with significantly more complex construction methods Significant construction complexity due to staging of detour of road and rail, and tunneling required for construction of at-grade and grade separated detour roads, pumping station, rail bridges, and second track in order to complete underpass 	<ul style="list-style-type: none"> Common construction materials and techniques Moderate construction complexity due to construction of at-grade and grade separated detour roads and overpass
Summary of Infrastructure Design	Most Preferred	Least Preferred	Less Preferred
ECONOMIC ENVIRONMENT AND COST EFFECTIVENESS			
Accommodate Planned Development and Growth	<ul style="list-style-type: none"> Supports approved development in the study area by providing adequate capacity and transportation choices to accommodate planned growth Potential impact to growth due to congestion at the rail crossing 	<ul style="list-style-type: none"> Supports approved development in the study area by providing adequate capacity and transportation choices to accommodate planned growth Accommodates planned development and growth by easing congestion at the rail crossing 	
Minimize Impacts on Business Properties	<ul style="list-style-type: none"> No direct impacts on business properties as roadway platform is not in proximity to any buildings 	<ul style="list-style-type: none"> Potential temporary encroachment on commercial parking lot as a result of the construction of the detour route 	
Improve Access to Businesses and Key Employment Areas	<ul style="list-style-type: none"> Reduction in access at employment areas and cross-streets due to increased traffic congestion with at-grade crossing and resultant delays for transit and vehicles Moderate improvement to transit, pedestrian, and cycling access with provision of dedicated facilities Minor temporary impacts to access due to construction 	<ul style="list-style-type: none"> Significant improvement to access at employment areas and cross-streets due to reduced traffic congestion Moderate improvement to transit, pedestrian, and cycling access with provision of dedicated facilities Moderate temporary impacts to access due to construction due to construction of detour roads 	<ul style="list-style-type: none"> Significant improvement to access at employment areas and cross-streets due to reduced traffic congestion Moderate improvement to transit, pedestrian, and cycling access with provision of dedicated facilities Moderate temporary impacts to access due to construction due to construction of detour roads
Improve Access to Market Village and Hollywood Square Plaza	<ul style="list-style-type: none"> No impact to existing Market Village driveway due to existing access restriction to right-out only No impact to existing Hollywood Square access due to existing access restriction to right-in, right-out only Maintain travelling distance to plazas for pedestrians, cyclists, and transit users 	<ul style="list-style-type: none"> Minor impact to existing Market Village driveway to tie into underpass design due to little / no road re-profiling Moderate impact to Hollywood Square access due to re-profiling of access Moderate increase to travelling distance to plazas for pedestrians, cyclists, and transit users 	<ul style="list-style-type: none"> Significant impact to existing Market Village driveway due to access closure on Kennedy Road. Access would be via Clayton Drive/Pacific Mall Entrance. Significant impact to existing Hollywood Square Plaza access due to access closure on Kennedy Road. Access would be via Gorvette Road. Significant increase in access distance to plazas for pedestrians and cyclists. Significant increase in travelling distance to plazas for pedestrians, cyclists, and transit users
Maximize Construction Value	<ul style="list-style-type: none"> Moderate capital costs to widen road 	<ul style="list-style-type: none"> Very significant capital costs to construct rail bridges, second rail track, retaining walls, grade separated and at-grade detour roads, raised AT facilities, underpass, and drawdown pumping system. Approximate Structure Cost: \$50,406,000 (<i>considers bridge design/construction, rail work, and excavation/retaining wall/U-channel</i>) Approximate Pumping Station Cost: \$6,000,000 	<ul style="list-style-type: none"> Significant capital costs to construct overpass structure, retaining walls, and grade separated and at-grade detour roads Approximate Structure Cost: \$19,175,000 Approximate Road Cost: \$\$\$ to accommodate reconstruction of Clayton Drive and Gorvette Road intersection with 5% grade for AODA compliance

CRITERIA	ALTERNATIVE 1: Modified Typical Section – At-Grade Crossing with AT Improvements	ALTERNATIVE 2: UNDERPASS – Modified Typical Section with AT Improvements	ALTERNATIVE 3: OVERPASS – Modified Typical Section with AT Improvements
		<ul style="list-style-type: none">Approximate Road Cost due to more excavation: \$\$	
Minimize Property Requirements	<ul style="list-style-type: none">Minimal property requirements from Market Village and Hollywood Square Plaza to support the recommended improvementsNo property identified from residential properties		
Minimize Operating Costs	<ul style="list-style-type: none">Minor increase in operating costs for active transportation facilities and maintenance of widened road	<ul style="list-style-type: none">Significant increase in operating costs with rail bridges, retaining walls, raised AT facilities, and drawdown pumping system	<ul style="list-style-type: none">Moderate increase in operating costs with retaining walls and overpass
Summary of Economic Environment and Cost Effectiveness	Most Preferred	Less Preferred	Least Preferred
OVERALL SUMMARY			
Recommendation by Consultants – For discussion	This option provides improved active transportation facilities and dedicated transit/ HOV lanes; however, it does not address vehicle queuing caused by increased GO Train service or safety of at-grade crossing for pedestrians and cyclists.	This option provides improved active transportation facilities, dedicated transit/ HOV lanes, and mitigates vehicle queuing caused by increased GO Train service. Pedestrian and cyclists also travel along a raised platform to minimize travelling distance and are grade separated from the rail crossing.	This option provides improved active transportation facilities, dedicated transit/ HOV lanes, and mitigates vehicle queuing caused by increased GO Train service. Pedestrian and cyclists travel along an incline resulting in increased travel distance and result in impacts to existing accesses.
	Recommended	Ultimate Vision	

Hagerman Cemeteries, Design Alternatives

The Hagerman Cemeteries are located on the east and west side of Kennedy Road, between 14th Avenue and Duffield Drive. This segment of Kennedy Road has one of the most constrained right-of-ways (ROWs) generally less than 33 metres, with the most constrained location at approximately 25.3 metres. Currently, this segment does not support cycling facilities and pedestrian safety is an issue as there is minimal separation between pedestrian and vehicular traffic. There are also heritage considerations at this segment due to the proximity of Hagerman Cemeteries and Thomas Morley House to the existing road ROW.

Due to the sensitivities of the adjacent cemeteries and Thomas Morley House (Designated under Part V of the Ontario Heritage Act, By-Law 37-93), alternative design concepts looked at opportunities to minimize potential impacts to these lands deviating from the typical section. Alternatives considered reduction in standard lane widths for six-lane roads, removal of active transportation facilities in the segment, provision of shared cycling facilities instead of separated facilities, and/or provision of priority measures (queue jump lanes) in place of dedicated Transit/HOV lanes etc. **Table 1** summarizes the alternatives considered for the Kennedy Road segment north of 14th Avenue. The design alternatives are illustrated in **Exhibit 1** through

Exhibit 8.

Table 1: Alternative Design Concepts considered for the Hagerman Cemeteries segment

Alternative #	Title	Description
1	Reduced Lane Width with MUP and Sidewalk, Best Fit Approach	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Reduced lane width, no centre median, MUP one side and sidewalk other side • Road alignment is shifted west of Hagerman East and east at Hagerman West (“best fit” approach) • No direct impacts to adjacent graves • Potential impacts to the heritage home on the east side
2	Standard Lane Width with MUPs on both sides, Best Fit Approach	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Standard lane width, no centre median and MUP on both sides • Road alignment is shifted west of Hagerman East and east at Hagerman West (“best fit” approach) • Potential impacts to adjacent graves • Impacts to the heritage home on the east side • Impacts to hydro and watermain
3	Standard Lane Width with MUPs on both sides, Shift alignment West	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Standard lane width, no centre median and MUP on both sides • Road alignment is shifted west of Hagerman East • Potential impacts to adjacent graves • No direct impacts to the heritage home on the east side • Impacts to hydro
4	Standard Lane Width with MUPs on both sides, Shift alignment East	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Standard lane width, no centre median and MUP on both sides • Road alignment is shifted east of Hagerman West • Impacts to adjacent graves • Impacts to the heritage home on the east side • Impacts to hydro and watermain
5	Centre Median AT Facility	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Standard lane width • Centre median with MUP for cycling and pedestrian in the middle of the road • Potential impacts to adjacent graves • Potential impacts to the heritage home on the east side

6	Shared Roadway with Cyclists, and Sidewalks	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Standard lane width and no centre median • Cycling in shared curb lane with Transit/HOV vehicles (sharrow lane) • Sidewalks on either side • Potential impacts to adjacent graves • Potential impacts to the heritage home on the east side
7	No AT Facilities	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Standard lane width with minimum centre median • No pedestrian and cycling facilities in the corridor • No impacts to adjacent graves • No direct impacts to the heritage home on the east side
8	No widening, MUPs on both sides, and queue jump lanes	<ul style="list-style-type: none"> • Maintain four lanes with centre left-turn lane • Standard lane width and MUP on both sides • Transit/HOV lanes transition into this segment through queue jump lanes for Transit/HOV vehicles at intersections with 14th Avenue and Duffield Drive (or future Miller Ave. extension). • Potential impacts to adjacent graves • Potential impacts to the heritage home on the east side

Between Hagerman Cemeteries



Between Hagerman West and Thomas Morely House

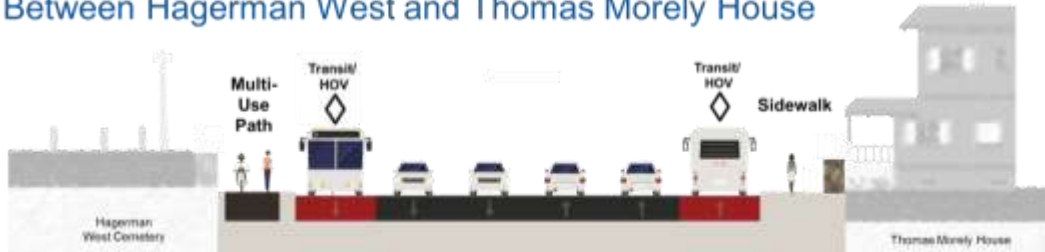


Exhibit 1: Alternative 1 – Reduced Lane Width with MUP and Sidewalk, Best Fit Approach



Between Hagerman Cemeteries



Between Hagerman West and Thomas Morely House



Exhibit 2: Alternative 2 – Standard Lane Width with MUPs on Both Sides, Best Fit Approach



Between Hagerman Cemeteries



Between Hagerman West and Thomas Morely House



Exhibit 3: Alternative 3 – Standard Lane Width with MUPs on Both Sides, Shift Alignment West



Between Hagerman Cemeteries



Between Hagerman West and Thomas Morely House



Exhibit 4: Alternative 4 – Standard Lane Width with MUPs on Both Sides, Shift Alignment East



Exhibit 5: Alternative 5 – Centre Median AT Facility



Exhibit 6: Alternative 6 – Shared Roadways with Cyclists, and Sidewalks



Exhibit 7: Alternative 7 – No AT Facilities



Exhibit 8: Alternative 8 – No Widening, MUPs on Both Sides, and Queue Jump Lanes

HAGERMAN CEMETERIES, EVALUATION

A high level screening of the alternative design concepts developed at the Hagerman Cemeteries was completed based on compliance of the alternatives with YR-TMP recommendations and YR Pedestrian and Cyclist Guidelines. The results are provided in **Table 2**.

Table 2: High Level Screening of Hagerman Cemetery Options

	Alternative	Discussion / Recommendation
1	Reduced Lane Width with MUP and Sidewalk, Best Fit Approach	Carry Forward
2	Standard Lane Width with MUPs on both sides, Best Fit Approach	Carry Forward
3	Standard Lane Width with MUPs on both sides, Shift alignment West	This alternative results in direct impacts to adjacent graves. Screened out – Do not carry forward
4	Standard Lane Width with MUPs on both sides, Shift alignment East	This alternative results in direct impacts to adjacent graves. Screened out – Do not carry forward
5	Centre Median AT Facility	Centre median AT facility does not provide pedestrian and cyclist access to adjacent lands between Duffield Drive and 14 th Avenue. Access to boulevards is only provided at signalized intersections. This alternative is not compliant with York Region's Pedestrian and Cyclist Guidelines. Screened out – Do not carry forward
6	Shared Roadway with Cyclists, and Sidewalks	Cyclists travelling in shared Transit/HOV curb lane are not provided with dedicated, separated facilities as per the YR-TMP recommendations. This alternative is not compliant with YR-TMP recommendations nor the York Region's Pedestrian and Cyclist Guidelines. Screened out – Do not carry forward
7	No AT Facilities	Cyclists and pedestrians are not accommodated in the Kennedy Road corridor. This alternative does not provide AT access for any of the adjacent land use between Duffield Drive and 14 th Avenue and there are no adjacent pedestrian and cyclist connections on the local street network. This alternative is not compliant with the YR-TMP recommendations and impacts the AT network. Screened out – Do not carry forward
8	No widening, MUPs and queue jump lanes	Transit/HOV lanes from six-lane road transition into four general purpose lane segment. Queue jump lanes used for transition of transit/HOV vehicles at intersections with 14 th Avenue and Duffield Drive (or future Miller Ave. extension) will be challenging to implement and monitor use for compliance. This alternative is also not compliant with the YR-TMP recommendations. Screened out – Do not carry forward

Based on consultation with the City of Markham, a request was made to consider a modification to Option 1 to accommodate dual MUP, but maintain a sub-standard width to avoid impacts with the cemetery lands. The sub-standard width for the path would be addressed through warning signage to indicate to users of the respective narrow path ahead and potential need to dismount. This variation was prepared as Option1B. The evaluation and recommendations for the options carried forward is presented in **Table 3**.

Table 3: Kennedy Road north of 14th Avenue, Hagerman East and Hagerman West Cemeteries Evaluation

Criteria	Option 1A: Reduced Lane Width with Narrow MUP and Sidewalk, Best Fit Approach	Option 1B: Reduced Lane Width with Dual Narrow MUP, Best Fit Approach	Option 2: Standard Lane Width with Dual MUP, Best Fit Approach
Description	The lane widths will be reduced to 3.0m general purpose lanes and 3.2m Transit/HOV lanes. A minimum MUP (2.4m wide) will be provided on one side, and sidewalk on the other side.	The lane widths will be reduced to 3.0m general purpose lanes and 3.2m Transit/HOV lanes. A minimum MUP (2.4m wide) will be provided on both sides; which in some constrained locations narrows to sub-standard width of <2.4m.	The lane widths will be to standard, 3.3m general purpose lanes and 3.5m Transit/HOV lanes. A minimum MUP (2.4m wide) will be provided on both sides.
Transportation Service			
Create a Pedestrian-Friendly Environment	<ul style="list-style-type: none">• Minor reduction in level of comfort for pedestrians as MUP on one side will require shared facilities with cyclists	<ul style="list-style-type: none">• Moderate reduction in level of comfort for pedestrians as MUPs will require shared facilities with cyclists on both sides• Restricted locations for pedestrian and cyclist path on both sides at some locations with substandard width (<2.4m)	<ul style="list-style-type: none">• Moderate reduction in level of comfort for pedestrians as MUPs will require shared facilities with cyclists on both sides
Create a Cyclist-Friendly Environment	<ul style="list-style-type: none">• Minor improvement to cyclist environment with shared cycling facility (MUP) on one side only	<ul style="list-style-type: none">• Moderate Improvement to cyclist environment through the provision of continuous, shared cycling facilities (MUPs) on both sides• Restricted locations for pedestrian and cyclist path on both sides at some locations with substandard width (<2.4m)	<ul style="list-style-type: none">• Moderate Improvement to cyclist environment through the provision of continuous, shared cycling facilities (MUPs) on both sides
Improve Safety for All Travel Modes	<ul style="list-style-type: none">• Moderate potential for improved cyclist and pedestrian safety due to provision of dedicated active transportation facilities (separated pedestrian facility on one side, shared on the other), reducing conflict with motorists• Potential to reduce vehicle speed due to narrow lane widths	<ul style="list-style-type: none">• Potential for improved cyclist and pedestrian safety due to provision of dedicated shared active transportation facilities on both sides, reducing conflict with motorists• Potential to reduce vehicle speed due to narrow lane widths	<ul style="list-style-type: none">• Potential for improved cyclist and pedestrian safety due to provision of dedicated shared active transportation facilities on both sides, reducing conflict with motorists• No reduction in speed due to standard lane widths
Improve Driver Level of Comfort	<ul style="list-style-type: none">• Driver comfort reduced due to through lanes with narrow widths		<ul style="list-style-type: none">• Driver comfort unaffected due to through lanes with standard widths
Improve Mode Choice	<ul style="list-style-type: none">• Minor Improvement to mode choice through provision of Transit/HOV lanes and addition of cyclist facility on one side	<ul style="list-style-type: none">• Moderate improvement to mode choice through provision of Transit/HOV lanes and addition of pedestrians and cyclist facilities on both boulevards	
Summary of Transportation Service	Least Preferred	Less Preferred	Most Preferred
Natural Environment			
Protect Designated Natural Areas	<ul style="list-style-type: none">• No impact to designated natural areas as no Areas of Natural And Scientific Interest (ANSI), Provincially Significant Wetlands (PSWs), or Environmentally Sensitive Area (ESA) are located within the study area segment		
Protect Vegetation and wildlife	<ul style="list-style-type: none">• No impact to vegetation due to construction of road widening• No impact to trees with 50dbh or higher.• No impact to rare, threatened, or endangered species		
Storm and Groundwater Management	<ul style="list-style-type: none">• Minor impact with increased roadway width and hard surface area to accommodate additional Transit/HOV lanes and active transportation facilities Stormwater	<ul style="list-style-type: none">• Minor-Moderate impact with increased roadway width and hard surface area to accommodate additional	<ul style="list-style-type: none">• Moderate impact with increased roadway width and hard surface area to accommodate additional Transit/HOV lanes and active transportation facilities (widest pavement



Criteria	Option 1A: Reduced Lane Width with Narrow MUP and Sidewalk, Best Fit Approach	Option 1B: Reduced Lane Width with Dual Narrow MUP, Best Fit Approach	Option 2: Standard Lane Width with Dual MUP, Best Fit Approach
	quantity will increase and quality mitigation may be required; however, this can be addressed through design <ul style="list-style-type: none">• Minor impact to shallow groundwater system due to potential increase in contaminants related to increased roadway width (i.e. road salt, etc.)	Transit/HOV lanes and active transportation facilities (wider pavement width than Option 1A) <ul style="list-style-type: none">• Stormwater quantity will increase and quality mitigation may be required; however, this can be addressed through design• Minor-Moderate impact to shallow groundwater system due to potential increase in contaminants related to increased roadway width (i.e. road salt, etc.)	width) Stormwater quantity will increase and quality mitigation may be required; however, this can be addressed through design <ul style="list-style-type: none">• Moderate impact to shallow groundwater system due to potential increase in contaminants related to increased roadway width (i.e. road salt, etc.)
Improve Air Quality	<ul style="list-style-type: none">• Moderate improvement to air quality through increased Transit/HOV use and reduced congestion• Active transportation and transit service improvements can reduce dependence on automobiles and provide air quality improvements		
Minimize Effects on Climate Change	<ul style="list-style-type: none">• Lower reliance on automobiles through increased mode choice however limited for cyclists on one boulevard only and decreased congestion can minimize effects on climate change (i.e. by reducing greenhouse gas emissions)	<ul style="list-style-type: none">• Lowest reliance on automobiles through increased mode choice with dedicated AT facilities for pedestrians and cyclists on both boulevards, and decreased congestion can minimize effects on climate change (i.e. by reducing greenhouse gas emissions)	
Summary of Natural Environment	Less Preferred	Most Preferred	Least Preferred
Social Environment			
Minimize Impacts on Existing Residential, Institutional and Recreational Dwellings / Properties	<ul style="list-style-type: none">• Direct impact to Thomas Morley House (heritage home) which is listed as Designated under Part V of the OHA, By-Law 37-93. (see discussion under heritage features)• Impacts to the retaining wall currently 2m away from the west façade of Thomas Morley House, requiring demolition and reconstruction, however the retaining wall is not an identified heritage attribute of the property.• Alteration of the current property boundaries; requires the least encroachment	<ul style="list-style-type: none">• Direct impact to Thomas Morley House (heritage home) which is listed as Designated under Part V of the OHA, By-Law 37-93. (see discussion under heritage features)• Impacts to the retaining wall currently 2m away from the west façade of Thomas Morley House, requiring demolition and reconstruction, however the retaining wall is not an identified heritage attribute of the property.• Alteration of the current property boundaries; requires less encroachment than Option 2	<ul style="list-style-type: none">• Direct impact to Thomas Morley House (heritage home) which is listed as Designated under Part V of the OHA, By-Law 37-93. (see discussion under heritage features)• Impacts to the retaining wall currently 2m away from the west façade of Thomas Morley House, requiring demolition and reconstruction, however the retaining wall is not an identified heritage attribute of the property.• Alteration of the current property boundaries; requires the greatest encroachment
Improve Access to Residential Areas, Institutional and Recreational Facilities	<ul style="list-style-type: none">• Accesses restricted to right-in-right-out with six lane widening.• Pedestrian access provided on both boulevards; cyclist access provided from one boulevard only	<ul style="list-style-type: none">• Accesses restricted to right-in-right-out with six lane widening.• Pedestrian and cyclist access provided on both boulevards	
Minimize Traffic Noise	<ul style="list-style-type: none">• Noise levels are anticipated to increase moderately with future traffic growth and additional lanes in closer proximity to properties		
Preserve Archaeological and Cultural Heritage Features	<ul style="list-style-type: none">• Minimal anticipated archaeological impacts on cemetery lands on one side of the corridor to accommodate minor property requirements at Hagerman East in location anticipated with no direct impacts to graves.• Direct impact to Thomas Morley House which is listed as <i>designated under Part V of the OHA, By-Law 37-93</i>. Direct impacts to retaining wall currently 2m away from the west façade of Thomas Morley House, West Wing and South Porch, and alteration of the current property boundaries.• Least encroachment on protected heritage property for Thomas Morley House• Potential to Relocate Thomas Morley House east on its existing lot or to a new site and encroach on 7779-81 Kennedy Road based on the identified road	<ul style="list-style-type: none">• Minimal anticipated archaeological impacts on cemetery lands on one side of the corridor to accommodate minor property requirements at Hagerman East in location anticipated with no direct impacts to graves.• Direct impact to Thomas Morley House which is listed as <i>designated under Part V of the OHA, By-Law 37-93</i>. Direct impacts to retaining wall currently 2m away from the west façade of Thomas Morley House, West Wing and South Porch, and alteration of the current property boundaries.• Moderate encroachment on protected heritage property for Thomas Morley House• Potential to Relocate Thomas Morley House east on its existing lot or to a new site and encroach on 7779-81 Kennedy Road based on the identified road	<ul style="list-style-type: none">• Significant anticipated direct archaeological impacts on cemetery lands to accommodate property requirements with direct impacts to graves.• Direct impact to Thomas Morley House which is listed as <i>designated under Part V of the OHA, By-Law 37-93</i>. Direct impacts from road construction will require demolition or relocation of the structure’s West Wing and South Porch.• Significant encroachment on protected heritage property for Thomas Morley House and cemetery lands• Potential to Relocate Thomas Morley House east on its existing lot or to a new site and encroach on 7779-81 Kennedy Road based on the identified road improvements. Relocation would retain the building’s

Criteria	Option 1A: Reduced Lane Width with Narrow MUP and Sidewalk, Best Fit Approach	Option 1B: Reduced Lane Width with Dual Narrow MUP, Best Fit Approach	Option 2: Standard Lane Width with Dual MUP, Best Fit Approach
	improvements. Relocation would retain the building's heritage attributes and present an opportunity for rehabilitation and adaptive reuse <ul style="list-style-type: none">• Direct and indirect impacts to Thomas Morley House and protected heritage property that are irreversible, permanent, will occur once, are widespread, and overall represent a major change	improvements. Relocation would retain the building's heritage attributes and present an opportunity for rehabilitation and adaptive reuse <ul style="list-style-type: none">• Direct and indirect impacts to Thomas Morley House and protected heritage property that are irreversible, permanent, will occur once, are widespread, and overall represent a major change	heritage attributes and present an opportunity for rehabilitation and adaptive reuse <ul style="list-style-type: none">• Direct and indirect impacts to Thomas Morley House and protected heritage property that are irreversible, permanent, will occur once, are widespread, and overall represent a major change
Minimize Impacts to Cemeteries and Burial Grounds	<ul style="list-style-type: none">• Minor potential impact to the cemetery lands, located on both sides of the corridor due to proposed widening and AT facilities within the existing right-of-way. Impacts may require rebuilding of existing retaining wall at Hagerman West and minor property encroachment to Hagerman East in location anticipated with no direct impacts to graves.		<ul style="list-style-type: none">• Significant potential for direct impact to the cemetery lands and graves, located on both sides of the corridor due to proposed widening and AT facilities
Improve Visual Aesthetics	<ul style="list-style-type: none">• Visual aesthetics will be moderately reduced due to increased pavement width for Transit/HOV lanes and active transportation facilities		
Improve Community Character	<ul style="list-style-type: none">• Community character will moderately improve through the provision of improved transit, cycling, and pedestrian facilities		
Summary of Social Environment	Most Preferred	Less Preferred	Least Preferred
Infrastructure Design			
Minimize Constructability Complexity	<ul style="list-style-type: none">• Moderate construction complexity due to addition of travel lanes and active transportation facilities, relocation of Thomas Morley House and utility relocation within constrained property and existing right-of-way adjacent to cemetery lands.		<ul style="list-style-type: none">• Significant construction complexity due to addition of travel lanes and active transportation facilities, relocation of Thomas Morley House, specialized construction practices and monitoring at cemetery lands for disturbance of graves, and utility relocation within constrained property.
Summary of Infrastructure Design	Most Preferred	Most Preferred	Least Preferred
Economic Environment and Cost Effectiveness			
Maximize Construction Value	<ul style="list-style-type: none">• Moderate cost for property acquisition and relocation of Thomas Morley House property, where complications may be involved with relocating the structure.		<ul style="list-style-type: none">• Significant cost for additional property acquisition and relocation of Thomas Morley House property, where complications may be involved with relocating the structure
Minimize Operating Costs	<ul style="list-style-type: none">• Increase in annual maintenance cost due to provision of wider road and improved active transportation facilities		
Minimize Property Requirements	<ul style="list-style-type: none">• Moderate property acquisition required at residential properties, Thomas Morley House property, and cemetery land located on the east side		<ul style="list-style-type: none">• Significant property acquisition required at residential properties, Thomas Morley House and cemetery lands
Summary of Economic Environment	Most Preferred	Most Preferred	Least Preferred
Overall Summary			



Criteria	Option 1A: Reduced Lane Width with Narrow MUP and Sidewalk, Best Fit Approach	Option 1B: Reduced Lane Width with Dual Narrow MUP, Best Fit Approach	Option 2: Standard Lane Width with Dual MUP, Best Fit Approach
Recommendation	This option provides improved active transportation facilities on one side and sidewalk on one side, dedicated Transit/ HOV lanes and avoids direct impacts to grave sites on cemetery lands. Although driver comfort may be modified due to reduced lane widths, narrower lanes may result in a reduction in vehicle speed creating a safer environment for all users. Relocation of Thomas Morley House would retain the building's heritage attributes and present an opportunity for rehabilitation and adaptive reuse.	This option provides improved active transportation facilities on both sides, dedicated Transit/ HOV lanes and avoids direct impacts to grave sites on cemetery lands. Although driver comfort is modified due to reduced lane widths, narrower lanes may result in a reduction in vehicle speed creating a safer environment for all users. Relocation of Thomas Morley House would retain the building's heritage attributes and present an opportunity for rehabilitation and adaptive reuse.	This option provides improved active transportation facilities on both sides, dedicated Transit/ HOV lanes but results in impacts to cemetery lands and potential for direct impacts to grave sites. There is no change in driver comfort or vehicle speed due to standard lane widths. Relocation of Thomas Morley House would retain the building's heritage attributes and present an opportunity for rehabilitation and adaptive reuse. This option has the most significant impacts to adjacent properties.
		RECOMMENDED	

St. Philips on-the-Hill Cemetery and Bethesda Lutheran Cemetery, Design Alternatives

St. Philips-on-the-Hill and Bethesda Lutheran Cemeteries are located on the west and east side of Kennedy Road respectively, between Beckett Avenue and Wilfred Murison Avenue. This segment of Kennedy Road has one of the most constrained right-of-ways (ROWs) generally less than 33 metres, with the most constrained location at approximately 25.3 metres, between the St. Philips-on-the-Hill Anglican Church property and Bethesda Lutheran Cemetery. Currently, this segment does not support cycling facilities and pedestrian level of service is low due to existing issues with pedestrian safety. There are also heritage considerations at this segment due to the proximity of St. Philips and Bethesda Cemeteries and Thomas Lownsbrough House to the existing ROW.

Due to the sensitivities of the adjacent cemeteries and Thomas Lownsbrough House (listed on the City of Markham's Register of Properties of Cultural Heritage) alternative design concepts looked at opportunities to minimize potential impacts to these lands deviating from the typical section. Alternatives considered reduction in standard lane widths for six-lane roads, removal of active transportation facilities in the corridor, provision of shared cycling facilities instead of separated facilities, and/or provision of priority measures (queue jump lanes) in place of dedicated Transit/HOV lanes etc. **Table 1** presents the alternatives considered for the Kennedy Road segment north of 16th Avenue. The design alternatives are illustrated in **Exhibit 1** through **Exhibit 7**.

Table 1: Alternative Design Concepts considered for the St. Philips and Bethesda Cemeteries Segment

Alternative #	Title	Description
1	Reduced Lane Width with MUP and Sidewalk, Best Fit Approach	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Reduced lane width, no centre median, MUP one side and sidewalk other side • Road alignment is shifted east of St.Philips-On-the Hill Cemetery and west of Bethesda Lutheran Cemetery (“best fit” approach) • No impacts to adjacent graves • Potential impacts to the heritage home on the west side
2	Standard Lane Width with MUPs on both sides, Best Fit Approach	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Standard lane width, no centre median and MUP on both sides • Road alignment is shifted east of St.Philips-On-the Hill Cemetery and west of Bethesda Lutheran Cemetery (“best fit” approach) • Potential impacts to adjacent graves • Potential impacts to the heritage home on the west side
3	Standard Lane Width with MUPs on both sides, Shift alignment East	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Standard lane width, no centre median and MUP on both sides • Road alignment is shifted east of St.Philips-on-the-Hill Cemetery • Impacts to adjacent graves • No direct impacts to the heritage home on the west side • Impacts to hydro and watermain
4	Standard Lane Width with MUPs on both sides, discontinuous AT, Shift alignment West	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Standard lane width, no centre median and MUP on both sides with discontinuous MUP at St.Philips-on-the-Hill Cemetery • Road alignment is shifted west of Bethesda Lutheran Cemetery • Potential impacts to adjacent graves • Impacts to the heritage home on the west side • Impacts to hydro and watermain
5	Shared Roadway with Cyclists, and Sidewalks	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Standard lane width and no centre median • Cycling in shared curb lane with Transit/HOV vehicles (sharrow lane) • Sidewalks on either side • Potential impacts to adjacent graves • Potential impacts to the heritage home on the west side

6	No AT Facilities	<ul style="list-style-type: none"> • Six lane widening for Transit/HOV • Standard lane width with minimum centre median • No pedestrian and cycling facilities in the corridor • No impacts to adjacent graves • No impacts to the heritage home on the west side
7	No widening, MUPs and queue jump lanes	<ul style="list-style-type: none"> • Maintain four lanes with centre left-turn lane • Standard lane width and MUP on both sides • Transit/HOV lanes transition into this segment through queue jump lanes for Transit/HOV vehicles at intersections with Wilfred Murison Avenue and Beckett Avenue • No impacts to adjacent graves • No direct impacts to the heritage home on the west side

Between St. Philips and Bethesda Cemetery



Between Thomas Lownsbrough House and Bethesda Cemetery



Exhibit 1: Alternative 1 – Reduced Lane Width with MUP and Sidewalk, Best Fit Approach



Between St. Philips and Bethesda Cemetery



Between Thomas Lownsborough House and Bethesda Cemetery



Exhibit 2: Alternative 2 – Standard Lane Width with MUPs on both sides, Best Fit Approach



Between St. Philips and Bethesda Cemetery



Between Thomas Lownsborough House and Bethesda Cemetery



Exhibit 3: Alternative 3 – Standard Lane Width with MUPs on both sides, Shift alignment East



Between St. Philips and Bethesda Cemetery



Between Thomas Lownsborough House and Bethesda Cemetery



Exhibit 4: Alternative 4 – Standard Lane Width with MUPs on both sides, discontinuous AT, Shift alignment West



Exhibit 5: Alternative 5 – Shared Roadway with Cyclists, and Sidewalks



Exhibit 6: Alternative 6 – No AT Facilities



Exhibit 7: No Widening, MUPs and Queue Jump Lanes

A high level screening of the alternative design concepts developed at the cemeteries located north of 16th Avenue was completed based on compliance of the alternatives with YR-TMP recommendations and YR Pedestrian and Cyclist Guidelines. The results are provided in **Table 2**.

Table 2: High Level Screening of St. Philips-on-the-Hill and Bethesda Lutheran Cemetery Options

Alternative	Discussion / Recommendation
1 Reduced Lane Width with MUP and Sidewalk, Best Fit Approach	Carry Forward
2 Standard Lane Width with MUPs on both sides, Best Fit Approach	Carry Forward
3 Standard Lane Width with MUPs on both sides, Shift alignment East	This alternative results in direct impacts to adjacent graves. Screened out – Do not carry forward
4 Standard Lane Width with MUPs on both sides, discontinuous AT, Shift alignment West	This alternative results in direct impacts to adjacent graves. Screened out – Do not carry forward
5 Shared Roadway with Cyclists, and Sidewalks	Cyclists travelling in shared Transit/HOV curb lane are not provided with dedicated, separated facilities as per the YR-TMP recommendations. This alternative is not complaint with YR-TMP recommendations nor the York Region's Pedestrian and Cyclist Guidelines. Screened out – Do not carry forward
6 No AT Facilities	Cyclists and pedestrians are not accommodated in the Kennedy Road corridor. This alternative does not provide AT access for any of the adjacent land use between Murison Avenue and Beckett Avenue and adjacent pedestrian and cyclist connections on the local street network are not in proximity to the Kennedy Road corridor. This alternative is not complaint with the YR-TMP recommendations and impacts the AT network. Screened out – Do not carry forward
7 No widening, MUPs and queue jump lanes	Transit/HOV lanes from six-lane road transition into four general purpose lane segment. Queue jump lanes used for transition of transit/HOV vehicles at intersections with Murison Avenue and Beckett Avenue will be challenging to implement and monitor use for compliance. This alternative is also not complaint with the YR-TMP recommendations. Screened out – Do not carry forward

Based on consultation with the City of Markham, a request was made to consider a modification to Option 1 to accommodate dual MUP, but maintain a sub-standard width to avoid impacts with the cemetery lands. The sub-standard width for the path would be addressed through warning signage to indicate to users of the respective narrow path ahead and potential need to dismount. This variation was prepared as Option1B. The evaluation and recommendations for the options carried forward is presented in **Table 3**.

Table 3: Kennedy Road north of 16th Avenue, St.Philip’s and Bethesda Cemeteries Evaluation

Criteria	Option 1A: Reduced Lane Width with Narrow MUP and Sidewalk, Best Fit Approach	Option 1B: Reduced Lane Width with Dual Narrow MUP, Best Fit Approach	Option 2: Standard Lane Width with Dual MUP, Best Fit Approach
Description	The lane widths will be reduced to 3.0m general purpose lanes and 3.2m Transit/HOV lanes. A minimum MUP (2.4m wide) will be provided on one side, and sidewalk on the other side.	The lane widths will be reduced to 3.0m general purpose lanes and 3.2m Transit/HOV lanes. A minimum MUP (2.4m wide) will be provided on both sides; which in some constrained locations narrows to sub-standard width of <2.4m.	The lane widths will be to standard, 3.3m general purpose lanes and 3.5m Transit/HOV lanes. A minimum MUP (2.4m wide) will be provided on both sides.
Transportation Service			
Create a Pedestrian-Friendly Environment	<ul style="list-style-type: none">• Minor reduction in level of comfort for pedestrians as MUP on one side will require shared facilities with cyclists	<ul style="list-style-type: none">• Moderate reduction in level of comfort for pedestrians as MUPs will require shared facilities with cyclists on both sides• Restricted locations for pedestrian and cyclist path on both sides at some locations with substandard width (<2.4m)	<ul style="list-style-type: none">• Moderate reduction in level of comfort for pedestrians as MUPs will require shared facilities with cyclists on both sides
Create a Cyclist-Friendly Environment	<ul style="list-style-type: none">• Minor improvement to cyclist environment with shared cycling facility (MUP) on one side only	<ul style="list-style-type: none">• Moderate Improvement to cyclist environment through the provision of continuous, shared cycling facilities (MUPs) on both sides• Restricted locations for pedestrian and cyclist path on both sides at some locations with substandard width (<2.4m)	<ul style="list-style-type: none">• Moderate Improvement to cyclist environment through the provision of continuous, shared cycling facilities (MUPs) on both sides
Improve Safety for All Travel Modes	<ul style="list-style-type: none">• Moderate potential for improved cyclist and pedestrian safety due to provision of dedicated active transportation facilities (separated pedestrian facility on one side, shared on the other), reducing conflict with motorists• Potential to reduce vehicle speed due to narrow lane widths	<ul style="list-style-type: none">• Potential for improved cyclist and pedestrian safety due to provision of dedicated shared active transportation facilities on both sides, reducing conflict with motorists• Potential to reduce vehicle speed due to narrow lane widths	<ul style="list-style-type: none">• Potential for improved cyclist and pedestrian safety due to provision of dedicated shared active transportation facilities on both sides, reducing conflict with motorists• No reduction in speed due to standard lane widths
Improve Driver Level of Comfort	<ul style="list-style-type: none">• Driver comfort reduced due to through lanes with narrow widths		<ul style="list-style-type: none">• Driver comfort unaffected due to through lanes with standard widths
Improve Mode Choice	<ul style="list-style-type: none">• Minor Improvement to mode choice through provision of Transit/HOV lanes and addition of cyclist facility on one side	<ul style="list-style-type: none">• Moderate improvement to mode choice through provision of Transit/HOV lanes and addition of pedestrians and cyclist facilities on both boulevards	
Summary of Transportation Service	Least Preferred	Less Preferred	Most Preferred
Natural Environment			
Protect Designated Natural Areas	<ul style="list-style-type: none">• No impact to designated natural areas as no Areas of Natural And Scientific Interest (ANSI), Provincially Significant Wetlands (PSWs), or Environmentally Sensitive Area (ESA) are located within the study area segment		
Protect Vegetation and wildlife	<ul style="list-style-type: none">• No impact to vegetation due to construction of road widening• No impact to trees with 50dbh or higher.• No impact to rare, threatened, or endangered species		
Storm and Groundwater Management	<ul style="list-style-type: none">• Minor impact with increased roadway width and hard surface area to accommodate additional Transit/HOV lanes and active transportation facilities Stormwater quantity will increase and quality mitigation may be required; however, this can be addressed through design	<ul style="list-style-type: none">• Minor-Moderate impact with increased roadway width and hard surface area to accommodate additional Transit/HOV lanes and active transportation facilities (wider pavement width than Option 1A)• Stormwater quantity will increase and quality mitigation may be required; however, this can be addressed through design	<ul style="list-style-type: none">• Moderate impact with increased roadway width and hard surface area to accommodate additional Transit/HOV lanes and active transportation facilities (widest pavement width) Stormwater quantity will increase and quality mitigation may be required; however, this can be addressed through design

Criteria	Option 1A: Reduced Lane Width with Narrow MUP and Sidewalk, Best Fit Approach	Option 1B: Reduced Lane Width with Dual Narrow MUP, Best Fit Approach	Option 2: Standard Lane Width with Dual MUP, Best Fit Approach
	<ul style="list-style-type: none"> Minor impact to shallow groundwater system due to potential increase in contaminants related to increased roadway width (i.e. road salt, etc.) 	<ul style="list-style-type: none"> Minor-Moderate impact to shallow groundwater system due to potential increase in contaminants related to increased roadway width (i.e. road salt, etc.) 	<ul style="list-style-type: none"> Moderate impact to shallow groundwater system due to potential increase in contaminants related to increased roadway width (i.e. road salt, etc.)
Improve Air Quality	<ul style="list-style-type: none"> Moderate improvement to air quality through increased Transit/HOV use and reduced congestion Active transportation and transit service improvements can reduce dependence on automobiles and provide air quality improvements 		
Minimize Effects on Climate Change	<ul style="list-style-type: none"> Lower reliance on automobiles through increased mode choice and decreased congestion can minimize effects on climate change (i.e. by reducing greenhouse gas emissions) 	<ul style="list-style-type: none"> Lowest reliance on automobiles through increased mode choice with dedicated AT facilities for pedestrians and cyclists on both boulevards, and decreased congestion can minimize effects on climate change (i.e. by reducing greenhouse gas emissions) 	
Summary of Natural Environment	Less Preferred	Most Preferred	Least Preferred
Social Environment			
Minimize Impacts on Existing Residential, Institutional and Recreational Dwellings / Properties	<ul style="list-style-type: none"> Direct impact to Thomas Lownsbrough House (heritage home) which is listed on the City of Markham Register (<i>see discussion under heritage features</i>) Alteration of the current property boundaries from residential and church; requires the least encroachment 	<ul style="list-style-type: none"> Direct impact to Thomas Lownsbrough House (heritage home) which is listed on the City of Markham Register (<i>see discussion under heritage features</i>) Alteration of the current property boundaries from residential and church; requires less encroachment than Option 2 	<ul style="list-style-type: none"> Direct impact to Thomas Lownsbrough House (heritage home) which is listed on the City of Markham Register (<i>see discussion under heritage features</i>) Alteration of the current property boundaries from residential and church; requires the greatest encroachment
Improve Access to Residential Areas, Institutional and Recreational Facilities	<ul style="list-style-type: none"> Maintains vehicular access to residential and institutional facilities Pedestrian access provided on both boulevards; cyclist access provided from one boulevard only 	<ul style="list-style-type: none"> Maintains vehicular access to residential and institutional facilities Pedestrian and cyclist access provided on both boulevards 	
Minimize Traffic Noise	<ul style="list-style-type: none"> Noise levels are anticipated to increase moderately with future traffic growth and lanes in closer proximity to properties 		
Preserve Archaeological and Cultural Heritage Features	<ul style="list-style-type: none"> Minimal anticipated archaeological impacts on cemetery lands on west side of the corridor to accommodate minor property requirements at St.Philips Cemetery in location anticipated with no direct impacts to graves. Potential for existing retaining wall to remain in place at Bethesda Lutheran Cemetery. Direct impact to Thomas Lownsbrough House which is listed on the City of Markham Register. Direct impacts to structure's West Wing Extension and garage, and alteration of the current property boundaries. However, the West Wing Extension and Garage are later additions and their removal will not negatively impact the cultural heritage value of Thomas Lownsbrough House as they are not identified heritage attributes. Least encroachment on protected heritage property for Lownsbrough House Potential to demolish the West Wing Extension and garage of Thomas Lownsbrough House, relocate its Main Block and West Wing further west on its current lot, then encroach on 9392 Kennedy Road based on the 	<ul style="list-style-type: none"> Minimal anticipated archaeological impacts on cemetery lands on west side of the corridor to accommodate minor property requirements at St.Philips Cemetery in location anticipated with no direct impacts to graves. Potential for existing retaining wall to remain in place at Bethesda Lutheran Cemetery. Direct impact to Thomas Lownsbrough House which is listed on the City of Markham Register. Direct impacts to structure's West Wing Extension and garage, and alteration of the current property boundaries. However, the West Wing Extension and Garage are later additions and their removal will not negatively impact the cultural heritage value of Thomas Lownsbrough House as they are not identified heritage attributes. Moderate encroachment on protected heritage property for Lownsbrough House Potential to demolish the West Wing Extension and garage of Thomas Lownsbrough House, relocate its Main Block and West Wing further west on its current lot, then encroach on 9392 Kennedy Road based on the 	<ul style="list-style-type: none"> Significant anticipated direct archaeological impacts on cemetery lands to accommodate property requirements with potential direct impacts to graves at both cemetery locations. Minimal anticipated archaeological impacts on cemetery lands on west side of the corridor to accommodate minor property requirements at St.Philips Cemetery in location anticipated with no direct impacts to graves. Direct impact to Thomas Lownsbrough House which is listed on the City of Markham Register. Direct impacts to structure's West Wing Extension and garage, and alteration of the current property boundaries. However, the West Wing Extension and Garage are later additions and their removal will not negatively impact the cultural heritage value of Thomas Lownsbrough House as they are not identified heritage attributes. Significant encroachment on protected heritage property for Lownsbrough House

Criteria	Option 1A: Reduced Lane Width with Narrow MUP and Sidewalk, Best Fit Approach	Option 1B: Reduced Lane Width with Dual Narrow MUP, Best Fit Approach	Option 2: Standard Lane Width with Dual MUP, Best Fit Approach
	<p>identified road improvements. This option provides an opportunity to rehabilitate the structure and retain its connection to Hunter's Corners</p> <ul style="list-style-type: none"> Direct and indirect impacts to Thomas Lownsbrough House that are irreversible, permanent, will occur once, are widespread, and overall represent a major change 	<p>identified road improvements. This option provides an opportunity to rehabilitate the structure and retain its connection to Hunter's Corners</p> <ul style="list-style-type: none"> Direct and indirect impacts to Thomas Lownsbrough House that are irreversible, permanent, will occur once, are widespread, and overall represent a major change 	<ul style="list-style-type: none"> Potential to demolish the West Wing Extension and garage of Thomas Lownsbrough House, relocate its Main Block and West Wing further west on its current lot, then encroach on 9392 Kennedy Road based on the identified road improvements. This option provides an opportunity to rehabilitate the structure and retain its connection to Hunter's Corners Direct and indirect impacts to Thomas Lownsbrough House that are irreversible, permanent, will occur once, are widespread, and overall represent a major change
Minimize Impacts to Cemeteries and Burial Grounds	<ul style="list-style-type: none"> Minor potential impact to the St.Philips Cemetery lands, located on west side of the corridor due to proposed widening and AT facilities within the existing right-of-way. Impacts may require minor property encroachment to St.Philips in location anticipated with no direct impacts to grave. Potential for existing retaining wall to remain in place at Bethesda Lutheran Cemetery as no property requirements are identified. 		<ul style="list-style-type: none"> Significant potential for direct impact to the cemetery lands and graves, located on both sides of the corridor due to proposed widening and AT facilities
Improve Visual Aesthetics	<ul style="list-style-type: none"> Visual aesthetics will be moderately reduced due to increased pavement width for Transit/HOV lanes and active transportation facilities 		
Improve Community Character	<ul style="list-style-type: none"> Community character will be moderately improved through the provision of improved transit, cycling, and pedestrian facilities 		
Summary of Social Environment	Most Preferred	Less Preferred	Least Preferred
Infrastructure Design			
Minimize Constructability Complexity	<ul style="list-style-type: none"> Moderate construction complexity due to addition of travel lanes and active transportation facilities, modifications to Thomas Lownsbrough House (demolish the West Wing Extension and garage and relocate its Main Block and West Wing further west on its current lot), and utility relocation within constrained property and existing right-of-way adjacent to cemetery lands. 		<ul style="list-style-type: none"> Significant construction complexity due to addition of travel lanes and active transportation facilities, modifications to Thomas Lownsbrough House (demolish the West Wing Extension and garage and relocate its Main Block and West Wing further west on its current lot), specialized construction practices and monitoring at cemetery lands for disturbance of graves and utility relocation within constrained property.
Summary of Infrastructure Design	Most Preferred	Most Preferred	Least Preferred
Economic Environment and Cost Effectiveness			
Maximize Construction Value	<ul style="list-style-type: none"> Moderate cost for property acquisition and modifications to Thomas Lownsbrough House property, where complications may be involved with relocating the structure. 		<ul style="list-style-type: none"> Significant cost for additional property acquisition and modifications to Thomas Lownsbrough House property, where complications may be involved with relocating the structure
Minimize Operating Costs	<ul style="list-style-type: none"> Increase in annual maintenance cost due to provision of wider road and improved active transportation facilities 		
Minimize Property Requirements	<ul style="list-style-type: none"> Moderate property acquisition required at St.Philips on the Hill, Thomas Lownsbrough House property, and St.Philips cemetery lands located on the west side 		<ul style="list-style-type: none"> Significant property acquisition required at St.Philips on the Hill, Thomas Lownsbrough House property, St.Philips cemetery lands located on the west side, and Bethesda Lutheran Cemetery located on the east side.
Summary of Economic Environment and Cost Effectiveness	Most Preferred	Most Preferred	Least Preferred

Criteria	Option 1A: Reduced Lane Width with Narrow MUP and Sidewalk, Best Fit Approach	Option 1B: Reduced Lane Width with Dual Narrow MUP, Best Fit Approach	Option 2: Standard Lane Width with Dual MUP, Best Fit Approach
Overall Summary			
Recommendation	This option provides improved active transportation facilities on one side and sidewalk on one side, dedicated Transit/ HOV lanes and avoids direct impacts to grave sites on cemetery lands. Although driver comfort may be modified due to reduced lane widths, narrower lanes may result in a reduction in vehicle speed creating a safer environment for all users. Modifications to Thomas Lownsbrough House would retain the building's heritage attributes and connection to Hunter's Corners.	This option provides improved active transportation facilities on both sides, dedicated Transit/ HOV lanes and avoids direct impacts to grave sites on cemetery lands. Although driver comfort is modified due to reduced lane widths, narrower lanes may result in a reduction in vehicle speed creating a safer environment for all users. Modifications to Thomas Lownsbrough House would retain the building's heritage attributes and connection to Hunter's Corners.	This option provides improved active transportation facilities on both sides, dedicated Transit/ HOV lanes but results in impacts to cemetery lands and potential for direct impacts to grave sites. There is no change in driver comfort or vehicle speed due to standard lane widths. Modifications to Thomas Lownsbrough House would retain the building's heritage attributes and connection to Hunter's Corners. This option has the most significant impacts to adjacent properties.
		RECOMMENDED	

Design Decision – CN Rail Detour

Rail diversion concept plans and typical sections were developed for the following options: North Rail Diversion, South – 1 Rail Diversion and South -2 Rail Diversion.

These concepts were presented to CN on August 20, 2018 and next steps discussed on April 4, 2019. Refer to the design packages for each option.

North Rail Detour option is carried forward as it meets the current vertical clearance requirements for the structure.

Rail Detour Option	Preliminary Considerations	Recommendation
North	<ul style="list-style-type: none">• No property impacts to commercial and residential properties adjacent to the CN Rail Line• Impacts to hydro lands and access road to DH Cockburn Transformer Station• No impacts to hydro towers and operations• Greatest vertical clearance from bottom of temporary rail bridge and Kennedy Road, meets new standard for vertical clearance.	Carried Forward
South – 1	<ul style="list-style-type: none">• Impacts to commercial and residential properties south of the CN Rail Line• No impacts to hydro lands, access road to DH Cockburn Transformer Station• Detour is longer in length, greater impacts to CN Rail Line• Reduction in vertical clearance from bottom of temporary rail bridge and Kennedy Road. Rail raise not acceptable to CN; lowering of Kennedy Road profile has potential impacts to Duffield Drive and cemeteries	Not carried forward – Does not meet standard for vertical clearance for new structure.
South – 2	<ul style="list-style-type: none">• Reduced separation between temporary bridge structure and existing bridge structure• Reduced impacts to commercial and residential properties south of the CN Rail Line• No impacts to hydro lands, access road to DH Cockburn Transformer Station• Reduction in vertical clearance from bottom of temporary rail bridge and Kennedy Road. Rail raise not acceptable to CN; lowering of Kennedy Road profile has potential impacts to Duffield Drive and cemeteries	Not carried forward – Does not meet standard for vertical clearance for new structure.

Kennedy Road improvements at the CN rail crossing have been determined to require a new rail structure over Kennedy Road to accommodate the road widening from four to six lanes for Transit/HOV and active transportation (AT) facilities. To accommodate this construction, a rail detour of the CN track is required which will result in the construction of a temporary rail bridge over Kennedy Road along with the permanent rail bridge over Kennedy Road. An evaluation of North Rail Detour vs. South Rail Detour was prepared under a separate cover to assess the feasibility of both options. Based on the assessment a north side rail detour is carried forward.

The recommendation to replace the existing CN structure at Kennedy Road resulted in the request from the City of Markham to re-evaluate opportunities for the Miller Avenue Extension alignment.

The following design alternatives are based on recommendation for North Rail Detour for the implementation of improvements at Kennedy Road and the CN Rail crossing.

Option Descriptions

ALTERNATIVE 1: Maintain Markham EA Preferred Alignment K-1A

- Miller Avenue alignment through the hydro corridor, crossing under the CN rail through a new structural culvert west of Kennedy Road, and connecting into Duffield Drive for access to Kennedy Road. Miller Avenue is a four lane road with Multi Use Path (MUP) on one side.
- Kennedy Road crosses under the CN Rail through a new bridge structure. This requires a new rail bridge and temporary rail bridge at Kennedy Road. The temporary rail bridge might need to only accommodate existing Kennedy Road (depending on how Kennedy widening is staged). This is the typical situation for Kennedy Road widening. The cross-section for Kennedy is 6 lanes with curb lanes for transit/HOV, and separated AT facilities in the boulevard.

ALTERNATIVE 2: Loop with Bridge Extension

- Miller Avenue alignment through the hydro corridor, crossing under the CN rail through a new larger bridge structure at Kennedy Road with an opening size to accommodate passage of Miller Avenue and Kennedy Road. Miller Avenue then connects to Duffield Drive for access to Kennedy Road. This requires a new rail bridge and temporary rail bridge at Kennedy Road. The temporary rail bridge might need to only accommodate existing Kennedy Road (depending on how Kennedy widening is staged). The cross-section for Kennedy is 6 lanes with curb lanes for transit/HOV, and separated AT facilities in the boulevard. Miller Avenue is a four lane road with MUP on one side.

ALTERNATIVE 3: Buttonhook with New Bridge

- Miller Avenue alignment through the hydro corridor with no crossing of CN rail. Miller Avenue is a four lane road with MUP on one side, however Miller Avenue splits north of CN ROW in the hydro corridor with 2 lanes (EB and WB) and one side MUP for a direct right-in-right-out connection at west side of Kennedy Road to allow for southbound travel. The other 2 lanes (EB and WB) run parallel to the CN ROW, travelling over Kennedy Road on the temporary rail bridge (now a permanent road bridge) adjacent to the CN Rail corridor; MUP is not anticipated to follow this portion of Miller Avenue. This temporary rail bridge would have had to carry the north rail detour within the CN ROW, then moved out of the CN ROW to become the permanent bridge for the 2 travel lanes at Miller Avenue. Miller Avenue then loops around the hydro corridor to provide second right-in-right-out direct access at the east side of Kennedy Road to allow for northbound travel. Miller Avenue AT facility not assumed to be carried over bridge structure. Connections at Kennedy Road are unsignalized and do not permit left-in nor left-out movements.
- Kennedy Road crosses under the CN Rail through a new bridge structure. This needs a new rail bridge and temporary rail bridge at Kennedy. The temporary rail bridge would need to accommodate the future Kennedy opening (6 lane plus AT) since it is being kept for the Miller Ave Ext. Cross-section for Kennedy Road is 6 lanes with curb lanes for transit/HOV, and separated AT facilities in the boulevard.

ALTERNATIVE 4: Markham EA Option K-2

- Miller Avenue alignment through the hydro corridor with no crossing of CN rail. Miller Avenue connects to Kennedy Road and permits southbound right-turn, eastbound right-turn and northbound left-turn movements at the connection. Eastbound left-turn movement for northbound travel on Kennedy Road is restricted with this configuration. Connections at Kennedy Road are unsignalized. Miller Avenue is a four lane road with MUP on one side.
- Kennedy Road crosses under the CN Rail through a new bridge structure. Kennedy Road widening in separate new bridge, but needs to accommodate an additional left turn lane. This needs a new rail bridge and temporary rail bridge at Kennedy. The temporary rail bridge might need to only accommodate existing Kennedy Rd opening (depending on how Kennedy widening is staged). Cross-section for Kennedy Road has 6 lanes with curb lanes for transit/HOV with an additional left turn lane, and separated AT facilities in the boulevard.

Alternative 1, Maintain (Markham EA Preferred Alignment K-1A) is illustrated in **Exhibit 1**.

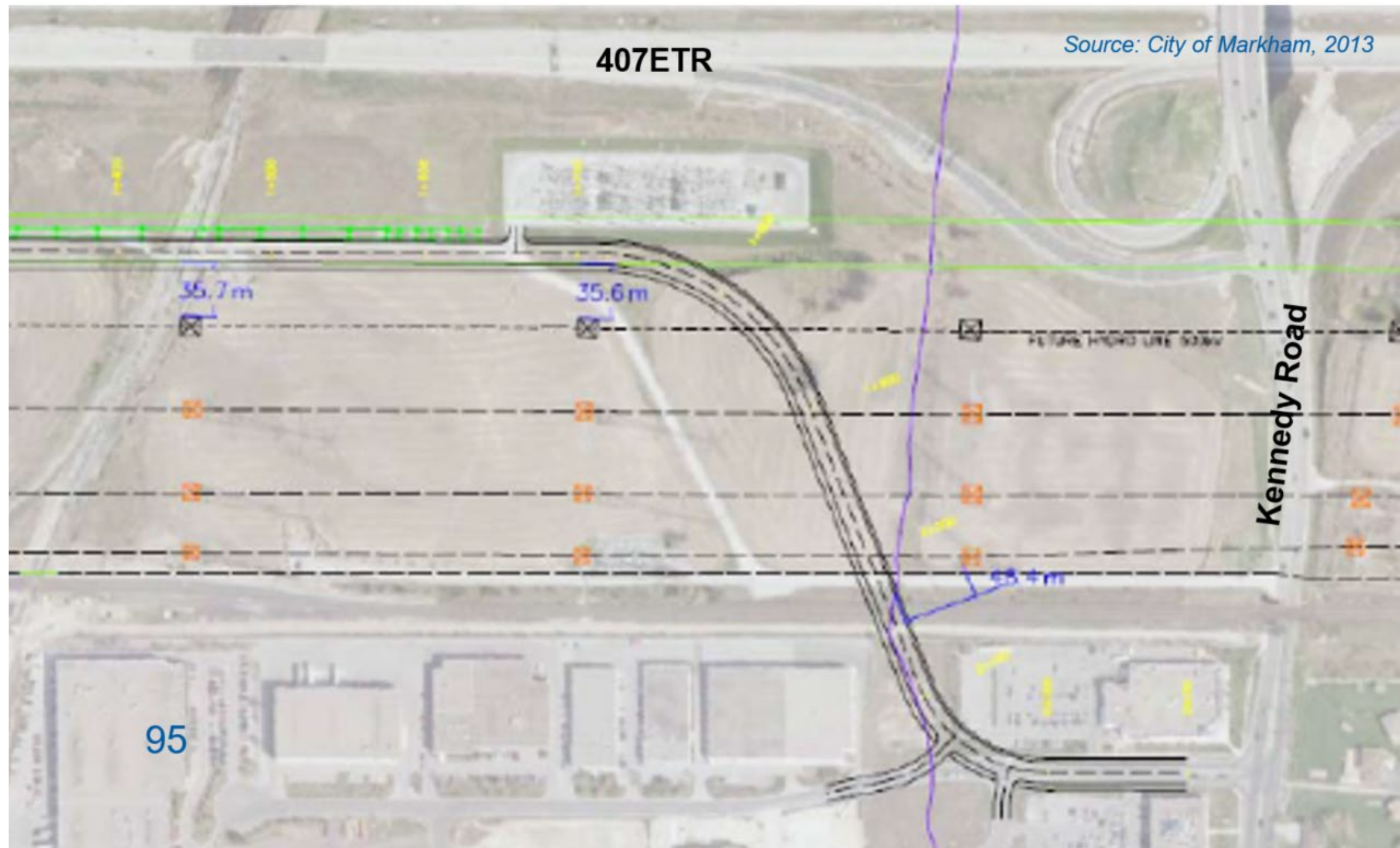


Exhibit 1: Alternative 1, Maintain (Markham EA Preferred Alignment K-1A)

Alternative 2, Loop with Bridge Extension, is illustrated in **Exhibit 2** and **Exhibit 3** below.

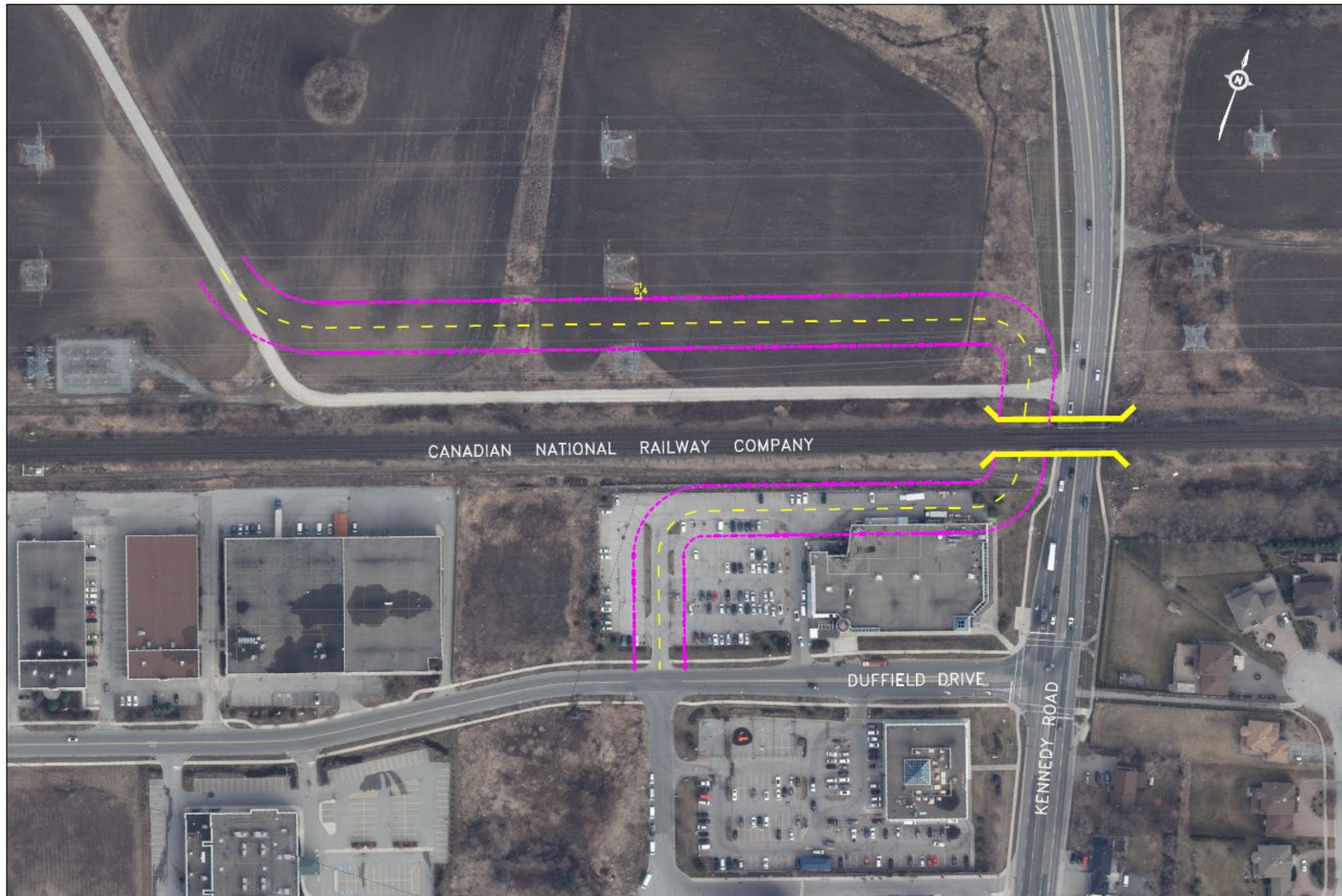


Exhibit 2: Alternative 2, Loop with Bridge Extension

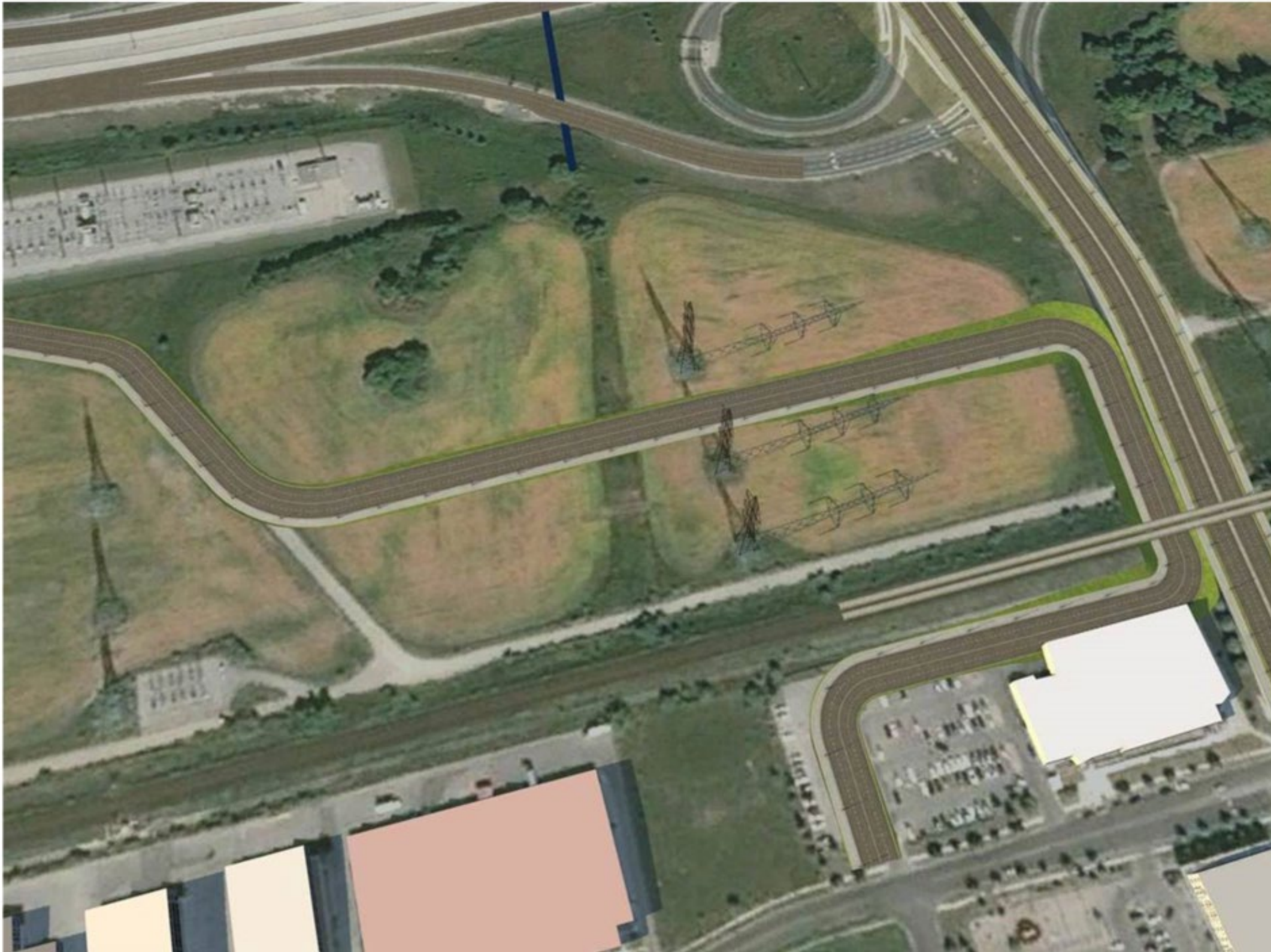


Exhibit 3: Alternative 2, Loop with Bridge Extension

Alternative 3, Buttonhook with New Bridge, is illustrated in **Exhibit 4** and **Exhibit 5** below.

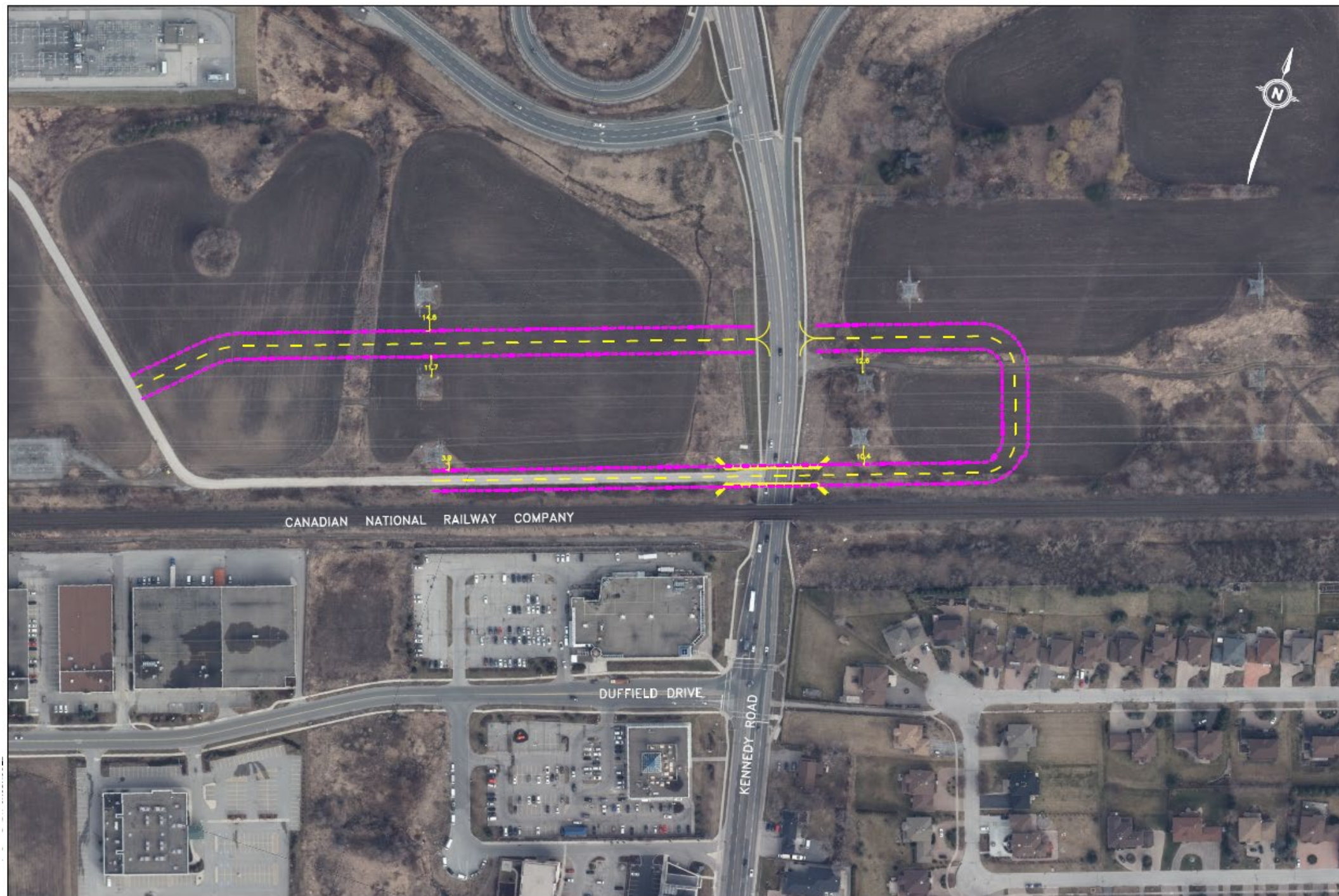


Exhibit 4: Alternative 3, Buttonhook with New Bridge



Exhibit 5: Alternative 3, Buttonhook with New Bridge

Alternative 4, Markham EA Option K-2, is illustrated in **Exhibit 6** below.

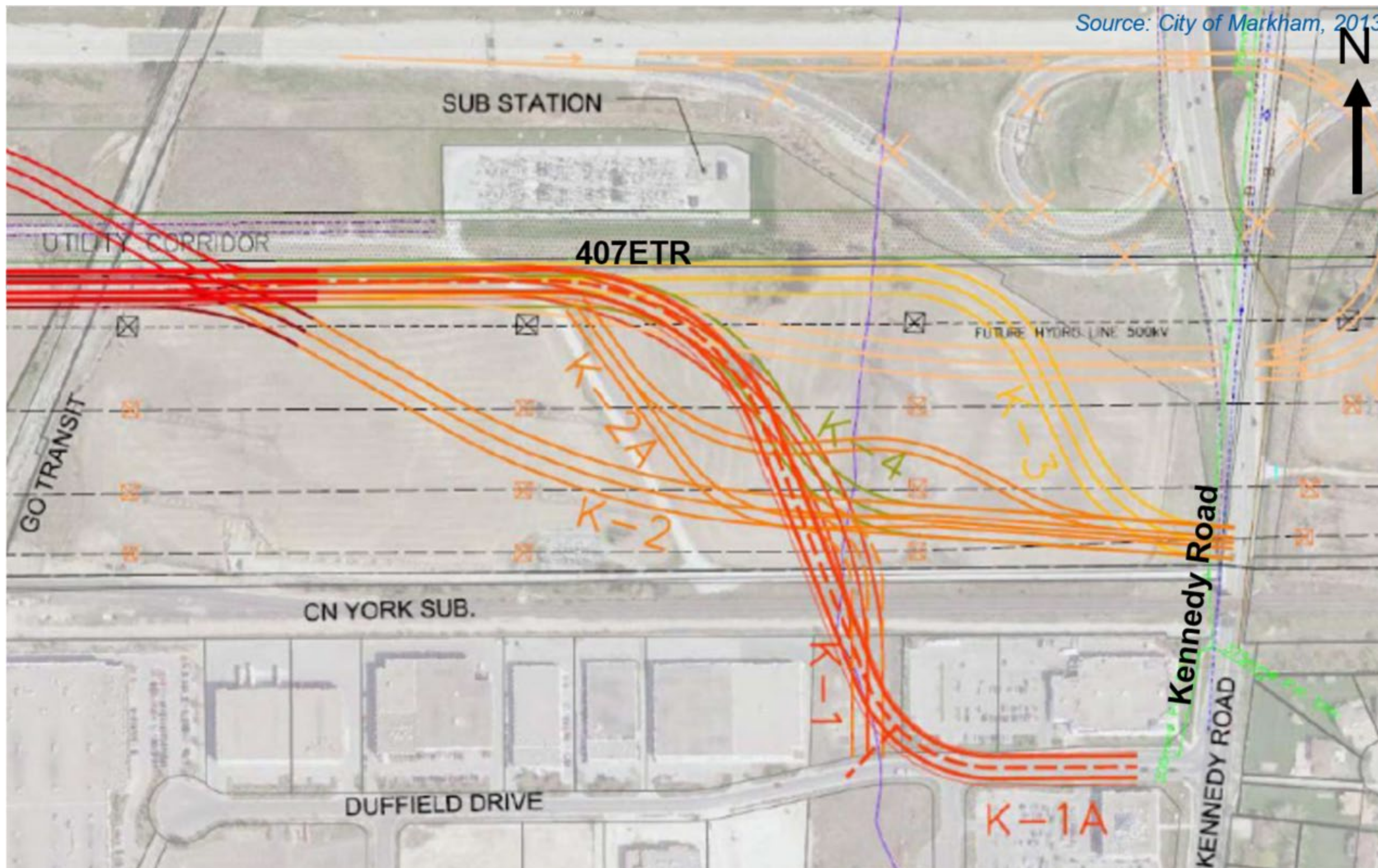


Exhibit 6: Alternative 4, Markham EA Option K-2

CRITERIA	ALTERNATIVE 1: Maintain Markham EA Preferred Alignment K-1A	ALTERNATIVE 2: Loop with Bridge Extension	ALTERNATIVE 3: Buttonhook with New Bridge	ALTERNATIVE 4: Markham EA Option K-2
Transportation Service				
Improve Public Transit Service	<ul style="list-style-type: none"> • Direct connection to Kennedy Road through signalized Duffield Drive intersection, full movements. • Opportunity to provide transit route along Miller Avenue to connect to Kennedy Road at a signalized intersection 	<ul style="list-style-type: none"> • Indirect connection to Kennedy Road (Crossing CN rail bridge, intersecting Duffield Drive with a three legged intersection) • Opportunity to provide transit route along Miller Avenue to connect to Kennedy Road at a signalized intersection 	<ul style="list-style-type: none"> • Direct connection to Kennedy Road at two unsignalized right-in, right-out (RIRO) access <ul style="list-style-type: none"> ○ Unsignalized because signalization is not permissible based on proximity to 407ETR interchange and proximity to other signalized intersection. • Increased travel distance to access Kennedy Road in the northbound direction. • Opportunity to provide transit route along Miller Avenue to connect to Kennedy Road. Access to Kennedy Road requires waiting for a gap in traffic in the Transit/HOV lane on Kennedy Road for northbound and southbound travel. 	<ul style="list-style-type: none"> • Direct connection to Kennedy Road at one unsignalized right-in right-out and left-in access. <ul style="list-style-type: none"> ○ Unsignalized because signalization is not permissible based on proximity to 407ETR interchange and proximity to other signalized intersection. • No access to Kennedy Road in the northbound direction from Miller Avenue as eastbound left turn is restricted with this configuration. • Minor improvement in transit connections between Kennedy Road and Miller Avenue. • Opportunity to provide transit route along Miller Avenue to connect to Kennedy Road. Access to Kennedy Road requires waiting for a gap in traffic in the Transit/HOV lane on Kennedy Road for southbound travel.
Reduce Traffic Congestion, Delays, and Travel Distance	<ul style="list-style-type: none"> • Direct connection to Kennedy Road through signalized Duffield Drive intersection, full movements. • Increase in traffic volumes along Duffield Drive and the Duffield Drive/Kennedy Road intersection • Short travel distance for vehicles traveling from Miller Ave accessing Kennedy Road for northbound and southbound travel. 	<ul style="list-style-type: none"> • Indirect connection to Kennedy Road through signalized Duffield Drive intersection, full movements. • Increase in traffic volumes along Duffield Drive and the Duffield Drive/Kennedy Road intersection • Longer travel distance for vehicles traveling from Miller Ave accessing Kennedy Road for northbound and southbound travel. 	<ul style="list-style-type: none"> • Direct connection to Kennedy Road at two unsignalized right-in right-out (RIRO) access <ul style="list-style-type: none"> ○ Unsignalized because of proximity to Highway 407 interchange. • No change in traffic volumes along Duffield Drive and the Duffield Drive/Kennedy Road intersection direct connection with Miller Avenue. • Longer travel distance for vehicles traveling from Miller Ave accessing Kennedy Road for southbound travel. • Longest travel distance for vehicles traveling from Miller Ave accessing Kennedy Road for northbound travel. 	<ul style="list-style-type: none"> • Direct connection to Kennedy Road at one unsignalized right-in right-out and left-in access. • Unsignalized because of proximity to Highway 407 interchange. No access to Kennedy Road in the northbound direction. • No change in traffic volumes along Duffield Drive and the Duffield Drive/Kennedy Road intersection • Shortest travel distance for vehicles traveling from Miller Ave accessing Kennedy Road for southbound travel. • No opportunities for vehicles to travel from Miller Avenue to northbound on Kennedy Road as connection is not provided.
Create a Pedestrian-	<ul style="list-style-type: none"> • No change for pedestrians travelling along Kennedy Road. 	<ul style="list-style-type: none"> • No change for pedestrians travelling along Kennedy Road. 	<ul style="list-style-type: none"> • Significant decrease in level of pedestrian comfort due to increased potential for conflict 	<ul style="list-style-type: none"> • Moderate decrease in level of pedestrian comfort due to increased potential for conflict on one side of

CRITERIA	ALTERNATIVE 1: Maintain Markham EA Preferred Alignment K-1A	ALTERNATIVE 2: Loop with Bridge Extension	ALTERNATIVE 3: Buttonhook with New Bridge	ALTERNATIVE 4: Markham EA Option K-2
Friendly Environment	<p>Direct access from Miller Avenue to Kennedy Road east and west boulevards at signalized Duffield Drive intersection with protected crossing.</p> <ul style="list-style-type: none"> • Short travel distance for pedestrians traveling from Miller Ave to Kennedy Road. • Opportunity for Miller Avenue users to have direct east-west crossing at Kennedy Road at Duffield Drive intersection. 	<ul style="list-style-type: none"> • Indirect access from Miller Avenue to Kennedy Road east and west boulevards at signalized Duffield Drive intersection with protected crossing. • Potential for direct access to Kennedy Road west boulevard from Miller Avenue at structure location • Longest travel distance for pedestrians traveling from Miller Ave to Kennedy Road. • Opportunity for Miller Avenue users to have direct east-west crossing at Kennedy Road at Duffield Drive intersection. 	<p>on both sides of Kennedy Road with right-in-right-out movements at two access points</p> <ul style="list-style-type: none"> • Direct access from Miller Avenue to west boulevard at Kennedy Road • No access from Miller Ave to Kennedy Road east boulevard as Miller Avenue AT facility not assumed to be carried over bridge structure. • Shortest travel distance for pedestrians traveling from Miller Ave to Kennedy Road west boulevard. • No opportunity for Miller Avenue users to have direct east-west crossing at Kennedy Road. 	<p>Kennedy Road with right-in-right-out and left-in movements at one access point</p> <ul style="list-style-type: none"> • Direct access from Miller Avenue to west boulevard at Kennedy Road • No access from Miller Ave to Kennedy Road east boulevard • Shortest travel distance for pedestrians traveling from Miller Ave to Kennedy Road west boulevard. • No opportunity for Miller Avenue users to have direct east-west crossing at Kennedy Road.
Create a Cyclist-Friendly Environment	<ul style="list-style-type: none"> • No change for cyclists travelling along Kennedy Road. • Direct access from Miller Avenue to Kennedy Road east and west boulevards at signalized Duffield Drive intersection with protected crossing. • Short travel distance for cyclists traveling from Miller Ave to Kennedy Road. • Opportunity for Miller Avenue users to have direct east-west crossing at Kennedy Road at Duffield Drive intersection. 	<ul style="list-style-type: none"> • No change for cyclists travelling along Kennedy Road. • Indirect access from Miller Avenue to Kennedy Road east and west boulevards at signalized Duffield Drive intersection with protected crossing. • Potential for direct access to Kennedy Road west boulevard from Miller Avenue at structure location • Longest travel distance for cyclists traveling from Miller Ave to Kennedy Road; potential direct connection to Kennedy Road west boulevard at structure location. • Opportunity for Miller Avenue users to have direct east-west crossing at Kennedy Road at Duffield Drive intersection. 	<ul style="list-style-type: none"> • Significant decrease in level of cyclist comfort due to increased potential for conflict on both sides of Kennedy Road with right-in-right-out movements at two access points • Direct access from Miller Avenue to west boulevard at Kennedy Road. • No access from Miller Ave to Kennedy Road east boulevard as Miller Avenue AT facility not assumed to be carried over bridge structure. • Shortest travel distance for cyclists traveling from Miller Ave to the west boulevard of Kennedy Road • No opportunity for Miller Avenue users to have direct east-west crossing at Kennedy Road. 	<ul style="list-style-type: none"> • Moderate decrease in level of pedestrian comfort due to increased potential for conflict on one side of Kennedy Road with right-in-right-out and left-in movements at one access point • Direct access from Miller Avenue to west boulevard at Kennedy Road • No access from Miller Ave to Kennedy Road east boulevard • Shortest travel distance for cyclists traveling from Miller Ave to Kennedy Road west boulevard. • No opportunity for Miller Avenue users to have direct east-west crossing at Kennedy Road.
Improve Safety for All Travel Modes	<ul style="list-style-type: none"> • No change in level of comfort for all modes along Kennedy Road • Skewed intersection along Miller Avenue alignment introduced at Duffield Drive and Deverill Court. 	<ul style="list-style-type: none"> • Minor reduction in level of comfort for all modes along Kennedy Road due to decreased separation from the new road. 	<ul style="list-style-type: none"> • Moderate reduction in level of comfort for all modes along Kennedy Road due to addition of two unsignalized RIRO intersections and no protected signalized crossings on Kennedy Rd from Miller Ave. • Significant increase in pedestrian and cyclist conflicts at Kennedy Road with introduction of two right-in-right-out accesses in both Kennedy Road boulevards. 	<ul style="list-style-type: none"> • Significant reduction in level of comfort for all modes along Kennedy Road due to addition of one unsignalized RIRO intersections and no protected signalized crossings on Kennedy Rd from Miller Ave. • Moderate increase in pedestrian and cyclist conflicts at Kennedy Road with introduction of right-in-right-out-left-in access at Kennedy Road west boulevard.
Improve Mode Choice	<ul style="list-style-type: none"> • No change in mode choice for all option as all modes are accommodated. 			

CRITERIA	ALTERNATIVE 1: Maintain Markham EA Preferred Alignment K-1A	ALTERNATIVE 2: Loop with Bridge Extension	ALTERNATIVE 3: Buttonhook with New Bridge	ALTERNATIVE 4: Markham EA Option K-2
Summary of Transportation Service	Most Preferred	Most Preferred	Less Preferred	Least Preferred
Natural Environment				
Protect Vegetation	<ul style="list-style-type: none"> Least impact to manicured vegetation. Disruption to manicured vegetation on the west side of Kennedy Road. 	<ul style="list-style-type: none"> Moderate impact to manicured vegetation. Disruption to manicured vegetation on the west side of Kennedy Road. 	<ul style="list-style-type: none"> Most impact to manicured vegetation. Disruption to manicured vegetation on both sides of Kennedy Road. 	<ul style="list-style-type: none"> Same as Alternative 2
Summary of Natural Environment	Most Preferred	Less Preferred	Least Preferred	Less Preferred
Social Environment				
Minimize Impacts on Existing Residential, Institutional and Recreational Dwellings / Properties	<ul style="list-style-type: none"> No impacts to existing residential, institutional and recreational dwellings / properties. 	<ul style="list-style-type: none"> Same as Alternative 1 	<ul style="list-style-type: none"> Minor indirect impact to existing residential, institutional and recreational dwellings / properties due to Miller Ave extension located closer to existing residential properties in the southeast of the Kennedy Road crossing of the existing CN rail bridge. 	<ul style="list-style-type: none"> Same as Alternative 1
Improve Access to Residential Areas, Institutional and Recreational Facilities	<ul style="list-style-type: none"> No change in access to residential areas, institutional and recreational facilities. 			
Improve Visual Aesthetics	<ul style="list-style-type: none"> Opportunities to enhance visual aesthetics through localized tree plantings and other boulevard treatments wherever possible within right-of-way. 	<ul style="list-style-type: none"> Opportunities to enhance visual aesthetics through localized tree plantings with adjacent Miller Ave and Kennedy Rd boulevards, joint bridge structure, and other boulevard treatments wherever possible within right-of-way. 	<ul style="list-style-type: none"> Reduced opportunities to enhance visual aesthetics as tree plantings and other boulevard treatments are offset by significant additional infrastructure with second bridge over Kennedy Road and easterly extension of Miller Avenue through the hydro corridor. 	<ul style="list-style-type: none"> Opportunities to enhance visual aesthetics through localized tree plantings and other boulevard treatments wherever possible within right-of-way.
Improve Community Character	<ul style="list-style-type: none"> Community connectivity will be moderately improved due to added connection to Kennedy Road from the west. 			
Summary of Social Environment	Most Preferred	Most Preferred	Less Preferred	Most Preferred
Infrastructure Design				
Minimize Disruption due to Construction	<ul style="list-style-type: none"> Significant disruption at Duffield Drive and Deverill Court due to required realignment at the new intersection. Minor disruption to service road located on the north side of the CN ROW. The proposed Miller Avenue extension will need to cross the service road. 	<ul style="list-style-type: none"> Minor disruption at Duffield Drive and Deverill Court as the road extension will generally align with the existing intersection. Minor disruption to service road located on the north side of the CN ROW. The proposed Miller Avenue extension will need to cross the service road. Significant disruption to the commercial plaza and parking lot located on the south 	<ul style="list-style-type: none"> No disruption at Duffield Drive or Deverill Court. Significant disruption to service road located on the north side of the CN ROW. The proposed Miller Avenue extension is located along a portion of the service road. No disruption to the commercial plaza located on the south side of the CN ROW west of Kennedy Road. 	<ul style="list-style-type: none"> No disruption at Duffield Drive or Deverill Court. No disruption to service road located on the north side of the CN ROW as the proposed Miller Avenue road does not cross. No disruption to the commercial plaza located on the south side of the CN ROW west of Kennedy Road.

CRITERIA	ALTERNATIVE 1: Maintain Markham EA Preferred Alignment K-1A	ALTERNATIVE 2: Loop with Bridge Extension	ALTERNATIVE 3: Buttonhook with New Bridge	ALTERNATIVE 4: Markham EA Option K-2
	<ul style="list-style-type: none"> • Moderate disruption to the parking lot of the commercial plaza located on the south side of the CN ROW west of Kennedy Road as the proposed road extension would require reconstruction at the west entrance. • Significant disruption of CN operations due to construction of two underpass structures along the CN ROW and temporary rail detour requirements. • Shortest construction duration - anticipated to be 2 years • Refer to CN Impacts criteria for more details 	<p>side of the CN ROW west of Kennedy Road as the proposed road extension would impact the existing building.</p> <ul style="list-style-type: none"> • Moderate disruption of CN operations due to widening of CN bridge at Kennedy Road and temporary rail detour requirements. • Shorter construction duration - anticipated to be 2 -3 years • Refer to CN Impacts criteria for more details 	<ul style="list-style-type: none"> • Moderate disruption of CN operations due to widening of CN bridge at Kennedy Road and temporary rail detour requirements. • Longest construction duration - anticipated to be 3 to 4 years • Refer to CN Impacts criteria for more details 	<ul style="list-style-type: none"> • Moderate disruption of CN operations due to widening of CN bridge at Kennedy Road and temporary rail detour requirements. • Shorter construction duration - anticipated to be 2 -3 years • Refer to CN Impacts criteria for more details
Minimize Constructability Complexity	<ul style="list-style-type: none"> • Significant construction complexity includes construction of one permanent crossing the CN Rail ROW. Requires temporary rail detour and temporary shoring; proximity of overhead power line is a potential constraint to use of cranes for girder erection etc. and re-alignment of Duffield Drive. • Markham EA identifies pumping station requirement at crossing at CN for Miller Avenue • Construction of Miller Ave. Extension can be independent of Kennedy Road Improvements 	<ul style="list-style-type: none"> • Moderate construction complexity includes construction of one permanent larger crossing the CN Rail ROW. Requires temporary rail detour and permanent and temporary structures for north rail detour; requires temporary shoring; proximity of overhead power line is a potential constraint to use of cranes for girder erection etc. and tie-in to Duffield Drive. • Construction of Miller Ave. Extension is dependent on Kennedy Road Improvements 	<ul style="list-style-type: none"> • Most significant construction complexity includes construction of one permanent crossing the CN Rail ROW and conversion of the temporary rail bridge to permanent bridge to carry 2 travel lanes of Miller Avenue. Requires temporary rail detour and permanent and temporary structures for north rail detour; requires temporary shoring; proximity of overhead power line is a potential constraint to use of cranes for girder erection etc. Specialist contractors/techniques required to shift the temporary bridge into the final alignment for proposed Miller Road. This results in considerably higher risk associated with significantly more complex construction method of sliding the bridge. • Construction of Miller Ave. Extension is dependent on Kennedy Road Improvements 	<ul style="list-style-type: none"> • Moderate construction complexity includes construction of one permanent crossing the CN Rail ROW. Requires temporary rail detour and permanent and temporary structures for north rail detour; temporary shoring; proximity of overhead power line is a potential constraint to use of cranes for girder erection etc. • Construction of Miller Ave. Extension can be independent of Kennedy Road Improvements
CN Impacts	<ul style="list-style-type: none"> • Most significant impacts to CN • No change to permanent new Kennedy Road bridge structure resulting from Miller Avenue Extension • New structural culvert under CN ROW at proposed crossing of Miller Avenue • Temporary rail bridge to accommodate north rail detour with opening for Kennedy Road (depending on staging may only be for existing four lane Kennedy Road) • Rail detour and flagging requirements. 	<ul style="list-style-type: none"> • Moderate impacts to CN • Permanent new Kennedy Road bridge structure is largest to accommodate opening for Miller Avenue Extension • Eliminates needs for separate structure west of the existing crossing location compared to option 1 • New temporary rail bridge to accommodate north rail detour with opening for Kennedy Road (depending on staging may only be for existing four lane Kennedy Road) • Rail detour and flagging requirements. 	<ul style="list-style-type: none"> • Significant impacts to CN • No change to permanent new Kennedy Road bridge structure resulting from Miller Avenue Extension • Temporary rail bridge to accommodate north rail detour with opening for future six lane Kennedy Road and AT facilities, will be converted to permanent structure to carry 2 lanes of Miller Avenue extension. Will require shifting temporary bridge to final alignment outside of CN ROW • Rail detour and flagging requirements. 	<ul style="list-style-type: none"> • Moderate impacts to CN • Permanent new Kennedy Road bridge structure is slightly larger to accommodate left turn lane to support Miller Avenue Extension • Eliminates needs for separate structure west of the existing crossing location • New temporary rail bridge to accommodate north rail detour with opening for Kennedy Road (depending on staging may only be for existing four lane Kennedy Road) • Rail detour and flagging requirements.

CRITERIA	ALTERNATIVE 1: Maintain Markham EA Preferred Alignment K-1A	ALTERNATIVE 2: Loop with Bridge Extension	ALTERNATIVE 3: Buttonhook with New Bridge	ALTERNATIVE 4: Markham EA Option K-2
Hydro Corridor Impacts	<ul style="list-style-type: none"> • Less impact to Hydro Corridor lands • Least length of Miller Avenue alignment through hydro corridor, west of Kennedy Road • Road alignment achieves minimum spacing from Hydro Towers (>15m) horizontal clearance (towers are ~30m apart) 	<ul style="list-style-type: none"> • Moderate impact to Hydro Corridor lands • Greater length of Miller Avenue alignment through hydro corridor, west of Kennedy Road • Road alignment does not achieve minimum spacing from Hydro Towers (>15m) at two locations; guiderail barriers will be required to mitigate substandard horizontal clearance (towers are ~30m apart) 	<ul style="list-style-type: none"> • Most significant impact to Hydro Corridor lands • Greatest length of Miller Avenue alignment through hydro corridor, east and west of Kennedy Road • Miller Avenue runs in close proximity and as a parallel corridor to hydro towers and hydro lines when raised over Kennedy Road • Road alignment does not achieve minimum spacing from Hydro Towers (>15m) at six locations; guiderail barriers will be required to mitigate substandard horizontal clearance (towers are ~30m apart) 	<ul style="list-style-type: none"> • Least impact to Hydro Corridor lands • Least length of Miller Avenue alignment through hydro corridor, west of Kennedy Road • Road alignment does not achieve minimum spacing from Hydro Towers (>15m) at four locations; guiderail barriers will be required to mitigate substandard horizontal clearance (towers are ~30m and 40m apart)
Summary of Infrastructure Design	Less Preferred	Less preferred	Least Preferred	Most Preferred
Economic Environment and Cost Effectiveness				
Accommodate Planned Development and Growth	<ul style="list-style-type: none"> • Moderate impact to future redevelopment on the south side of the CN bridge (7866 Kennedy Road and parcel west of this property) • The proposed Miller Avenue extension leaves a larger parcel of land unaffected for potential future redevelopment. • Miller Avenue Extension accommodated independently of timing of Kennedy Road improvements 	<ul style="list-style-type: none"> • Moderate impact to future redevelopment on the south side of the CN bridge (7866 Kennedy Road and parcel west of this property) • The proposed Miller Avenue extension leaves a smaller parcel of land unaffected for potential future redevelopment. • Miller Avenue Extension required to be advanced to meet timing for Kennedy Road improvements 	<ul style="list-style-type: none"> • No anticipated impact to potential future redevelopment on the south side of the CN bridge. (7866 Kennedy Road and parcel west of this property) • Miller Avenue Extension required to be advanced to meet timing for Kennedy Road improvements 	<ul style="list-style-type: none"> • No anticipated impact to potential future redevelopment on the south side of the CN bridge. (7866 Kennedy Road and parcel west of this property) • Miller Avenue Extension accommodated independently of timing of Kennedy Road improvements
Minimize Impacts on Business Properties	<ul style="list-style-type: none"> • Minor impact to business property located on the south side of the CN bridge as entrance reconstruction is required at the west entrance. 	<ul style="list-style-type: none"> • Significant impact to business property located on the south side of the CN bridge as the proposed road has direct impact to building and existing parking lot. 	<ul style="list-style-type: none"> • No impacts to business property located on the south side of the CN bridge. 	<ul style="list-style-type: none"> • Same as Alternative 3.
Improve Access to Businesses and Key Employment Areas	<ul style="list-style-type: none"> • Provides direct access to businesses and key employment areas south of CN 	<ul style="list-style-type: none"> • Provides direct access to businesses and key employment areas south of CN 	<ul style="list-style-type: none"> • Indirect access to businesses and key employment areas south of CN 	<ul style="list-style-type: none"> • Indirect access to businesses and key employment areas south of CN
Maximize Construction Value	<ul style="list-style-type: none"> • Most significant construction costs. • Approximate structure costs at Kennedy (temp and perm): \$31.0M • Approximate structure costs at Miller Avenue as separate crossing west of Kennedy based on Markham-approved EA construction cost estimate (accounting for escalation/inflation to costs, this estimate is variable pending 	<ul style="list-style-type: none"> • Moderate construction costs • Approximate structure costs at Kennedy (temp and perm) extended for Miller Ave: \$34.9M • Approximate Miller Ave road costs: \$2.4M • Cost for rail detour for structure at Kennedy Road: \$\$ (same for all options) 	<ul style="list-style-type: none"> • Significant construction costs • Approximate structure costs at Kennedy and second structure for Miller Ave parallel to CN at Kennedy \$43.7M • Approximate Miller Ave road costs: \$3.1M • Cost for rail detour for structure at Kennedy Road: \$\$ (same for all options) 	<ul style="list-style-type: none"> • Moderate construction costs • Approximate structure costs at Kennedy (temp and perm) accounting for additional northbound left-turn lane for access to Miller: \$32.3M • Approximate Miller Ave road costs: \$4.5M • Cost for rail detour for structure at Kennedy Road: \$\$ (same for all options)

CRITERIA	ALTERNATIVE 1: Maintain Markham EA Preferred Alignment K-1A	ALTERNATIVE 2: Loop with Bridge Extension	ALTERNATIVE 3: Buttonhook with New Bridge	ALTERNATIVE 4: Markham EA Option K-2
	<p>method of construction and timing of implementation): \$20-25M</p> <ul style="list-style-type: none">• Markham EA identifies need for pumping station at second structure. \$\$\$• Approximate Miller Ave road costs: \$2.8M• Cost for rail detour for structure at Kennedy Road: \$\$ (same for all options)• Cost for additional rail detour for structure at Miller Avenue west of Kennedy Road if construction timing is not coordinated with Kennedy Road EA: \$\$\$\$• Alternatively if coordinated with Kennedy Road construction, utilizing the same rail detour for structure at Miller Avenue west of Kennedy Road, anticipated cost will like be 30%-40% additional cost to accommodate the additional mobilization/demobilization and materials: \$\$\$			
Minimize Property Requirements	<ul style="list-style-type: none">• Significant property acquisition required at lot west of 7866 Kennedy Road• Minor property acquisition/entrance reconstruction required at 7866 Kennedy Road• Moderate property acquisition from Hydro One lands	<ul style="list-style-type: none">• No property acquisition required at lot west of 7866 Kennedy Road• Significant property acquisition required at 7866 Kennedy Road• Moderate property acquisition from Hydro One lands	<ul style="list-style-type: none">• No potential for property acquisition for the lands on the south side of the CN bridge (7866 Kennedy Road and parcel on the west).• Significant property acquisition from Hydro One lands	<ul style="list-style-type: none">• No potential for property acquisition for the lands on the south side of the CN bridge (7866 Kennedy Road and parcel on the west).• Moderate property acquisition from Hydro One lands
Minimize Maintenance and Operating Costs	<ul style="list-style-type: none">• Conventional maintenance requirements. Existing maintenance requirements significantly increased with two structures under CN ROW	<ul style="list-style-type: none">• Conventional maintenance requirements. Existing maintenance requirements moderately increased.	<ul style="list-style-type: none">• Conventional maintenance requirements. Existing maintenance requirements significantly increased.	<ul style="list-style-type: none">• Conventional maintenance requirements. Existing maintenance requirements moderately increased.
Summary of Economic Environment and Cost Effectiveness	Less Preferred	Least Preferred	Least Preferred	Most Preferred
Overall Summary				
Recommendation	Alternative 1 Do Nothing (Markham EA Preferred Alignment K-1A) is recommended because traffic operations permit full movement access to Kennedy Road at Duffield Drive signalized intersection allowing for northbound and southbound	Alternative 2 Loop with Bridge Extension is not recommended because although it only requires one crossing of CN ROW in a significantly wider permanent bridge structure, one temporary bridge structure and rail detour and has the lowest capital costs, this option	Alternative 3 Buttonhook with new bridge is not recommended because although it requires only one crossing of the CN ROW, requiring a permanent bridge structure and rail detour, the temporary bridge structure is later converted to a second permanent bridge structure. This results in	Alternative 4 Markham EA Option K-2 is not recommended because although it requires only one slightly wider crossing of the CN ROW, requiring a permanent bridge structure and rail detour and has lower capital costs, the traffic operations are

CRITERIA	ALTERNATIVE 1: Maintain Markham EA Preferred Alignment K-1A	ALTERNATIVE 2: Loop with Bridge Extension	ALTERNATIVE 3: Buttonhook with New Bridge	ALTERNATIVE 4: Markham EA Option K-2
	travel, and AT users are accommodated with protected crossings at this signalized intersection. This option is independent of timing of redevelopment of parcel west of Kennedy Road. Although this option requires two permanent crossings of CN ROW and significantly higher capital costs, the construction of Miller Ave. Extension can be independent of Kennedy Road Improvements. .	results in significant impacts to an existing commercial building and parking lot and the construction of Miller Ave. Extension is dependent of Kennedy Road Improvements. Traffic operations permit full movement access to Kennedy Road at Duffield Drive signalized intersection, allowing for northbound and southbound travel, and AT users are accommodated with a protected crossing at Kennedy Road at Duffield Drive signalized intersection.	a permanent road parallel to CN Rail and Hydro One high voltage lines and towers, and more complex structure construction. This option also has the second highest capital costs and traffic operations are limited to two right-in-right-out (RIRO) unsignalized accesses to Kennedy Road. Although this configuration permits northbound and southbound travel, there are longer travel distances for northbound travel to Kennedy Road. As well AT users do not have a protected access to Kennedy Road and two conflict points are introduced to Kennedy Road AT users at the two access points. The construction of Miller Ave. Extension is also dependent of Kennedy Road Improvements.	limited to one unsignalized, connection to Kennedy Road and permits southbound right-turn, eastbound right-turn and northbound left-turn movements at the connection. Eastbound left-turn movements for northbound travel on Kennedy Road is restricted with this configuration but allows for southbound travel on Kennedy Road from Miller Avenue. As well AT users are do not have a protected access to Kennedy Road and a conflict point is introduced to Kennedy Road AT users at the new access point. The construction of Miller Ave. Extension is also independent of Kennedy Road Improvements.
	RECOMMENDED	NOT RECOMMENDED	NOT RECOMMENDED	NOT RECOMMENDED

Highway 407ETR Crossing Alternatives

VISSIM micro-simulation analysis was undertaken at the Kennedy Road/407ETR interchange. The purpose of the analysis was to assess impacts to 407ETR users with and without dedicated Speed Change Lanes (SCL) in addition to the proposed improvements to the Kennedy Road EA study corridor [widening from four lanes to six lanes for Transit/High Occupancy Vehicle (HOV)].

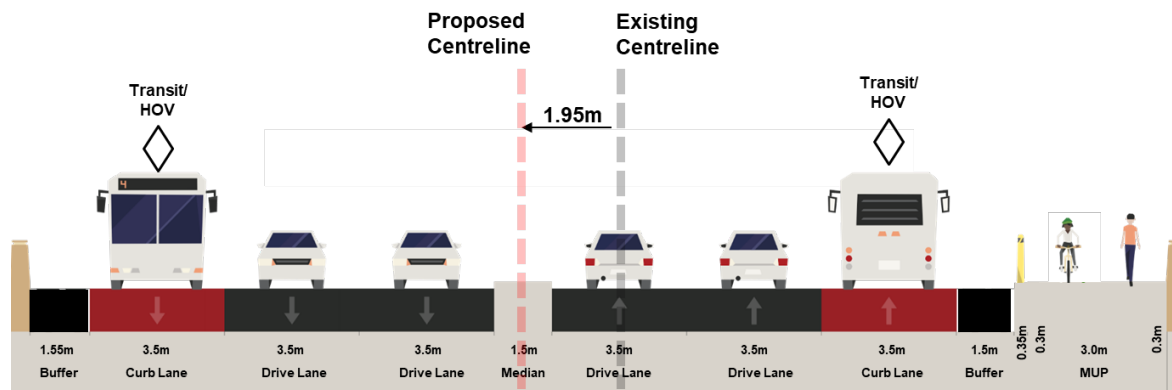
The analysis determined that there is negligible improvement to travel time, delay and level of service at each of the four on-ramps with the provision of dedicated speed change lanes in comparison to the scenario without dedicated speed change lanes. As such, dedicated speed change lanes at the Kennedy Road/407ETR interchange are not recommended based on traffic operations. Refer to *Kennedy / 407ETR Interchange VISSIM Analysis Memo, January 2019* prepared under separate cover.

A meeting with 407ETR, MTO and the project team was held on January 18th, 2019 to discuss the findings of the VISSIM micro-simulation analysis. No concerns were raised regarding the implementation of the Transit/HOV curb lane in place of the dedicated speed change lanes through the interchange. As a result, dedicated speed change lanes were not carried further for further consideration in the development and evaluation of Alternative Designs through the interchange.

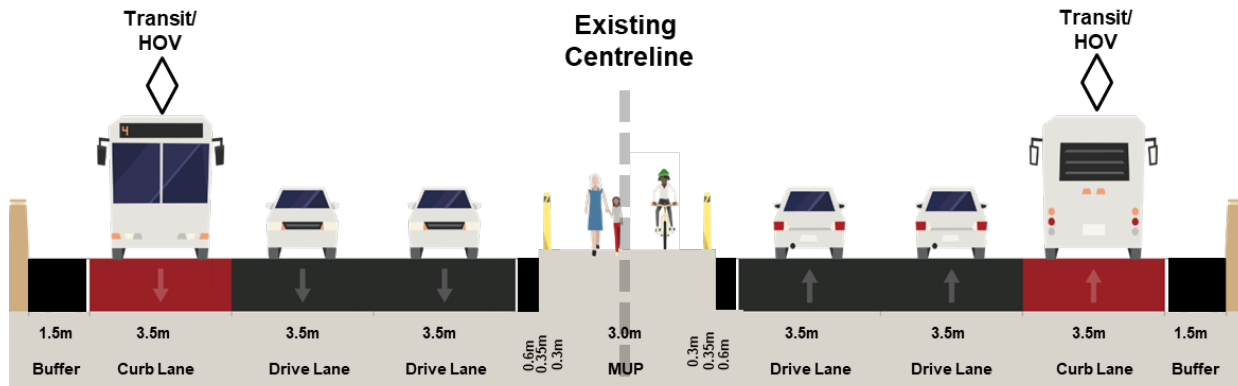
The following design alternatives presented in **Tables 1** and **2** address considerations for active transportation (AT) facilities through the 407 interchange. Bridge widening to accommodate AT facilities are identified based on the existing structure and its ability to meet vertical clearance requirements with widening.

Description of Alternatives:

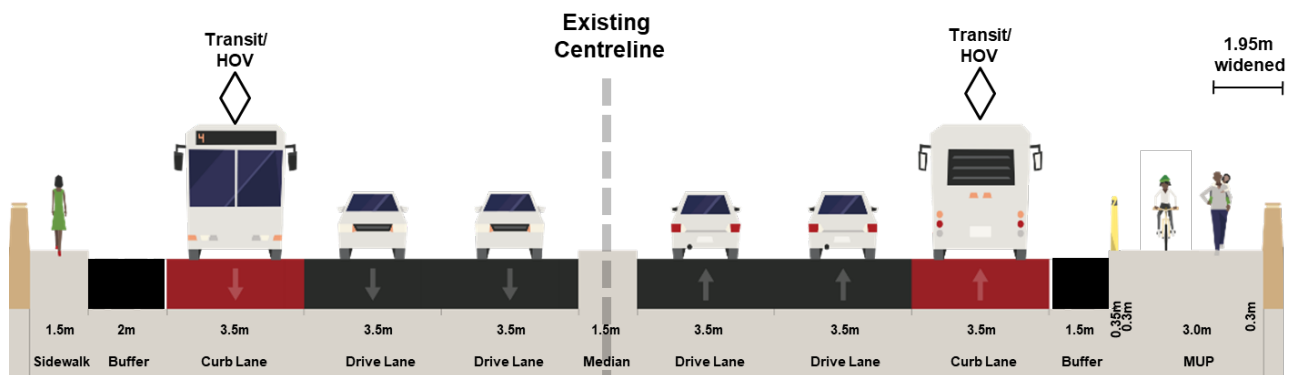
ALTERNATIVE 1: No structure widening, 1 MUP (Road Shift) - The current bridge width will be maintained, with the West sidewalk removed, MUP constructed on the East side, and road centreline will be shifted 1.95m to the West.



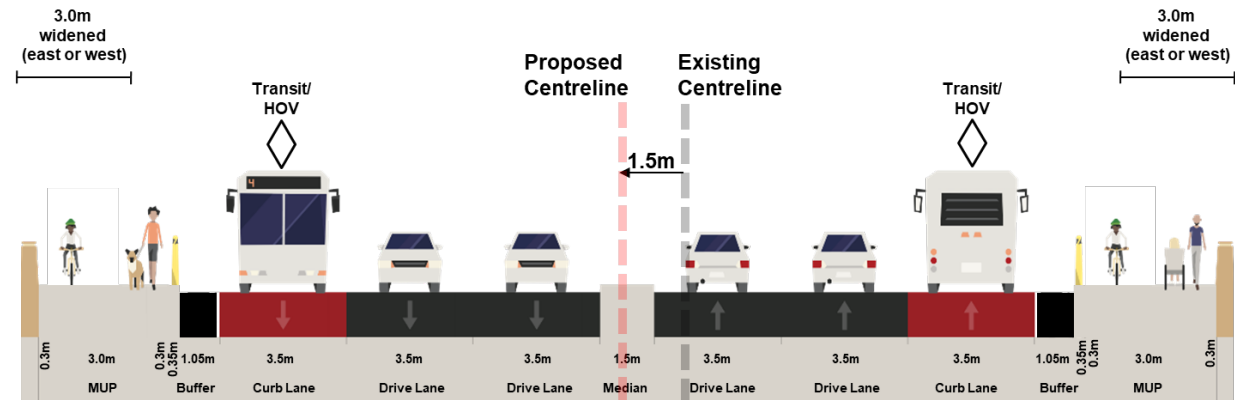
ALTERNATIVE 2: No structure widening, 1 MUP in Median (No Road Shift) - The current bridge width will be maintained, with both existing sidewalks removed, MUP constructed at the centre median, and road centreline will be maintained.



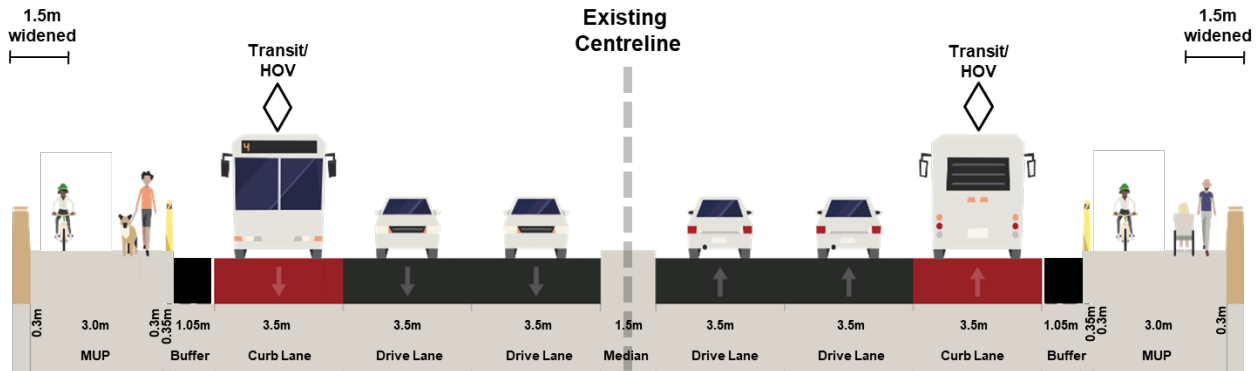
ALTERNATIVE 3: Structure Widened by 1 Girder, 1 MUP + 1 Sidewalk (No Road Shift) - The bridge will be widened 1.95m to the East, with the existing West sidewalk remaining, MUP constructed on the East side, and road centreline will be maintained.



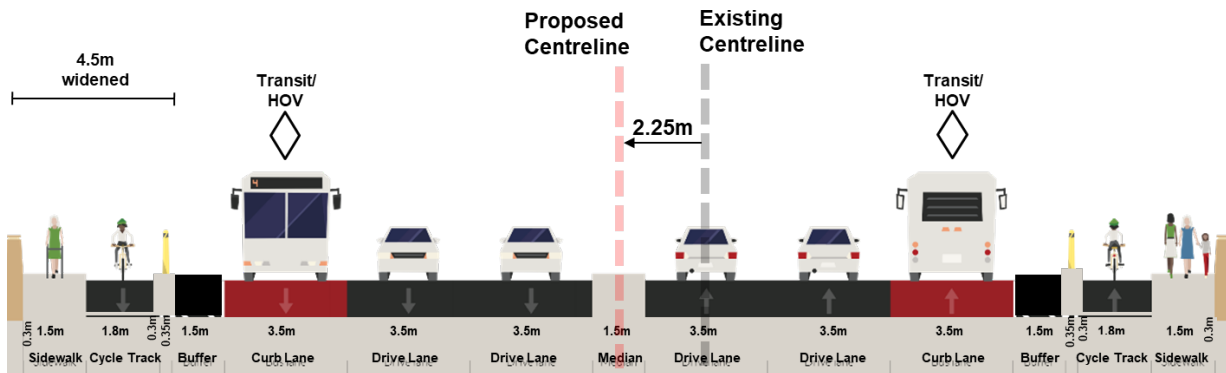
ALTERNATIVE 4.1: Structure Widened by 1 Girder, 2 MUPs (Road Shift) - The bridge will be widened 3m either to the East/West, with MUP's constructed on both sides, shoulder widths will be reduced, and road centreline will be shifted 1.5m.



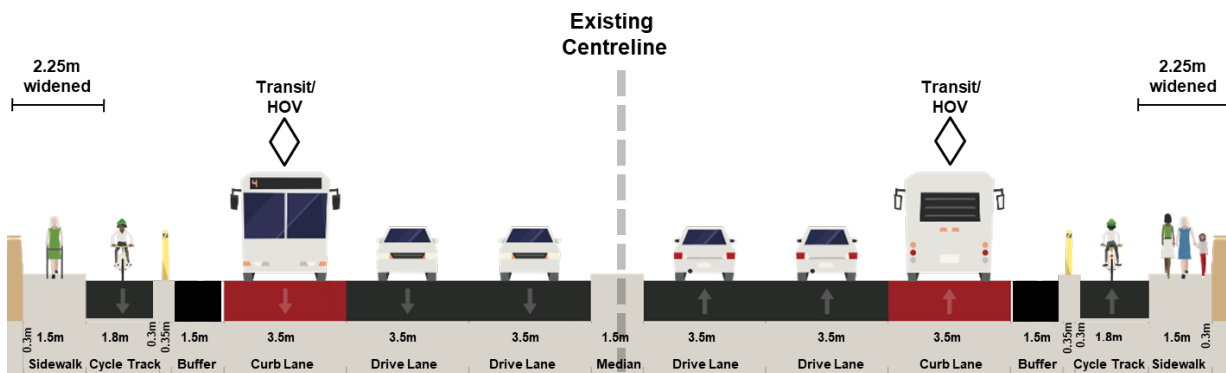
ALTERNATIVE 4.2: Structure Widened by Propped Cantilevers, 2 MUPs (No Road Shift) - The bridge will be widened 1.5m on both sides, with MUP's constructed on both sides, shoulder widths will be reduced, and road centreline will be maintained.



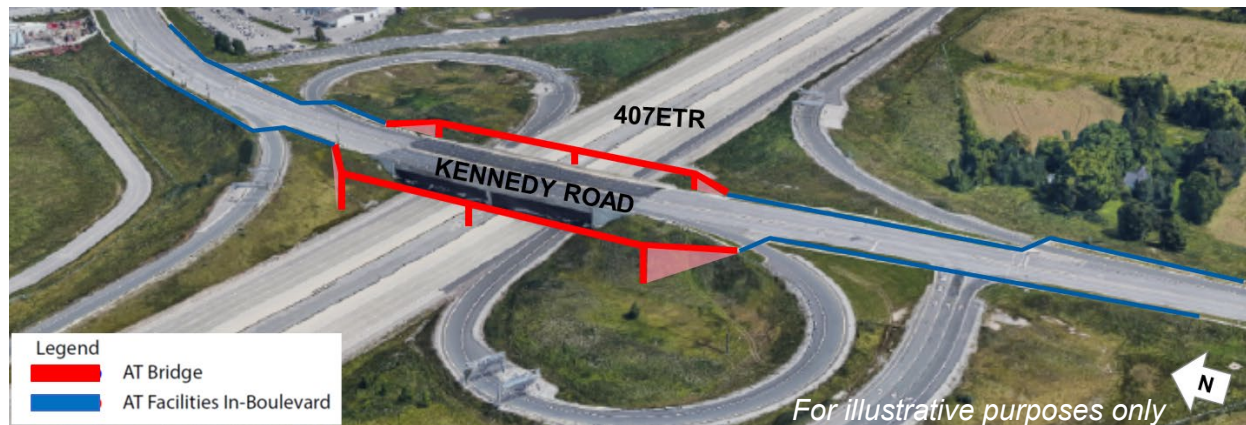
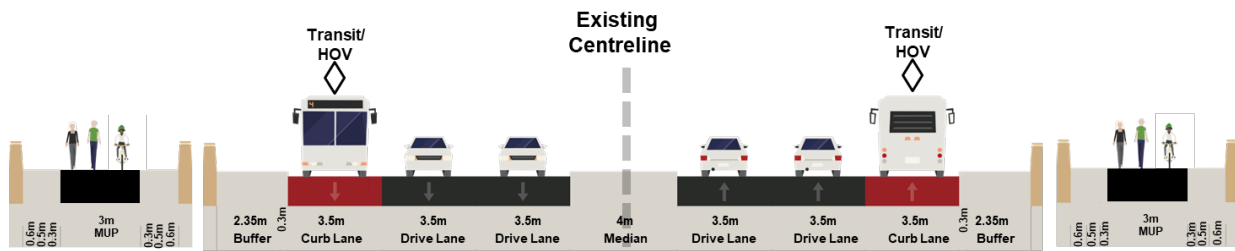
ALTERNATIVE 5.1: Structure Widened by 2 Girders/1 Pier, Sidewalks and Cycle Tracks on Both Sides (Road Shift) - The bridge will be widened 4.5m to the West, with sidewalks and cycle tracks constructed on both sides, and road centreline will be shifted 2.25m to the West.



ALTERNATIVE 5.2: Structure Widened by 2 Girders/2 Pier, Sidewalks and Cycle Tracks on Both Sides (No Road Shift) - The bridge will be widened 2.25m on both sides, with sidewalks and cycle tracks constructed on both sides, and road centreline will be maintained.



ALTERNATIVE 6A: No Structure Widening with Separate AT Bridge(s) - A separate AT bridge will be constructed on both sides of the bridge and will carry a 3m MUP over Hwy 407ETR



ALTERNATIVE 6B: No Widening with Separate AT Bridge adjacent to existing structure over north and south ramps - In addition to Alternative 6A, a separate AT Bridge will be constructed across the North and South on-ramps on both sides and will carry a 3m MUP over the ramps.

The intent of Alternative 6B is to address opportunities to eliminate at-grade crossing conflicts between AT users and ramp traffic.

Table 1: Kennedy Road Evaluation of 407ETR Crossing – Alternatives 1, 2, 3, 4.1, 4.2

CRITERIA	ALTERNATIVE 1: No structure widening, 1 MUP (Road Shift)	ALTERNATIVE 2: No structure widening, 1 MUP in Median (No Road Shift)	ALTERNATIVE 3: Structure Widened by 1 Girder, 1 MUP + 1 Sidewalk (No Road Shift)	ALTERNATIVE 4.1: Structure Widened by 1 Girder, 2 MUPs (Road Shift)	ALTERNATIVE 4.2: Structure Widened by Propped Cantilevers, 2 MUPs (No Road Shift)
Description	The current bridge width will be maintained, with the West/East sidewalk removed, MUP constructed on the east side, and road centreline will be shifted 1.95m.	The current bridge width will be maintained, with both existing sidewalks removed, MUP constructed at the centre median, and road centreline will be maintained.	The bridge will be widened 1.95m to the East/West, with the existing opposite sidewalk remaining, MUP constructed on the widened side, and road centreline will be maintained.	The bridge will be widened 3m to either the East/West, with MUP's constructed on both sides, shoulder widths will be reduced, and road centreline will be shifted 1.5m.	The bridge will be widened 1.5m on both sides, with MUP's constructed on both sides, shoulder widths will be reduced, and road centreline will be maintained.
TRANSPORTATION SERVICES					
Create a Pedestrian-Friendly Environment	<ul style="list-style-type: none"> • Moderate improvement to perceived safety for pedestrians due to wider path on one side shared with cyclists • Conflict points reduced to two on-ramps on one side • Increased crossing distance as pedestrians must cross to one side at signalized ramp terminals 	<ul style="list-style-type: none"> • Moderate improvement to perceived safety due to separate facility in median shared with cyclists, however AT users require two-stage crossing at intersections and are travelling with vehicle lanes on either side • Increased travel time as pedestrians must enter and exit the centre median at signalized ramp terminals intersections that require a 2-stage crossing • Reduction of three conflict points at the on-ramps; however, pedestrians and cyclists require a 2-stage crossing to enter and exit the median at signalized intersections 	<ul style="list-style-type: none"> • Moderate improvement to perceived safety for pedestrians due to wider path on one side shared with cyclists, and sidewalk on one side • Conflict points exist at all four on-ramps 	<ul style="list-style-type: none"> • Moderate improvement to perceived safety for pedestrians due to wider path on both sides, but shared facilities with cyclists • Conflict points exist at all four on-ramps 	<ul style="list-style-type: none"> • Moderate improvement to perceived safety for pedestrians due to wider path on both sides, but shared facilities with cyclists • Conflict points exist at all four on-ramps
Create a Cyclist-Friendly Environment	<ul style="list-style-type: none"> • Minor improvement to perceived safety for cyclists due to separation from automobiles on one side, shared with pedestrians • Increased crossing distance as cyclist must cross to one side at signalized ramp terminals • Conflict points reduced to two on-ramps on one-side 	<ul style="list-style-type: none"> • Moderate improvement to perceived safety for cyclists due to separate facility in median, shared with pedestrians however AT users require two-stage crossing at intersections and are travelling with vehicle lanes on either side • Increased travel time as cyclists must enter and exit the centre median at signalized ramp terminals intersections that require a 2-stage crossing • Reduction of three conflict points with ramp traffic. Cyclists require a 2-stage crossing to enter and exit the median at signalized intersections 	<ul style="list-style-type: none"> • Minor improvement to perceived safety for cyclists due to separation from automobiles on one side and shared facility with pedestrians • Increased crossing distance as cyclist must cross to one side at signalized ramp terminals • Conflict points reduced to two on-ramps on one-side 	<ul style="list-style-type: none"> • Moderate improvement to perceived safety for cyclists due to separation from automobiles on both sides and shared facilities with pedestrians • Conflict points exist at all four on-ramps 	<ul style="list-style-type: none"> • Moderate improvement to perceived safety for cyclists due to separation from automobiles on both sides and shared facilities with pedestrians • Conflict points exist at all four on-ramps

CRITERIA	ALTERNATIVE 1: No structure widening, 1 MUP (Road Shift)	ALTERNATIVE 2: No structure widening, 1 MUP in Median (No Road Shift)	ALTERNATIVE 3: Structure Widened by 1 Girder, 1 MUP + 1 Sidewalk (No Road Shift)	ALTERNATIVE 4.1: Structure Widened by 1 Girder, 2 MUPs (Road Shift)	ALTERNATIVE 4.2: Structure Widened by Propped Cantilevers, 2 MUPs (No Road Shift)
Improve Safety for all Travel Modes	<ul style="list-style-type: none">• Minor Improvement to safety for all travel modes due to greater separation of pedestrians and cyclists from automobiles on one side and reduction in conflict points with ramp traffic• Reduction of two conflict points at the on-ramps due to provision of one-side AT facility only. This reduces the potential conflicts with ramp traffic	<ul style="list-style-type: none">• Significant improvement to safety for all travel modes due to greater separation of pedestrians and cyclists from automobiles• Increased delays for vehicles at ramp intersections to accommodate additional crossing time at signal• Reduction of three conflict points	<ul style="list-style-type: none">• Minor Improvement to safety for all travel modes due to maintenance of sidewalk on one side and separation of pedestrians and cyclists from automobiles on one side, but maintains conflict points with ramp traffic at all four locations• Reduction of conflict points at the on-ramps for cyclists, no reduction of conflict points with pedestrians, which increases potential conflicts with ramp traffic	<ul style="list-style-type: none">• Minor-Moderate Improvement to safety for all travel modes due to separation of pedestrians and cyclists from automobiles on both sides, but maintains conflict points with ramp traffic at all four locations• No reduction of conflict points at the on-ramps, which increases potential conflicts with ramp traffic	<ul style="list-style-type: none">• Minor-Moderate Improvement to safety for all travel modes due to separation of pedestrians and cyclists from automobiles on both sides, but maintains conflict points with ramp traffic at all four locations• No reduction of conflict points at the on-ramps, which increases potential conflicts with ramp traffic
Summary of Transportation Service	Less Preferred	Less Preferred	Least Preferred	Less Preferred	Less Preferred
NATURAL ENVIRONMENT					
Protect Designated Natural Areas	<ul style="list-style-type: none">• No impact to designated natural areas as no Areas of Natural And Scientific Interest (ANSI), Provincially Significant Wetlands (PSWs), or Environmentally Sensitive Area (ESA) are located within the study area segment				
Protect vegetation and wildlife	<ul style="list-style-type: none">• No impact to vegetation due to construction of road widening• No impact to trees with 50dbh or higher.• No impact to rare, threatened, or endangered species				
Summary of Natural Environment	Most Preferred	Most Preferred	Most Preferred	Most Preferred	Most Preferred
SOCIAL ENVIRONMENT					
Property Impacts	<ul style="list-style-type: none">• No direct impacts to commercial properties immediately adjacent to the 407ETR crossing• No areas of Cultural Heritage Value or Interest (CHVI) at this section• No areas with archaeological potential at this section				
Improve Visual Aesthetics	<ul style="list-style-type: none">• No measurable change to existing aesthetics for residences• No Opportunity for tree planting or landscaping				
Summary of Social Environment	Most Preferred	Most Preferred	Most Preferred	Most Preferred	Most Preferred
INFRASTRUCTURE DESIGN					
Minimize Utility Relocation	<ul style="list-style-type: none">• No impact to utility location				
Minimize disruption due to construction	Construction duration – Short	Construction duration - Long	Construction duration - Medium	Construction duration - Long	Construction duration - Medium

CRITERIA	ALTERNATIVE 1: No structure widening, 1 MUP (Road Shift)	ALTERNATIVE 2: No structure widening, 1 MUP in Median (No Road Shift)	ALTERNATIVE 3: Structure Widened by 1 Girder, 1 MUP + 1 Sidewalk (No Road Shift)	ALTERNATIVE 4.1: Structure Widened by 1 Girder, 2 MUPs (Road Shift)	ALTERNATIVE 4.2: Structure Widened by Propped Cantilevers, 2 MUPs (No Road Shift)
Minimize Constructability Complexity	<ul style="list-style-type: none"> Common construction materials and techniques No significant ramp modifications anticipated to east side No significant impact to NE loop. Impact to NW ramp. Reconstruction of bull nose and approximately 200m of the ramp. Minor modification to impact to W-N/S ramp 	<ul style="list-style-type: none"> Common construction materials and techniques Significant construction impacts to existing bridge structure to remove existing sidewalks, heighten the barrier wall, and construct median MUP and accommodate traffic staging on Kennedy Road Significant construction impacts to loop ramps requiring reconstruction as follows: <ul style="list-style-type: none"> Impact to NE loop. Reconstruction of bull nose and approximately 200m of the ramp. Impact to NW. Reconstruction of bull nose and approximately 200m of the ramp. Impact to SE loop. Reconstruction of bull nose and approximately 200m of the ramp. Impact to SW loop. Reconstruction of bull nose and approximately 200m of the ramp. Minor impact to W-N/S and E-N/S ramps 	<ul style="list-style-type: none"> Common construction materials and techniques No significant ramp modifications anticipated to east or west side 	<ul style="list-style-type: none"> Common construction materials and techniques <p>If road alignment shifted to west side:</p> <ul style="list-style-type: none"> Impact to NW ramp. Reconstruction of bull nose and approximately 200m of the ramp. Minor impact to exit gore length for NE loop. Reconstruction of bull nose and approximately 10-20m of the ramp. Minor modification to W-N/S ramp Minor modification to SE ramp Minor impact to SW ramp Minor modification to E-N/S ramp <p>If road alignment shifted to east side:</p> <ul style="list-style-type: none"> Minor modification to NW ramp. Minor modification to NE loop. Minor modification to W-N/S ramp Minor impact to SE ramp. Reconstruction of bull nose and approximately 200m of the ramp Minor impact to SW ramp. Reconstruction of bull nose and approximately 10-20m of the ramp Minor modification to impact to E-N/S ramp 	<ul style="list-style-type: none"> Common construction materials and techniques No significant ramp modifications anticipated to east or west side
Future Maintenance of AT and vehicular bridge(s)	<ul style="list-style-type: none"> Vehicular bridge can be rehabilitated easier with the removals of centre island to shift traffic during construction Minimize disruption to vehicular traffic has opportunities to maintain 2 lanes of traffic in each direction 	<ul style="list-style-type: none"> With the median MUP, there will be challenges to rehabilitate the bridge while minimizing disruptions to both vehicular and active transportation users Vehicular traffic may need to be reduced to one lane if median MUP is maintained, causing significant delays on Kennedy Road during bridge rehabilitation, or MUP will need to be shifted/ reduced to provide sufficient work space. Alternatively, if 2 lanes of traffic need to be maintained, then bridge rehabilitation will be very 	<ul style="list-style-type: none"> Vehicular bridge can be rehabilitated easier with the removals of centre island to shift traffic during construction Minimize disruption to vehicular traffic has opportunities to maintain 2 lanes of traffic in each direction 		

CRITERIA	ALTERNATIVE 1: No structure widening, 1 MUP (Road Shift)	ALTERNATIVE 2: No structure widening, 1 MUP in Median (No Road Shift)	ALTERNATIVE 3: Structure Widened by 1 Girder, 1 MUP + 1 Sidewalk (No Road Shift)	ALTERNATIVE 4.1: Structure Widened by 1 Girder, 2 MUPs (Road Shift)	ALTERNATIVE 4.2: Structure Widened by Propped Cantilevers, 2 MUPs (No Road Shift)
		challenging as the median MUP may impact shifts in traffic staging during rehabilitation.			
Summary of Infrastructure Design	Less Preferred	Least Preferred	Less Preferred	Least Preferred	Less Preferred
ECONOMIC ENVIRONMENT AND COST EFFECTIVENESS					
Maximize Construction Value	<ul style="list-style-type: none">Approximate structure modification cost: \$1,017,049Approximate ramp modification cost: \$0.75M	<ul style="list-style-type: none">Approximate structure modification cost: \$809,244Approximate ramp modification cost: \$1.8M	<ul style="list-style-type: none">Approximate structure modification cost: \$1,678,362Approximate ramp modification cost: \$0.5M	<ul style="list-style-type: none">Approximate structure modification cost: \$3,268,519Approximate ramp modification cost: \$0.8M	<ul style="list-style-type: none">Approximate structure modification cost: \$2,492,464Approximate ramp modification cost: \$0.5M
Minimize Property Requirements	No property requirements at the 407ETR crossing				
Minimize Operating Costs	<ul style="list-style-type: none">Conventional maintenance requirementsExisting maintenance requirements maintainedConventional inspection requirementsSingle lane closure on Kennedy would be sufficient for mobile access/inspection vehicle to view underside of bridge	<ul style="list-style-type: none">Conventional maintenance requirements.Existing maintenance requirements maintainedConventional inspection requirementsSingle lane closure on Kennedy would be sufficient for mobile access/inspection vehicle to view underside of bridge	<ul style="list-style-type: none">Conventional maintenance requirementsExisting maintenance requirements marginally increasedConventional inspection requirementsSingle lane closure on Kennedy would be sufficient for mobile access/inspection vehicle to view underside of bridge	<ul style="list-style-type: none">Conventional maintenance requirementsExisting maintenance requirements marginally increasedConventional inspection requirementsSingle lane closure on Kennedy would be sufficient for mobile access/inspection vehicle to view underside of bridge	<ul style="list-style-type: none">Conventional maintenance requirementsExisting maintenance requirements marginally increasedConventional inspection requirementsSingle lane closure on Kennedy would be sufficient for mobile access/inspection vehicle to view underside of bridge
Summary of Economic Environment and Cost Effectiveness	Most Preferred	Less Preferred	Less Preferred	Least Preferred	Less Preferred
OVERALL SUMMARY					

CRITERIA	ALTERNATIVE 1: No structure widening, 1 MUP (Road Shift)	ALTERNATIVE 2: No structure widening, 1 MUP in Median (No Road Shift)	ALTERNATIVE 3: Structure Widened by 1 Girder, 1 MUP + 1 Sidewalk (No Road Shift)	ALTERNATIVE 4.1: Structure Widened by 1 Girder, 2 MUPs (Road Shift)	ALTERNATIVE 4.2: Structure Widened by Propped Cantilevers, 2 MUPs (No Road Shift)
Recommendation by Consultants – For discussion	This option does not require bridge widening and provides improved AT facilities on one side, but eliminates a sidewalk on one side. Pedestrians and cyclists can only cross the 407ETR on one side, which decreases the number of conflict points to two. This option will impact the road alignment and ramps.	This option does not require bridge widening and provides active transportation facilities in the centre median. This results in longer crossing distances for pedestrians and cyclists and increased delays to traffic at the ramp terminal signaled intersections. This option will impact the ramps on both the east and west sides.	This option requires bridge widening on one side and provides improved AT facilities on one side and maintains a sidewalk on the other side. Pedestrians can cross the 407ETR on both sides, while cyclists can only cross the 407ETR on one side. The number of conflict points remains unchanged for pedestrians, but reduced to two for cyclists. This option does not impact the road alignment, and requires minor modifications to ramps.	This option requires bridge widening on one side (either east or west) and provides improved AT facilities on both sides. Pedestrians and cyclists can cross the 407ETR on both sides; however, the number of conflict points remains unchanged. This option will impact the road alignment and ramps.	This option requires bridge widening on both sides and provides improved AT facilities on both sides. Pedestrians and cyclists can cross the 407ETR on both sides; however, the number of conflict points remains unchanged. This option does not impact the road alignment and require minor modifications to ramps.

Table 2: Kennedy Road Evaluation of 407ETR Crossing – Alternatives 5.1, 5.2, 6A and 6B

CRITERIA	ALTERNATIVE 5.1: Structure Widened by 2 Girders/1 Pier, Sidewalks and Cycle Tracks on Both Sides (Road Shift)	ALTERNATIVE 5.2: Structure Widened by 2 Girders/2 Pier, Sidewalks and Cycle Tracks on Both Sides (No Road Shift)	ALTERNATIVE 6A (Interim Bridge): No Widening with Separate AT Bridge adjacent to existing structure	ALTERNATIVE 6B (Ultimate Bridge): No Widening with Separate AT Bridge adjacent to existing structure over north and south ramps
Description	The bridge will be widened 4.5m to the West, with sidewalks and cycle tracks constructed on both sides, and road centreline will be shifted 2.25m to the West.	The bridge will be widened 2.25m on both sides, with sidewalks and cycle tracks constructed on both sides, and road centreline will be maintained.	A separate AT bridge will be constructed on both sides of the bridge and will carry a 3m MUP over 407ETR. Modifications to the existing structure include the removal of sidewalks and increased height of the barrier wall to address cyclists that elect to travel in vehicle lanes instead of the separated AT bridge(s). AT users cross the four on-ramps using at-grade crossings as per existing conditions.	This alternative can be considered with Alternative 6A. Separate AT bridges will be constructed to carry a 3m MUP over the north and south on-ramps on both sides of Kennedy Road. Modifications to the existing structure include the removal of sidewalks and increased height of the barrier wall to address cyclists that elect to travel in vehicle lanes instead of the separated AT bridge(s) are addressed through Alternative 6A.
TRANSPORTATION SERVICES				
Create a Pedestrian-Friendly Environment	<ul style="list-style-type: none"> Moderate-Significant improvement to perceived safety for pedestrians due to cycling track and buffer between sidewalk and automobile traffic on both sides and separate facilities from cyclists Conflict points exist at all four on-ramps 	<ul style="list-style-type: none"> Moderate-Significant improvement to perceived safety for pedestrians due to cycling track and buffer between sidewalk and automobile traffic on both sides and separate facilities from cyclists Conflict points exist at all four on-ramps 	<ul style="list-style-type: none"> Moderate-Significant improvement to perceived safety for pedestrians due to AT bridge over Hwy 407ETR separated from automobiles, shared with cyclists Conflict points exist at all four on-ramps as per existing conditions. Pedestrians are required to wait for gaps and cross a perpendicular crossing in compliance with OTM requirements Increased travel distance to access separate AT bridge 	<ul style="list-style-type: none"> Significant improvement to perceived safety for pedestrians due to AT bridges over the north and south Hwy 407ETR on-ramps, shared with cyclists Reduction of four conflict point at the on-ramps on both sides Increased travel distance to access separate AT bridges on either side Increased grade changes to accommodate the grade separation at the on-ramps
Create a Cyclist-Friendly Environment	<ul style="list-style-type: none"> Moderate - Significant improvement to perceived safety for cyclists due to dedicated and separated cycle track with barrier wall between cyclist and automobile traffic on both sides, and separate facilities from pedestrians Conflict points exist at all four on-ramps 	<ul style="list-style-type: none"> Moderate - Significant improvement to perceived safety for cyclists due to dedicated and separated cycle track with barrier wall between cyclist and automobile traffic on both sides, and separate facilities from pedestrians Conflict points exist at all four on-ramps 	<ul style="list-style-type: none"> Moderate-Significant improvement to perceived safety for cyclists due to AT bridge over Hwy 407ETR separated from automobiles, shared with pedestrians Conflict points exist at all four at-grade on-ramps as per existing conditions. Cyclists are required to wait for gaps and cross a perpendicular crossing in compliance with OTM requirements Increased travel distance to access separate AT bridge 	<ul style="list-style-type: none"> Significant improvement to perceived safety for cyclists due to separate AT bridge over the north and south on-ramps and Hwy 407ETR, shared with pedestrians Reduction of four conflict point at the north and south on-ramps on both sides Increased travel distance to access separate AT bridges Increased grade changes to accommodate the grade separation at the on-ramps
Improve Safety for all Travel Modes	<ul style="list-style-type: none"> Moderate Improvement to safety for all travel modes due to separation of pedestrians and cyclists from automobiles on both sides, but maintains conflict points with ramp traffic at all four locations No reduction of conflict points at the on-ramps, which increases potential conflicts with ramp traffic 	<ul style="list-style-type: none"> Moderate Improvement to safety for all travel modes due to separation of pedestrians and cyclists from automobiles on both sides, but maintains conflict points with ramp traffic at all four locations No reduction of conflict points at the on-ramps, which increases potential conflicts with ramp traffic 	<ul style="list-style-type: none"> Moderate-significant Improvement to safety for all travel modes due to greatest separation of pedestrians and cyclists from automobiles on both sides, but maintains conflict points with ramp traffic at all four locations No reduction of conflict points at the on-ramps, which increases potential conflicts with ramp traffic. Pedestrians required to wait for gaps and cross a perpendicular 	<ul style="list-style-type: none"> Significant improvement to safety for all travel modes due to separation of pedestrians and cyclists from automobiles Reduction of four conflict points at on-ramps on both sides

CRITERIA	ALTERNATIVE 5.1: Structure Widened by 2 Girders/1 Pier, Sidewalks and Cycle Tracks on Both Sides (Road Shift)	ALTERNATIVE 5.2: Structure Widened by 2 Girders/2 Pier, Sidewalks and Cycle Tracks on Both Sides (No Road Shift)	ALTERNATIVE 6A (Interim Bridge): No Widening with Separate AT Bridge adjacent to existing structure	ALTERNATIVE 6B (Ultimate Bridge): No Widening with Separate AT Bridge adjacent to existing structure over north and south ramps
			crossing in compliance with OTM requirements	
Summary of Transportation Service	Less Preferred	Less Preferred	Less Preferred	Most Preferred
NATURAL ENVIRONMENT				
Protect Designated Natural Areas	<ul style="list-style-type: none"> • No impact to designated natural areas as no Areas of Natural And Scientific Interest (ANSI), Provincially Significant Wetlands (PSWs), or Environmentally Sensitive Area (ESA) are located within the study area segment 			
Protect vegetation and wildlife	<ul style="list-style-type: none"> • No impact to vegetation due to construction of road widening • No impact to trees with 50dbh or higher. • No impact to rare, threatened, or endangered species 			
Summary of Natural Environment	Most Preferred	Most Preferred	Most Preferred	Most Preferred
SOCIAL ENVIRONMENT				
Property Impacts	<ul style="list-style-type: none"> • No direct impacts to commercial properties immediately adjacent to the 407ETR crossing • No areas of Cultural Heritage Value or Interest (CHVI) at this section • No areas with archaeological potential at this section 			
Improve Visual Aesthetics	<ul style="list-style-type: none"> • No measurable change to existing aesthetics for residences • No Opportunity for tree planting or landscaping 			
Summary of Social Environment	Most Preferred	Most Preferred	Most Preferred	Most Preferred
INFRASTRUCTURE DESIGN				
Minimize Utility Relocation	<ul style="list-style-type: none"> • No impact to utility location 			<ul style="list-style-type: none"> • Potential impact to overhead power lines with construction of AT bridges over on-ramps
Minimize disruption due to construction	<ul style="list-style-type: none"> • Construction duration - Long 	<ul style="list-style-type: none"> • Construction duration - Longest 	<ul style="list-style-type: none"> • Construction duration - Moderate 	<ul style="list-style-type: none"> • Construction duration – Moderate-Long
Minimize Constructability Complexity	<ul style="list-style-type: none"> • Common construction materials and techniques • No significant ramp modifications anticipated to east side • Impact to NW ramp. Reconstruction of bull nose and approximately 200m of the ramp. • Minor impact to exit gore length for NE loop. Reconstruction of bull nose and approximately 10-20m of the ramp. • Minor modification to W-N/S ramp • Minor modification to SE ramp • Minor impact to SW ramp • Minor modification to E-N/S ramp 	<ul style="list-style-type: none"> • Common construction materials and techniques • No significant ramp modifications anticipated to east or west side 	<ul style="list-style-type: none"> • Common construction materials and techniques • Minor construction impact to loop-ramps. • Significant construction impacts to 407ETR ROW for pier construction of AT bridge over 407ETR • Modification to existing bridge includes sidewalk removal and increased barrier height to accommodate AT bridges over the 407ETR 	<ul style="list-style-type: none"> • Common construction materials and techniques • Moderate construction impact to 407ETR ROW at loop-ramps for pier construction of AT bridges over on-ramps. • No additional impacts to existing bridge (modifications to existing bridge completed through Alternative 6A) • Slightly more complicated construction procedure than other options due to the proximity of overhead power lines

CRITERIA	ALTERNATIVE 5.1: Structure Widened by 2 Girders/1 Pier, Sidewalks and Cycle Tracks on Both Sides (Road Shift)	ALTERNATIVE 5.2: Structure Widened by 2 Girders/2 Pier, Sidewalks and Cycle Tracks on Both Sides (No Road Shift)	ALTERNATIVE 6A (Interim Bridge): No Widening with Separate AT Bridge adjacent to existing structure	ALTERNATIVE 6B (Ultimate Bridge): No Widening with Separate AT Bridge adjacent to existing structure over north and south ramps
Future Maintenance of AT and vehicular bridge(s)	<ul style="list-style-type: none">Vehicular bridge can be rehabilitated easier with the removals of centre island to shift traffic during constructionMinimize disruption to vehicular traffic has opportunities to maintain 2 lanes of traffic in each direction		<ul style="list-style-type: none">AT bridge can be rehabilitated without significant impacts to vehicular usersVehicular bridge can be rehabilitated easier with the removals of centre island to shift traffic during constructionMinimize disruption to vehicular traffic has opportunities to maintain 2 lanes of traffic in each direction	<ul style="list-style-type: none">AT bridge can be rehabilitated without significant impacts to vehicular usersVehicular bridge can be rehabilitated easier with the removals of centre island to shift traffic during constructionMinimize disruption to vehicular traffic has opportunities to maintain 2 lanes of traffic in each direction
Summary of Infrastructure Design	Least preferred	Less Preferred	Most Preferred	Most Preferred
ECONOMIC ENVIRONMENT AND COST EFFECTIVENESS				
Maximize Construction Value	<ul style="list-style-type: none">Approximate structure modification cost: \$4,096,001Approximate ramp modification cost: \$0.8M	<ul style="list-style-type: none">Approximate structure modification cost: \$4,680,696Approximate ramp modification cost: \$0.5M	<ul style="list-style-type: none">Approximate Structure Cost: \$4,205,046 for two separate AT bridges on both sides of the 407ETR (including modifications to existing structure for sidewalk removal and increased barrier height for cycling)No ramp modifications	<ul style="list-style-type: none">Approximate Structure Cost: \$19,388,655 for two separate AT bridges on both sides of the 407ETR with the AT bridges over each of the on-ramps (including modifications to existing structure for sidewalk removal and increased barrier height for cycling)No ramp modifications
Minimize Property Requirements	No property requirements at the 407ETR crossing			
Minimize Operating Costs	<ul style="list-style-type: none">Conventional maintenance requirementsExisting maintenance requirements moderately increasedConventional inspection requirementsSingle lane closure on Kennedy would be sufficient for mobile access/inspection vehicle to view underside of bridge	<ul style="list-style-type: none">Conventional maintenance requirementsExisting maintenance requirements moderately increasedConventional inspection requirementsSingle lane closure on Kennedy would be sufficient for mobile access/inspection vehicle to view underside of bridge	<ul style="list-style-type: none">Conventional maintenance requirements. Existing maintenance requirements significantly increasedConventional inspection requirementsLane closures on 407ETR would be required to access underside of bridge as the AT bridge would not be able to accommodate mobile access/inspection vehicles	
Summary of Economic Environment and Cost Effectiveness	Less Preferred	Least Preferred	Less Preferred	Least Preferred
OVERALL SUMMARY				

CRITERIA	ALTERNATIVE 5.1: Structure Widened by 2 Girders/1 Pier, Sidewalks and Cycle Tracks on Both Sides (Road Shift)	ALTERNATIVE 5.2: Structure Widened by 2 Girders/2 Pier, Sidewalks and Cycle Tracks on Both Sides (No Road Shift)	ALTERNATIVE 6A (Interim Bridge): No Widening with Separate AT Bridge adjacent to existing structure	ALTERNATIVE 6B (Ultimate Bridge): No Widening with Separate AT Bridge adjacent to existing structure over north and south ramps
Recommendation by Consultants – For discussion	This option requires bridge widening on one side and provides improved, separated active transportation facilities on both sides. Pedestrians and cyclists are accommodated in separate facilities and can cross the 407ETR on both sides; however, the number of conflict points remain unchanged. This option will impact the road alignment and ramps.	This option requires bridge widening on both sides and provides improved, separated active transportation facilities on both sides. Pedestrians and cyclists are accommodated in separate facilities and can cross the 407ETR on both sides; however, the number of conflict points remain unchanged. This option will not impact the road alignment and requires minor modifications to ramps.	This option provides a separated active transportation bridge over the 407ETR on both sides, providing the greatest separation from automobiles; however, the number of conflict points remain unchanged. This also results in increased travel distance for pedestrians and cyclists. This option does not impact the road alignment and does not require ramp reconstruction but requires modification of the existing bridge to remove the sidewalk and increase the barrier height for cyclists. As pedestrian and cyclist demands increase, this option provides flexibility to incorporate additional AT structures (Alternative 6B) to reduce conflict points at a later stage. This option also provides flexibility when bridges need to be rehabilitated in the future, while minimizing vehicular traffic disruption.	This option provides separated active transportation bridges on both sides to eliminate four conflict points at the 407ETR north and south on-ramps, providing the greatest separation from automobiles. This also results in increased travel distance for pedestrians and cyclists. This option does not impact the road alignment and does not require ramp reconstruction. This option can be considered in combination with Alternative 6A. Although this option would be significantly higher in cost, it provides higher flexibility when the bridges need to be rehabilitated in the future, while minimizing vehicular traffic disruption.
			RECOMMENDED	ULTIMATE VISION

The **Recommended** design is for **ALTERNATIVE 6A: No Widening with Separate AT Bridges adjacent to existing structure** and the **Ultimate Vision** is for **Alternative 6B: No Widening with Separate AT Bridge adjacent to existing structure over north and south ramps**.

Proposed VIVA Rapidway

The YR-TMP outlines York Region's Rapid Transit Network and has identified Kennedy Road, between YMCA Boulevard to Highway 7 as a link for the Highway 7 rapidway to service Downtown Markham. This recommendation was carried forward from the Highway 7 Corridor and Vaughan North-South Link Public Transit Improvements Environmental Assessment. The recommendation to implement the rapidway on this section of Kennedy Road was considered alongside the recommendation to widen to 6 lanes for Transit/HOV. Currently, this segment does not support cycling facilities and pedestrian level of service is low due to existing issues with pedestrian safety. In discussions with YRRTC and York Region it was also identified that YRT transit vehicles within this section of the Kennedy Road must service curbside transit stops as there is insufficient available right-of-way to provide YRT transit stops within a median rapidway. **Table 1** presents the alternatives considered to address the problems and opportunities which must also align with YRRTC's Preferred Solution for the Highway 7 rapidway. The alternatives are illustrated in **Exhibit 1** through **Exhibit 3**. The evaluation of the three alternatives is provided in **Table 2**.

Table 1: Alternative Design Concepts considered for the Proposed VIVA Rapidway

Alternative #	Title	Description
1	Median VIVA Rapidway with AT facilities (YRRTC EA modified)	<ul style="list-style-type: none"> Median VIVA Rapidway as per YRRTC EA recommendations, without dedicated lanes for Transit/HOV AT facilities continuous through this segment
2	Median VIVA Rapidway, Transit/HOV curb lanes, with AT facilities	<ul style="list-style-type: none"> Median VIVA Rapidway Transit/HOV curb lanes AT facilities continuous through this segment
3	Shift VIVA Rapidway to share Transit/HOV curb lanes, with AT facilities	<ul style="list-style-type: none"> VIVA Rapidway to operate in shared Transit/HOV curb lanes AT facilities continuous through this segment

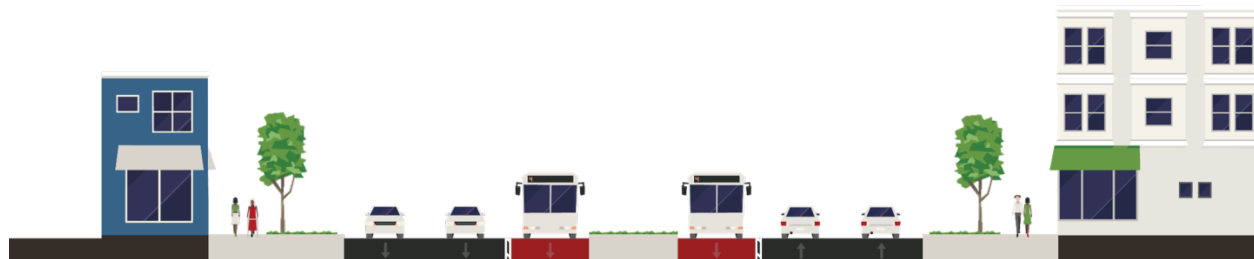


Exhibit 1: Alternative 1 – Median VIVA Rapidway with AT facilities (YRRTC EA modified)

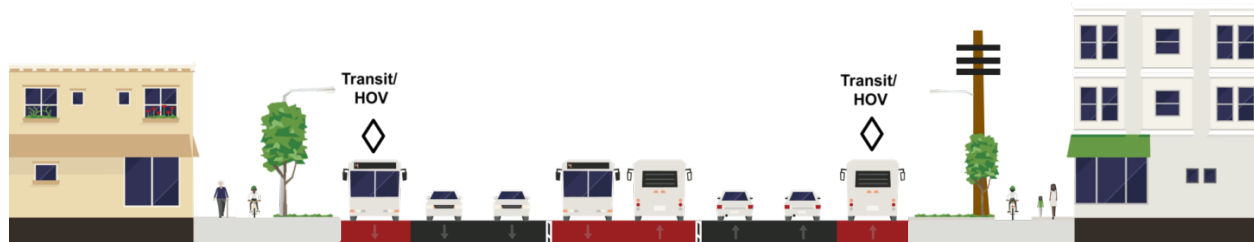


Exhibit 2: Alternative 2 – Median VIVA Rapidway, Transit/HOV curb lanes, with AT facilities

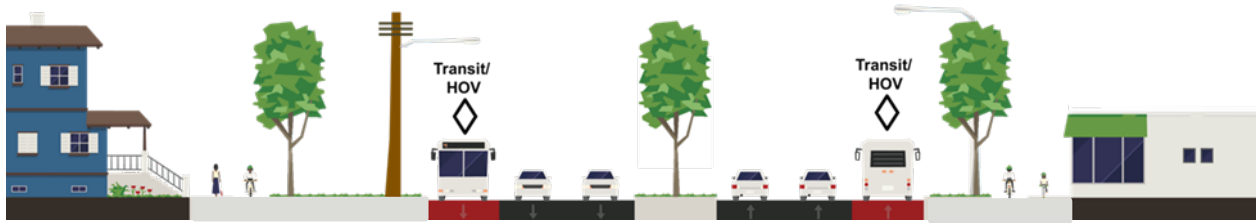


Exhibit 3: Alternative 3 – Shift VIVA Rapidway to share Transit/HOV curb lanes, with AT facilities

Table 2: VIVA Rapidway Evaluation Table

CRITERIA	Alternative 1: Median VIVA Rapidway with AT facilities (YRRTC EA modified)	Alternative 2: Median VIVA Rapidway with Transit/HOV curb lanes, with AT facilities	Alternative 3: Shift VIVA Rapidway to share Transit/HOV curb lane, with AT facilities
TRANSPORTATION SERVICES			
Improve Public Transit Services (YRT)	<ul style="list-style-type: none">Significant delays to YRT transit service compared to Alternatives 2 and 3, if required to travel in general purpose curb lane (only 2 in each direction). Potential for YRT to service from median rapidwayGood connectivity for YRT buses to access curbside transit stops from curb lane	<ul style="list-style-type: none">YRT transit service on Kennedy Road would be enhanced and delays minimized compared to Alternative 1, with a reduction in traffic congestion due to the provision of Transit/HOV lanes to minimize transit interactions with automobiles and potential bus baysExcellent connectivity for YRT buses as Transit/HOV lanes and potential bus bays are provided allowing for more efficient access to curbside transit stops	
Improve Public Transit Services (VIVA)	<ul style="list-style-type: none">Excellent connectivity for VIVA buses as Rapidway is providedNo anticipated change to VIVA service as no proposed VIVA transit stations confirmed for Kennedy Road corridor; allows for future platform at South Unionville Ave / Unionville Gate and Avoca Drive. VIVA operates in dedicated right-of-way with transit priority signals		<ul style="list-style-type: none">VIVA buses to transition from curbside Transit/ HOV lanes to centre rapidway at Highway 7 and Helen Avenue intersectionsNo anticipated change to VIVA service in the interim as bus bays will mitigate delays from YRT transit boardings / alightings. No proposed VIVA transit stations confirmed for Kennedy Road corridorWith increased YRT service in the Frequent Transit Network, potential for delays to VIVA transit in the longer term
Improve Public Transit Services - Compatibility for Future LRT	<ul style="list-style-type: none">Centre Rapidway lanes protect for future transition to LRT and minimize reconstruction		<ul style="list-style-type: none">ROW would protect for future LRT system; however, it would require significant reconstruction
Reduce Traffic Congestion, Delays, and Travel Distance	<ul style="list-style-type: none">Significant congestion as only two general purpose lanes in each direction providedResults in discontinuous Transit / HOV network	<ul style="list-style-type: none">Delays at signalized intersections resulting from transit priority signals for rapidway and protected left turn phasesImproved operations with increasing capacity to meet future demands with widening for additional Transit/HOV lanesResults in continuous Transit / HOV network	<ul style="list-style-type: none">Improved operations with increasing capacity to meet future demands with widening for additional Transit/HOV lanesResults in continuous Transit / HOV network
Create a Pedestrian-Friendly Environment Create a Cyclist-Friendly Environment	<ul style="list-style-type: none">Provides 3.0m MUP in both boulevards to service pedestrians and cyclists		
Improve Safety for all Travel Modes	<ul style="list-style-type: none">Results in longer crossing distances with wider intersection from rapidwayReduced collision potential at intersections with management of potential conflicts and protected left turn; however increased collision potential resulting from traffic congestion and driver frustrationHigh potential for improved cyclist and pedestrian safety due to provision of dedicated active transportation facilities, reducing conflict with motorists	<ul style="list-style-type: none">Results in longest crossing distances with wider intersection from rapidway and widened Kennedy RoadReduced collision potential with management of potential conflicts and protected left turns, reduced traffic congestion, and reduced driver frustrationHigh potential for improved cyclist and pedestrian safety due to provision of dedicated active transportation facilities, reducing conflict with motorists	<ul style="list-style-type: none">Results in moderate crossing distances with wider intersection from widened Kennedy RoadReduced collision potential with management of potential conflicts, reduced traffic congestion, and reduced driver frustrationHigh potential for improved cyclist and pedestrian safety due to provision of dedicated active transportation facilities, reducing conflict with motorists
Improve Mode Choice	<ul style="list-style-type: none">Enhanced transit service with RapidwayAll modes are accommodated	<ul style="list-style-type: none">Significantly enhanced transit service with dedicated Transit/HOV lanes and RapidwayAll modes are accommodated	<ul style="list-style-type: none">Enhanced transit service with dedicated Transit/HOV lanesAll modes are accommodated
Summary of Transportation Services	Least Preferred	Most Preferred	Less Preferred
NATURAL ENVIRONMENT			
Protect Designated Natural Areas, Vegetation and Wildlife	<ul style="list-style-type: none">There are no Areas of Natural and Scientific Interest (ANSIs)There are no Provincially Significant Wetlands (PSWs)Moderate impact to manicured vegetation. Disruption to manicured vegetation on both sides of Kennedy RoadPotential for minor impacts on wildlife due to a wider roadway platformWhile highly disturbed, vegetative communities yielding wildlife habitat are generally sparse on both sides of study corridor due to existing land-use	<ul style="list-style-type: none">There are no Areas of Natural and Scientific Interest (ANSIs)There are no Provincially Significant Wetlands (PSWs)Greatest impact to manicured vegetation. Disruption to manicured vegetation on both sides of Kennedy RoadPotential for minor impacts on wildlife due to a widest roadway platformWhile highly disturbed, vegetative communities yielding wildlife habitat are generally sparse on both sides of study corridor due to existing land-use	<ul style="list-style-type: none">There are no Areas of Natural and Scientific Interest (ANSIs)There are no Provincially Significant Wetlands (PSWs)Moderate impact to manicured vegetation. Disruption to manicured vegetation on both sides of Kennedy RoadPotential for minor impacts on wildlife due to a wider roadway platformWhile highly disturbed, vegetative communities yielding wildlife habitat are generally sparse on both sides of study corridor due to existing land-use
Storm and Groundwater Management	<ul style="list-style-type: none">Moderate impact with increased roadway width and hard surface area to accommodate rapidway lanes and active transportation facilities, stormwater quantity will increase and quality mitigation may be required; however, can be addressed through designModerate impact to shallow groundwater system due to potential increase in contaminants related to increased roadway width (i.e. road salt, etc.)	<ul style="list-style-type: none">Significant impact with increased roadway width and hard surface area to accommodate additional Rapidway, Transit/HOV lanes and active transportation facilities, stormwater quantity will increase and quality mitigation may be required; however, can be addressed through designSignificant impact to shallow groundwater system due to potential increase in contaminants related to increased roadway width (i.e. road salt, etc.)	<ul style="list-style-type: none">Moderate impact with increased roadway width and hard surface area to accommodate additional Transit/HOV lanes and active transportation facilities, stormwater quantity will increase and quality mitigation may be required; however, can be addressed through designModerate impact to shallow groundwater system due to potential increase in contaminants related to increased roadway width (i.e. road salt, etc.)
Improve Air Quality	<ul style="list-style-type: none">Reduction to air quality from increased congestion and emissionsLess reliance on automobiles through increased mode choice and provision of only 4 general purpose lanes and rapidway	<ul style="list-style-type: none">Moderate improvement to air quality through increased high-occupancy vehicles and transit use, and reduced congestionActive transportation and transit service improvements can reduce dependence on automobile and provide air quality improvements	

CRITERIA	Alternative 1: Median VIVA Rapidway with AT facilities (YRRTC EA modified)	Alternative 2: Median VIVA Rapidway with Transit/HOV curb lanes, with AT facilities	Alternative 3: Shift VIVA Rapidway to share Transit/HOV curb lane, with AT facilities
	<ul style="list-style-type: none">Active Transportation facilities and rapidway transit service improvements can reduce dependence on automobile and provide air quality improvements		
Minimize Effects on Climate Change	<ul style="list-style-type: none">Limited improvements for YRT transit service as YRT service accessing curbside stops operate within general purpose lanes; opportunities for YRT service to be provided through median rapidway. Increased emissions from congestion but limited to four GPL provide effects on climate change (i.e. potential to increase greenhouse gas emissions)Opportunities for implementation of tree plantings and Low Impact Development stormwater management strategies as part of road improvements do not improve the study corridor resiliency to climate change	<ul style="list-style-type: none">Less reliance on automobiles through increased mode choice and decreased congestion can minimize effects on climate change (i.e. by reducing greenhouse gas emissions)Opportunities for implementation of tree plantings and Low Impact Development stormwater management strategies as part of road improvements can improve the study corridor resiliency to climate change	
Summary of Natural Environment	Less Preferred	Least Preferred	Most Preferred
SOCIAL ENVIRONMENT			
Minimize Impacts on Existing Residential, Institutional and Recreational Dwellings / Properties	<ul style="list-style-type: none">No residential impacts or displacement		
Improve access to Residential Areas, Institutional and Recreational Facilities	<ul style="list-style-type: none">Increased traffic congestion will impact access to residential areas and intersectionsModerate temporary impacts during construction to driveways/access points as there commercial properties with direct accessAllows for left-turn access at all signalized intersections, other accesses restricted to RIROSignalized intersections are accommodated at existing locations: Highway 7, Avoca Drive, South Unionville / Unionville Gate, and Helen Avenue	<ul style="list-style-type: none">Reduced traffic congestion will improve access to residential areas and intersectionsModerate temporary impacts during construction to driveways/access points as there are commercial properties with direct accessAllows for left-turn access at all signalized intersections, other accesses restricted to RIROSignalized intersections are accommodated at existing locations: Highway 7, Avoca Drive, South Unionville / Unionville Gate, and Helen Avenue	
Minimize Traffic Noise	<ul style="list-style-type: none">Noise levels are anticipated to increase with future traffic growth and lanes in closer proximity to propertiesYork Region’s Retrofit Program for noise mitigation would need to satisfy retrofit criteria	<ul style="list-style-type: none">Noise levels are anticipated to increase with future traffic growth and lanes in closest proximity to propertiesYork Region’s Retrofit Program for noise mitigation would need to satisfy retrofit criteria	<ul style="list-style-type: none">Noise levels are anticipated to increase with future traffic growth and lanes in closer proximity to propertiesYork Region’s Retrofit Program for noise mitigation would need to satisfy retrofit criteria
Preserve Archaeological and Cultural Heritage Features	<ul style="list-style-type: none">No impacts to cultural heritage feature propertiesNo impacts to areas of previous disturbance with low archaeological potential		
Improve Visual Aesthetics	<ul style="list-style-type: none">Visual aesthetics will be moderately reduced due to increased pavement width for Rapidway and active transportation facilitiesVisual aesthetics can be greatly improved through localized tree plantings and other boulevard treatments wherever possible within ROW, with opportunities for streetscaping in both boulevards and rapidway streetscaping	<ul style="list-style-type: none">Visual aesthetics will be significantly reduced due to increased pavement width for Rapidway, Transit/HOV lanes and active transportation facilitiesVisual aesthetics can be improved through localized tree plantings and other boulevard treatments wherever possible within ROW, with opportunities for streetscaping in both boulevards and rapidway streetscaping	<ul style="list-style-type: none">Visual aesthetics will be moderately reduced due to increased pavement width for Transit/HOV lanes and active transportation facilitiesVisual aesthetics can be improved through localized tree plantings and other boulevard treatments wherever possible within ROW, with greatest opportunities for streetscaping in both boulevards and limited opportunities for median landscaping due to left turn lanes
Improve Community Character	<ul style="list-style-type: none">Community character will be moderately improved through the provision of improved transit (Rapidway), cycling and pedestrian facilitiesCommunity connectivity will be reduced due congestion for vehicles and potential reduction in efficiency for YRT service unless operating from median rapidway, but improved for rapidway vehicles from reduced rapidway service delays	<ul style="list-style-type: none">Community character will be significantly improved through the provision of improved transit (Rapidway and YRT), cycling, and pedestrian facilitiesCommunity connectivity will be significantly improved due to improved traffic flow and reduction of transit service delays	<ul style="list-style-type: none">Community character will be moderately improved through the provision of improved transit, cycling, and pedestrian facilitiesCommunity connectivity will be moderately improved due to improved traffic flow and reduction of transit service delays
Summary of Social Environment	Less Preferred	Least Preferred	Most Preferred
INFRASTRUCTURE DESIGN			
Minimize Utility Relocation	<ul style="list-style-type: none">Moderate to significant impact to utility relocation to accommodate additional Rapidway lanes and active transportation facilities	<ul style="list-style-type: none">Significant impact to utility relocation to accommodate additional Transit/HOV lanes, Rapidway and active transportation improvements	<ul style="list-style-type: none">Moderate to significant impact to utility relocation to accommodate additional Transit / HOV lanes and active transportation improvements
Minimize Disruption Due to Construction	<ul style="list-style-type: none">Moderate impacts to roadway users and surrounding property owners to construct additional lanes for active transportation facilities	<ul style="list-style-type: none">Significant impacts to roadway users and surrounding property owners to construct additional Transit / HOV lanes, additional lanes for Rapidway, and active transportation facilities	<ul style="list-style-type: none">Moderate impacts to roadway users and surrounding property owners to construct additional Transit/HOV lanes and active transportation facilities

CRITERIA		Alternative 1: Median VIVA Rapidway with AT facilities (YRRTC EA modified)	Alternative 2: Median VIVA Rapidway with Transit/HOV curb lanes, with AT facilities	Alternative 3: Shift VIVA Rapidway to share Transit/HOV curb lane, with AT facilities
Minimize Constructability Complexity		<ul style="list-style-type: none">• Moderate construction complexity due to widening for construction of Rapidway and active transportation facilities	<ul style="list-style-type: none">• Significant construction complexity due to widening for construction of Rapidway, Transit / HOV lanes and AT facilities	<ul style="list-style-type: none">• Low construction complexity due to widening for construction of Transit / HOV lanes and AT facilities
Summary of Infrastructure Design		Less Preferred	Least Preferred	Most Preferred
ECONOMIC ENVIRONMENT AND COST EFFECTIVENESS				
Accommodate planned Development and Growth		<ul style="list-style-type: none">• Partially supports approved development in the study area as no capacity improvements provided but improved transportation choices to accommodate planned growth with rapidway and active transportation facilities	<ul style="list-style-type: none">• Supports approved development in the study area by providing adequate capacity and transportation choices to accommodate planned growth	
Minimize Impacts on Business Properties		<ul style="list-style-type: none">• No anticipated loss of business parking• Moderate-minor property requirements in both boulevards• No anticipated business displacement	<ul style="list-style-type: none">• Significant loss of business parking on west side; minor loss of business parking on east side• Significant property requirements from west boulevard; minor property impacts to east boulevard• Anticipated business displacement	<ul style="list-style-type: none">• No anticipated loss of business parking• Moderate property requirements from west boulevard; minor property impacts to east boulevard• No anticipated business displacement
Improve Access to Businesses and Key Employment Areas		<ul style="list-style-type: none">• Reduced access at commercial driveways, employment areas and cross-streets due to increased traffic congestion• Improved transit, pedestrian and cycling access• Allows for left-turn access at all signalized intersections, other accesses restricted to RIRO• Signalized intersections are accommodated at existing locations: Highway 7, Avoca Drive, South Unionville / Unionville Gate, and Helen Avenue	<ul style="list-style-type: none">• Improved access at commercial driveways, employment areas and cross-streets due to reduced traffic congestion• Improved transit, pedestrian, and cycling access• Allows for left-turn access at all signalized intersections, other accesses restricted to RIRO• Signalized intersections are accommodated at existing locations: Highway 7, Avoca Drive, South Unionville / Unionville Gate, and Helen Avenue	
Maximize Construction Value		<ul style="list-style-type: none">• Moderate-significant capital cost for construction of Rapidway and AT facilities• Provides improvements for all travel modes	<ul style="list-style-type: none">• Significant capital cost for construction of Rapidway, widening for Transit/HOV lanes and AT facilities• Provides improvements for all travel modes	<ul style="list-style-type: none">• Moderate capital cost for construction of widening for Transit/HOV lanes and AT facilities• Provides improvements for all travel modes
Minimize Property Requirements		<ul style="list-style-type: none">• Reduced potential for property acquisition along the study corridor	<ul style="list-style-type: none">• Significant potential for property acquisition along the study corridor requiring business displacement at three properties	<ul style="list-style-type: none">• Potential for property acquisition along the study corridor
Minimize Operating Costs		<ul style="list-style-type: none">• Moderate to significant increase in operating costs with additional roadway width (additional lanes for Rapidway) to maintain• Minor increase in operating costs to maintain active transportation facilities	<ul style="list-style-type: none">• Significant increase in operating costs with additional roadway width (additional lanes and Rapidway) to maintain• Minor increase in operating costs to maintain active transportation facilities	<ul style="list-style-type: none">• Moderate increase in operating costs with additional roadway width (additional lanes and rapidway) to maintain• Minor increase in operating costs to maintain active transportation facilities
Summary of Economic Environment and Cost Effectiveness		Less Preferred	Least Preferred	Most Preferred
RECOMMENDATIONS		Ultimate Vision This option provides continuous pedestrian and cyclist facilities with street planting opportunities throughout while minimizing potential impacts to businesses (property and parking loss), and no anticipated business displacement. This option will result in increased congestion in the general purpose lanes but allows for VIVA buses to operate within the median rapidway and protects for future LRT. This option may negatively impact YRT service if operating from curb side transit stops from congested general purpose lanes, but has the potential to mitigate this impact if YRT operates from the median rapidway.	Not carried forward This option provides continuous pedestrian and cyclist facilities with street planting opportunities throughout but requires significant impacts to businesses (property and parking loss), and requires business displacement. This option reduces congestion and provides transit connectivity for YRT in Transit / HOV lanes. It allows for VIVA buses to operate within the median rapidway and protects for future LRT.	Recommended This option provides continuous pedestrian and cyclist facilities with street planting opportunities throughout. It requires minimal impacts to businesses (property requirements), and no business displacement. This option reduces congestion and provides transit connectivity for YRT buses in Transit/HOV lanes; however, VIVA buses are required to share the Transit/HOV lanes.

Based on the findings of the evaluation it was determined that:

- **(Alternative 1) Median VIVA rapidway without the Transit/HOV curb lane** is **carried forward** as the ***Ultimate Vision***, as although it will result in a discontinuous Transit/HOV network, potential delays to YRT service from congestion operating within the two general purpose lanes has the potential to be mitigated if operating out of median rapidway. The dedicated median VIVA rapidway protects for future opportunities to implement higher order transit service (light rail transit) within the median in the longer term, continuous AT facilities and streetscaping opportunities while balancing impacts to the Kennedy Road corridor.
- **(Alternative 2) Median VIVA Rapidway with Transit/HOV curb lanes** is **not recommended**, as although a dedicated median VIVA rapidway protects for future opportunities to implement higher order transit service (light rail transit) within the median in the longer term and continuity of the Transit/HOV network along Kennedy Road, there are limited opportunities to provide streetscaping and sufficient boulevard widths without significant impacts to the Kennedy Road corridor.
- **(Alternative 3) Shift VIVA Rapidway to share Transit/HOV curb lane** is **carried forward** by York Region as ***Recommended***, as it allows for YRT and VIVA to service the corridor while minimizing impacts, and provides for continuity of the Transit/HOV network, AT facilities and streetscaping opportunities along Kennedy Road

Typical Cross-Sections (Alternative 1 - Ultimate Vision and Alternative 3 - Recommended)

In consultation with YRRTC there is a need to identify the right-of-way required to protect for Alternative 1 as the Ultimate Vision for the future that is based on minimizing the amount of re-construction and future utility relocations from Alternative 3 – Recommended to construct Alternative 1 – Ultimate Vision. The following was developed based on the design approach to maintain the boulevards from Alternative 3 at the time of re-construction for Alternative 1.

To develop the recommended typical sections for Alternatives 1 and 3, a screening exercise was undertaken to review the required elements and associated widths. This was then used to inform the development of typical cross-section.

DESIGN PARAMETERS

Key design parameters to inform the decision making are provided in **Table 3** and are based on a review of YRRTC's vivaNext 6-lane Roadway Cross-section minimum and maximum widths, alongside desirable widths for Transit/HOV lanes, active transportation facilities and streetscaping opportunities. Combinations of various parameters were considered.

Table 3: Cross-Section Key Design Parameters

ELEMENT	WIDTH / CLEARANCE	SOURCE/NOTES
Right-of-Way (designated)	Up to 45 m between YMCA Boulevard and Highway 7	Map 12 of the Region's Official Plan, 2010
<i>Transitway and Roadway Elements</i>		
Rapid Transit Lane	3.5 m, one in each direction	YRRTC vivaNext 6-lane Roadway
Buffers to Rapid Transit Lanes	0.3m painted buffer (minimum) 0.5m painted buffer (maximum) 1.0m physical buffer	OPSD 600.080 Discussions with YRRTC and YR to prevent non-rapidway vehicles crossing the median rapidway
Median / Station to Rapidway Lanes	1.4m to 4.0 m concrete median 0.25 m curb & gutter to median (maximum)	YRRTC vivaNext 6-lane Roadway
Lane Widths	3.3m through lanes 3.5 m Transit/HOV lanes 3.3 m auxiliary left-turn lane, adjacent to 0.3m painted buffer (minimum) 3.5m auxiliary left turn lane, adjacent to 0.5m painted buffer (desired).	Section 5.1 of Towards Great Regional Streets, 2008 YRRTC vivaNext 6-lane Roadway
<i>Boulevard Elements</i>		
Curb and Gutter	0.30m	OPSD 600.040 modified
Boulevard Cycle Track	1.9m adjacent to 0.61m continuity strip	YRRTC vivaNext 6-lane Roadway
Furnishing Zone /	2.35m	YRRTC vivaNext 6-lane Roadway
Planting Zone /	3.5m	Discussions with York Region Internal Team
Above-Ground Utility Zone	2.0 m minimum (1.0 m from back of curb to edge of pole; 0.7 m maximum pole diameter; 0.3 m minimum buffer from edge of pole to edge of AT facility)	Discussions with York Region Internal Team
Sidewalk	2.0m desirable Minimum 1.5 m (additional 0.5 m if adjacent to curb)	YRRTC vivaNext 6-lane Roadway Section 5.6 of Towards Great Regional Streets, 2008
Multi-Use Path	3.0 m (ideal) – Minimum 2.4 m at constrained locations (additional 0.5 m if adjacent to curb)	Ontario Traffic Manual – Book 18, 2013
Rounding	0.3 m to 0.6m	YRRTC

DESIGN APPROACH

Upon review of the various design parameters, the following design approach was proposed to inform the typical section options:

- AT facility type consistent with Kennedy Road EA corridor (3.0m MUP) for continuity
- Opportunities for streetscaping and above-ground utility zones

Alternative 1 Considerations:

- Two 3.5m Median Transitway Lanes
- One 3.3m through lane and a 3.5m curb lane
- Consistent width allocated for left turn lane with buffer and opposing station / platform width at intersections; minimum platform width of 4.0m
- 1.0m physical buffer on one side of the rapidway to prevent non-rapidway vehicles from crossing the median rapidway; 0.5m painted buffer on other side

Alternative 3 Considerations:

- Two 3.3m through lanes and a 3.5m curb Transit/HOV lane

TYPICAL SECTION(S)

The existing right-of-way for Kennedy Road between YMCA Boulevard and Highway 7 ranges from 36m north of Castan Avenue to 43m south of Castan Avenue, and the Official Plan designated right-of-way is 45m. Various combinations of the identified design parameters were considered to develop typical section options at the midblock and intersections. These options were reviewed against opportunities to acquire additional ROW for the improvements, while minimizing the resulting impacts to surrounding businesses and other properties.

Typical sections were developed for the Ultimate Vision (Alt 1 - Rapidway + 4 GPL + AT facilities) and a design for Six Lanes with Transit / HOV + AT facilities. These options were compared to establish the Recommended (Alt 3 – Six Lane Transit / HOV + AT facilities) Typical Section on the premise of maintaining the boulevards from the Ultimate Vision (Alt 1) to minimize future reconstruction and utility relocations. Additional width to implement the Ultimate Vision from the Recommended is allocated to a wider centre median. The sections are provided in **Exhibit 4** through **Exhibit 9**.

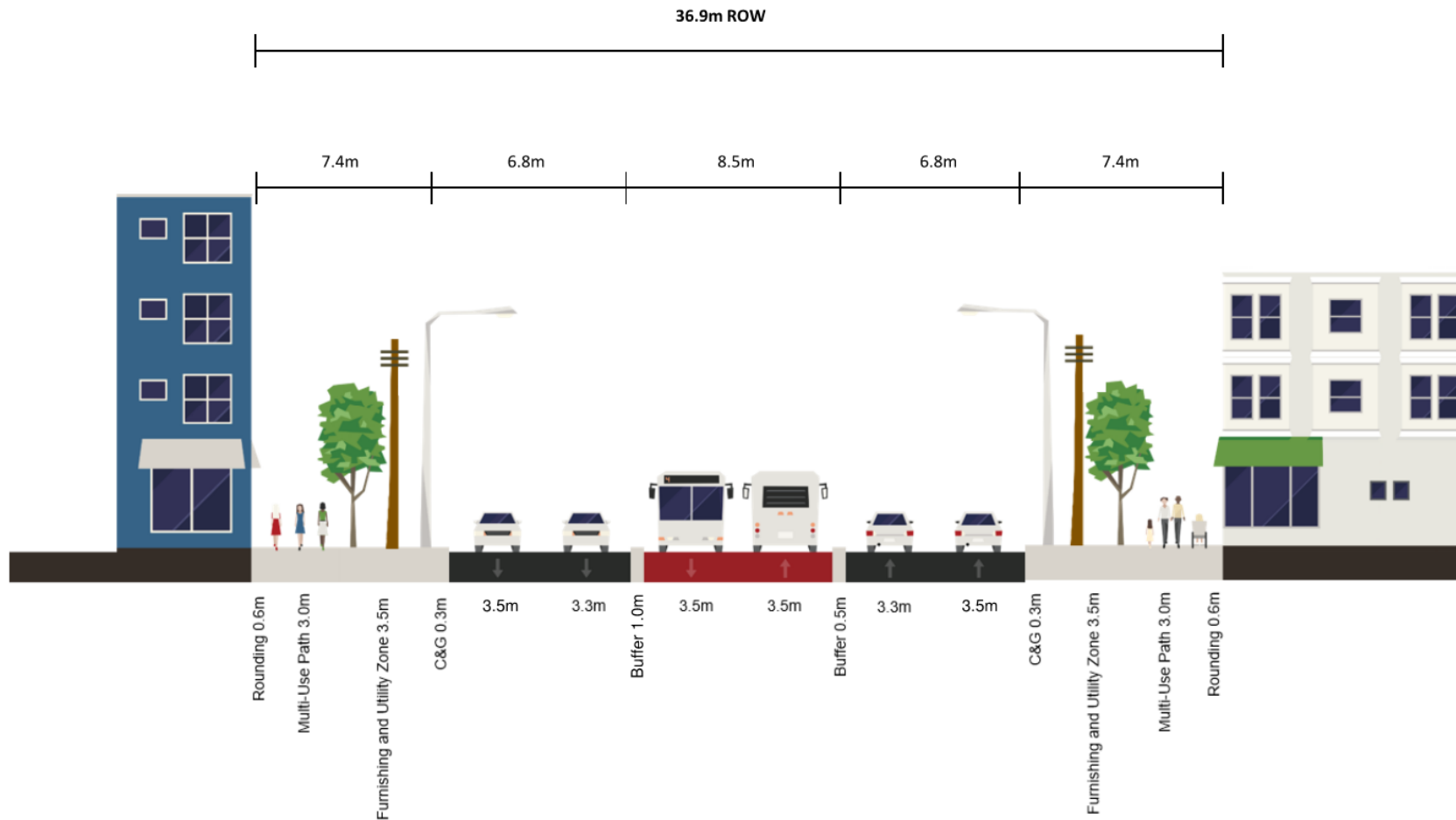


Exhibit 4: ULTIMATE VISION Midblock Typical Section – Rapidway with 4 GPL with AT facilities

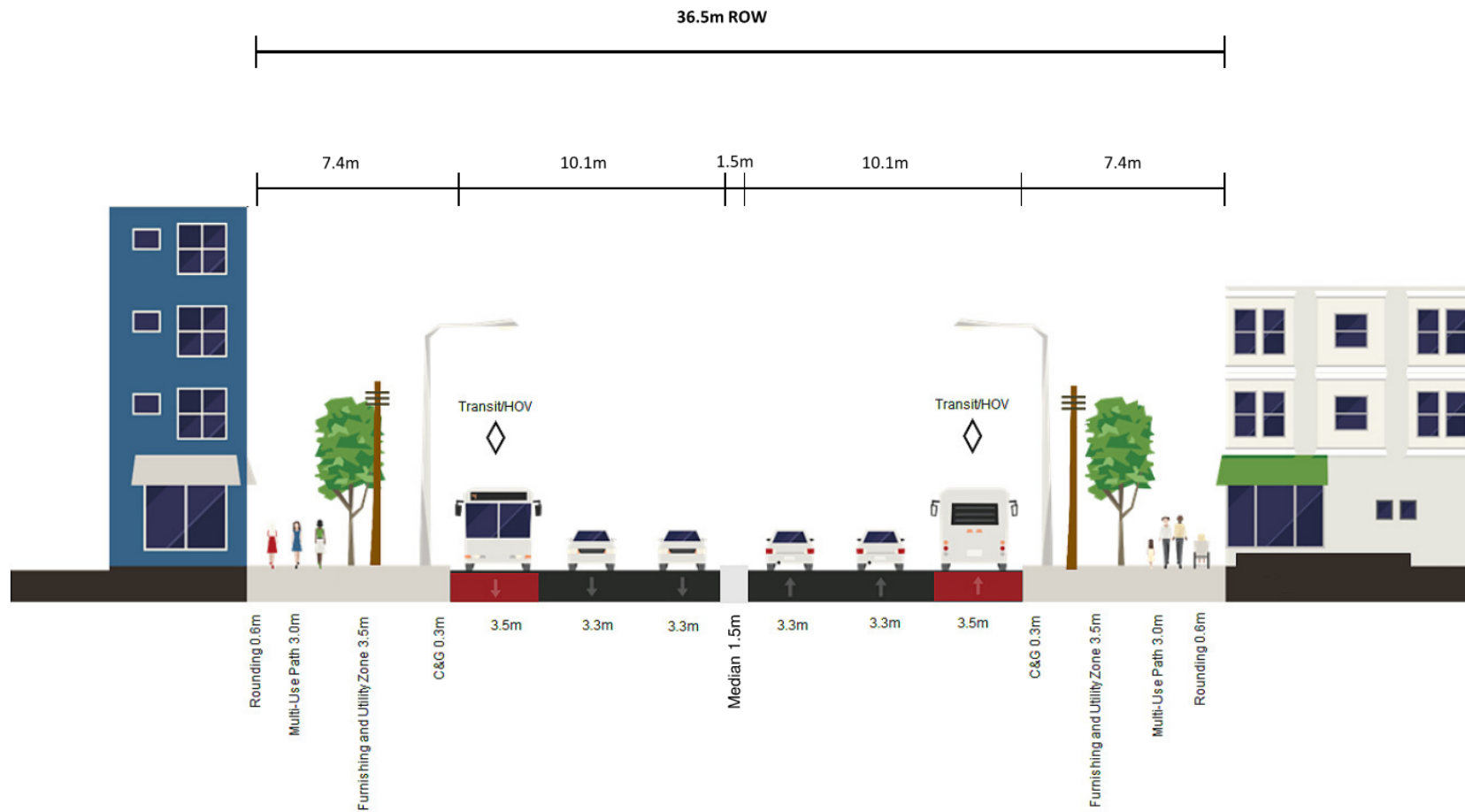


Exhibit 5: Midblock Typical Section – Six Lanes for Transit / HOV with AT facilities

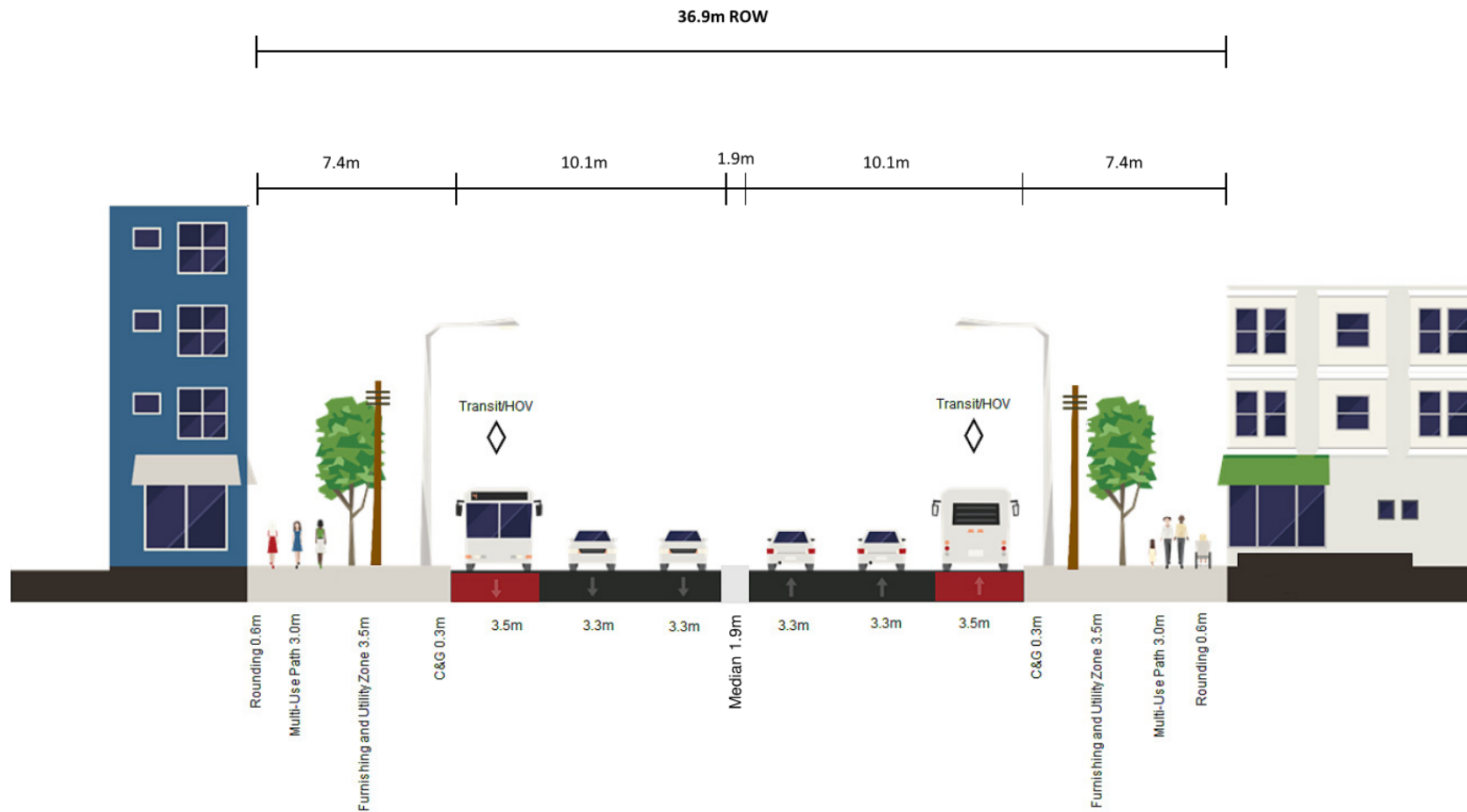


Exhibit 6: RECOMMENDED Midblock Typical Section – Six Lanes for Transit / HOV with AT facilities for Future Conversion

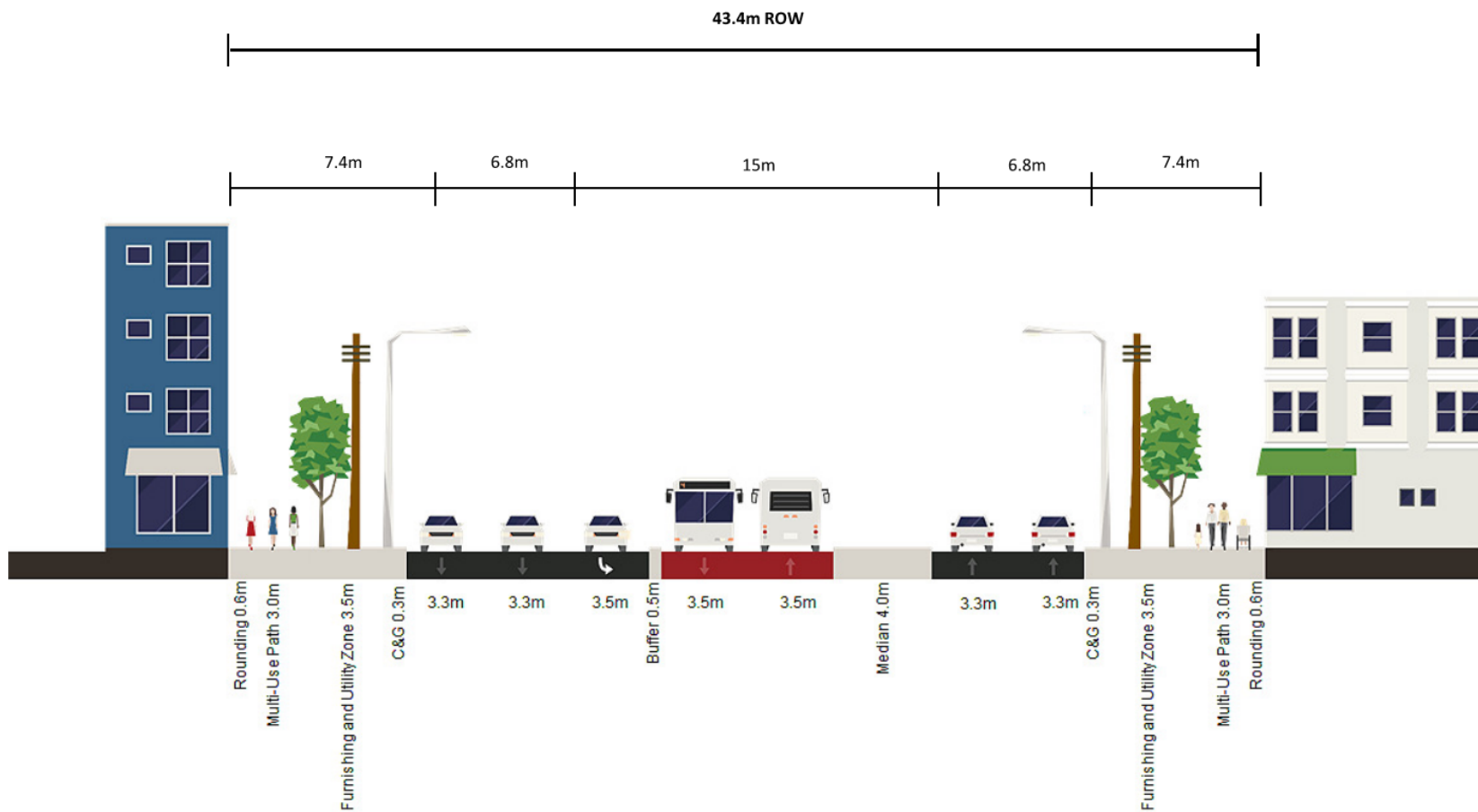


Exhibit 7: ULTIMATE VISION Intersection / Station Typical Section – Rapidway with 4 GPL with AT facilities

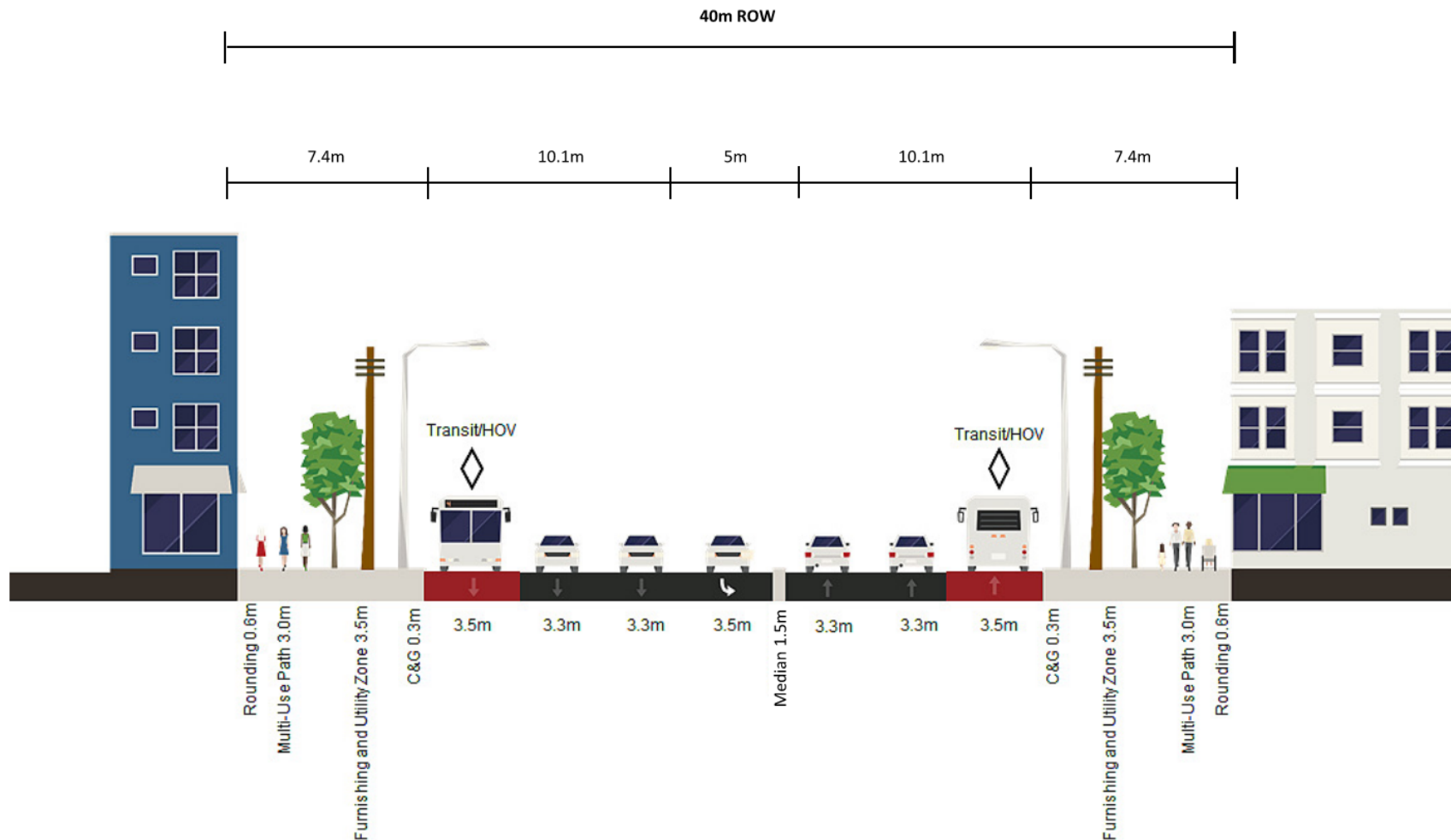


Exhibit 8: Intersection Typical Section – Six Lanes for Transit / HOV with AT facilities

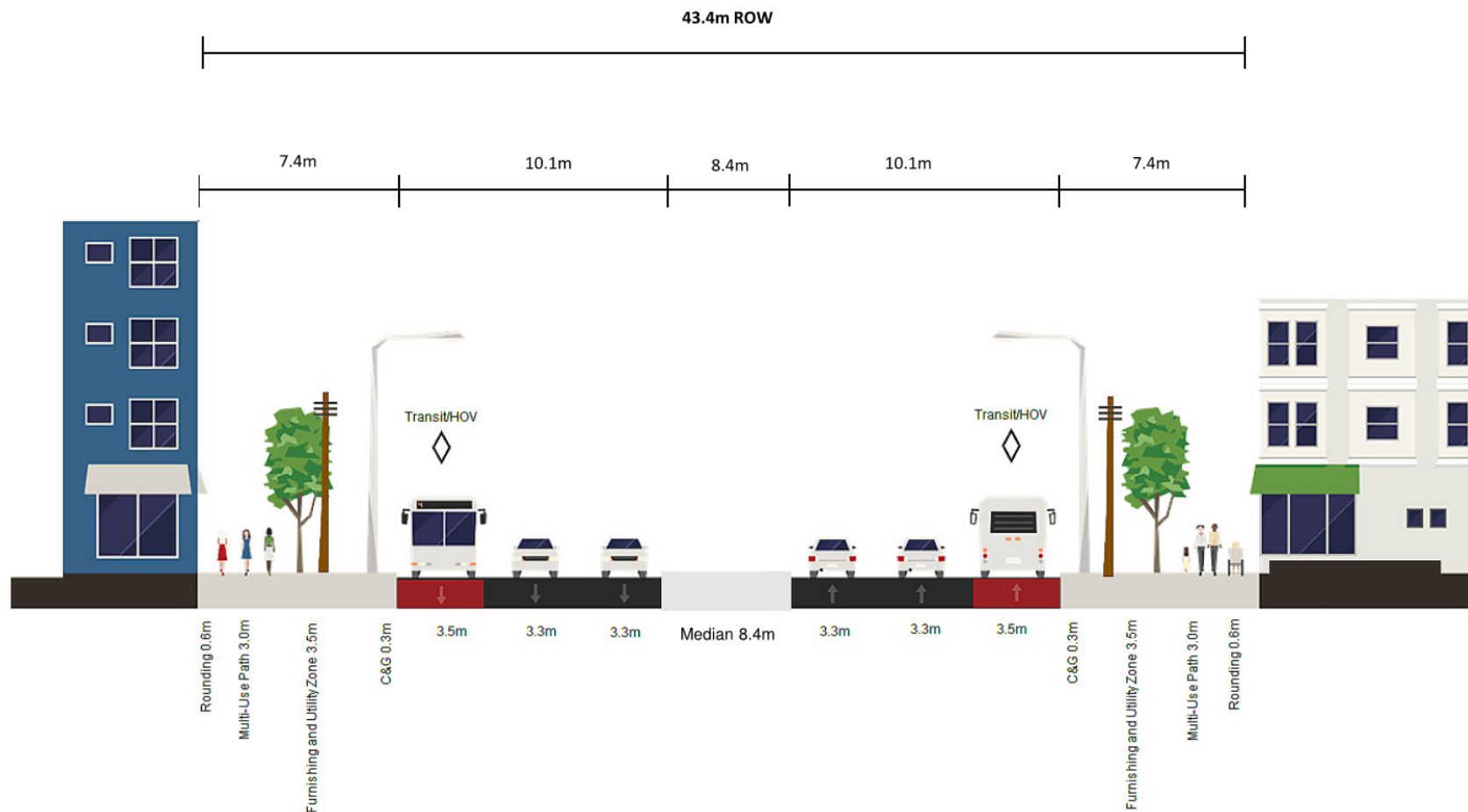


Exhibit 9: RECOMMENDED Intersection Typical Section – Six Lanes for Transit / HOV with AT facilities for Future Conversion

Summary of Recommendations:

Based on the assessment of the corridor, **(Alternative 3) Shift VIVA Rapidway to share Transit/HOV curb lane** is the **Recommended** option as it allows for YRT and VIVA to service the corridor while minimizing impacts, and provides for continuity of the Transit/HOV network, AT facilities and streetscaping opportunities along Kennedy Road. **(Alternative 1) Median VIVA Rapidway** is identified as the **Ultimate Vision** based on maintaining the boulevards of Alternative 3 and reconstructing and re-designating the travel lanes and median as per the recommended typical sections (see **Exhibit 10**). At the time of implementation of the Ultimate Vision, YRRTC in consultation with YRT and YR will review and confirm the identified elements and associated widths and impacts and revise as required based on the information and design standards available at the time.

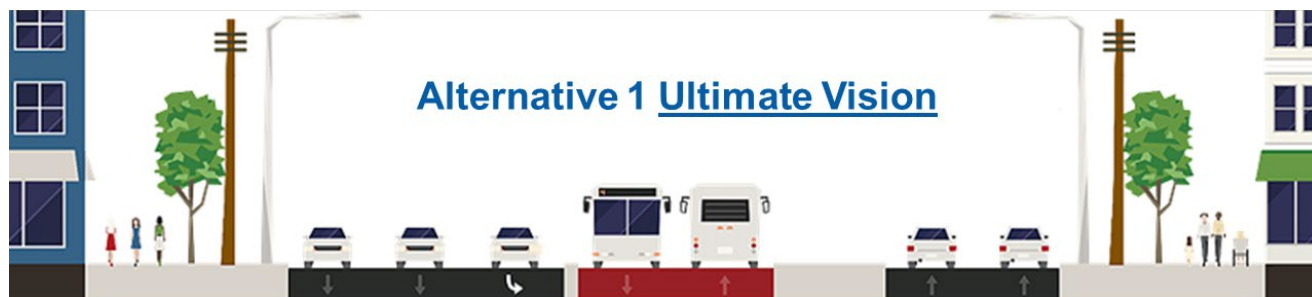


Exhibit 10: RECOMMENDED and ULTIMATE VISION Typical Sections