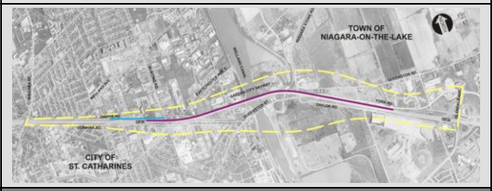
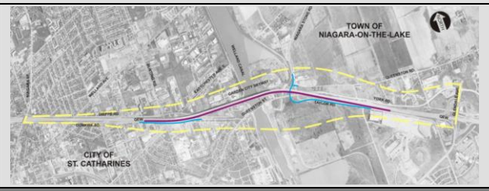
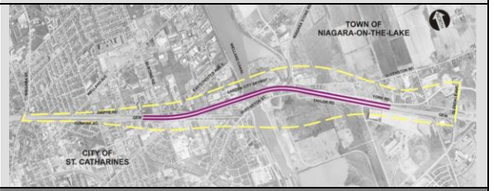
Widening Alternatives

Alternatives Evaluation - Widening Alternative

Alternative Type				Widening		
Alternative Identifier				**W1**	**W2**	**W3**
Description				**Widen to the North**	**Widen to the South**	**Widen to Both Sides**
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
1.0 Socio-Economic Environment						
1.1 Property and Property Access	1.1.1 Property and Property Access	• Municipal land use information • Approved development plans	a) Number of properties directly impacted	Number of impacted properties by type: Residential: 0 Commercial: 12 Industrial: 4 Open Space: 4 (includes 1 MTO property) Utility: 0 Agricultural: 0 Total: 20	Number of impacted properties by type: Residential: 0 Commercial: 6 Industrial: 2 Open Space: 6 (includes 2 MTO properties) Utility: 1 Agricultural: 0 Total: 15	Number of impacted properties by type: Residential: 0 Commercial: 2 Industrial: 0 Open Space: 3 (includes 1 MTO property) Utility: 0 Agricultural: 0 Total: 5
			b) Number of residences potentially displaced	None anticipated.		
			c) Qualitative assessment of changes to residential property access	No changes anticipated to residential property access.		
			d) Number of businesses potentially displaced	1 business potentially displaced.	None anticipated.	1 business potentially displaced.
			e) Qualitative assessment of changes to business property access	No major changes to business property access; several businesses along Dieppe Road will require minor modifications to entrances.	No major changes to business property access; several businesses along Dunkirk Road and two businesses on Niagara Stone Road will require minor modifications to entrances.	No changes anticipated.
			f) Number of roads closed	No road closures		
Summary – Property and Access				All alternatives result in no road closures, no changes to residential access and no displacements of residential property. Alternative W3 results in the fewest property impacts. Alternatives W1 and W2 would result in minor modifications to a number of business entrances, while Alternative W3 would not result in any changes to business entrances. Alternatives W1 and W3 result in the potential displacement of one business. As a result, from a property and access perspective, **Alternative W3 is preferred**.		
1.2 Community Effects	1.2.1 Community facilities (cemeteries, schools, places of worship, recreation centres)	• Municipal land use information • Approved development plans	a) Number of cemeteries directly impacted or potentially displaced	None		
			b) Number of schools directly impacted or potentially displaced	None		
			c) Number of places of worship directly impacted	None		

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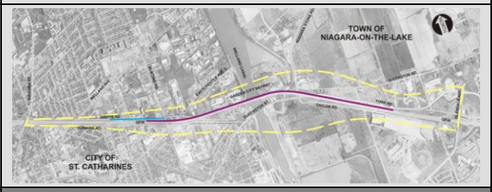
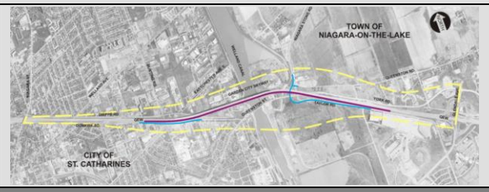
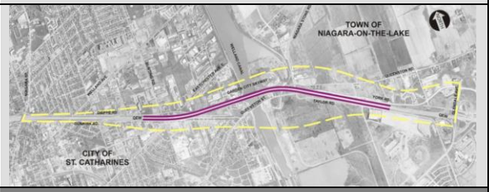
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
			or potentially displaced			
			d) Number of recreation centres directly impacted or potentially displaced	One; Niagara Ball Hockey Club is potentially displaced.	None	
			e) Qualitative assessment of changes to access to community facilities (cemeteries, schools, places of worship, recreation centres)	Minor impacts to access to the Niagara Ball Hockey Club during construction. Property directly impacted by widened bridge footprint; however, it may be possible to avoid displacement of the business.	None	
	1.2.2 Recreational and Tourist Features	• Municipal land use information • Approved development plans	a) Number of parks and trails directly impacted	One; no impacts to parks and minor impacts to trails during construction.		
		• Input from the St. Lawrence Seaway Management Corporation and Transport Canada	b) Impacts to recreational boating traffic within the Welland Canal	No significant impacts anticipated.		
		• Input from the Ministry of Tourism and Culture	c) Impacts to the Tourism Information Centre	Impacts to TIC building and access; reconstruction and/or relocation required.	No impact.	TIC access and 'through' driveway impacted; no direct impacts to building. In order to maintain TIC in its existing building, major access modifications would be required, either by: 1) Removing freeway access; access would be from York Road only, or 2) Shifting existing TIC freeway on- and off-ramps and TIC 'through' driveway to the north of the existing building (currently, these features are on the south side of the existing building). This would require a realignment of York Road to the north, and this would require additional private property. Alternatively, the TIC could be reconstructed and/or relocated.

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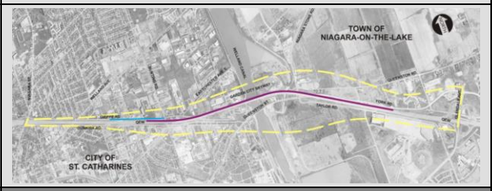
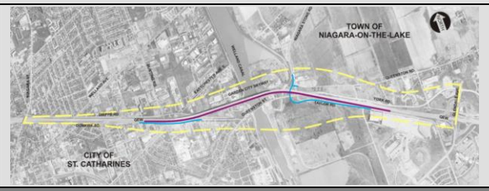
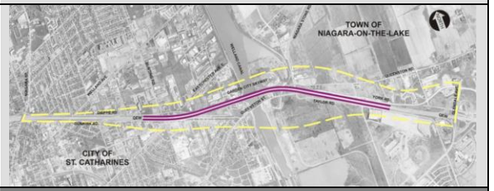
SKETCH						
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	1.2.3 Land Use Opportunities	• Municipal planning departments	a) Potential for new development opportunities	Same opportunities for new land use as with existing structure.		
	1.2.4 Agricultural Resources	• Topographic maps • Municipal land use information • Approved development plans	a) Impact on local agricultural resources using quantitative measure of area (ha)	None		
			b) Number of agricultural operations directly impacted	None		
	1.2.5 Approved local, Regional, and Provincial plans and policies	• Municipal land use information • Approved development plans • Official Plans • Secondary Plans • Niagara Escarpment Plan • Greenbelt Plan	a) Assessment of conformity with approved local, Regional, and Provincial plans and policies	Conforms with Greenbelt Plan polices regarding new infrastructure; conforms to the Niagara Region Policy Plan.		
Summary – Community Effects				For many of the criteria there is no difference between the alternatives. Only Alternative W1 would impact a recreational facility and access to that facility (Niagara Ball Hockey Club). Alternative W2 does not impact the Tourism Information Centre. Alternatives W1 would directly impact the Tourism Information Centre. Alternative W3 would impact access to the Tourism Information Centre. As a result, **Alternative W2 is preferred** from a community effects perspective.		
1.3 Nuisance Effects	1.3.1 Noise	• Topographic maps • Municipal land use information • Approved development plans	Noise Impact: • Highway alignment shifting towards adjacent NSAs is expected to increase noise levels • Highway alignment shifting away from adjacent NSAs is expected to decrease noise levels. • The approximate number of houses represented by each NSA are:	• Highway alignment shifts north away from NSA 8, NSA 9, NSA 10, NSA 11, which is expected to decrease noise levels • Highway alignment shifts closer to NSA 12 which is expected to increase noise levels	• Highway alignment shifts south towards NSA 8, NSA 9, NSA 10, NSA 11, which is expected to increase noise levels • Highway alignment shifts away from NSA 12 which is expected to decrease noise levels	• Highway alignment is widened north and south (symmetrically) and moves closer to NSA 8, NSA 9, NSA 10, NSA 11, NSA 12, NSA 13, which is expected to increase noise levels

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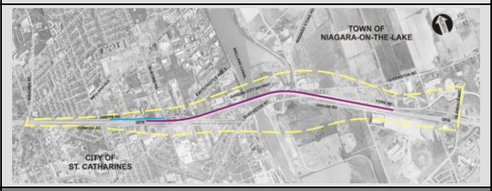
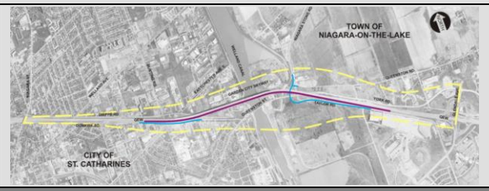
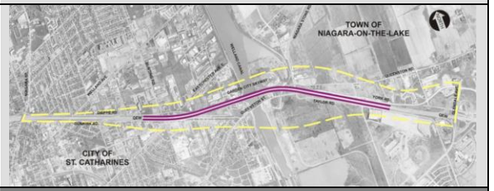
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
			NSA 8: > 50 NSA 9: > 50 NSA 10: > 5 NSA 11: ~ 2 NSA 12: ~ 3 NSA 13: > 10			
	1.3.2 Air quality		a) Qualitative assessment of impacts to air quality (Based on proximity of receptors to bridge/tunnel. More weight was given to residential receptors than to industrial areas as potential receptors)	West bound lanes shift slightly away from residential areas to the south but closer to residences on Queenston Rd. near Niagara Stone Rd. Small mixed effect.	East bound traffic slightly closer to residential areas to the south and slightly farther from residences on Queenston Rd. near Niagara Stone Rd. Small mixed effect.	Both lanes marginally closer to residences on either side of the alignment. Small negative effect.
	1.3.3 Vibration		a) Qualitative assessment of vibration impacts	Operation: • No impacts expected Construction: • With diesel pile driving some vibration may be felt as residences are approximately 45m north of the alternative	Operation: • No impacts expected Construction: • With diesel pile driving some vibration may be felt as residences are approximately 75m north of the alternative	Operation: • No impacts expected Construction: • With diesel pile driving some vibration may be felt as residences are approximately 50m north of the alternative
Summary – Nuisance Effects				Alternative W3 will result in increased noise at six NSAs. Alternative W2 will result in increased noise at four NSAs, including those with the highest number of receptors, and reduced noise at one small NSA. Alternative W1 would result in the least noise impacts as it will result in increased noise at 1 small NSA and reduced noise at four NSAs, including those with the highest number of receptors. Based on this, Alternative W1 is preferred from a noise perspective. Both Alternatives W1 and W2 will result in a small mixed effect to air quality, while Alternative W3 will result in a small negative effect to air quality. No vibration impacts are anticipated during operations. While impacts may occur during construction, those impacts may be reduced through mitigation and will be temporary (limited to pile driving). Due to the distance from residences, Alternative W2 has the least potential for construction vibration-related impact while the impacts of Alternatives W1 and W3 are similar. As a result, **Alternative W1 is preferred** from a nuisance effects perspective.		
Overall Summary – Socio-Economic Environment				From a property and property access perspective, Alternative W3 is preferred as it results in the fewest property impacts. Considering nuisance effects, Alternative W1 is slightly preferred as it results in the greatest decrease in noise levels at adjacent Noise Sensitive Areas (NSAs) and is comparable with Alternative W2 in regards to air quality impacts. Alternative W2 would result in the fewest potential construction-related vibration impacts due to its greater distance from residences. From a community effects perspective, the three alternatives are comparable for many of the criteria, though Alternative W2 is slightly preferred as it avoids impacts to recreation facilities and the Travel Information Centre. However, the potential community and nuisance effects will be more easily mitigated through design and, therefore, more consideration should be given to property and property access impacts. As a result, from a socio-economic perspective **Alternative W3 is slightly preferred**.		

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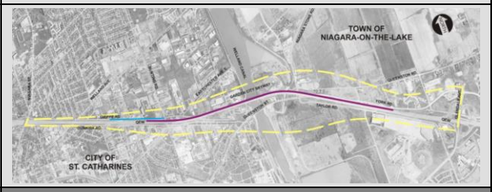
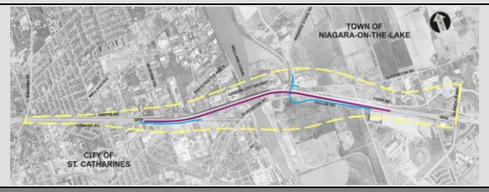
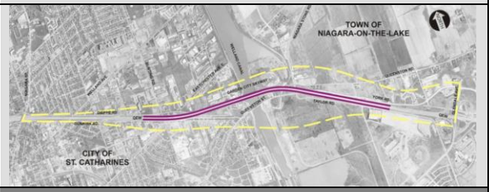
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
2.0 Cultural Environment						
2.1 Archaeology	2.1.1 Archaeological sites	• Stage 1 Archaeological Assessment	a) Impact to known archaeological features or areas of archaeological potential	Impacts areas of archaeological potential.		
2.2 Heritage Features	2.2.1 Built heritage and cultural heritage landscapes	• Heritage Existing Conditions Report for the QEW Garden City Skyway study area • Cultural Heritage Evaluation Report for the QEW Garden City Skyway • Historical mapping and aerial photographs, cemetery lists, municipal, provincial and federal inventories, listings, plaques, easements and designations of National Historic Sites and under the Ontario Heritage Act • Input from other factor areas • Consultation with municipal and regional heritage planning staff or designates, historical societies and other heritage	a) Number of listed built heritage resources (BHR) displaced or disrupted	2 BHR	1 BHR	1 BHR Note: Widening on both sides is a more notable impact to the existing QEW Garden City Skyway Bridge.
			b) Number of cultural heritage landscape (CHL) resources displaced or disrupted	2 CHL	3 CHL	2 CHL

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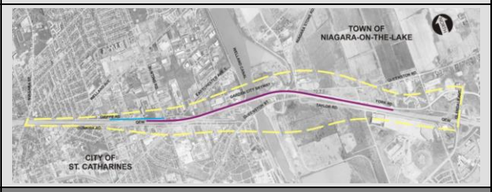
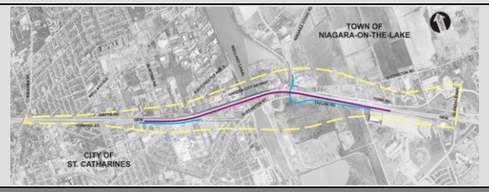
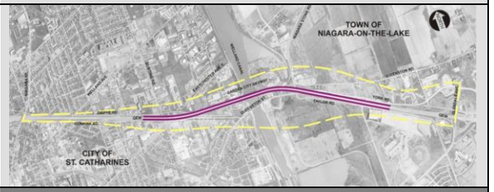
SKETCH						
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		groups as necessary • Municipal heritage inventories for designated and listed built heritage structures • Ontario Genealogical Society for Cemeteries				
Overall Summary – Cultural Environment				All alternatives impact areas of archaeological potential. Alternative W1 impacts the greatest number of built heritage resources but is comparable to Alternative W3 for cultural heritage landscape impacts. Alternative W2 impacts the greatest number of cultural heritage landscapes. Alternative W3 has the greatest impact to the existing QEW Garden City Skyway, a provincial heritage bridge with provincial significance, and is therefore least preferred from a cultural heritage perspective. As a result, from a cultural environment perspective **Alternatives W1 and W2 are equally preferred**.		
3.0 Natural Environment						
3.1 Fisheries and Aquatic Habitat	3.1.1 Fish and fish habitat, considering: • Sensitivity of Fish and Fish Habitat[2] • Relative Magnitude of Potential Effect	• Topographic maps • Watershed Management Plans • Existing information gathered from MNR field studies and fish records, NPCA, Interest Groups, public consultation, municipalities • Reconnaissance-level field assessments • Provincial Policy Statement and	a) Determination of Sensitivity of Fish and Fish Habitat based on evaluation of attributes such as: • presence of any critical/specialized habitat, • presence of habitat for species of conservation concern, including Species At Risk as identified by COSEWIC and COSSARO, • habitat resiliency based on thermal regimes (warm, cool, cold water) and flow regime (DFO Risk	Four watercourses (Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek, and Eight Mile Creek) traverse this bridge alignment. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent.	Four watercourses (Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek, Eight Mile Creek) traverse these bridge and road alignments. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent.	Four watercourses (Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek, Eight Mile Creek) traverse this bridge alignment. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent.

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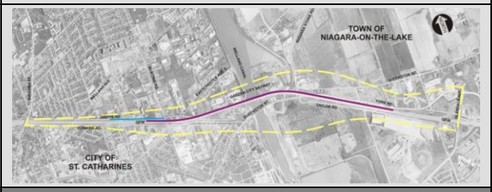
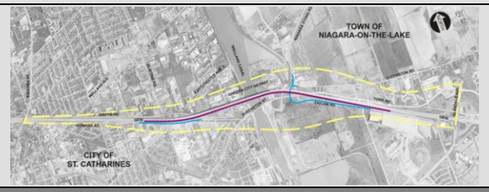
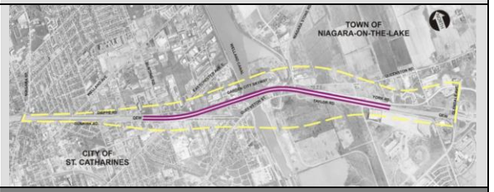
SKETCH						
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		associated MNR Natural Heritage Training Manual • The Fish Community of the Fourth Welland Canal: Welland to Port Colborne (MNR 1998) • MNR (Natural Resource Values Inventory Systems (NRVIS)) mapping) • NHIC (MNR) and Species At Risk mapping (DFO) • Species at Risk Recovery Plans and Management Guidelines	Management Framework 2006, MTO Environmental Guide for Fish and Fish Habitat 2006). b) Determination of Potential works and Impacts (e.g. instream piers, tunnel, need for channel realignment or culvert works).	<u>Widen Bridge to North</u> • Welland Canal – 2 instream piers required. • Tributary of Welland Canal – likely spanned. • Tributary of Eight Mile Creek – extensions required on QEW culvert. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized removal and disturbance of riparian vegetation associated with the pier construction. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized disturbance and removal of riparian vegetation and temporary alteration of channel banks and bed. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.	<u>Widen Bridge to South</u> • Welland Canal – 2 instream piers required. • Tributary of Welland Canal – likely spanned. • Tributary of Eight Mile Creek – extension required on south side of QEW culvert. <u>Re-alignment of Niagara Stone Road and Taylor Road</u> • Tributary of Welland Canal – channel re-alignment required and possible new culvert under Queenston Street. Also infill of open water wetland area connected to the tributary on south side of Queenston Street. • Tributary of Eight Mile Creek – extension required on south side of Taylor Road culvert. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized disturbance and removal of riparian vegetation associated with the pier construction. The infilling of the open water wetland area (connected to the Tributary of the Welland Canal) will also require displacement of the wetland bed and localized disturbance and removal of riparian vegetation. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized disturbance and removal of	<u>Widen Bridge on Both Sides</u> • Welland Canal – 2 instream piers required. • Tributary of Welland Canal – likely spanned. • Tributary of Eight Mile Creek – extensions required on QEW culvert. • Eight Mile Creek - extensions required on QEW culvert. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized disturbance and removal of riparian vegetation associated with the pier construction. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized disturbance and removal of riparian vegetation and temporary alteration of channel banks and bed. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.

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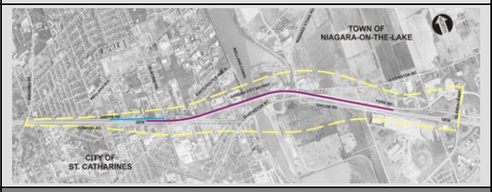
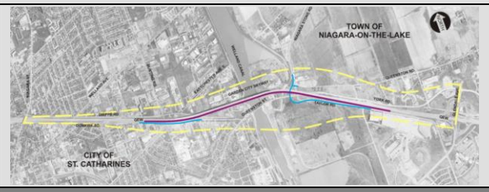
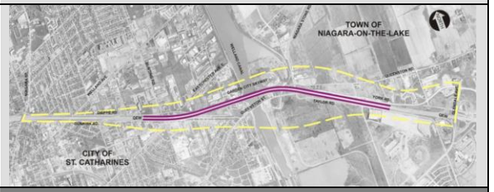
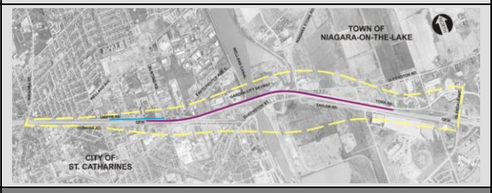
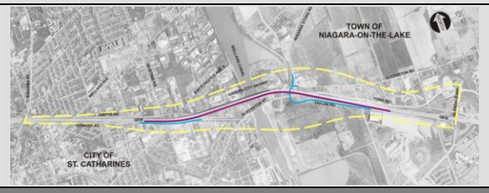
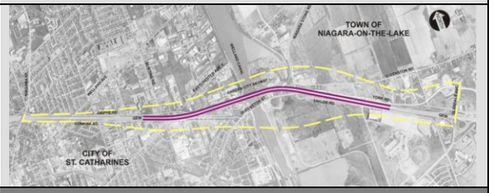
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
					riparian vegetation and temporary alteration of channel banks and bed. Direct impacts of the proposed realignment should be limited to temporary disturbance of the channel and localized disturbance and removal of riparian vegetation. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.	
Summary – Fisheries and Aquatic Habitat				Alternatives W1 and W3 do not require any watercourse realignments, do not require infill of wetland / tributary (fish habitat) and require minor culvert works. Alternative W2 requires tributary realignment and infill of wetland / tributary (fish habitat). As a result, from a fisheries and aquatic habitat perspective **Alternatives W1 and W3 are equally preferred**.		
3.2 Terrestrial Ecosystems	3.2.1 Wetland vegetation communities, considering: • Sensitivity / Quality / Significance of Wetland Vegetation[2] • Habitat Relative Magnitude of Potential Effect	• Topographic maps • MNR NRVIS data • MNR District staff • NHIC/Biodiversity Explorer • Bird Studies Canada/Breeding Bird Atlas • Municipal Official Plans • Existing information gathered from MNR, NPCA, Interest Groups, public consultation, municipalities • Reconnaissance-level field inventories • Species at Risk Recovery Plans and Management	a) Determination of *Sensitivity/Quality/Significance of Wetland* based on designated status (PSW, LSW, unevaluated), supported by evaluation of attributes such as: • Presence of species of conservation concern including Species At Risk as identified by COSEWIC and COSSARO • Presence of potential habitat for SAR • Habitat resiliency based on size, maturity, physical considerations (e.g. drainage, groundwater discharge, slope, etc.)	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • No known wetland communities within W1 alignment footprint • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Very low** potential for wetland-associated SAR within W1 footprint based on habitat types observed and general absence of wetland communities within the alignment footprint.	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • 2 small, young deciduous swamp communities within W2 footprint (Units 14, 16) • 2 areas of regenerating lands with thicket swamp and meadow marsh components within W2 footprint (Units 15, 17) • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Low** potential for wetland-associated SAR within W2 footprint based on habitat types observed. • Affected wetland communities are generally young and/or regenerating from agricultural lands.	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • No known wetland communities within W3 alignment footprint • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Very low** potential for wetland-associated SAR within W3 footprint based on habitat types observed and general absence of wetland communities within the alignment footprint.
			b) Determination of Magnitude of Potential Effect using qualitative assessment of potential impact (edge	<u>Widen Bridge to the North</u> -no known or anticipated impacts to wetland communities ***no realignment of Niagara Stone Road or**	<u>Widen Bridge to the South</u> -edge removal of cultural meadow with meadow marsh components (Unit 17) <u>Realignment of Niagara Stone Rd and Taylor Rd</u>	<u>Widen Bridge to Both Sides</u> -no known or anticipated impacts to wetland communities ***no realignment of Niagara Stone Road, Taylor**

[1] Sources of information for all factor areas include the design alternatives, existing conditions surveys and aerial photography
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Widening		
Alternative Identifier				W1	W2	W3
Description				Widen to the North	Widen to the South	Widen to Both Sides
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
		Guidelines	encroachment versus fragmentation, change to wetland size and shape etc.)	**Taylor Road required** <u>Realignment of Dunkirk Rd</u> -no known or anticipated impacts to wetland communities	-edge removals of young deciduous swamp community (Unit 14) -edge removal of regenerating lands with thicket swamp and meadow marsh components (Unit 15) <u>Realignment of Dunkirk Rd</u> -no known or anticipated impacts to wetland communities	**Road OR Dunkirk Road required**
	3.2.2 Upland Vegetation Communities considering: • Sensitivity / Quality / Significance of Vegetation[2] • Relative Magnitude of Potential Effect		a) Determination of *Sensitivity/Quality/Significance of Upland Vegetation* (including cultural communities) based on evaluation of attributes such as: • Community rarity/sensitivity/tolerance and local representation/distribution on the landscape • Rarity of species (species of conservation concern including Species At Risk as identified by COSEWIC and COSSARO) • Presence of specialized habitat for species of conservation concern • Habitat resiliency based on size, maturity, physical considerations (e.g. drainage, slope, etc.)	• Affected upland communities are generally young cultural woodlands and cultural meadows. • No mature, high quality forest communities were encountered in the vicinity of W1 (based on area accessible). • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.	• Affected upland communities are generally young deciduous forest, cultural woodlands, cultural thicket and cultural meadows. • No mature, high quality forest communities were encountered in the vicinity of W2 (based on area accessible). • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.	• Affected upland communities are generally young cultural woodlands and cultural meadows. • No mature, high quality forest communities were encountered in the vicinity of W3 (based on area accessible). • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.
			b) Determination of Magnitude of Potential Effect using qualitative assessment of potential impact (edge encroachment versus	<u>Widen Bridge to the North</u> • 2 small wooded blocks **removed** north of existing bridge, east of Welland Canal • **Edge** of 1 small cultural woodland removed (Unit 6)	<u>Widen Bridge to the South</u> • **Edge** removal of cultural meadow with meadow marsh components (Unit 17) • **Removal** of 2 small cultural woodlands along Niagara Stone Road	<u>Widen Bridge to Both Sides</u> • **Edges** of 4 small wooded blocks removed • **Edge** of 1 small cultural woodland removed (Unit 6) • Removal of cultural meadow habitat within

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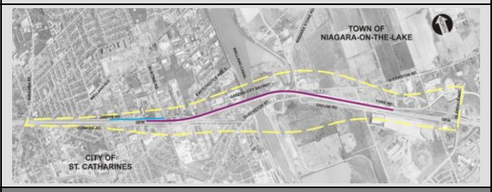
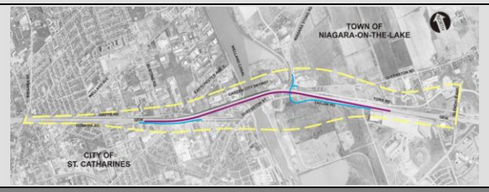
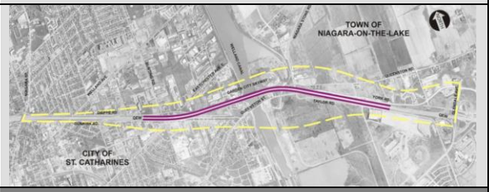
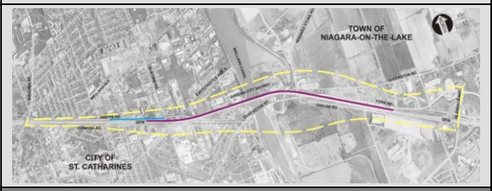
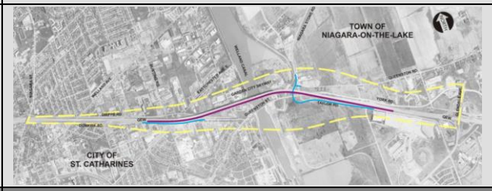
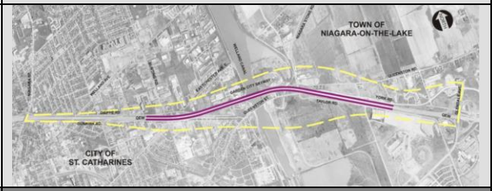
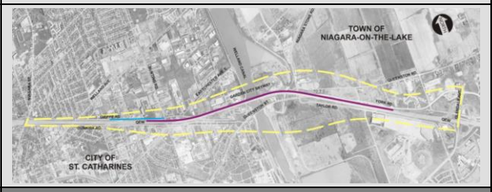
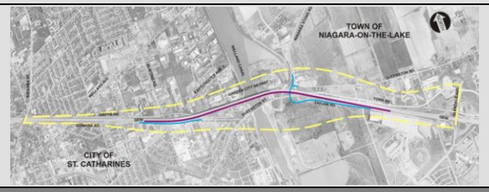
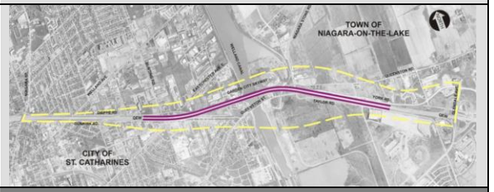
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Widening		
Alternative Identifier				W1	W2	W3
Description				Widen to the North	Widen to the South	Widen to Both Sides
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
			fragmentation, change to patch size and shape, etc.)	• Removal of cultural meadow habitat within existing ROW, north of the QEW • **Possible indirect impacts to 2 Butternut trees** ***No realignment of Niagara Stone Road or Taylor Road required.**	<u>Realignment of Niagara Stone Road and Taylor Road</u> • Fragments deciduous forest / cultural thicket mosaic (Unit 13) • Edge removal of regenerating community with cultural meadow components (Unit 15) <u>Realignment of Dunkirk Road</u> • Minimal upland vegetation impacts	existing ROW, both sides of the QEW • **Possible indirect impacts to 2 Butternut trees.** ***No realignment of Niagara Stone Road, Taylor Road OR Dunkirk Road required.**
	3.2.3 Wildlife and Habitat considering: • Sensitivity / Quality / Significance of Wildlife and Habitat[2] • Relative Magnitude of Potential Effect		a) Determination of *Sensitivity/Quality/Significance of Wildlife* and *Habitat* based on evaluation of attributes such as: • Presence of Significant Wildlife Habitat (SWH; e.g. deer yards and heronries as identified by MNR or NPCA; other specialized habitat such as Important Bird Areas etc.), interior and deep interior forest habitat • Presence of species of conservation concern including SAR as identified by COSEWIC and COSSARO • Presence of *potential* habitat for SAR • Habitat resiliency based on size (including interior and deep interior forest habitat), maturity, physical considerations • Presence of movement corridors (linkages) between natural areas/nodes on regional and local levels	• No previously identified SWH within W1 area **Alignment within known habitat for 2 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) **Alignment within habitat for 5 potential SAR:** • Barn Owl (END) – low potential • Chimney Swift (THR) – high potential • Yellow-breasted Chat (SC) – low potential • Milksnake (SC) – high potential • Ribbonsnake (SC) – moderate potential	• -no previously identified SWH within W2 area **Alignment within known habitat for 4 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) • Snapping Turtle (SC) • Milksnake (SC) **Alignment within habitat for 6 potential SAR:** • Barn Owl (END) – low potential • Chimney Swift (THR) – high potential • Yellow-breasted Chat (SC) – low potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Golden-winged Warbler (COSEWIC-THR, MNR-SC) – moderate potential	• -no previously identified SWH within W3 area **Alignment within known habitat for 2 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) **Alignment within habitat for 5 potential SAR:** • Barn Owl (END) – low potential • Chimney Swift (THR) – high potential • Yellow-breasted Chat (SC) – low potential • Milksnake (SC) – high potential • Ribbonsnake (SC) – moderate potential
			b) Determination of Magnitude of Potential	<u>Widen Bridge to the North</u> • M**inor edge** impacts to **low** quality	<u>Widen Bridge to the South</u> • **Edge** impacts to **low** quality successional	<u>Widen Bridge to Both Sides</u> • M**inor edge** impacts to **low** quality

[1] Sources of information for all factor areas include the design alternatives, existing conditions surveys and aerial photography
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Widening		
Alternative Identifier				**W1**	**W2**	**W3**
Description				**Widen to the North**	**Widen to the South**	**Widen to Both Sides**
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
			Effect considering: • Habitat type affected within footprint • Degree of habitat fragmentation • Habitat quality and sensitivity	successional and cultural habitat ***No realignment of Niagara Stone Road or Taylor Road required.**	habitat (west of the bridge) and **low** quality cultural habitat (east of the bridge) <u>Niagara Stone Road realignment</u> • **Edge fragmentation** of **moderate** quality successional habitat	successional and cultural habitat ***No realignment of Niagara Stone Road, Taylor Road OR Dunkirk Road required.**
Summary – Terrestrial Ecosystem				Alternatives W1 and W3 will result in comparable impacts to wetland and upland vegetation and wildlife and wildlife habitat. Alternative W2 will result in the most impacts to wetland and upland vegetation and wildlife and wildlife habitat including fragmentation of a deciduous forest / cultural thicket mosaic and edge fragmentation of moderate quality successional habitat. As a result, from a terrestrial ecosystems perspective **Alternatives W1 and W3 are equally preferred**.		
3.3 Designated Natural Features	3.3.1 Designated Natural Features include, for example, Provincially Significant Wetlands (PSWs), Areas of Natural and Scientific Interest (ANSIs), Environmentally Sensitive/Significant Areas (ESAs), Niagara Escarpment Plan Area, Greenbelt Plan Area, Regional Greenlands Systems. These features are defined by resource agencies, municipalities, the government and/or the public, through legislation, policies, or	• MNR NRVIS data • NHIC/Biodiversity Explorer • Municipal Official Plans • NPCA • Niagara Escarpment Plan (2005) • Greenbelt Plan (2005)	a) Qualitative assessment of potential impacts to designated areas within the identified alternatives. • Where feasible / applicable, the extent of the potential impact to designated areas will be quantitatively evaluated. • (Note: Impacts to designated natural features may also be captured within the evaluation of impacts to upland and wetland vegetation, or wildlife habitat. Where overlap between evaluating impacts to designated natural features and upland/wetland vegetation exists, it will be clearly stated so that impacts are not 'double counted'.)	**No impacts** to lands designated as 'Natural Heritage System' under the *Greenbelt Plan* (2005) located south of Queenston Street and west of Homer Road.	**Edge** impacts to lands designated as 'Natural Heritage System' under the *Greenbelt Plan* (2005) located south of Queenston Street and west of Homer Road.	**No impacts** to lands designated as 'Natural Heritage System' under the *Greenbelt Plan* (2005) located south of Queenston Street and west of Homer Road.

[1] Sources of information for all factor areas include the design alternatives, existing conditions surveys and aerial photography
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Widening		
Alternative Identifier				W1	W2	W3
Description				Widen to the North	Widen to the South	Widen to Both Sides
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
	approved management plans, to have special or unique value.					
Summary– Designated Natural Features				Alternatives W1 and W3 will not impact the Greenbelt Plan area south of Queenston Street and west of Homer Road. Alternative W2 will result in edge impacts to the Greenbelt Plan area south of Queenston Street and west of Homer Road. As a result, from a designated natural features perspective **Alternatives W1 and W3 are equally preferred**.		
3.4 Contaminated Sites	3.4.1 Known contaminated sites	• Contaminant Overview Study for the QEW Garden City Skyway study area • Contaminant Investigation Report for the QEW Garden City Skyway • MOE Waste Generator Database • MOE PCB Storage Site Database • Technical Standards & Safety Authority • Aerial photographs • Municipal directories and assessment maps • OMB and NTS mapping • Historical plans, soils, hydrological and geological maps • Libraries,	a) Number of known contaminated sites impacted	There are 2 known contaminated sites within this proposed alignment.	There are 2 known contaminated sites within this proposed alignment.	There are 3 known contaminated sites within this proposed alignment.

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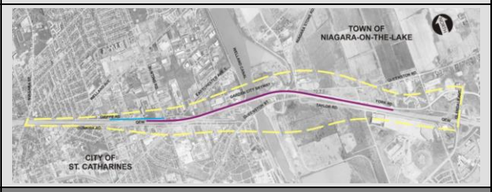
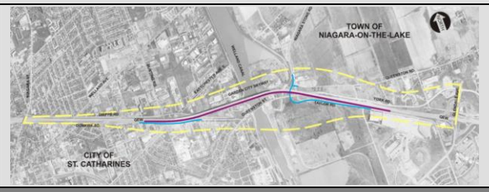
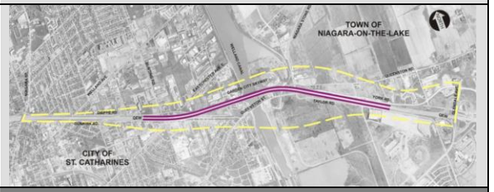
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Widening		
Alternative Identifier				W1	W2	W3
Description				Widen to the North	Widen to the South	Widen to Both Sides
SKETCH						
Environmental Factor /Criteria		Data Source[1]	Measures			
		historical archives, land registry offices and municipal offices • MOE Waste Disposal Site Inventory • MOE Coal Gasification Plant Database • Ecolog ERIS Retail Fuel Storage Tanks Database • Brownfields Environmental Site Registry				
	3.4.2 Potentially contaminated sites	• Contaminant Overview Study for the QEW Garden City Skyway study area • Contaminant Investigation Report for the QEW Garden City Skyway • Review of aerial photography • Field investigations • MOE Coal Gasification Plant Database • Ecolog ERIS Retail Fuel Storage Tanks Database	a) Number of potentially contaminated sites impacted	There are 7 potentially contaminated sites within the proposed alignment located in one large industrial/commercial area west of the Garden City Skyway.	There are 8 potentially contaminated sites within the proposed alignment, mostly within the large industrial/commercial area west of the Garden City Skyway and also on the east side of the Garden City Skyway.	There are 2 potentially contaminated properties within the proposed alignment.

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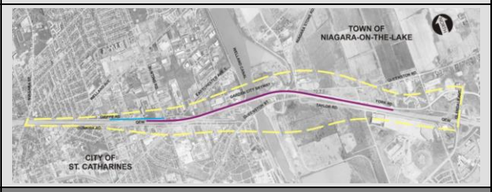
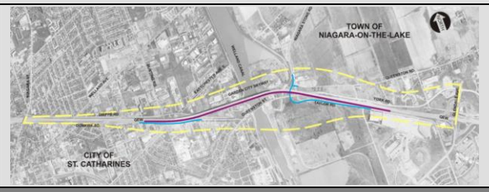
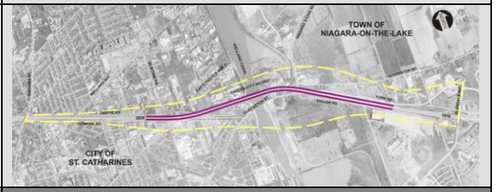
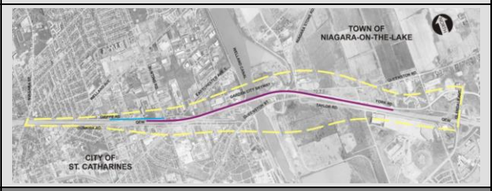
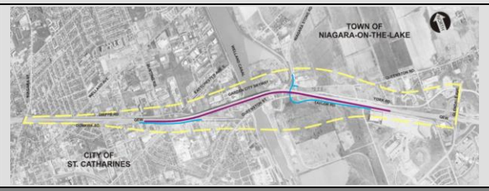
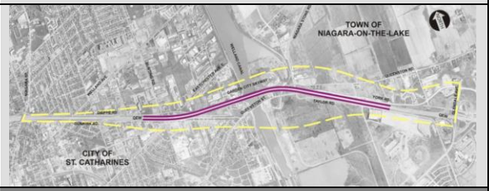
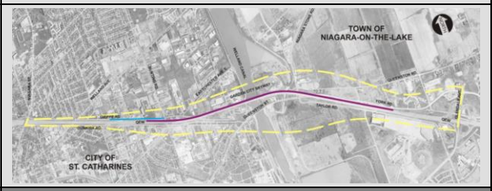
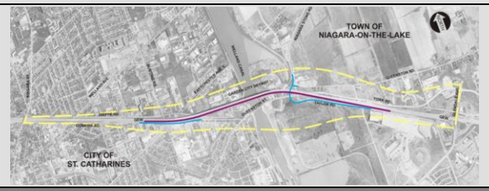
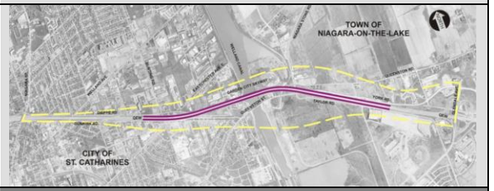
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Widening		
Alternative Identifier				**W1**	**W2**	**W3**
Description				**Widen to the North**	**Widen to the South**	**Widen to Both Sides**
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
		• Brownfields Environmental Site Registry • MOE Waste Generator Database • MOE PCB Storage Site Database • Technical Standards & Safety Authority				
Summary – Contaminated Sites				Alternative W3 results in the fewest impacts to potentially contaminated properties, though it also results in slightly greater impacts to known contaminated sites as compared to Alternatives W1 and W2. Alternative W2 results in the greatest impacts to potentially contaminated properties but is equal to Alternative W1 for fewest impacts to known contaminated sites. **Alternative W3 is therefore slightly preferred** from a contaminated sites perspective.		
3.5 Excess Materials Management	3.5.1 Excess material management requirements with consideration for the quantity and type of materials	• Design plans	a) Approximate quantity of excess materials (relative to other alternatives).	Requires disposal of existing bridge deck, approximately 20,000 m^3 of concrete and asphalt. Negligible amounts of other excess materials.		
			b) Types of excess materials.	Steel-reinforced concrete, asphalt.		
Summary – Excess Materials Management				All alternatives will require comparable quantities and types of excess materials. As a result, from an excess materials management perspective **all alternatives are equally preferred.**		
3.6 Surface Water	3.6.1 Hydraulics	• MTO Highway Drainage Design Standards • MTO Drainage Management Manual • MTO Drainage Directives • Canadian Highway Bridge Design Code • NPCA Flood and Fill Line	a) Hydraulic impact of the alternatives on the Welland Canal.	No impact; size of navigational channel opening far exceeds hydraulic requirements.		

[1] Sources of information for all factor areas include the design alternatives, existing conditions surveys and aerial photography
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Widening		
Alternative Identifier				**W1**	**W2**	**W3**
Description				**Widen to the North**	**Widen to the South**	**Widen to Both Sides**
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
		Regulation • HEC-RAS Model Manual				
	3.6.2 Highway Drainage and Stormwater Management	• MTO Highway Drainage Design Standards • MTO Drainage Management Manual • MTO Drainage Directives • MOE Stormwater Management Planning and Design Manual • MTO Gravity Pipe Design Guidelines • NPCA SWM Guidelines	a) Impacts on existing highway drainage system (culverts, storm sewers, ditches).	1565 m of existing median storm sewer impacted. 670 m of existing ditch impacted. 1 culvert (total length 51 m) requires replacement or widening.	1915 m of existing median storm sewer impacted. 855 m of existing ditch impacted. No culverts impacted.	No impacts to existing median storm sewer anticipated. 753 m of existing ditch impacted. 1 culvert (total length 51 m) requires replacement or widening.
			b) Ability to provide adequate stormwater management (quantity, quality, and erosion protection)	No significant challenges anticipated, relative to other bridge alternatives; however, additional property may be required for stormwater management pond(s).		
Summary – Surface Water				All alternatives are expected to have similar surface water drainage requirements. No significant challenges anticipated. As a result, from a surface water perspective, **all alternatives are equally** preferred.		
3.7 Groundwater	3.7.1 Groundwater	• Design plans • Borehole logs • Aquifer vulnerability mapping	a) Qualitative assessment of impacts to groundwater	No significant impacts anticipated.		
			b) Quantitative assessment of impacts to groundwater	n/a		
Summary – Groundwater				None of the alternatives are anticipated to impact groundwater. As a result, from a groundwater perspective **all alternatives are equally preferred**.		
Overall Summary – Natural Environment				Alternative W2 results in the greatest impacts to fish and fish habitat, as it would require watercourse realignment and the infill of fish habitat unlike Alternatives W1 and W3. Alternative W2 also results in the greatest terrestrial ecosystem impacts, including the fragmentation of a deciduous forest / cultural thicket mosaic; it also impacts Greenbelt lands, unlike Alternatives W1 and W3. Alternative W3 is slightly preferred from a contaminated sites perspective as it impacts the fewest potentially contaminated properties, while Alternative W2 impacts the greatest number of potentially contaminated properties. From a Surface Water perspective, all alternatives are equally preferred. From Excess Materials Management and Groundwater perspectives, all alternatives are equally preferred. As a result, from a natural environment perspective **Alternative W3** is slightly preferred over **Alternative W1**.		
4.0 Structural Engineering						
	4.1.1 Structural	• *Canadian*	a) Life span and durability of	• Existing structure design life is approximately 75 years (as determined by the Study Team)		

[1] Sources of information for all factor areas include the design alternatives, existing conditions surveys and aerial photography
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Widening		
Alternative Identifier				W1	W2	W3
Description				Widen to the North	Widen to the South	Widen to Both Sides
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
		Highway Bridge Design Code • MTO *Structure Rehabilitation Manual* • MTO *Ontario Heritage Bridge Guidelines* • Design plans • Base mapping	structure	• New structure design life is 75-100 years • Potentially incompatible design life		
			b) Treatment of existing bridge	• Replace concrete deck • Replace/retrofit deteriorated steel • Ongoing maintenance and rehabilitation of existing and new structures		
			c) Maintenance (including consideration of salt use for winter maintenance)	• Stainless steel or GFRP rebar can be used to protect the structures from salt use during winter maintenance • Ongoing asphalt patch and pave		
			d) Flexibility for future bridge rehabilitation / expansion	**Pros**: • Ongoing deck repairs for the widened bridge is possible in 3 construction stages **Cons**: • Challenging to accommodate additional future deck widening due to issues such as lateral thermal movements, inspection and drainage • Severe lane reductions or bridge closures during future replacement of existing bridge • Replacing the existing structure in the future will be challenging and costly as the work significantly impacts the newer linked structure		**Pros**: • Ongoing deck repairs for the widened bridge is possible in 3 construction stages **Cons**: • As compared with other widening alternatives, most difficult to accommodate additional future deck widening due to issues such as lateral thermal movements, inspection and drainage • Severe lane reductions or bridge closures during future replacement of existing bridge • Replacing the existing structure in the future will be challenging and costly as the work significantly impacts the newer linked structure.
	4.1.2 Constructability	• Ontario *Geometric Design Standards for Ontario Highways* • Transportation Association of Canada *Geometric Design Guide for Canadian Roads* • Construction standards and specifications • Design plans • Base mapping	a) Potential need for special and/or unfamiliar construction techniques	Minimal need for special and/or unfamiliar construction techniques		
			b) Potential construction cost and/or schedule risks	Minimal risks to construction cost and/or schedule risks. With all rehabilitation and widening projects, there is a potential risk for cost overruns; however, considered to be minor here.		
		• Design plans • Foundations field	c) Potential foundations risks	Potential conflicts with existing bridge foundations.	Potential conflicts with existing bridge foundations.	Potential conflicts with existing bridge foundations. Higher potential as compared with

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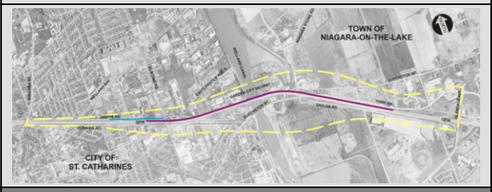
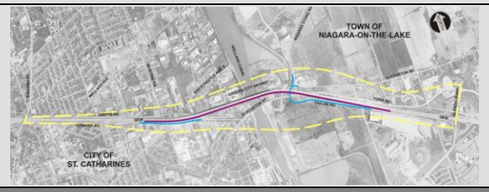
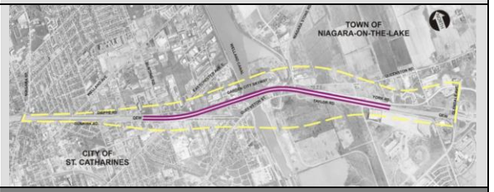
Alternative Type			Widening		
Alternative Identifier			**W1**	**W2**	**W3**
Description			**Widen to the North**	**Widen to the South**	**Widen to Both Sides**
SKETCH					
Environmental Factor /Criteria	**Data Source[1]**	**Measures**			
	investigations and draft report				other widening alternatives, as twice as many piers are required for this alternative.
4.1.3 Staging	• Design plans • *Ontario Traffic Manual, Book 7: Temporary Conditions* • *Geometric Design Standards for Ontario Highways*	a) Construction staging impacts • Number of stages • Total duration • Lane restriction/reduction requirements • Potential for traffic disruption during construction	• 4 stages • 5 years of construction • Lane reductions from 6 to 5 during first phase of construction.		
4.1.4 Construction Materials	• *Canadian Highway Bridge Design Code* • MTO *Structure Rehabilitation Manual* • Design plans • Base mapping	a) Use of existing infrastructure	• Existing bridge will remain in service • Remove approximately 5 m of steel crossbeam on north side of structure • Maintain girders and substructure • Remainder will be removed and replaced.	• Existing bridge will remain in service • Remove approximately 5 m of steel crossbeam on south side of structure • Maintain girders and substructure • Remainder will be removed and replaced.	• Existing bridge will remain in service • Remove approximately 5 m of steel crossbeam on each side of structure • Maintain girders and substructure • Remainder will be removed and replaced.
4.1.5 Critical Infrastructure Protection	• NCHRP Report 525 – Surface Transportation Security, Volume 3: Incorporating Security into the Transportation Planning Process • Discussions with OPP	a) Vulnerability of QEW and Welland Canal	Catastrophic failure of the bridge would cause major disruptions to both the QEW and Welland Canal.		
		b) Prevention of security incidents	Impossible to limit access to structure via vehicles both on and below the bridge. Difficult to prevent access to bridge piers from below (fencing, closed-circuit cameras and security are all possible countermeasures).		
		c) Protection of structure from catastrophic events (i.e., 'target hardening')	Very limited potential for hardening of the bridge, due to retention of existing 'core' structure.		
		d) Redundancy	No redundancy; in that if the bridge is unserviceable, traffic would need to use an alternate route.		
		e) Recovery (i.e., ability to respond to an emergency after a catastrophic event)	No significant challenges to recovery, as compared with other bridge alternatives.		
4.1.6 Contract Delivery	• Industry practice	a) Flexibility in contract delivery	Limited flexibility in contract delivery. Alternative delivery methods (e.g., design/build) are possible; however, separate contracts for rehabilitation of the original bridge deck and new construction are not possible.		
Overall Summary – Structural Engineering			**Alternatives W1 and W2 are equally preferred**, as they have the least potential for conflicts with the existing bridge foundations, have the least impact to the existing structure, and have the most flexibility for future improvements and maintenance.		
5.0 Transportation & Other Considerations					

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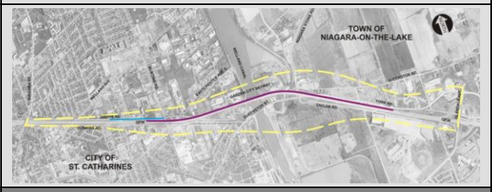
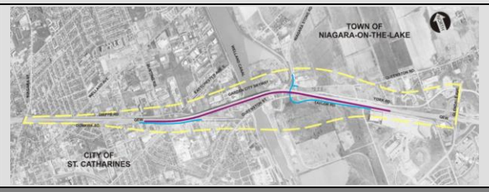
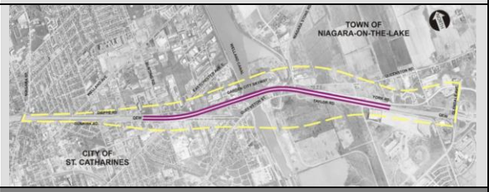
Alternative Type				Widening		
Alternative Identifier				W1	W2	W3
Description				Widen to the North	Widen to the South	Widen to Both Sides
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
	5.1.1 Flexibility for future improvements	• Base mapping • Design plans • Other Studies • Provincial policy papers (e.g., Places to Grow)	a) Qualitative assessment of future expansion/compatibility	Future capacity improvements would require twinning or additional widening of the bridge (or conversion of shoulders to general-purpose lanes). Additional widening would be technically challenging and may not be cost-effective.		Future capacity improvements would require twinning or additional widening of the bridge (or conversion of shoulders to general-purpose lanes). Additional widening would be the most technically challenging, as compared with other widening alternatives, and may not be cost-effective.
	5.1.2 Highway Geometrics	• *Geometric Design Standards for Ontario Highways* • *Transportation Association of Canada Geometric Design Guide for Canadian Roads* • *Proposed Draft Concepts for New Rural Freeways* • Other MTO standards • Design plans • Base mapping	a) Compatibility with current highway design standards and practices.	Does not address substandard (design speed = 90 km/h) vertical crest curve on main span. Wide shoulders would be required to improve horizontal design speed to 120 km/h. Improved highway cross section meets current standards (with exception noted above).		
	5.1.3 Traffic Operations	• Transportation planning and land use forecasting model • Design plans • Base mapping & field review	a) Impacts to traffic operations	Lane reductions from 6 lanes to 5 are required during first phase of construction, which would result in traffic disruptions. Once constructed, improved QEW operations are expected due to the addition of truck-climbing lane and improved roadside (i.e., shoulders).		
	5.1.4 Safety	• Transportation planning and land use forecasting model • Historical collision data • Design plans • Base mapping & field review	a) Ability to address existing deficiencies	Addresses narrow shoulder width concerns and provides truck-climbing lane. Does not provide improvements to vertical and horizontal alignments.		
			b) Impact on driver behavior / expectations	Some improvements expected due to widened shoulders.		
	5.1.5 Compatibility	• Local and regional	a) Impact on local road	Relatively minor impacts; realignment of Dieppe	Moderate impacts; realignment of Dunkirk Road.	No notable impacts identified.

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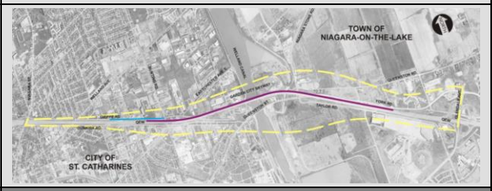
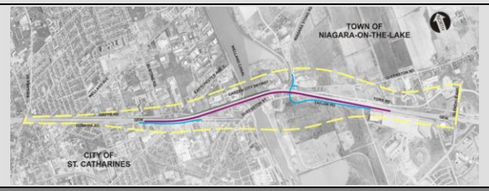
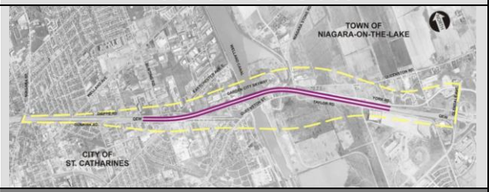
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Widening		
Alternative Identifier				W1	W2	W3
Description				Widen to the North	Widen to the South	Widen to Both Sides
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
	with road network (QEW and local)	transportation plans, official plans • Other EA studies • Design plans	network: • Local road realignment requirements • Construction staging requirements	Road from Grantham Ave. to Bunting Road.	Relocation of Niagara Stone/Taylor/Queenston/York intersection. Realignment of Taylor Road and Niagara Stone Road. Short extension of Queenston Road.	
			b) Impact on QEW	Improved operations due to truck-climbing lane and improved cross section. Minor modifications to Niagara St. E-N/S ramp required.	Improved operations due to truck-climbing lane and improved cross section. Minor modifications to Niagara St. N/S-E ramp required.	Improved operations due to truck-climbing lane and improved cross section. Minor modifications to Niagara St. E-N/S and N/S-E ramps required.
	5.1.6 Seaway and Airport Operations	• Input from the St. Lawrence Seaway Management Corporation and Transport Canada • Input from Niagara Regional Airport and Transport Canada	a) Potential impacts on St. Lawrence Seaway operations during construction	In-water pier construction required; however, no significant impacts are anticipated.		
			b) Impact on Niagara Regional Airport operations	No major impacts anticipated. It is acknowledged that the existing bridge encroaches into the Airport's outer surface height restriction, and that a widening of the bridge to the north would bring the bridge closer to the Airport.	No major impacts anticipated. It is acknowledged that the existing bridge encroaches into the Airport's outer surface height restriction. A widening of the bridge to the south would keep new construction further from the airport than the existing bridge; however, the new structural and illumination elements would still encroach into the outer surface restriction.	No major impacts anticipated. It is acknowledged that the existing bridge encroaches into the Airport's outer surface height restriction. A widening of the bridge to both the north and south would bring half of the new structural and illumination elements closer to the airport than the existing bridge, and these would encroach into the outer surface restriction.
	5.1.7 Emergency Response	• Input from Ontario Provincial Police • Input from municipal emergency services • Design plans	a) Impacts to emergency access/routing	Some potential for short-term impacts during first phase of construction; otherwise, no impacts anticipated.		
			b) Potential challenges to incident management	Improved safety of emergency personnel responding to incidents on the bridge. No new challenges anticipated.		
	5.1.8 Utilities	• Existing Utility Records • NEB Regulations • MTO CMO requirements • Design plans • Base mapping	a) Type of utility impacted	Major municipal sewer, major municipal watermain, hydro transmission line.		
			b) Length and type (i.e., crossing or relocation) of direct impact to existing utility corridors	1 major municipal sewer crossing; 93 m potentially impacted. 1 major existing municipal watermain crossing; 24 m potentially impacted. Future Bunting Road watermain potentially impacted. 1 hydro transmission line crossing. Numerous minor utility impacts.	1 major municipal sewer crossing; 70 m potentially impacted. 2 major existing municipal watermain crossings; 440 m potentially impacted. Future Bunting Road watermain potentially impacted. 1 hydro transmission line crossing. Numerous minor utility impacts.	1 major municipal sewer crossing; 95 m potentially impacted. 1 major existing municipal watermain crossing; 20 m potentially impacted. Future Bunting Road watermain potentially impacted. 1 hydro transmission line crossing. Numerous minor utility impacts.
Overall Summary – Transportation & Other Considerations				Alternative W3 is least preferred in terms of flexibility for future improvements, as additional widening would be most technically challenging. Alternative W2 has the greatest impacts to local road networks, while Alternative W3 results in the fewest. **Alternative W1 and Alternative W3 are both preferred**. While Alternative W3 provides the least flexibility for future improvements, it would also result in		

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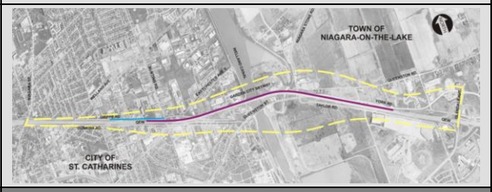
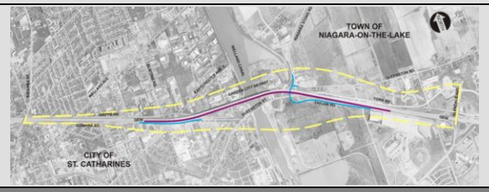
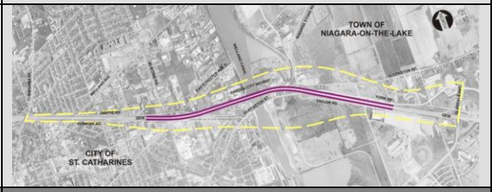
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Widening		
Alternative Identifier				**W1**	**W2**	**W3**
Description				**Widen to the North**	**Widen to the South**	**Widen to Both Sides**
SKETCH						
Environmental Factor /Criteria	**Data Source[1]**	**Measures**				
				the fewest impacts to the existing road network. Alternative W2 is least preferred, as it requires the relocation of the existing Niagara Stone Road/Queenston Street/Taylor Road/York Road intersection and has the greatest utilities impacts.		
6.0 Cost[3]						
	6.1.1 Cost	• MTO Parametric Estimating Guide • HiCo • Previous studies	a) Structure Capital Cost (Note: excludes contingencies)	$278M ($2011)	$278M ($2011)	$282M ($2011)
		• MTO Parametric Estimating Guide • HiCo • Previous studies • MTO Structural Manual	b) Structure Lifecycle Cost (Structure Capital Cost + Future Maintenance) (Note: excludes contingencies)	$397-472M ($2011)	$397-472M ($2011)	$405-482M ($2011)
		• MTO Parametric Estimating Guide • HiCo • Previous studies • MTO Structural Manual • Input from MTO Property Office	c) Total Construction Cost (Structure Capital Cost + Highway Costs + Property) (Notes: costs rounded; includes contingencies; 25% additional contingency added to high range)	$366M Structure Costs $17M Highway Costs $15M Property Costs **$415-515M Total Cost**	$366M Structure Costs $17M Highway Costs $5M Property Costs **$405-505M Total Cost**	$373M Structure Costs $9M Highway Costs $15M Property Costs **$415-515M Total Cost**
Summary – Cost				**All Alternatives** are similarly preferred, as costs are within 10% of each other.		
Overall Summary				**Overall Alternative W1 is the preferred Widening alternative. It is equally preferred from cultural, structural engineering, and transportation perspectives. While Alternative W3 is slightly preferred from a socio-economic and natural environment perspective, it results in the greatest cultural environment and structural engineering impacts.**		

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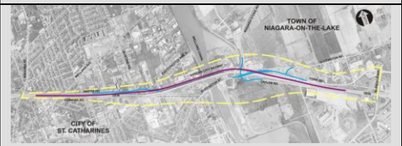
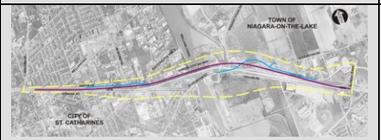
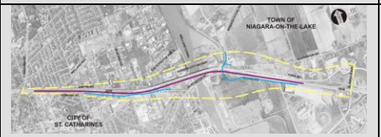
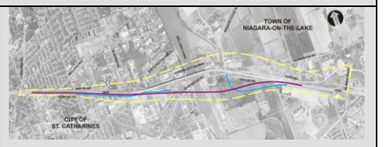
Twinning Alternatives

Alternatives Evaluation – Twinning Alternative

Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria	**Data Source[1]**	**Measures**					
1.0 Socio-Economic Environment							
1.1 Property and Property Access	1.1.1 Property and Property Access	• Municipal land use information • Approved development plans	a) Number of properties directly impacted	Number of impacted properties by type: Residential: 4 Commercial: 17 Industrial: 4 Open Space: 7 Utility: 1 Agricultural: 1 Total: 34 Includes 2 MTO properties.	Number of impacted properties by type: Residential: 4 Commercial: 22 Industrial: 4 Open Space: 6 Utility: 1 Agricultural: 1 Total: 38 Includes 1 MTO property.	Number of impacted properties by type: Residential: 0 Commercial: 14 Industrial: 4 Open Space: 9 Utility: 1 Agricultural: 0 Total: 28 Includes 3 MTO properties.	Number of impacted properties by type: Residential: 0 Commercial: 13 Industrial: 3 Open Space: 4 Utility: 1 Agricultural: 0 Total: 21 Includes 1 MTO property.
			b) Number of residences potentially displaced	4 residences potentially displaced.		None anticipated.	
			c) Qualitative assessment of changes to residential property access	No significant changes to residential property access, as all affected residential properties will be displaced by direct impacts.		No significant changes anticipated.	Minor changes. Access to one residential property on Dunkirk Road would require modifications to existing access; new driveway would pass under new bridge.
			d) Number of businesses potentially displaced	9 businesses potentially displaced.	10 businesses potentially displaced.	12 businesses potentially displaced, including Structural Steel Manufacturing Plant.	3 businesses potentially displaced, including Structural Steel Manufacturing Plant.
			e) Qualitative assessment of changes to business property access	Minor changes to business accesses along Dieppe Road; some modifications required.		Moderate impacts to business accesses on Dunkirk Road and Niagara Stone Road.	Moderate impacts to business accesses on Dunkirk Road.
			f) Number of roads closed	Coon Road closed. Queenston Road closed between Coon Road and Niagara Stone Road; Queenston Road realigned to connect to York Road near Coon Road.		No road closures.	Section of Dunkirk Road closed east of Bunting; replaced with realigned section of existing roadway.
Summary – Property and Access				Alternatives ST2 and ST2A result in impacts to existing businesses that are significant and difficult to mitigate. While Alternatives NT2A and NT2 will impact several businesses, these impacts are easier to mitigate than impacts resulting from Alternatives ST2 and ST2A.			

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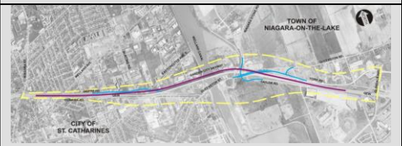
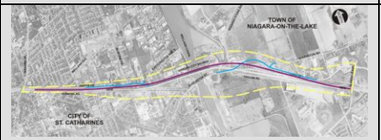
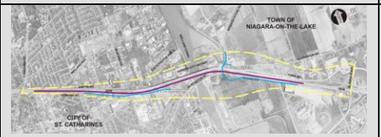
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
				As a result, **Alternative NT2** is slightly preferred over Alternative NT2A from a property effects perspective.			
1.2 Community Effects	1.2.1 Community facilities (cemeteries, schools, places of worship, recreation centres)	• Municipal land use information • Approved development plans	a) Number of cemeteries directly impacted or potentially displaced	None			
			b) Number of schools directly impacted or potentially displaced	None			
			c) Number of places of worship directly impacted or potentially displaced	One; St. George's Anglican Church's western access to Queenston Road will be impacted, however, new access road will provide access to the church's east side.		No impacts	
			d) Number of recreation centres directly impacted or potentially displaced	One; Niagara Ball Hockey Club is displaced.		None	
			e) Qualitative assessment of changes to access to community facilities (cemeteries, schools, places of worship, recreation centres)	None			
	1.2.2 Recreational and Tourist Features	• Municipal land use information • Approved development plans	a) Number of parks and trails directly impacted	No parks impacted; impacts to trails during construction.			
		• Input from the St. Lawrence Seaway Management Corporation and Transport Canada	b) Impacts to recreational boating traffic within the Welland Canal	No significant impacts anticipated.			

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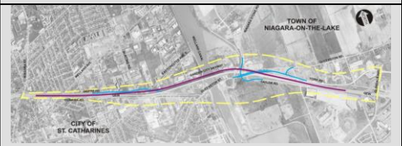
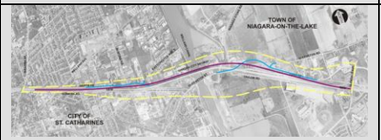
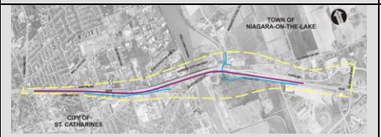
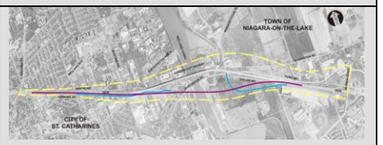
Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
		• Input from the Ministry of Tourism and Culture	c) Impacts to the Tourism Information Centre	Direct impacts to TIC building; relocation required.	Relocation required, as TIC building would be located in the median.	No impacts to TIC building; relatively minor modifications to ramps required.	
	1.2.3 Land Use Opportunities	• Municipal planning departments	a) Potential for new development opportunities	None	Some potential to use space between each bridge structure for construction staging and stormwater management ponds.	None	Land use will be taken away with new bridge structure and associated access roads / ramps.
	1.2.4 Agricultural Resources	• Topographic maps • Municipal land use information • Approved development plans	a) Impact on local agricultural resources using quantitative measure of area (ha)	None			
			b) Number of agricultural operations directly impacted	None			
	1.2.5 Approved local, Regional, and Provincial plans and policies	• Municipal land use information • Approved development plans • Official Plans • Secondary Plans • Niagara Escarpment Plan • Greenbelt Plan	a) Assessment of conformity with approved local, Regional, and Provincial plans and policies	Conforms with Greenbelt Plan polices regarding new infrastructure; conforms to the Niagara Region Policy Plan.			
Summary – Community Effects				For many of the criteria there is no difference between the alternatives. Alternative NT2 and NT2A will displace the Niagara Ball Hockey Club and alter the access to St. George's Anglican Church. Alternatives ST2 and ST2A will not impact the Niagara Ball Hockey or St. George's Anglican Church. Alternatives NT2 and NT2A will require the relocation of the Tourism Information Centre. Alternatives ST2 and ST2A will not impact the Tourism Information Centre building but will require minor modifications to the ramps. Alternative NT2A will result in opportunities to use space between each bridge structure for construction staging and stormwater management ponds, while Alternative ST2A will result in a reduction of land use opportunities. As a result, from a community effects perspective, **Alternative ST2A is preferred**.			

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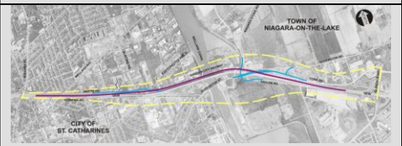
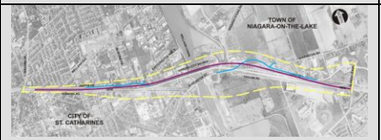
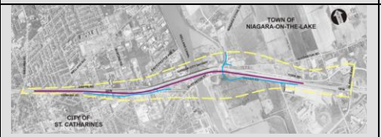
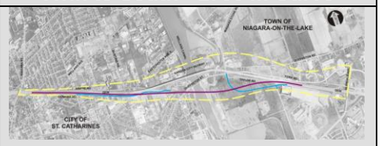
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
1.3 Nuisance Effects	1.3.1 Noise	• Topographic maps • Municipal land use information • Approved development plans	a) Noise Impact: • Highway alignment shifting towards adjacent NSAs is expected to increase noise levels • Highway alignment shifting away from adjacent NSAs is expected to decrease noise levels. • The approximate number of houses represented by each NSA are: NSA 8: > 50 NSA 9: > 50 NSA 10: > 5 NSA 11: ~ 2 NSA 12: ~ 3 NSA 13 : > 10	• Highway alignment shifts north away from NSA 8, NSA 9, NSA 10, NSA 11, which is expected to decrease noise levels • Highway alignment displaces NSA 12	• Highway alignment shifts north away from NSA 8, NSA 9, NSA 10, NSA 11, which is expected to decrease noise levels. • Highway alignment shifts closer to NSA 12, NSA 13, which is expected to increase noise levels	• Highway alignment shifts south towards NSA 8, NSA 9, NSA 10, which is expected to increase noise levels. • Highway alignment displaces NSA 11 • Highway alignment shifts further away from NSA 12, which is expected to decrease noise levels	• Highway alignment shifts south towards NSA 8, NSA 9, NSA 10, which is expected to increase noise levels. • Highway alignment shifts further away from NSA 11, NSA12, which is expected to decrease noise levels
	1.3.2. Air quality		a) Qualitative assessment of impacts to air quality (based on the proximity of receptors to bridge/tunnel. More weight was given to residential receptors than to industrial areas as potential receptors. **Note**: It was assumed that receptors on Queenston Road would be removed to make way for NT2 and NT2A and was not taken into consideration for those alternatives)	West bound lanes shift away from residential areas to the south and towards industrial areas to the north. Small positive effect.	West bound lanes shift away from residential areas to the south and towards residences on Queenston Road, near Niagara Stone Road. Small mixed effect.	East bound lanes shift closer to residential areas to the south and farther away from residences on Queenston Road near Niagara Stone Road. Small mixed effect.	East bound lanes shift much closer to residential areas to the south but farther away from residences on Queenston Road, near Niagara Stone Road. Mixed effect.
	1.3.3 Vibration		a) Qualitative assessment of vibration impacts	Operation: • No impacts expected	Operation: • No impacts expected	Operation: • No impacts expected	Operation: • No impacts expected

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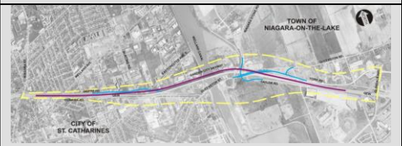
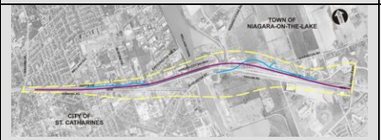
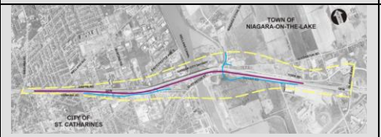
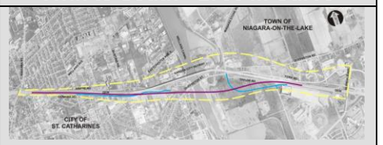
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
				Construction: • With diesel pile driving, some vibration may be felt as the residences are located approximately 50 m south of the alternative.	Construction: • With diesel pile driving, some vibration may be felt as the residences are located approximately 25 m south of the alternative.	Construction: • With diesel pile driving, vibration may cause concern and disruption as residences are located approximately 15 m south of the alternative.	Construction: • With diesel pile driving, some vibration may be felt as residences are located approximately 50 m south of the alternative.
Summary – Nuisance Effects				Alternative NT2 will result in decreased noise levels at the largest NSAs, though it will also displace one NSA. Alternatives NT2A and ST2A will result in both noise increases and noise decreases at some NSAs, though NT2A decreases noise levels at the largest NSAs whereas ST2A increases noise levels at the largest NSAs. As a result, **NT2A is most preferred** from a noise perspective. Alternative ST2 is least preferred as it results in increased noise levels at the larger NSAs and also displaces one NSA. Due to a shift away from residential properties Alternative NT2 is the most beneficial from an air quality perspective. Alternative ST2A is the least preferable from an air quality perspective due to a shift much closer to residential properties. No vibration impacts are anticipated during operation. While impacts may occur during construction, those impacts may be reduced through mitigation and will be temporary (limited to pile driving). Due to the shortest distance from residences, Alternative ST2 results in the greatest potential construction-related vibration impact. From a nuisance effects perspective, **Alternative NT2 is slightly preferred** over Alternative NT2A.			
Overall Summary – Socio-Economic Environment				From a property and property access perspective, Alternatives NT2 and NT2A are preferred over Alternatives ST2 and ST2A as the business impacts resulting from twinning to the north are easier to mitigate than the significant impacts resulting from south twinning. From a community effects perspective, Alternative ST2A is preferred due to fewer impacts to recreational features, places of worship, and the existing Travel Information Centre. From a nuisance effects perspective, Alternative NT2 is slightly preferred due to its reduced noise impacts, air quality impacts, and construction-related vibration impacts. As a result, from a socio-economic environment perspective **Alternative NT2 is preferred**.			
2.0 Cultural Environment							
2.1 Archaeology	2.1.1 Archaeological sites	• Stage 1 Archaeological Assessment	a) Impact to known archaeological features or areas of archaeological potential	All alternatives impact areas of archaeological potential.			
2.2 Heritage Features	2.2.1 Built heritage and cultural heritage landscapes	• Heritage Existing Conditions Report for the QEW Garden City Skyway study area • Cultural Heritage Evaluation Report for	a) Number of listed built heritage resources (BHR) displaced or disrupted	5 BHR Note: The 875 m Curve is more sympathetic to the existing QEW Garden City Skyway.	5 BHR • 2 residential • 1 religious • 1 public works (former travel information centre / commercial building) • Garden City Skyway: road bridge	1 BHR Note: The 875 m Curve is more sympathetic to the existing QEW Garden City Skyway	0 BHR

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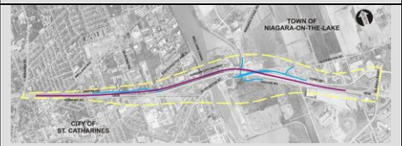
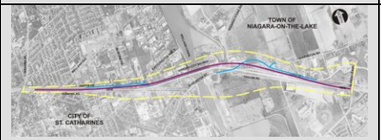
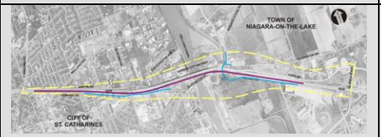
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
		the QEW Garden City Skyway • Historical mapping and aerial photographs, cemetery lists, municipal, provincial and federal inventories, listings, plaques, easements and designations of National Historic Sites and under the Ontario *Heritage Act* • Input from other factor areas • Consultation with municipal and regional heritage planning staff or designates, historical societies and other heritage groups as necessary • Municipal heritage inventories for designated and listed built heritage structures • Ontario Genealogical Society for Cemeteries	b) Number of cultural heritage landscapes (CHL) displaced or disrupted	3 CHL	4 CHL	3 CHL	4 CHL
Summary – Cultural Environment				All alternatives impact areas of archaeological potential. Given the number of impacts to built heritage, Alternatives NT2 and NT2A are the least preferred alternatives from a cultural environment perspective. Alternatives ST2 and ST2A are similar in their impacts to cultural heritage resources. However, while Alternative ST2A does not impact any built heritage resources, it is not as sympathetic to the existing QEW Garden City Skyway. As a result, from a cultural environment perspective **Alternative ST2 is slightly preferred** over Alternative ST2A.			

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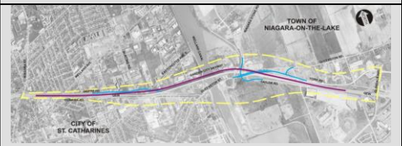
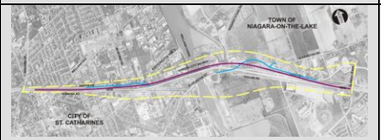
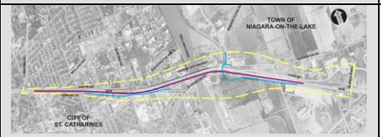
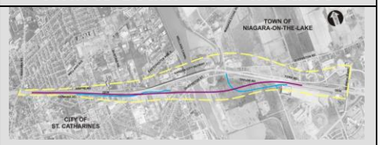
SKETCH							
Environmental Factor / Criteria	**Data Source[1]**	**Measures**					
3.0 Natural Environment							
3.1 Fisheries and Aquatic Habitat	3.1.1 Fish and fish habitat, considering: • Sensitivity of Fish and Fish Habitat[2] • Relative Magnitude of Potential Effect	• Topographic maps • Watershed Management Plans • Existing information gathered from MNR field studies and fish records, NPCA, Interest Groups, public consultation, municipalities • Reconnaissance-level field assessments • Provincial Policy Statement and associated MNR Natural Heritage Training Manual • The Fish Community of the Fourth Welland Canal: Welland to Port Colborne (MNR 1998) • MNR (Natural Resource Values Inventory Systems (NRVIS) mapping) • NHIC (MNR) and Species At Risk mapping (DFO) • Species at Risk Recovery Plans and Management Guidelines	a) Determination of Sensitivity of Fish and Fish Habitat based on evaluation of attributes such as: • Presence of any critical/specialized habitat • Presence of habitat for species of conservation concern, including Species At Risk as identified by COSEWIC and COSSARO, • Habitat resiliency based on thermal regimes (warm, cool, cold water) and flow regime (DFO Risk Management Framework 2006, MTO Environmental Guide for Fish and Fish Habitat 2006).	Three watercourses (Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek) traverse these bridge and road alignments. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent.	Four watercourses (Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek, Eight Mile Creek) traverse these bridge and road alignments. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent.	Three watercourses (Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek) traverse these bridge and road alignments. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent.	
			b) Determination of Magnitude of Potential Effect using qualitative assessment as a relative measure of	<u>Twin Bridge to the North</u> • Welland Canal – requires 2 instream piers. • Tributary of Welland Canal – likely spanned.	<u>Twin Bridge to the North</u> • Welland Canal – requires 2 instream piers. • Tributary of Welland Canal – likely spanned.	<u>Twin Bridge to the South</u> • Welland Canal – requires 2 instream piers. • Tributary of Welland Canal – likely spanned.	<u>Twin Bridge to the South</u> • Welland Canal – requires 2 instream piers. • Tributary of Eight Mile Creek – extension on the south side of

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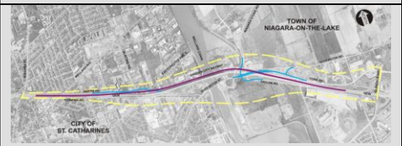
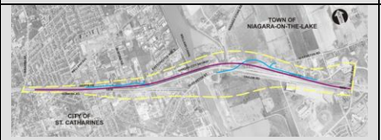
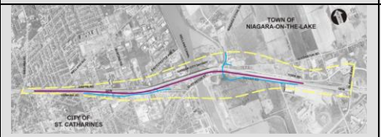
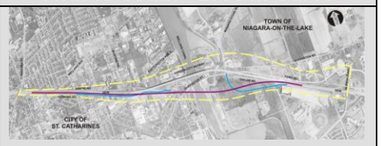
SKETCH							
Environmental Factor / Criteria		Data Source[1]	Measures				
			potential effects (e.g. piers, tunnel, need for channel realignment or culvert extensions).	• Tributary of Eight Mile Creek – extension required on north side of QEW. <u>Re-alignment of Niagara Stone Road, York Road and Taylor Road</u> • Tributary of Welland Canal – new culvert required north of QEW. Also some infill of open water wetland area connected to the tributary on south side of Queenston Street. • Tributary of Eight Mile Creek – new culvert required. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. The infilling of the open water wetland area (connected to the Tributary of the Welland Canal) will also require displacement of the wetland bed and localized disturbance and removal of riparian vegetation. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized disturbance and removal of riparian vegetation associated with the pier construction. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized removal of riparian vegetation and temporary alteration of channel banks and bed. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.	• Tributary of Eight Mile Creek – new culvert required • Eight Mile Creek – extension of the north side of the QEW culvert required <u>Re-alignment of York Road</u> • Tributary of Welland Canal – possible culvert extensions at Queenston Street. • Tributary of Eight Mile Creek – new culvert required. • Eight Mile Creek – extension of York Road culvert required. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized disturbance and removal of riparian vegetation associated with the pier construction. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized removal of riparian vegetation and temporary alteration of channel banks and bed. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.	• Tributary of Eight Mile Creek – extensions to QEW culvert required. <u>Re-alignment of Niagara Stone Road and Taylor Road</u> • Tributary of Welland Canal – requires culvert extension on laneway found north of bridge. New culvert and possible channel re-alignment required south of Queenston Street. Also infill of open water wetland area connected to the tributary on south side of Queenston Street. • Tributary of Eight Mile Creek – extension required on south side of Taylor Road culvert. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. The infilling of the open water wetland area (connected to the Tributary of the Welland Canal) will also require some displacement of the wetland bed and localized disturbance and removal of riparian vegetation. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized disturbance and removal of riparian vegetation associated with the pier construction. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized disturbance and removal of riparian vegetation and temporary	Taylor Road required <u>Re-alignment of York Road</u> • Tributary of Welland Canal – new culvert required. • Tributary of Eight Mile Creek – new culvert required. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized removal of riparian vegetation and temporary alteration of channel banks and bed. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.

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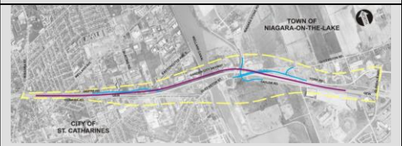
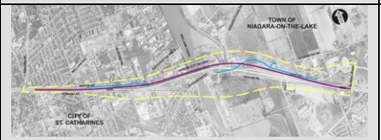
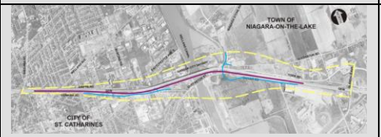
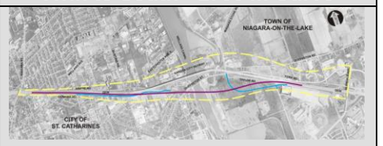
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
						alteration of channel banks and bed. Direct impacts of the proposed re-alignment should be limited to temporary disturbance of the channel and localized disturbance and removal or riparian vegetation. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.	
Summary – Fisheries and Aquatic Habitat				Alternatives NT2A and ST2A do not require any watercourse realignments, do not require infill of wetlands or tributaries (fish habitat), and require comparatively more culvert works. Alternative NT2 requires some infill of wetland / tributary (fish habitat) and a long enclosure of a tributary in a culvert. Alternative ST2 requires infill of wetland / tributary (fish habitat) and realignment of a tributary. As a result, from a fisheries and aquatic habitat perspective **Alternatives NT2A and ST2A are equally preferred**.			
3.2 Terrestrial Ecosystems	3.2.1 Wetland vegetation communities, considering: • Sensitivity / Quality / Significance of Wetland Vegetation[2] • Habitat Relative Magnitude of Potential Effect	• Topographic maps • MNR NRVIS data • MNR District staff • NHIC/Biodiversity Explorer • Bird Studies Canada/Breeding Bird Atlas • Municipal Official Plans • Existing information gathered from MNR, NPCA, Interest Groups, public consultation, municipalities • Reconnaissance-level field inventories • Species at Risk Recovery Plans and	a) Determination of *Sensitivity/Quality/ Significance of Wetland* based on designated status (PSW, LSW, unevaluated), supported by evaluation of attributes such as: • Presence of species of conservation concern including Species At Risk as identified by COSEWIC and COSSARO[2] , • Presence of potential	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • 1 small, young deciduous swamp (Unit 14) in vicinity of NT2 alignment. • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Low** potential for wetland-associated SAR within NT2 footprint based on habitat types observed. • Affected wetland community is young and culturally influenced.	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • No known wetland communities within NT2A alignment. • Wetland potential within deciduous forest block north of Queenston Road (Unit 5). • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Very low** potential for wetland-associated SAR within NT2A footprint based on habitat types observed and general absence of wetland communities within the alignment footprint.	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • 2 small, young deciduous swamp communities (Units 14, 16) • Regenerating lands with thicket swamp and meadow marsh wetland components (Units 15, 17) • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Low** potential for wetland-associated SAR within ST2 footprint based on habitat types observed. • Affected wetland communities are	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • 1 small, young deciduous swamp (Unit 16) • Regenerating lands with thicket swamp and meadow marsh wetland components (Unit 15) • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Low** potential for wetland-associated SAR within ST2A footprint based on habitat types observed. • Affected wetland communities are generally young and/or

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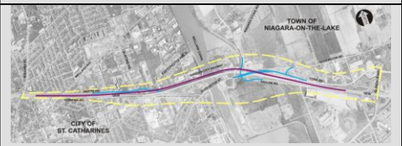
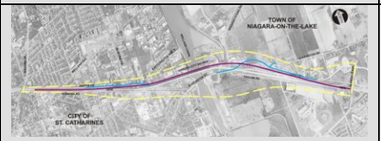
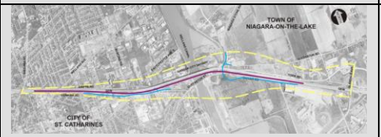
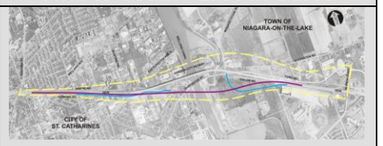
Alternative Type				Twinning			
Alternative Identifier				NT2	NT2A	ST2	ST2A
Description				Twin to North - 875 m Curve	Twin to North - 1700 m Curve	Twin to South - 875 m Curve	Twin to South - 1700 m Curve
SKETCH							
Environmental Factor / Criteria		Data Source[1]	Measures				
		Management Guidelines	habitat for SAR[2], and • Habitat resiliency based on size, maturity, physical considerations (e.g. drainage, groundwater discharge, slope, etc.)			generally young and/or regenerating from agricultural lands.	regenerating from agricultural lands.
			b) Determination of Magnitude of Potential Effect using qualitative assessment of potential impact (edge encroachment versus fragmentation, change to wetland size and shape etc.)	<u>Twin Bridge to the North</u> • No known or anticipated impacts to wetland communities <u>Realignment of Queenston Road</u> • No known or anticipated impacts to wetland communities <u>Realignment of Niagara Stone Road and Taylor Road</u> • **Edge** impacts to young deciduous swamp (Unit 14). <u>Realignment of Dunkirk Road</u> • No anticipated impacts to wetland communities. Alignment runs through currently developed lands.	<u>Twin Bridge to the North</u> • No known or anticipated impacts to wetland communities <u>Realignment of Queenston Road</u> • No known or anticipated impacts to wetland communities • Fragmentation of Unit 5 <u>Realignment of Dunkirk Road</u> • No anticipated impacts to wetland communities. Alignment runs through currently developed lands.	<u>Twin Bridge to the South</u> • **Edge** removal of cultural meadow with meadow marsh components (Unit 17) <u>Realignment of Niagara Stone Road and Taylor Road</u> • **Fragmentation** of a young deciduous swamp community (Unit 14) • **Edge** removal of regenerating lands with thicket swamp and meadow marsh components (Unit 15) and young deciduous swamp (Unit 16) <u>Realignment of Dunkirk Road</u> • No known or anticipated impacts to wetland communities	<u>Bridge to the South</u> • **Fragmentation** of the largest habitat block in the study area. Wetland components are present within this regenerating habitat mosaic (Units 15, 16). <u>Realignment of Niagara Stone Road and Taylor Road</u> • Further **fragmentation** of the largest habitat block in the study area. Wetland components are present within this regenerating habitat mosaic (Units 15, 16). <u>Realignment of Dunkirk Road</u> • No known or anticipated impacts to wetland communities
	3.2.2 Upland Vegetation Communities considering: • Sensitivity / Quality / Significance of Vegetation[2] • Relative Magnitude of Potential Effect		a) Determination of *Sensitivity/Quality/ Significance of Upland Vegetation* (including cultural communities - cultural meadow, thicket and hedgerow, wooded tablelands and valleys) based on	• Affected upland communities are generally young or remnant deciduous forest, cultural woodlands, cultural thickets and cultural meadows. • No mature, high quality forest communities were encountered in the vicinity of NT2, **however, some areas were inaccessible during**	• Affected upland communities are generally young or remnant deciduous forest, cultural woodlands, cultural thickets and cultural meadows. • No mature, high quality forest communities were encountered in the vicinity of NT2A, **however, some areas were inaccessible**	• Affected upland communities are generally young or remnant deciduous forest, cultural woodlands, cultural thickets and cultural meadows. • No mature, high quality forest communities were encountered in the vicinity of ST2, **however, some areas were inaccessible**	• Affected upland communities are generally young or remnant deciduous forest, cultural woodlands, cultural thickets and cultural meadows. • No mature, high quality forest communities were encountered in the vicinity of ST2A, **however, some areas were inaccessible**

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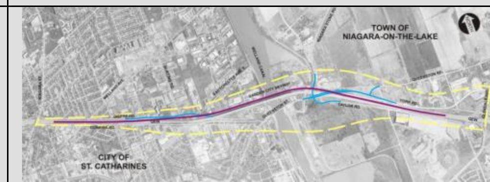
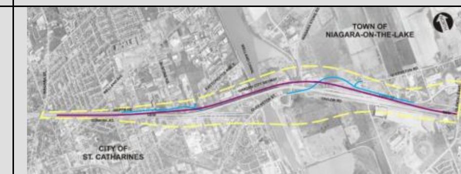
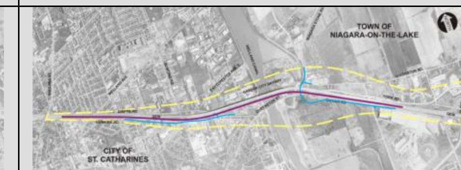
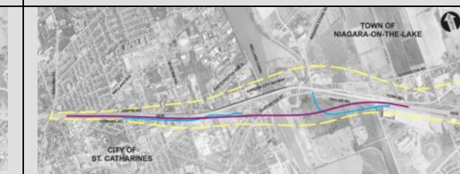
Alternative Type				Twinning			
Alternative Identifier				NT2	NT2A	ST2	ST2A
Description				Twin to North - 875 m Curve	Twin to North - 1700 m Curve	Twin to South - 875 m Curve	Twin to South - 1700 m Curve
SKETCH							
Environmental Factor / Criteria		Data Source[1]	Measures				
			evaluation of attributes such as: • Community rarity/sensitivity /tolerance and local representation/ distribution on the landscape • Rarity of species (species of conservation concern including Species At Risk as identified by COSEWIC and COSSARO) • Presence of specialized habitat for species of conservation concern • Habitat resiliency based on size, maturity, physical considerations (e.g. drainage, slope, etc.)	**field investigations.** • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.	**during field investigations.** • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.	**during field investigations.** • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.	**during field investigations.** • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.
			b) Determination of Magnitude of Potential Effect using qualitative assessment of potential impact (edge encroachment versus	Twin Bridge to the North • **Removal** of 4 small cultural woodland communities north of existing bridge • **Potential indirect (shading) impacts to 2 Butternut trees (or possibly removal).** Realignment of Queenston Road	Twin Bridge to the North • **Removal** of 2 small cultural woodland communities north of existing bridge • **Fragmentation** of regenerating cultural meadow between York Road and Queenston Road • **Potential indirect impacts to 2**	Twin Bridge to the South • **Edge** removal of cultural meadow with meadow marsh components (Unit 17) • **Removal** of 2 small cultural woodlands along Queenston Street Realignment of Niagara Stone Road	Twin Bridge to the South • **Fragmentation** of the largest habitat block in the study area. This regenerating habitat mosaic is composed of deciduous forest, cultural thicket and cultural meadow upland components. • Removal of hedgerow along

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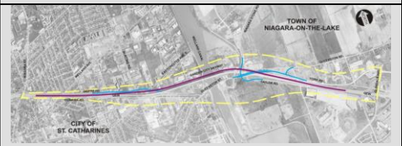
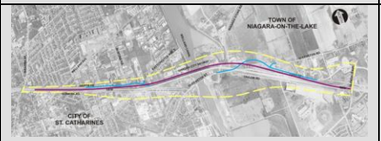
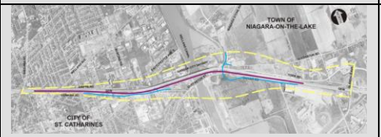
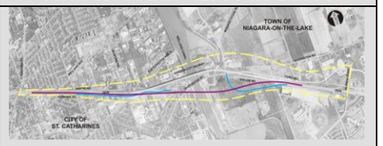
Alternative Type			Twinning			
Alternative Identifier			**NT2**	**NT2A**	**ST2**	**ST2A**
Description			**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH						
Environmental Factor / Criteria		**Data Source[1]**	**Measures**			
			fragmentation, change to patch size and shape, etc.)	• **Fragmentation** of regenerating cultural meadow habitat • **Edge** impacts to 2 cultural woodlands <u>Realignment of Niagara Stone Road and Taylor Road</u> • **Fragmentation** of 1 cultural woodland and 1 deciduous forest community. <u>Realignment of Dunkirk Road</u> • No upland vegetation impacts anticipated. Alignment is through developed lands	**Butternut trees in Unit 6.** <u>Realignment of Queenston Road</u> • Removes edge of 1 cultural woodland (Unit 6) and 1 riparian deciduous forest (Unit 1) • **Fragmentation** of a deciduous forest (Unit 5) • **Fragmentation** of regenerating cultural meadow habitat <u>Realignment of Dunkirk Road</u> • No upland vegetation impacts anticipated. Alignment is through developed lands	<u>and Taylor Road</u> • **Fragmentation** of a deciduous forest / cultural thicket mosaic (Unit 13) • **Edge** removal of regenerating community with cultural meadow components (Unit 15) <u>Realignment of Dunkirk Road</u> • Some limited hedgerow removals	Dunkirk Road <u>Realignment of Niagara Stone Road and Taylor Road</u> • Further **fragmentation** of the largest habitat block in the study area. This regenerating habitat mosaic is composed of deciduous forest, cultural thicket and cultural meadow upland components. • Removal of hedgerow along Dunkirk Road <u>Realignment of Dunkirk Road</u> • Minimal upland vegetation impacts anticipated
	3.2.3 Wildlife and Habitat considering: • Sensitivity / Quality / Significance of Wildlife and Habitat[2] • Relative Magnitude of Potential Effect		a) Determination of *Sensitivity/Quality/ Significance of Significant Wildlife* and *Habitat* based on evaluation of attributes such as: • Presence of Significant Wildlife Habitat (SWH; e.g. deer yards and heronries as identified by MNR or NPCA; other specialized habitat such as Important Bird Areas etc.), interior and deep interior forest habitat, • Presence of species of conservation concern	• No previously identified SWH within NT2 area • Large successional habitat area south of the QEW has a high potential to qualify as SWH based on the SWHTG **Alignment within known habitat for 5 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) • Snapping Turtle (SC) • Milksnake (SC) • Eastern Meadowlark (COSEWIC recommended for listing as THR) **Alignment within habitat for 5 potential SAR:** • Chimney Swift (THR) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential	• No previously identified SWH within NT2A area **Alignment within known habitat for 3 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) • Eastern Meadowlark (COSEWIC recommended for listing as THR) **Alignment within habitat for 6 potential SAR:** • Chimney Swift (THR) – high potential • Milksnake (SC) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential • Yellow-breasted Chat (SC) – low potential	• No previously identified SWH within ST2 area • Large successional habitat area south of the QEW has a high potential to qualify as SWH based on the SWHTG **Alignment within known habitat for 5 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) • Snapping Turtle (SC) • Milksnake (SC) • Eastern Meadowlark (COSEWIC recommended for listing as THR) **Alignment within habitat for 6 potential SAR:** • Chimney Swift (THR) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential	• No previously identified SWH within ST2A area • Large successional habitat area south of the QEW has a high potential to qualify as SWH based on the SWHTG **Alignment within known habitat for 3 SAR**: • Monarch (SC) • Milksnake (SC) • Barn Swallow (COSEWIC recommended for listing as THR) **Alignment within habitat for 7 potential SAR:** • Chimney Swift (THR) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential • Yellow-breasted Chat (SC) – low potential • Golden-winged Warbler

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Alternative Identifier			NT2	NT2A	ST2	ST2A
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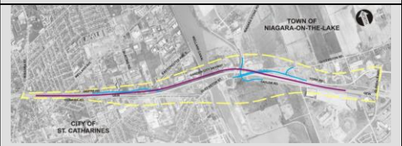
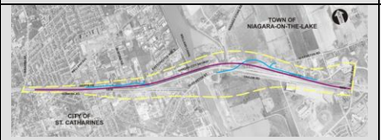
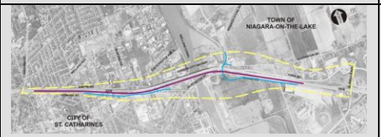
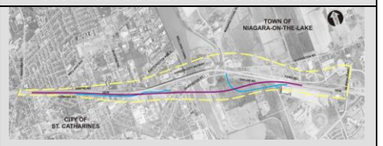
SKETCH						
Environmental Factor / Criteria		**Data Source[1]**	**Measures**			
			including SAR as identified by COSEWIC and COSSARO • Presence of potential habitat for SAR • Habitat resiliency based on size (including interior and deep interior forest habitat), maturity, physical considerations • Presence of movement corridors (linkages) between natural areas/nodes on regional and local levels	• Yellow-breasted Chat (SC) – low potential		• Yellow-breasted Chat (SC) – low potential • Golden-winged Warbler (COSEWIC-THR, MNR-SC) – moderate potential	(COSEWIC-THR, MNR-SC) – moderate potential • Eastern Meadowlark (COSEWIC recommended for listing as THR) – moderate potential
			b) Determination of Magnitude of Potential Effect considering: • Habitat type affected within footprint • Degree of habitat fragmentation • Habitat quality and sensitivity	<u>Twin Bridge to the North</u> • Limited impacts to wildlife habitat <u>Realignment of Queenston Road</u> • **Fragmentation** of **low** quality successional habitat (i.e. mid-successional habitat that is too weedy for grassland birds [e.g. Bobolink] and becoming marginal for Eastern Meadowlark) <u>Realignment of Niagara Stone Road and Taylor Road</u> • **Edge fragmentation** of **moderate** quality forest and successional	<u>Twin Bridge to the North</u> • **Fragmentation** of **low** quality successional habitat (i.e. mid-successional habitat that is too weedy for grassland birds [e.g. Bobolink] and becoming marginal for Eastern Meadowlark) • **Edge** impacts to **low** quality successional and cultural habitats <u>Realignment of Queenston Road</u> • **Further fragmentation** of **low** quality successional habitat (i.e. mid-successional habitat that is	<u>Twin Bridge to the South</u> • **edge** impact to **low** quality successional habitat • removal of 2 very small cultural woodlands <u>Realignment of Niagara Stone Road and Taylor Road</u> • **edge fragmentation** of **moderate** quality forest and successional habitat • **edge** impacts to **high** quality successional habitat	<u>Twin Bridge to the South</u> • **Central fragmentation** of **high** quality successional habitat mosaic with **high potential for SWH designation** <u>Realignment of Niagara Stone Road and Taylor Road</u> • further **central fragmentation** of **high** quality successional habitat mosaic with **high potential for SWH designation**

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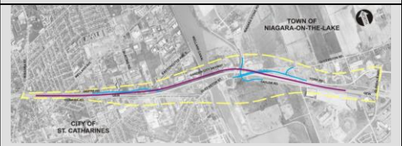
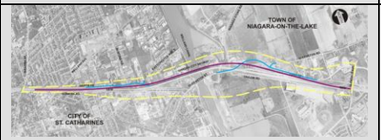
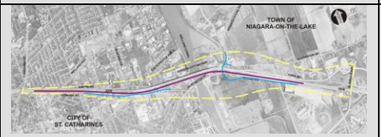
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
				habitat	too weedy for grassland birds [e.g. Bobolink] and becoming marginal for Eastern Meadowlark) • **fragmentation** of **low** quality successional woodland habitat ***no realignment of Niagara Stone Road required**		
Summary – Terrestrial Ecosystem				Alternatives NT2A and ST2 will result in comparable impacts to wetland and upland vegetation and wildlife and wildlife habitat; however, given the limited impacts to known SAR habitat, NT2A is anticipated to result in the least impact to wildlife and wildlife habitat. Alternative NT2 will result in the more notable impacts to wetland and upland vegetation and wildlife and wildlife habitat including potential impacts to two Butternut trees. Alternative ST2A will result in the most impacts to wetland and upland vegetation and wildlife and wildlife habitat including central fragmentation of high quality successional habitat mosaic with high potential for SWH designation. Alternative ST2A also has a high risk of impacts to SAR species. As a result, from a terrestrial ecosystems perspective, **Alternative NT2A is preferred**.			
3.3 Designated Natural Features	3.3.1 Designated Natural Features include, for example, Provincially Significant Wetlands (PSWs), Areas of Natural and Scientific Interest (ANSIs), Environmentally Sensitive/Significant Areas (ESAs), Niagara Escarpment Plan Area, Greenbelt Plan Area, Regional Greenlands Systems. These features are defined by resource agencies, municipalities, the	• MNR NRVIS data • NHIC/Biodiversity Explorer • Municipal Official Plans • NPCA • *Niagara Escarpment Plan* (2005) • *Greenbelt Plan* (2005)	a) Qualitative assessment of potential impacts to designated areas within the identified alternatives. • Where feasible/ applicable, the extent of the potential impact to designated areas will be quantitatively evaluated. • (Note: Impacts to designated natural features may also be captured within	• **Edge** impacts to lands designated as 'Natural Heritage System' under the *Greenbelt Plan* (2005) located south of Queenston Street and west of Homer Road.	• **No impacts** to lands designated as 'Natural Heritage System' under the *Greenbelt Plan* (2005) located south of Queenston Street and west of Homer Road.	• **Edge** impacts to lands designated as 'Natural Heritage System' under the *Greenbelt Plan* (2005) located south of Queenston Street and west of Homer Road.	• **Fragmentation** of a portion of lands designated as 'Natural Heritage System' under the *Greenbelt Plan* (2005) located south of Queenston Street and west of Homer Road.

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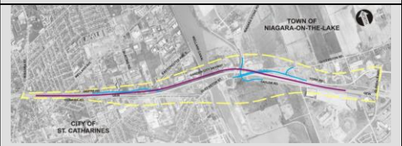
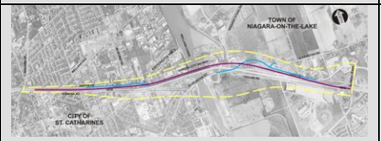
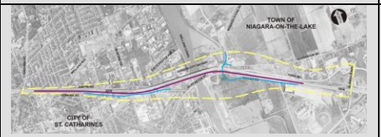
Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
	government and/or the public, through legislation, policies, or approved management plans, to have special or unique value.		the evaluation of impacts to upland and wetland vegetation, or wildlife habitat. Where overlap between evaluating impacts to designated natural features and upland/wetland vegetation exists, it will be clearly stated so that impacts are not 'double counted').				
Summary – Designated Natural Features				Alternatives NT2, ST2 and ST2A will all result in some impacts to the Greenbelt Plan area South of Queenston Street and west of Homer Road. Alternative NT2A will not impact the Greenbelt Plan area South of Queenston Street and west of Homer Road. As a result, from a designated natural features perspective, **Alternative NT2A is preferred**.			
3.4 Contaminated Sites	3.4.1 Known contaminated sites	• Contaminant Overview Study for the QEW Garden City Skyway study area • Contaminant Investigation Report for the QEW Garden City Skyway • MOE Waste Generator Database • MOE PCB Storage Site Database • Technical Standards & Safety Authority • Aerial photographs • Municipal directories and assessment maps	a) Number of known contaminated sites impacted	There are 4 known contaminated properties within this proposed alignment.	There are 3 known contaminated properties within this proposed alignment.	There is 1 known contaminated property within this proposed alignment.	There are 2 known contaminated properties within this proposed alignment.

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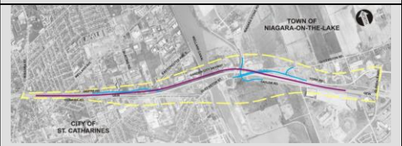
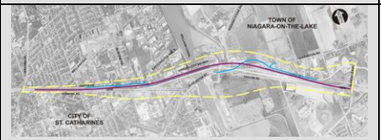
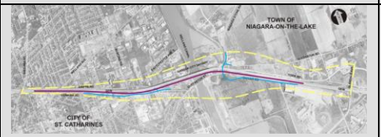
Alternative Type				Twinning			
Alternative Identifier				NT2	NT2A	ST2	ST2A
Description				Twin to North - 875 m Curve	Twin to North - 1700 m Curve	Twin to South - 875 m Curve	Twin to South - 1700 m Curve
SKETCH							
Environmental Factor / Criteria		Data Source[1]	Measures				
		• OMB and NTS mapping • Historical plans, soils, hydrological and geological maps • Libraries, historical archives, land registry offices and municipal offices • MOE Waste Disposal Site Inventory • MOE Coal Gasification Plant Database • Ecolog ERIS Retail Fuel Storage Tanks Database • Brownfields Environmental Site Registry					
	3.4.2 Potentially contaminated sites	• Contaminant Overview Study for the QEW Garden City Skyway study area • Contaminant Investigation Report for the QEW Garden City Skyway • Review of aerial photography • Field investigations • MOE Coal Gasification Plant Database • Ecolog ERIS Retail Fuel Storage Tanks Database • Brownfields Environmental Site Registry • MOE Waste Generator Database	a) Number of potentially contaminated sites impacted	There are 14 potentially contaminated properties within the proposed alignment.	There are 18 potentially contaminated properties within the proposed alignment.	There are 14 potentially contaminated properties within the proposed alignment.	There are 11 potentially contaminated properties within the proposed alignment.

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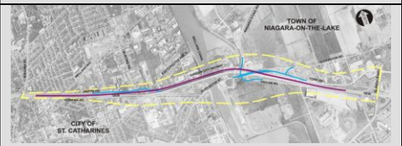
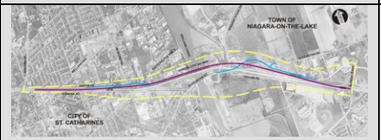
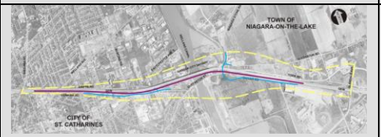
Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
		• MOE PCB Storage Site Database • Technical Standards & Safety Authority					
Summary – Contaminated Sites				Given the total number of known and potential contaminated properties impacted, Alternatives NT2, NT2A and ST2 will result in the most impacts to contaminated properties. Alternative ST2A will result in the fewest impacts to contaminated properties. As a result, from a contaminated sites perspective, **Alternative ST2A is the preferred alternative**.			
3.5 Excess Materials Management	3.5.1 Excess material management requirements with consideration for the quantity and type of materials.	• Design plans	a) Approximate quantity of excess materials (relative to other alternatives).	Negligible amounts of excess materials.			
			b) Types of excess materials.	N/A			
Summary – Excess Materials Management				All alternatives result in negligible amounts of excess materials. As a result, from an excess materials management perspective **all alternatives are equally preferred**.			
3.6 Surface Water	3.6.1 Hydraulics	• MTO Highway Drainage Design Standards • MTO Drainage Management Manual • MTO Drainage Directives • Canadian Highway Bridge Design Code • NPCA Flood and Fill Line Regulation • HEC-RAS Model Manual	a) Hydraulic impact of the alternatives on the Welland Canal.	No impact; size of navigational channel opening far exceeds hydraulic requirements.			

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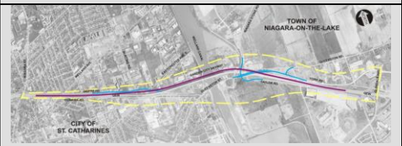
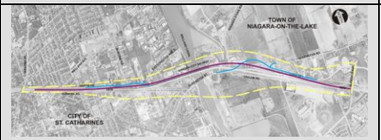
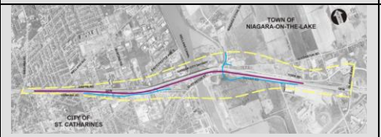
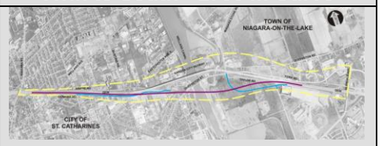
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
	3.6.2 Highway Drainage and Stormwater Management	• MTO Highway Drainage Design Standards • MTO Drainage Management Manual • MTO Drainage Directives • MOE Stormwater Management Planning and Design Manual • MTO Gravity Pipe Design Guidelines • NPCA SWM Guidelines	a) Impacts on existing highway drainage system (culverts, storm sewers, ditches).	• 1656 m of existing median storm sewer impacted. • 944 m of existing ditch impacted. • 1 culvert (total length 51 m) requires replacement or widening.	• 1950 m of existing median storm sewer impacted. • 574 m of existing ditch impacted. • 1 culvert (total length 51 m) requires replacement or widening.	• 2412 m of existing median storm sewer impacted. • 1381 m of existing ditch impacted. • 1 culvert (total length 51 m) requires replacement or widening.	• 2090 m of existing median storm sewer impacted. • 792 m of existing ditch impacted. • No culvert impacts.
			b) Ability to provide adequate stormwater management (quantity, quality, and erosion protection)	No significant challenges anticipated; however, additional property may be required for stormwater management pond(s).			
Summary – Surface Water				All alternatives will result in comparable impacts to surface water. As a result, from a surface water perspective **all alternatives are equally preferred**.			
3.7 Groundwater	3.7.1 Groundwater	• Design plans • Borehole logs • Aquifer vulnerability mapping	a) Qualitative assessment of impacts to groundwater	No significant impacts anticipated.			
			b) Quantitative assessment of impacts to groundwater	N/A			
Summary – Groundwater				All alternatives are not anticipated to result in significant impacts to groundwater. As a result, from a groundwater perspective **all alternatives are equally preferred**.			
Overall Summary – Natural Environment				From a fish and fish habitat perspective, Alternative NT2A and ST2A are equally preferred as they do not require watercourse realignments or the infill of wetlands or tributaries. From a terrestrial ecosystems perspective, NT2A is preferred as it will result in the fewest impacts to SAR, wildlife, and wildlife habitat, and comparable impacts to wetland and upland vegetation, wildlife, and wildlife habitat. Alternative ST2A results in the greatest impacts to wetland and upland vegetation, wildlife, and wildlife habitat, including the fragmentation of a high quality successional habitat mosaic with high potential for SWH designation. It also has the greatest risk of impacts to SAR species. Alternative NT2A is the only alternative to not impact any Greenbelt lands, and as a result is the preferred alternative from a designated natural features perspective.			

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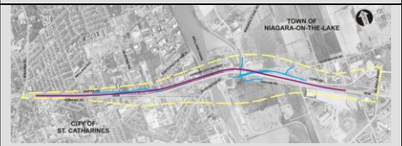
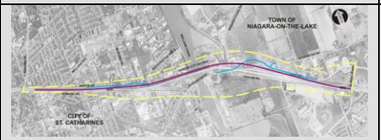
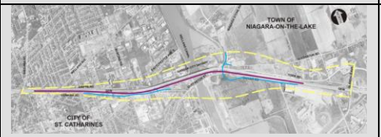
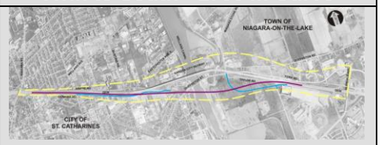
Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria	**Data Source[1]**	**Measures**					
				Alternative ST2A is preferred from a contaminated sites perspective, as it results in the fewest impacts to known or potentially contaminated sites. All of the alternatives are comparable when considering excess materials management, surface water, and groundwater impacts. **As a result**, **Alternative NT2A is preferred from a Natural Environment perspective.**			
4.0 Structural Engineering							
4.1 Structural	4.1.1 Structural	• *Canadian Highway Bridge Design Code* • MTO *Structure Rehabilitation Manual* • MTO *Ontario Heritage Bridge Guidelines* • Design plans • Base mapping	a) Life span and durability of structure	Existing structure design life is 50+ years (as determined by the Study Team). New structure design life is 75-100 years.			
			b) Treatment of existing bridge	• Replace concrete deck with durable material • Replace deteriorated steel, clean and coat • Ongoing maintenance and rehabilitation of existing and new structures			
			c) Maintenance (including consideration of salt use for winter maintenance)	• Stainless steel or GFRP rebar can be used to protect the (new and existing) structures from salt use during winter maintenance • Ongoing asphalt patch and pave			
			d) Flexibility for future bridge rehabilitation / expansion	• New twinning substructure can be designed to accommodate future expansions (ex. deck widening) • Having 2 bridge crossings reduces chances of closing the crossing during future rehabilitation/expansion work, or significant accidents • New twinning structure can be designed to carry all 6 lanes such that either structure (new or existing) can carry all traffic during future expansion work			
	4.1.2 Constructability	• Ontario *Geometric Design Standards for Ontario Highways* • Transportation Association of Canada *Geometric Design Guide for Canadian Roads* • Construction standards and specifications • Design plans • Base mapping	a) Potential need for special and/or unfamiliar construction techniques	Minimal need for special and/or unfamiliar construction techniques; probable structure type could be constructed by local contractors			
			b) Potential construction cost and/or schedule risks	Minimal risks to construction cost and/or schedule risks. A new bridge to the north will be further from the existing Homer Bridge and thus would have slightly fewer construction risks. Suitable candidate for Design-Build Project.		Minimal risks to construction cost and/or schedule risks. Suitable candidate for Design-Build Project.	
	4.1.3 Staging	• Design plans • *Ontario Traffic Manual, Book 7: Temporary Conditions* • *Geometric Design*	a) Construction staging impacts • Number of stages • Total duration • Lane restriction/reducti	• 1 or 2 stages • Construction duration of 3.5 years • No lane reduction • Traffic diversion during construction to complete rehabilitation in 2 stages			

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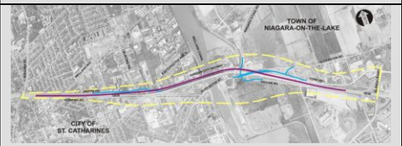
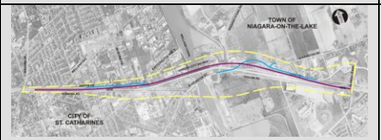
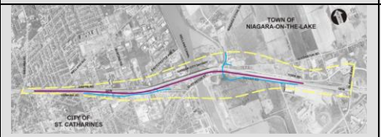
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
		Standards for Ontario Highways	on requirements • Potential for traffic disruption during construction				
	4.1.4 Construction Materials	• *Canadian Highway Bridge Design Code* • MTO *Structure Rehabilitation Manual* • Design plans • Base mapping	a) Use of existing infrastructure	Existing bridge will remain in service.			
	4.1.5 Critical Infrastructure Protection	• NCHRP Report 525 – Surface Transportation Security, Volume 3: Incorporating Security into the Transportation Planning Process • Discussions with OPP	a) Vulnerability of QEW and Welland Canal	Catastrophic failure of the bridge would cause significant disruptions to both the QEW and Welland Canal.			
			b) Prevention of security incidents	Impossible to limit access to structure via vehicles both on and below the bridge. Difficult to prevent access to bridge piers from below (fencing, closed-circuit cameras and security are all possible countermeasures).			
			c) Protection of structure from catastrophic events (i.e., 'target hardening')	Very limited potential for hardening of the original bridge. Potential to harden the new bridge.			
			d) Redundancy	Some redundancy, as two separate structures are required, one for each direction. In the event that one structure is unserviceable, the other structure (provided it is serviceable) could be used for bi-directional traffic with reduced lanes.			
			e) Recovery (i.e., ability to respond to an emergency after a catastrophic event)	No significant challenges to recovery.			
	4.1.6 Contract Delivery	• Industry practice	a) Flexibility in contract delivery.	Flexibility in contract delivery.			
Overall Summary – Structural Engineering				For nearly all of the criteria there is no difference between the alternatives, though Alternatives NT2 and NT2A would be constructed further from the existing Homer Bridge, resulting in slightly fewer construction risks. As a result, **Alternatives NT2 and NT2A** are slightly preferred over the other alternatives from a structural engineering perspective.			

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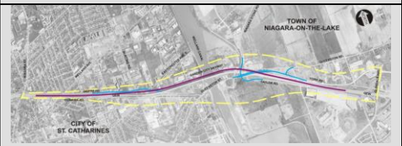
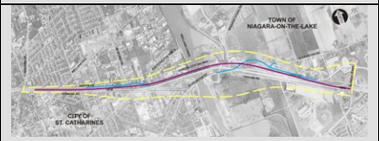
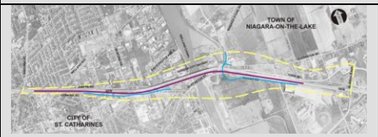
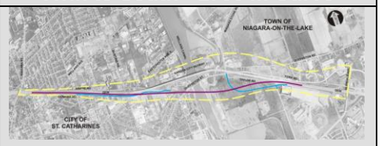
Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria	**Data Source[1]**	**Measures**					
5.0 Transportation & Other Considerations							
5.1 Transportation	5.1.1 Flexibility for future improvement	• Base mapping • Design plans • Other Studies Provincial policy papers (e.g., Places to Grow)	a) Qualitative assessment of future expansion/compatibility	Future capacity improvements would require widening of the 'new' structure, but original bridge has sufficient deck area for up to two additional lanes. Should functional needs change in future (need for more HOV lanes, LRT crossings, etc.) 1960's structure could be replaced to accommodate those needs.			
	5.1.2 Highway Geometrics	• *Geometric Design Standards for Ontario Highways* • *Transportation Association of Canada Geometric Design Guide for Canadian Roads* • *Proposed Draft Concepts for New Rural Freeways* • Other MTO standards • Design plans • Base mapping	a) Compatibility with current highway design standards and practices.	New structure meets current design standards and practices; however, additional shoulder width required to meet sight distance requirements at R=875 m curve. Existing structure retains below-standard (design speed = 90 km/h) vertical crest curve, and requires additional shoulder width to meet sight distance requirements at R=875 m curve.	New structure meets current design standards and practices. Existing structure retains below-standard (design speed = 90 km/h) vertical crest curve, and requires additional shoulder width to meet sight distance requirements at R=875 m curve.	New structure meets current design standards and practices; however, additional shoulder width required to meet sight distance requirements at R=875 m curve. Existing structure retains below-standard (design speed = 90 km/h) vertical crest curve, and requires additional shoulder width to meet sight distance requirements at R=875 m curve.	New structure meets current design standards and practices. Existing structure retains below-standard (design speed = 90 km/h) vertical crest curve, and requires additional shoulder width to meet sight distance requirements at R=875 m curve.
	5.1.3 Traffic Operations	• Transportation planning and land use forecasting model • Design plans • Base mapping & field review	a) Impacts to traffic operations.	Improved QEW operations are expected due to the addition of truck-climbing lane and improved roadside (i.e., shoulders).			
	5.1.4 Safety	• Transportation planning and land use forecasting model • Historical collision data • Design plans • Base mapping & field review	a) Ability to address existing deficiencies	Addresses narrow shoulder width concerns and provides truck-climbing lane. Improvement to vertical alignment for Toronto-bound traffic. No improvement to horizontal alignment.	Addresses narrow shoulder width concerns and provides truck-climbing lane. Improvements to vertical and horizontal alignments for Toronto-bound traffic.	Addresses narrow shoulder width concerns and provides truck-climbing lane. Improvement to vertical alignment for Niagara-bound traffic. No improvement to horizontal alignment.	Addresses narrow shoulder width concerns and provides truck-climbing lane. Improvements to vertical and horizontal alignments for Niagara-bound traffic.
			b) Impact on driver behavior / expectations	Some improvements expected due to widened shoulders on both bridges and upgraded geometry on the new bridge.			

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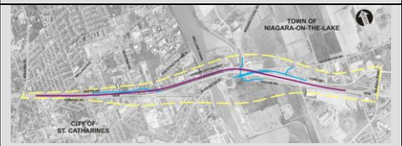
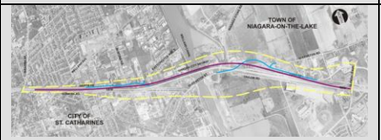
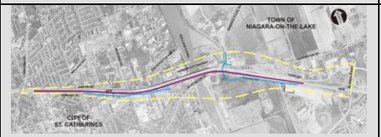
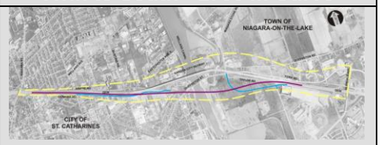
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
	5.1.5 Compatibility with road network (QEW and local)	• Local and regional transportation plans, official plans • Other EA studies • Design plans	a) Impacts to Local road network • Local road realignment requirements • Construction staging requirements	Moderate level of impacts to local road network. Realignments required for Dieppe Road, York Road, Queenston Road, Queenston Street, Niagara Stone Road, and Taylor Road. Partial closure of Queenston Road, and closure of Coon Road.	Moderate level of impacts to local road network. Realignments required for Dieppe Road, Eastchester Avenue East, York Road, Queenston Road, and Queenston Street. Partial closure of Queenston Road, and closure of Coon Road.	Moderate level of impacts to local road network. Realignments required for Dieppe Road, Dunkirk Road, Niagara Stone Road, and Taylor Road. Partial extension of Queenston Road required.	Moderate level of impacts to local road network. Realignments required for Dieppe Road, Dunkirk Road, and Taylor Road.
			b) Impact on QEW	Improved operations due to truck-climbing lane and improved cross section. Modifications to Niagara St. E-N/S and N/S-E ramps required.			
	5.1.6 Seaway and Airport Operations	• Input from the St. Lawrence Seaway Management Corporation and Transport Canada • Input from Niagara Regional Airport and Transport Canada	a) Potential impacts on St. Lawrence Seaway operations during construction	In-water pier construction may be required; however, no impacts are anticipated.			
			b) Impact on Niagara Regional Airport operations	No major impacts anticipated, provided a low-superstructure bridge is constructed. It is acknowledged that the existing bridge encroaches into the Airport's outer surface height restriction, and that a twin bridge to the north would be closer to the Airport. A high-superstructure bridge (e.g. cable-stayed) could have impacts on Airport operations.		No major impacts anticipated, provided a low-superstructure bridge is constructed. It is acknowledged that the existing bridge encroaches into the Airport's outer surface height restriction. A twin bridge to the south would be further from the Airport than a north-side bridge. A high-superstructure bridge (e.g., cable-stayed) could have impacts on Airport operations.	
	5.1.7 Emergency Response	• Input from Ontario Provincial Police • Input from municipal emergency services • Design plans	a) Impacts to emergency access/routing	Some potential for short-term impacts during first phase of construction; otherwise, no impacts anticipated.			
			b) Potential challenges to incident management	Improved safety of emergency personnel responding to incidents on the bridge. No new challenges anticipated.			
	5.1.8 Utilities	• Existing Utility Records • NEB Regulations • MTO CMO requirements • Design plans • Base mapping	a) Type of utility impacted	Major municipal sewer, major municipal watermain, hydro transmission line.			
			b) Length and type (i.e., crossing or relocation) of direct impact to existing utility corridors	2 major municipal sewer crossings; 121 m potentially impacted; probable displacement of a significant manhole. 1 major existing municipal watermain crossing; 62 m potentially impacted. Future Bunting Road watermain potentially impacted. 1 hydro transmission line crossing.	3 major municipal sewer crossings; 509 m potentially impacted; probable displacement of a significant manhole. 1 major existing municipal watermain crossing; 70 m potentially impacted. Future Bunting Road watermain potentially impacted.	1 major municipal sewer crossing; 211 m potentially impacted. 2 major existing municipal watermain crossings; 878 m potentially impacted. Future Bunting Road watermain potentially impacted. 1 hydro transmission line crossing. Numerous minor utilities impacts.	1 major municipal sewer crossing; 97 m potentially impacted. 2 major existing municipal watermain crossings; 978 m potentially impacted. Future Bunting Road watermain potentially impacted. 1 hydro transmission line crossing. Numerous minor utilities impacts.

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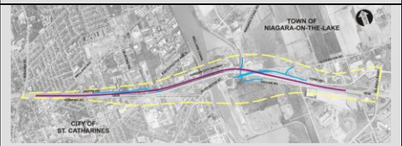
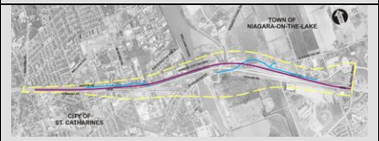
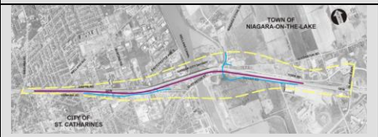
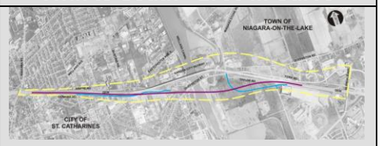
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Twinning			
Alternative Identifier				**NT2**	**NT2A**	**ST2**	**ST2A**
Description				**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH							
Environmental Factor / Criteria		**Data Source[1]**	**Measures**				
				Numerous minor utilities impacts.	1 hydro transmission line crossing. Numerous minor utilities impacts.		
Overall Summary – Transportation & Other Considerations				Alternative ST2A is slightly preferred over NT2A, which both have upgraded horizontal curvatures and require no shoulder widening on the structure. However, Alternative ST2A also results in the fewest impacts to the existing road network. Alternatives NT2 and ST2 are least preferred, as they result in the most impacts to the local road network, including the Niagara Stone Road/Queenston Street/York Road/Taylor Road intersection, and require shoulder widening to meet sight distance requirements due to their tighter horizontal curvature. Alternatives NT2 and NT2A are slightly less preferred when considering impacts to the Niagara District Airport, as they result in the new bridge being located closer to the Airport. From a utilities perspective, Alternatives ST2 and ST2A are preferred as they do not cross a significant manhole. It is noted that all alternatives adversely impact a hydro transmission corridor. As a result, **Alternatives ST2 and ST2A** are preferred from a transportation perspective.			
6.0 Cost[3]							
	6.1.1 Cost	• MTO Parametric Estimating Guide • HiCo • Previous studies	a) Structure Capital Cost (Note: excludes contingencies)	$293M ($2011)			
		• MTO Parametric Estimating Guide • HiCo • Previous studies • MTO Structural Manual	b) Structure Lifecycle Cost (Structure Capital Cost + Future Maintenance) (Note: excludes contingencies)	$398M ($2011)			
		• MTO Parametric Estimating Guide • HiCo • Previous studies • MTO Structural Manual • Input from MTO Property Office	c) Total Construction Cost (Structure Capital Cost + Highway Costs + Property) (Notes: costs rounded; includes contingencies; 25% additional contingency added to high range)	$560-710M (Includes $60M property costs.)	$575-725M (Includes $75M property costs.)	$540-690M (Includes $40M property costs.)	$515-665M (Includes $15M property costs.)

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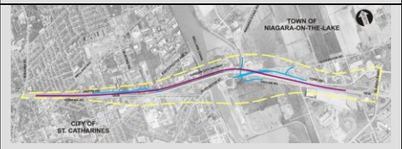
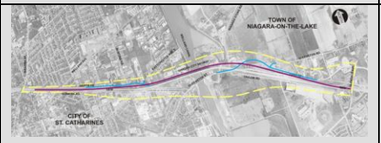
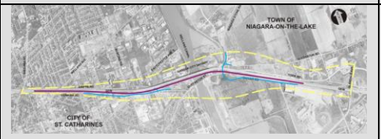
Alternative Type			Twinning			
Alternative Identifier			**NT2**	**NT2A**	**ST2**	**ST2A**
Description			**Twin to North - 875 m Curve**	**Twin to North - 1700 m Curve**	**Twin to South - 875 m Curve**	**Twin to South - 1700 m Curve**
SKETCH						
Environmental Factor / Criteria	**Data Source[1]**	**Measures**				
Summary - Cost			Preliminary cost estimates identified that all alternatives have similar costs. As a result, **all alternatives are equally preferred** from a cost perspective.			
Overall Summary			**Alternative NT2A is the preferred twinning alternative.** It results in the fewest impacts to the natural environment and is also preferred over south twinning alternatives from a socio-economic perspective due to more easily mitigated business impacts.			

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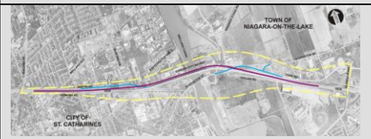
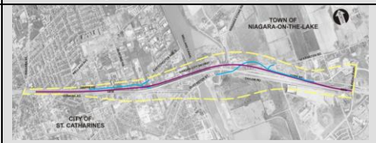
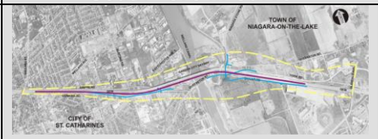
[3] Costs are preliminary in nature and subject to change in Detail Design

Replacement Bridge Alternatives

Alternatives Evaluation - Replacement Bridge Alternative

Alternative Type				Replacement Bridge			
Alternative Identifier				RB1	RB1A	RB2	RB2A
Description				Replacement Bridge to North - 875 m Curve	Replacement Bridge to North - 1700 m Curve	Replacement Bridge to South - 875 m Curve	Replacement Bridge to South - 1700 m Curve
SKETCH							
Environmental Factor /Criteria	**Data Source[1]**	**Measures**					
1.0 Socio-Economic Environment							
1.1 Property and Property Access	1.1.1 Property and Property Access	• Municipal land use information • Approved development plans	a) Number of properties directly impacted	Number of impacted properties by type: Residential: 4 Commercial: 18 Industrial: 4 Open Space: 4 (includes 1 MTO property) Utility: 1 Agricultural: 1 Total: 32	Number of impacted properties by type: Residential: 2 Commercial: 23 Industrial: 9 Open Space: 6 (includes 1 MTO property) Utility: 1 Agricultural: 1 Total: 42	Number of impacted properties by type: Residential: 0 Commercial: 18 Industrial: 4 Open Space: 8 (includes 3 MTO properties) Utility: 1 Agricultural: 0 Total: 31	Number of impacted properties by type: Residential: 0 Commercial: 19 Industrial: 4 Open Space: 4 (includes 1 MTO property) Utility: 1 Agricultural: 0 Total: 28
			b) Number of residences potentially displaced	4 residences potentially displaced.	2 residences potentially displaced.	None anticipated.	
			c) Qualitative assessment of changes to residential property access	No significant changes to residential property access, as all affected residential properties will be displaced by direct impacts.	No significant changes to residential property access, as all affected residential properties will be displaced by direct impacts and/or right-of-way requirements.	Minor changes; minor revision to one residential access required.	Minor changes. Access to one residential property on Dunkirk Road would require modifications to existing driveway; revised access from cul-de-saced section of Dunkirk Road; some out-of-way travel introduced.
			d) Number of businesses potentially displaced	11 businesses potentially displaced.	16 businesses potentially displaced.	10 businesses potentially displaced.	
			e) Qualitative assessment of changes to business property access	Minor changes to business accesses along Dieppe Road; some modifications required (most businesses along Dieppe Road are directly impacted, and no access is required).		Moderate impacts to business accesses on Dunkirk Road and Niagara Stone Road. Minor out-of-way travel required for some Dunkirk Road businesses east of Bunting Road.	Moderate impacts to business accesses on Dunkirk Road. Minor out-of-way travel required for some Dunkirk Road businesses east of Bunting Road.
			f) Number of roads closed	Coon Road closed. Queenston Road closed between Coon Road and Niagara Stone Road; Queenston Road realigned to connect to York Road near Coon Road.		No road closures.	Section of Dunkirk Road closed east of Bunting; replaced with realigned section of existing roadway, and existing section of Dunkirk Road cul-de-saced.
Summary– Property and Property Access				Alternative RB1A will impact the greatest number of properties including residences and businesses, and Alternatives RB2 and RB2A avoid impacts to any residences. Alternatives RB1 and RB1A will result in the greatest number of road closures, while Alternative RB2 results in no road closures. All alternatives will result in some changes to property access. The access changes as a result of Alternatives RB1 and RB1A are less of an impact compared to the access changes resulting from RB2 and RB2A; however, none of the changes are significant and in all cases access can be provided.				

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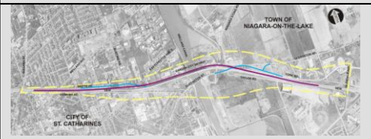
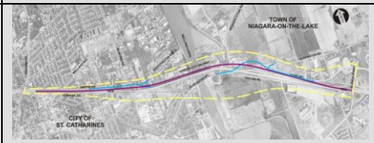
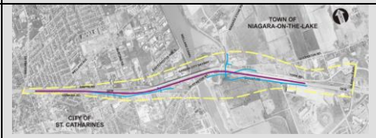
Alternative Type				Replacement Bridge			
Alternative Identifier				**RB1**	**RB1A**	**RB2**	**RB2A**
Description				**Replacement Bridge to North - 875 m Curve**	**Replacement Bridge to North - 1700 m Curve**	**Replacement Bridge to South - 875 m Curve**	**Replacement Bridge to South - 1700 m Curve**
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
				As a result, from a property and property access perspective **Alternative RB2 is preferred**.			
1.2 Community Effects	1.2.1 Community facilities (cemeteries, schools, places of worship, recreation centres)	• Municipal land use information • Approved development plans	a) Number of cemeteries directly impacted or potentially displaced	None		One; Homer Burial Ground may be potentially impacted during construction; however, impacts can be mitigated.	One: Victoria Lawn Cemetery may experience temporary impacts during construction; however, impacts can be mitigated.
			b) Number of schools directly impacted or potentially displaced	None			
			c) Number of places of worship directly impacted or potentially displaced	None			
			d) Number of recreation centres directly impacted or potentially displaced	One; Niagara Ball Hockey Club		None	
			e) Qualitative assessment of changes to access to community facilities (cemeteries, schools, places of worship, recreation centres)	Niagara Ball Hockey facility will be displaced.		None	
	1.2.2 Recreational and Tourist Features	• Municipal land use information • Approved development plans	a) Number of parks and trails directly impacted	Trails along Welland Canal will be temporarily impacted during construction. No parks impacted.			
		• Input from the St. Lawrence Seaway Management Corporation and Transport Canada	b) Impacts to recreational boating traffic within the Welland Canal	No impacts anticipated.			
		• Input from the Ministry of Tourism and Culture	c) Impacts to the Tourism Information Centre	Direct impacts to TIC building; relocation required.	Relocation required, as TIC building would be located on the Niagara-bound side of the highway. Also, impacts to parking facilities and possible direct impacts to TIC building.	No impacts to TIC building; moderate modifications to ramps required.	
	1.2.3 Land Use Opportunities	• Municipal planning departments	a) Potential for new development opportunities	Some potential for new development in existing bridge footprint lands.			
	1.2.4 Agricultural	• Topographic maps	a) Impact on local agricultural resources using quantitative	None	Potential for impact to lands designated for agriculture and not	Potential for impact to lands designated for agriculture and not currently used for agriculture.	

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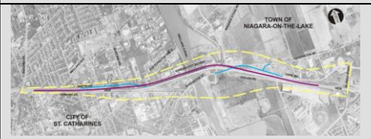
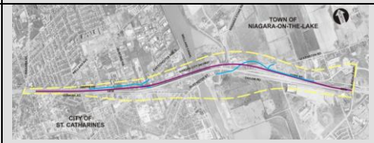
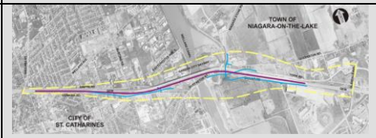
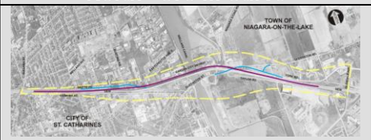
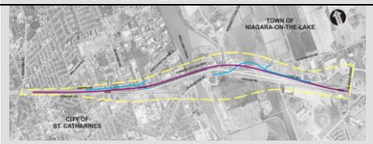
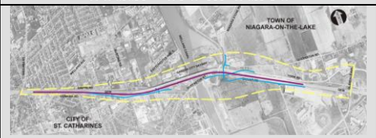
Alternative Type				Replacement Bridge			
Alternative Identifier				**RB1**	**RB1A**	**RB2**	**RB2A**
Description				**Replacement Bridge to North - 875 m Curve**	**Replacement Bridge to North - 1700 m Curve**	**Replacement Bridge to South - 875 m Curve**	**Replacement Bridge to South - 1700 m Curve**
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
	Resources	• Municipal land use information • Approved development plans	measure of area (ha)		currently used for agriculture.		
			b) Number of agricultural operations directly impacted	None			
	1.2.5 Approved local, Regional, and Provincial plans and policies	• Municipal land use information • Approved development plans • Official Plans • Secondary Plans • Niagara Escarpment Plan (2005) • Greenbelt Plan (2005)	a) Assessment of conformity with approved local, Regional, and Provincial plans and policies	Conforms with Greenbelt Plan polices regarding new infrastructure; conforms to the Niagara Region Policy Plan.			
Summary– Community Effects				For many of the criteria there is no difference between the alternatives. Alternatives RB1 and RB1A will displace the Niagara Ball Hockey Club, unlike Alternatives RB2 and RB2A. While Alternatives RB2 and RB2A each impact a cemetery, the impacts are temporary and can be mitigated. Alternatives RB1 and RB1A will also require the relocation of the Tourism Information Centre, while Alternatives RB2 and RB2A will only require modifications to the entrance ramps. Alternative RB1 is the only alternative to avoid impacts to lands designated for agriculture. As a result, from a community effects perspective **Alternatives RB2 and RB2A are most preferred**, and Alternative RB1A is least preferred.			
1.3 Nuisance Effects	1.3.1 Noise	• Topographic maps • Municipal land use information • Approved development plans	Noise Impact: • Highway alignment shifting towards adjacent NSAs is expected to increase noise levels • Highway alignment shifting away from adjacent NSAs is expected to decrease noise levels. • The approximate number of houses represented by each NSA are: NSA 8: > 50 NSA 9: > 50 NSA 10: > 5 NSA 11: ~ 2 NSA 12: ~ 3	• Highway alignment shifts north away from NSA 8, NSA 9, NSA 10, NSA 11, which is expected to decrease noise levels (Highway alignment displaces NSA 12)	• Highway alignment shifts north away from NSA 8, NSA 9, NSA 10, NSA 11, which is expected to decrease noise levels. • Highway alignment shifts closer to NSA 12, NSA 13, which is expected to increase noise levels	• Highway alignment shifts south towards NSA 8, NSA 9, NSA 10, which is expected to increase noise levels. • Highway alignment displaces NSA 11 • Highway alignment shifts further away from NSA 12, which is expected to decrease noise levels	• Highway alignment shifts south towards NSA 8, NSA 9, NSA 10, which is expected to increase noise levels. • Highway alignment shifts further away from NSA 11, NSA12, which is expected to decrease noise levels

[1] Sources of information for all factor areas include the design alternatives, existing conditions surveys and aerial photography
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Replacement Bridge			
Alternative Identifier				**RB1**	**RB1A**	**RB2**	**RB2A**
Description				**Replacement Bridge to North - 875 m Curve**	**Replacement Bridge to North - 1700 m Curve**	**Replacement Bridge to South - 875 m Curve**	**Replacement Bridge to South - 1700 m Curve**
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
			NSA 13: > 10				
	1.3.2 Air quality		a) Qualitative assessment of impacts to air quality (Based on proximity of receptors to bridge/tunnel. More weight was given to residential receptors than to industrial areas as potential receptors)	All lanes of traffic shift away from nearby residences to the south, but closer to any remaining residences on Queenston Road, near Niagara Stone Road. Small mixed effect.	Traffic lanes shift away from residences to the south but closer to residences on Queenston Road, near Niagara Stone Road. Small mixed effect.	Traffic lanes shift towards residential areas to the south and away from residences on Queenston Road, near Niagara Stone Road. Small mixed effect.	Traffic lanes shift much closer to residences to the south and farther from those on Queenston Road, near Niagara Stone Road. Effects are mixed.
	1.3.3 Vibration		a) Qualitative assessment of vibration impacts	Operation: • No impacts expected Construction: • With diesel pile driving, some vibration may be felt as the alternative is north of the closest residences approximately 90m away.	Operation: • No impacts expected Construction: • With diesel pile driving, some vibration may be felt as the alternative is north of the closest residences approximately 50m away.	Operation: • No impacts expected Construction: • With diesel pile driving, some vibration may be felt as the alternative is south of the closest residences approximately 100m away.	Operation: • No impacts expected Construction: • With diesel pile driving, some vibration may be felt as the alternative is north of the closest residences approximately 45m away.
Summary – Nuisance Effects				Alternative RB1 results in the fewest noise impacts, as it shifts the highway alignment away from NSAs and does not shift closer to any other NSAs. Alternatives RB2 and RB2A will result in greater noise impacts as they shift the alignment closer to more NSAs. Due to a proximity to residential properties, Alternatives RB1, RB1A and RB2 are most beneficial from an air quality perspective. Alternative RB2A is the least preferable from an air quality perspective due to a shift towards residential properties. No vibration impacts are anticipated during operation. While impacts may occur during construction those impacts may be reduced through mitigation and will be temporary (limited to pile driving). Due to the distance from residences Alternatives RB1A and RB2A have potential for the most construction vibration related impact. As a result, **Alternative RB1** is preferred from a nuisance effects perspective.			
Overall Summary – Socio-Economic Environment				From a property and property access perspective Alternative RB2 is preferred as it results in fewer property impacts and no road closures. From a community effects perspective, Alternatives RB2 and RB2A are equally preferred as they avoid displacement of the existing Travel Information Centre and one business. From a nuisance effects perspective, Alternative RB1 is preferred due to fewer noise, air quality and vibration impacts. **As a result, from a socio-economic environment perspective Alternative RB2 is preferred.**			
2.0 Cultural Environment							
2.1 Archaeology	2.1.1 Archaeological sites	• Stage 1 Archaeological Assessment	a) Impact to known archaeological features or areas of archaeological	Impacts areas of archaeological potential.			

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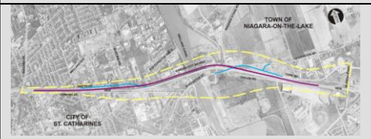
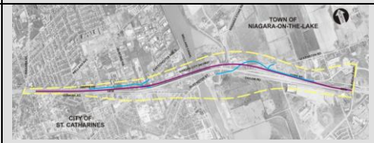
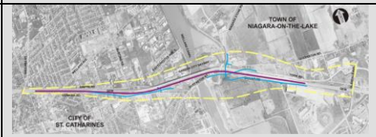
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Replacement Bridge			
Alternative Identifier				**RB1**	**RB1A**	**RB2**	**RB2A**
Description				**Replacement Bridge to North - 875 m Curve**	**Replacement Bridge to North - 1700 m Curve**	**Replacement Bridge to South - 875 m Curve**	**Replacement Bridge to South - 1700 m Curve**
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
			potential				
2.2 Heritage Features	2.2.1 Built heritage and cultural heritage landscapes	• Heritage Existing Conditions Report for the QEW Garden City Skyway study area • Cultural Heritage Evaluation Report for the QEW Garden City Skyway • Historical mapping and aerial photographs, cemetery lists, municipal, provincial and federal inventories, listings, plaques, easements and designations of National Historic Sites and under the Ontario *Heritage Act* • Input from other factor areas • Consultation with municipal and regional heritage planning staff or designates, historical societies and other heritage groups as necessary • Municipal heritage inventories for designated and listed built heritage structures • Ontario Genealogical Society for	a) Number of listed built heritage resources (BHR) displaced or disrupted	6 BHR Note: this includes the displacement of the existing QEW Garden City Skyway.	6 BHR Note: this includes the displacement of the existing QEW Garden City Skyway.	2 BHR Note: this includes the displacement of the existing QEW Garden City Skyway.	1 BHR Note: this includes the displacement of the existing QEW Garden City Skyway.
			b) Number of cultural heritage landscape (CHL) resources displaced or disrupted	2 CHL	3 CHL	3 CHL	5 CHL

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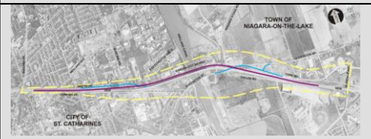
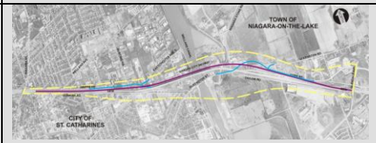
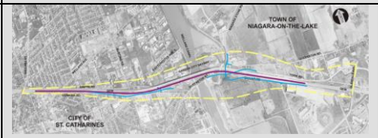
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Replacement Bridge			
Alternative Identifier				RB1	RB1A	RB2	RB2A
Description				Replacement Bridge to North - 875 m Curve	Replacement Bridge to North - 1700 m Curve	Replacement Bridge to South - 875 m Curve	Replacement Bridge to South - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		Cemeteries					
Overall Summary – Cultural Environment				All alternatives impact areas of archaeological potential. Given the number of impacts to cultural heritage resources, Alternative RB1A is least preferred. Alternatives RB2 and RB2A are similar in their impacts to cultural heritage resources; however, Alternative RB2A only impacts one BHR (the existing QEW Garden City Skyway). As a result, from a cultural environment perspective **Alternative RB2 is slightly preferred** over Alternative RB2A. It is important to note that the QEW Garden City Skyway Bridge holds high cultural heritage value and the loss of that bridge (due to replacement) make all of the replacement alternatives <u>very undesirable from a cultural heritage perspective</u>.			
3.0 Natural Environment							
3.1 Fisheries and Aquatic Habitat	3.1.1 Fish and fish habitat, considering: • Sensitivity of Fish and Fish Habitat[2] • Relative Magnitude of Potential Effect	• Topographic maps • Watershed Management Plans • Existing information gathered from MNR field studies and fish records, NPCA, Interest Groups, public consultation, municipalities • Reconnaissance-level field assessments • Provincial Policy Statement and associated MNR Natural Heritage Training Manual • The Fish Community of the Fourth Welland Canal:	a) Determination of Sensitivity of Fish and Fish Habitat based on evaluation of attributes such as: • Presence of any critical/specialized habitat • Presence of habitat for species of conservation concern, including Species At Risk as identified by COSEWIC and COSSARO, • Habitat resiliency based on thermal regimes (warm, cool, cold water) and flow regime (DFO Risk Management Framework 2006, MTO Environmental Guide for Fish and Fish Habitat 2006).	Three watercourses (Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek) traverse these bridge and road alignments. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent.	Four watercourses (Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek, Eight Mile Creek) traverse these bridge and road alignments. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent.	Three watercourses (Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek) traverse these bridge and road alignments. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent.

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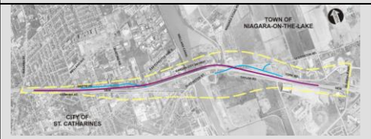
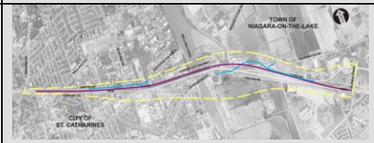
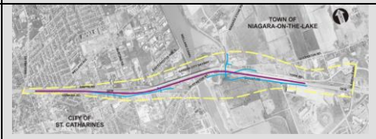
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Replacement Bridge			
Alternative Identifier				RB1	RB1A	RB2	RB2A
Description				Replacement Bridge to North - 875 m Curve	Replacement Bridge to North - 1700 m Curve	Replacement Bridge to South - 875 m Curve	Replacement Bridge to South - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		Welland to Port Colborne (MNR 1998) • MNR (Natural Resource Values Inventory Systems (NRVIS) mapping) • NHIC (MNR) and Species At Risk mapping (DFO) • Species at Risk Recovery Plans and Management Guidelines	b) Determination of Magnitude of Potential Effect using qualitative assessment as a relative measure of potential effects (e.g. piers, tunnel, need for channel realignment or culvert extensions).	<u>Replacement Bridge to North</u> • Welland Canal – requires 2 instream piers. • Tributary of Welland Canal – likely spanned. • Tributary of Eight Mile Creek – extensions required on York Road culvert. <u>Realignment of York Road</u> • Tributary of Welland Canal – possible extensions on Queenston Street culvert. • Tributary of Eight Mile Creek – new culvert required. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized removal and disturbance of riparian vegetation associated with the pier construction. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized removal of riparian vegetation and temporary alteration of channel banks and bed. Direct impacts and potential indirect impacts (e.g., erosion and sediment	<u>Replacement Bridge to North</u> • Welland Canal – requires 2 instream piers. • Tributary of Welland Canal – likely spanned. • Tributary of Eight Mile Creek – new culvert required. • Eight Mile Creek – extensions required on QEW culvert. <u>Realignment of York Road</u> • Tributary of Welland Canal – extension required on north side of Queenston Street culvert. • Tributary of Eight Mile Creek – new culvert required. • Eight Mile creek - extension required on north side of York Road. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized disturbance and removal of riparian vegetation associated with the pier construction. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized disturbance and removal of riparian vegetation and temporary alteration of channel banks and bed.	<u>Replacement Bridge to South</u> • Welland Canal – requires 2 instream piers. • Tributary of Welland Canal – likely spanned. • Tributary of Eight Mile Creek – extensions required on south sides of the QEW and Taylor Road culverts. <u>Realignment of Queenston Street, Niagara Stone Road and Taylor Road.</u> • Tributary of Welland Canal – culvert extension (or new culvert) required on north side of QEW and new culvert required for Queenston Street realignment. • Realignment of tributary and infill of open water wetland area (associated with the tributary) required on south side of QEW. • Tributary of Eight Mile Creek-extension required on south side of Taylor Road culvert. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized disturbance and removal of riparian vegetation associated with the pier construction.	<u>Replacement Bridge to South</u> • Welland Canal – requires 2 instream piers. • Tributary of Eight Mile Creek - extensions required on Taylor Road culvert. <u>Re-alignment of York Road</u> • Tributary of Welland Canal – new culvert required. • Tributary of Eight Mile Creek – new culvert required. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized disturbance and removal of riparian vegetation associated with the pier construction. The direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized disturbance and removal of riparian vegetation and temporary alteration of channel banks and bed. The direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.

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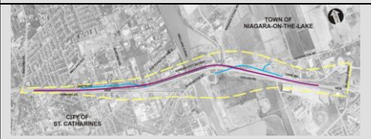
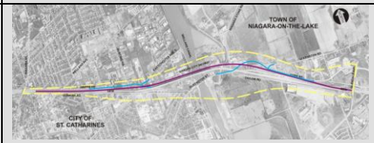
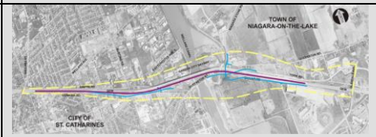
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Replacement Bridge			
Alternative Identifier				RB1	RB1A	RB2	RB2A
Description				Replacement Bridge to North - 875 m Curve	Replacement Bridge to North - 1700 m Curve	Replacement Bridge to South - 875 m Curve	Replacement Bridge to South - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
				control) can be managed using appropriate mitigation and restoration measures.	Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.	Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized disturbance and removal of riparian vegetation and temporary alteration of channel banks and bed. Direct impacts of the proposed realignment should be limited to temporary disturbance of the channel and localized disturbance and removal or riparian vegetation. The infilling of the open water wetland area (connected to the Tributary of the Welland Canal) will require some displacement of the wetland bed and localized disturbance and removal of riparian vegetation. The direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.	
Summary – Fisheries and Aquatic Habitat				Alternatives RB1, RB1A, RB2A do not require any watercourse realignments, do not require infill of wetland / tributary (fish habitat) and require comparatively more culvert works. Alternative RB2 requires infill of wetland/tributary (fish habitat) and realignment of a tributary. As a result, from a fisheries and aquatic habitat perspective **Alternatives RB1, RB1A and RB2A are equally preferred**.			

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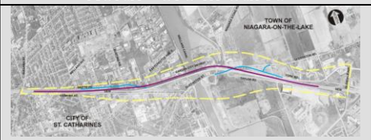
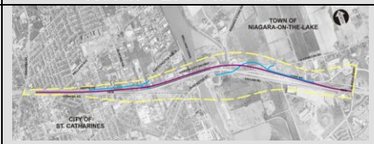
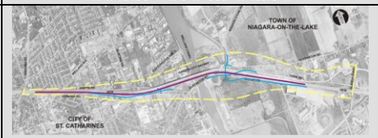
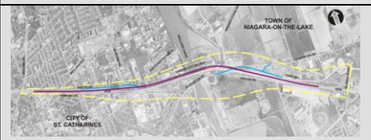
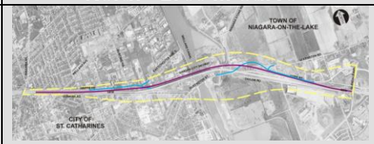
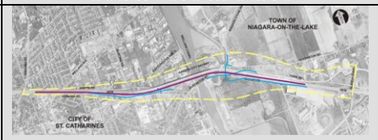
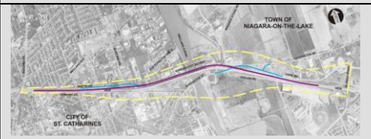
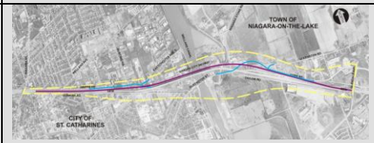
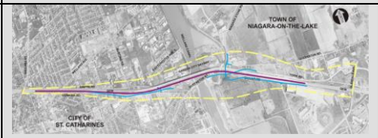
Alternative Type				Replacement Bridge			
Alternative Identifier				**RB1**	**RB1A**	**RB2**	**RB2A**
Description				**Replacement Bridge to North - 875 m Curve**	**Replacement Bridge to North - 1700 m Curve**	**Replacement Bridge to South - 875 m Curve**	**Replacement Bridge to South - 1700 m Curve**
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
3.2 Terrestrial Ecosystems	3.2.1 Wetland vegetation communities, considering: • Sensitivity / Quality / Significance of Wetland Vegetation[2] • Habitat Relative Magnitude of Potential Effect	• Topographic maps • MNR NRVIS data • MNR District staff • NHIC/Biodiversity Explorer • Bird Studies Canada/Breeding Bird Atlas • Municipal Official Plans • Existing information gathered from MNR, NPCA, Interest Groups, public consultation, municipalities • Reconnaissance-level field inventories • Species at Risk Recovery Plans and Management Guidelines	a) Determination of *Sensitivity/Quality/Significance of Wetland* based on designated status (PSW, LSW, unevaluated), supported by evaluation of attributes such as: • Presence of species of conservation concern including Species At Risk as identified by COSEWIC and COSSARO, • Presence of potential habitat for SAR, and • Habitat resiliency based on size, maturity, physical considerations (e.g. drainage, groundwater discharge, slope, etc.)	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • No known wetland communities within alignment footprint • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Very low** potential for wetland-associated SAR within footprint based on habitat types observed and general absence of wetland communities within the alignment footprint.	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • No known wetland communities within alignment footprint • **Wetland potential within forest block north of Queenston Road (Unit 5).** • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Very low** potential for wetland-associated SAR within footprint based on habitat types observed and general absence of wetland communities within the alignment footprint.	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • **2** small, young deciduous swamp communities (Units 14, 16) • Regenerating lands with thicket swamp and meadow marsh wetland components (Units 15, 17) • No wetland-associated flora of conservation concern records or observations in areas that were accessible. **Some areas were inaccessible during field investigations and were not assessed.** • **Low** potential for wetland-associated SAR within footprint based on habitat types observed. • Affected wetland communities are generally young and/or regenerating from agricultural lands.	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • **1** small, young deciduous swamp (Unit 16) • Regenerating lands with thicket swamp and meadow marsh wetland components (Unit 15) • No wetland-associated flora of conservation concern records or observations in areas that were accessible. **Some areas were inaccessible and were not assessed.** • **Low** potential for wetland-associated SAR within footprint based on habitat types observed. • Affected wetland communities are generally young and/or regenerating from agricultural lands.
			b) Determination of Magnitude of Potential Effect using qualitative assessment of potential impact (edge encroachment versus fragmentation, change to wetland size and shape etc.)	<u>Replace Bridge to the North</u> • No known or anticipated impacts to wetland communities <u>Realignment of Queenston Road</u> • No known or anticipated impacts to wetland communities <u>Realignment of Dunkirk Road</u> • No known or anticipated impacts to wetland communities ***No realignment of Niagara Stone Road or Taylor Road required.**	<u>Replace Bridge to the North</u> • No known or anticipated impacts to wetland communities • Edge impacts to Unit 5 <u>Realignment of Queenston Road</u> • No known or anticipated impacts to wetland communities • Fragmentation of Unit 5 <u>Realignment of Dunkirk Road</u> • No known or anticipated impacts to wetland communities ***No realignment of Niagara Stone Road or Taylor Road required.**	<u>Replace Bridge to the South</u> • **Edge removal** of a cultural meadow community with meadow marsh components (Unit 17) <u>Realignment of Niagara Stone Road and Taylor Road</u> • **Fragmentation** of a young deciduous swamp community (Unit 14) • **Edge removal** of regenerating lands with thicket swamp and meadow marsh components (Unit 15) and young deciduous swamp (Unit 16) <u>Realignment of Dunkirk Road</u> • No known or anticipated impacts to wetland communities	<u>Replace Bridge to the South</u> • **Central fragmentation** of the largest habitat block in the study area. Wetland components are present within this regenerating habitat mosaic (Units 15, 16). <u>Realignment of Niagara Stone Road and Taylor Road</u> • Further **central fragmentation** of the largest habitat block in the study area. Wetland components are present within this regenerating habitat mosaic (Units 15, 16). • Unit 16 is essentially removed by the combination of the new bridge/highway alignment and realigned roads. <u>Realignment of Dunkirk Road</u>

[1] Sources of information for all factor areas include the design alternatives, existing conditions surveys and aerial photography
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type			Replacement Bridge			
Alternative Identifier			RB1	RB1A	RB2	RB2A
Description			Replacement Bridge to North - 875 m Curve	Replacement Bridge to North - 1700 m Curve	Replacement Bridge to South - 875 m Curve	Replacement Bridge to South - 1700 m Curve
SKETCH						
Environmental Factor /Criteria		**Data Source[1]**	**Measures**			
						• No known or anticipated impacts to wetland communities
	3.2.2 Upland Vegetation Communities considering: • Sensitivity / Quality / Significance of Vegetation[2] • Relative Magnitude of Potential Effect		a) Determination of *Sensitivity/Quality/Significance of Upland Vegetation* (including cultural communities) based on evaluation of attributes such as: • Community rarity/sensitivity/tolerance and local representation/distribution on the landscape • Rarity of species (species of conservation concern including Species at Risk as identified by COSEWIC and COSSARO) • Presence of specialized habitat for species of conservation concern • Habitat resiliency based on size, maturity, physical considerations (e.g. drainage, slope, etc.)	• No mature, high quality forest communities were encountered in the vicinity of RB1. • Upland communities are generally young or remnant deciduous forest, cultural woodlands, cultural thickets and cultural meadows. • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.	• No mature, high quality forest communities were encountered in the vicinity of RB1A. • Upland communities are generally young or remnant deciduous forest, cultural woodlands, cultural thickets and cultural meadows. • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.	• No mature, high quality forest communities were encountered in the vicinity of RB2. • Upland communities are generally young or remnant deciduous forest, cultural woodlands, cultural thickets and cultural meadows. • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.	• No mature, high quality forest communities were encountered in the vicinity of RB2A. • Upland communities are generally young or remnant deciduous forest, cultural woodlands, cultural thickets and cultural meadows. • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.
			b) Determination of Magnitude of Potential Effect using qualitative assessment of potential impact (edge encroachment versus fragmentation, change to patch size and shape, etc.)	<u>Replace Bridge to the North</u> • 2 small wooded blocks and 1 small cultural woodland (Unit 6) removed • **2 Butternut trees removed** • edge removals of cultural meadow and cultural woodland communities (Units 8 and 18) <u>Realignment of Queenston Road</u> • **Fragmentation** of cultural meadow community between	<u>Replace Bridge to the North</u> • 2 small wooded blocks removed • edge removals of cultural woodland communities (Units 8 and 18) • **Indirect impacts to 2 Butternut trees** • **Fragmentation** of cultural meadow communities <u>Realignment of Queenston Road</u> • **Fragmentation** of cultural meadow	<u>Replace Bridge to the South</u> • Edge removal of a cultural meadow community with meadow marsh components (Unit 17) • Removal of 2 small cultural woodlands along Queenston Street <u>Realignment of Niagara Stone Road and Taylor Road</u> • **Fragmentation** of deciduous forest / cultural thicket mosaic (Unit 13) • **Edge** removal of regenerating	<u>Replace Bridge to the South</u> • **Central fragmentation** of the largest habitat block in the study area. This regenerating habitat mosaic is composed of deciduous forest, cultural thicket and cultural meadow upland components. • **Removal** of hedgerow along Dunkirk Road <u>Realignment of Niagara Stone Road and Taylor Road</u>

[1] Sources of information for all factor areas include the design alternatives, existing conditions surveys and aerial photography
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Replacement Bridge			
Alternative Identifier				RB1	RB1A	RB2	RB2A
Description				Replacement Bridge to North - 875 m Curve	Replacement Bridge to North - 1700 m Curve	Replacement Bridge to South - 875 m Curve	Replacement Bridge to South - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
				Queenston Road and York Road Realignment of Dunkirk Road • Minimal upland vegetation impacts anticipated. Alignment is through developed lands.	community between Queenston Road and York Road as well as cultural meadow east of Coon Road. Realignment of Dunkirk Road • Minimal upland vegetation impacts anticipated. Alignment is through developed lands.	community with cultural meadow components (Unit 15) • Removal of a large proportion of a cultural woodland community (Unit 8) Realignment of Dunkirk Road • -Minimal upland vegetation impacts anticipated.	• Further **central fragmentation** of the largest habitat block in the study area. This regenerating habitat mosaic is composed of deciduous forest, cultural thicket and cultural meadow upland components. • **Removal** of hedgerow along Dunkirk Road Realignment of Dunkirk Road • Minimal upland vegetation impacts anticipated.
	3.2.3 Wildlife and Habitat considering: • Sensitivity / Quality / Significance of Wildlife and Habitat[2] • Relative Magnitude of Potential Effect		a) Determination of *Sensitivity/Quality/Significance of Wildlife* and *Habitat* based on evaluation of attributes such as: • Presence of Significant Wildlife Habitat (SWH; e.g. deer yards and heronries as identified by MNR or NPCA; other specialized habitat such as Important Bird Areas etc.), interior and deep interior forest habitat • Presence of species of conservation concern including SAR as identified by COSEWIC and COSSARO • Presence of *potential* habitat for SAR • Habitat resiliency based on size (including interior and deep interior forest habitat), maturity, physical considerations • Presence of movement corridors (linkages)	• No previously identified SWH within RB1 area **Alignment within known habitat for 4 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) • Snapping Turtle (SC) • Eastern Meadowlark (COSEWIC recommended for listing as THR) **Alignment within habitat for 6 potential SAR:** • Chimney Swift (THR) – high potential • Milksnake (SC) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential • Yellow-breasted Chat (SC) – low potential	• No previously identified SWH within RB1A area **Alignment within known habitat for 4 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) • Snapping Turtle (SC) • Eastern Meadowlark (COSEWIC recommended for listing as THR) **Alignment within habitat for 6 potential SAR:** • Chimney Swift (THR) – high potential • Milksnake (SC) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential • Yellow-breasted Chat (SC) – low potential	• No previously identified SWH within RB2 area • Large successional habitat area south of the QEW has a high potential to qualify as SWH based on the SWHTG **Alignment within known habitat for 4 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) • Snapping Turtle (SC) • Milksnake (SC) **Alignment within habitat for 6 potential SAR:** • Chimney Swift (THR) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential • Yellow-breasted Chat (SC) – low potential • Golden-winged Warbler	• No previously identified SWH within RB2A area • Large successional habitat area south of the QEW has a high potential to qualify as SWH based on the SWHTG **Alignment within known habitat for 3 SAR**: • Monarch (SC) • Milksnake (SC) • Barn Swallow (COSEWIC recommended for listing as THR) **Alignment within habitat for 7 potential SAR:** • Chimney Swift (THR) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential • Yellow-breasted Chat (SC) – low potential • Golden-winged Warbler (COSEWIC-THR, MNR-SC) –

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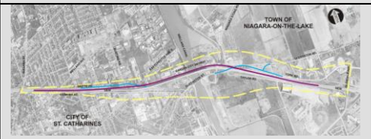
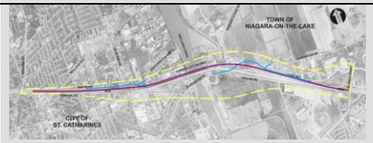
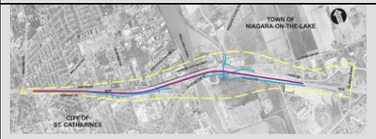
Alternative Type				Replacement Bridge			
Alternative Identifier				**RB1**	**RB1A**	**RB2**	**RB2A**
Description				**Replacement Bridge to North - 875 m Curve**	**Replacement Bridge to North - 1700 m Curve**	**Replacement Bridge to South - 875 m Curve**	**Replacement Bridge to South - 1700 m Curve**
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
			between natural areas/nodes on regional and local levels			(COSEWIC-THR, MNR-SC) – moderate potential	moderate potential • Eastern Meadowlark (COSEWIC recommended for listing as THR) – moderate potential
			b) Determination of Magnitude of Potential Effect considering: • Habitat type affected within footprint • Degree of habitat fragmentation • Habitat quality and sensitivity	Replace Bridge to the North • **Edge** impacts to **low** quality successional and cultural habitat Realignment of Queenston Road • **Fragmentation** of **low** quality successional habitat (i.e. mid-successional habitat that is too weedy for grassland birds [e.g. Bobolink] and becoming marginal for Eastern Meadowlark)	Replace Bridge to the North • **Edge** impacts to **low** quality successional and cultural habitat • **Fragmentation** of **low** quality successional habitat Realignment of Queenston Road • **Fragmentation** of **low** quality woodland habitat • **Fragmentation** of **low** quality successional habitat (i.e. mid-successional habitat that is too weedy for grassland birds [e.g. Bobolink] and becoming marginal for Eastern Meadowlark)	Replace Bridge to the South • **Edge** impacts to **low** quality successional and cultural habitat Realignment of Niagara Stone Road and Taylor Road • **Fragmentation** of **moderate** quality forest and successional habitat Realignment of Queenston Road • **Edge** impacts to **moderate** quality forest and **low** quality successional habitat	Replace Bridge to the South • **Central fragmentation** of **high** quality successional habitat mosaic with **high potential for SWH designation** Realignment of Niagara Stone Road and Taylor Road • Further **central fragmentation** of **high** quality successional habitat mosaic with **high potential for SWH designation**
Summary – Terrestrial Ecosystem				Alternatives RB1A and RB2 will result in the least impacts to wetland and upland vegetation. Alternative RB1 will result in the more notable impacts to upland vegetation including removal of two Butternut trees. Alternative RB2A will result in the most impacts to wetland and upland vegetation due to the central fragmentation of high quality successional habitat mosaic with high potential for SWH designation. Alternatives RB1and RB1A will result in the fewest impacts to wildlife and wildlife habitat. Alternative RB2 will result in more notable impacts to wildlife and wildlife habitat due to the fragmentation of moderate quality forest and successional habitat. Alternative RB2A will result in the most impacts to wildlife and wildlife habitat due to the central fragmentation of high quality successional habitat mosaic with high potential for SWH designation. Alternative RB2A also has a high risk of impacts to SAR species. As a result, from a terrestrial ecosystems perspective **Alternative RB1A is preferred**.			
3.3 Designated Natural Features	3.3.1 Designated Natural Features include, for example, Provincially Significant Wetlands (PSWs), Areas of Natural and Scientific Interest (ANSIs),	• MNR NRVIS data • NHIC/Biodiversity Explorer • Municipal Official Plans • NPCA • *Niagara Escarpment Plan* (2005) • *Greenbelt Plan* (2005)	a) Qualitative assessment of potential impacts to designated areas within the identified alternatives. • Where feasible/ applicable, the extent of the potential impact to designated areas will be quantitatively evaluated. • (Note: Impacts to designated natural features may also be captured within the	**No impacts** to lands designated as 'Natural Heritage System' under the *Greenbelt Plan* (2005) located south of Queenston Street and west of Homer Road.		**Edge** impacts to lands designated as 'Natural Heritage System' under the *Greenbelt Plan* (2005) located south of Queenston Street and west of Homer Road.	**Fragmentation** of a portion of the lands designated as 'Natural Heritage System' under the *Greenbelt Plan* (2005) located south of Queenston Street and west of Homer Road.

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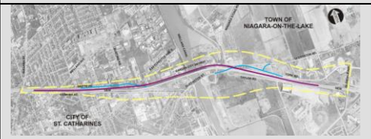
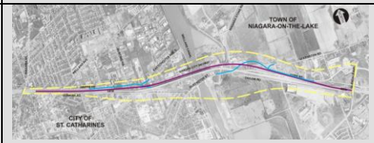
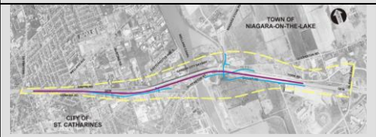
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Replacement Bridge			
Alternative Identifier				RB1	RB1A	RB2	RB2A
Description				Replacement Bridge to North - 875 m Curve	Replacement Bridge to North - 1700 m Curve	Replacement Bridge to South - 875 m Curve	Replacement Bridge to South - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
	Environmentally Sensitive/Significant Areas (ESAs), Niagara Escarpment Plan Area, Greenbelt Plan Area, Regional Greenlands Systems. These features are defined by resource agencies, municipalities, the government and/or the public, through legislation, policies, or approved management plans, to have special or unique value.		evaluation of impacts to upland and wetland vegetation, or wildlife habitat. Where overlap between evaluating impacts to designated natural features and upland/wetland vegetation exists, it will be clearly stated so that impacts are not 'double counted').				
Summary – Designated Natural Features				Alternatives RB2 and RB2A result in some impacts to lands designated under the *Greenbelt Plan* (2005) located south of Queenston Street and west of Homer Road. Alternatives RB1 and RB1A will not impact the lands designated under the *Greenbelt Plan* (2005) located south of Queenston Street and west of Homer Road. As a result, from a designated natural features perspective **Alternatives RB1 and RB1A are equally preferred**.			
3.4 Contaminated Sites	3.4.1 Known contaminated sites	• Contaminant Overview Study for the QEW Garden City Skyway study area • Contaminant Investigation Report for the QEW Garden City Skyway • MOE Waste Generator Database	a) Number of known contaminated sites impacted	There are 2 known contaminated properties within this proposed alignment.	There are 3 known contaminated properties within this proposed alignment.	There are 2 known contaminated properties within this proposed alignment.	

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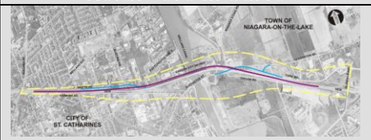
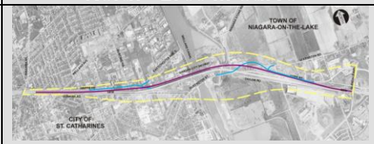
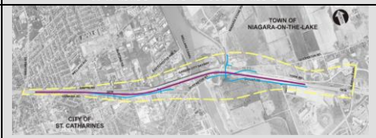
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Replacement Bridge			
Alternative Identifier				RB1	RB1A	RB2	RB2A
Description				Replacement Bridge to North - 875 m Curve	Replacement Bridge to North - 1700 m Curve	Replacement Bridge to South - 875 m Curve	Replacement Bridge to South - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		• MOE PCB Storage Site Database • Technical Standards & Safety Authority • Aerial photographs • Municipal directories and assessment maps • OMB and NTS mapping • Historical plans, soils, hydrological and geological maps • Libraries, historical archives, land registry offices and municipal offices • MOE Waste Disposal Site Inventory • MOE Coal Gasification Plant Database • Ecolog ERIS Retail Fuel Storage Tanks Database • Brownfields Environmental Site Registry					
	3.4.2 Potentially contaminated sites	• Contaminant Overview Study for the QEW Garden City Skyway study area • Contaminant Investigation Report for the QEW Garden City Skyway • Review of aerial photography • Field investigations	a) Number of potentially contaminated sites impacted	There are 17 potentially contaminated properties within the proposed alignment.	There are 19 potentially contaminated properties within the proposed alignment.	There are 17 potentially contaminated properties within the proposed alignment.	There are 21 potentially contaminated properties within the proposed alignment.

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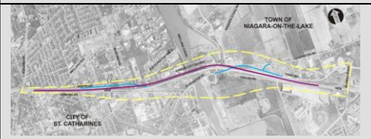
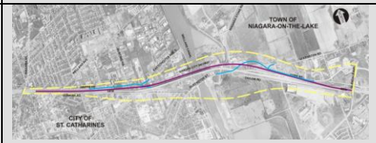
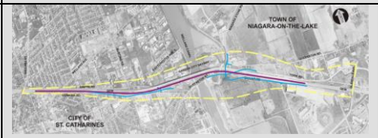
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Replacement Bridge			
Alternative Identifier				**RB1**	**RB1A**	**RB2**	**RB2A**
Description				**Replacement Bridge to North - 875 m Curve**	**Replacement Bridge to North - 1700 m Curve**	**Replacement Bridge to South - 875 m Curve**	**Replacement Bridge to South - 1700 m Curve**
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		• MOE Coal Gasification Plant Database • Ecolog ERIS Retail Fuel Storage Tanks Database • Brownfields Environmental Site Registry • MOE Waste Generator Database • MOE PCB Storage Site Database • Technical Standards & Safety Authority					
Summary – Contaminated Sites				Given the total number of known and potential contaminated properties impacted Alternatives RB1A and RB2A will result in the most impacts to contaminated properties. Alternatives RB1 and RB2 will result in the fewest impacts to contaminated properties. As a result, from a contaminated sites perspective **Alternatives RB1 and RB2 are equally preferred**.		
3.5 Excess Materials Management	3.5.1 Excess material management requirements with consideration for the quantity and type of materials.	• Design plans	a) Approximate quantity of excess materials (relative to other alternatives).	Moderate amounts of excess materials, including existing bridge deck, girders and substructure. Existing Garden City Skyway bridge materials would need to be disposed of and/or recycled.			
			b) Types of excess materials.	Concrete, steel and asphalt.			
Summary – Excess Materials Management				All alternatives will require comparable quantities and types of excess materials. As a result, from an excess materials management perspective **all alternatives are equally preferred.**			
3.6 Surface Water	3.6.1 Hydraulics	• MTO Highway Drainage Design Standards • MTO Drainage Management Manual • MTO Drainage Directives • Canadian Highway	a) Hydraulic impact of the alternatives on the Welland Canal.	No impact; size of navigational channel opening far exceeds hydraulic requirements.		No impact; size of navigational channel opening far exceeds hydraulic requirements.	

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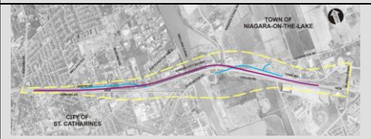
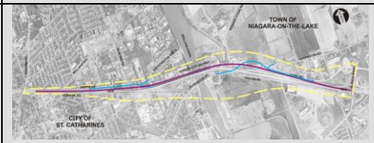
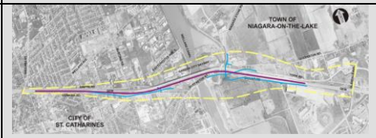
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Replacement Bridge			
Alternative Identifier				**RB1**	**RB1A**	**RB2**	**RB2A**
Description				**Replacement Bridge to North - 875 m Curve**	**Replacement Bridge to North - 1700 m Curve**	**Replacement Bridge to South - 875 m Curve**	**Replacement Bridge to South - 1700 m Curve**
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		Bridge Design Code • NPCA Flood and Fill Line Regulation • HEC-RAS Model Manual					
	3.6.2 Highway Drainage and Stormwater Management	• MTO Highway Drainage Design Standards • MTO Drainage Management Manual • MTO Drainage Directives • MOE Stormwater Management Planning and Design Manual • MTO Gravity Pipe Design Guidelines • NPCA SWM Guidelines	a) Impacts on existing highway drainage system (culverts, storm sewers, ditches).	3396 m of existing median storm sewer impacted. 1754 m of existing ditch impacted. 3 culverts (total length 135 m) require replacement or widening.	4100 m of existing median storm sewer impacted. 2185 m of existing ditch impacted. 3 culverts (total length 135 m) require replacement or widening.	2907 m of existing median storm sewer impacted. 1548 m of existing ditch impacted. 3 culverts (total length 135 m) require replacement or widening.	2569 m of existing median storm sewer impacted. 1641 m of existing ditch impacted. 3 culverts (total length 135 m) require replacement or widening.
			b) Ability to provide adequate stormwater management (quantity, quality, and erosion protection)	No significant challenges anticipated, relative to other bridge alternatives; however, additional property may be required for stormwater management pond(s).		No significant challenges anticipated, relative to other bridge alternatives; however, additional property may be required for stormwater management pond(s).	
Summary – Surface Water				All alternatives will result in comparable impacts to surface water. As a result, from a surface water perspective, **all alternatives are equally preferred**.			
3.7 Groundwater	3.7.1 Groundwater	• Design plans • Borehole logs • Aquifer vulnerability mapping	a) Qualitative assessment of impacts to groundwater	No significant impacts anticipated.			
			b) Quantitative assessment of impacts to groundwater	N/A			
Summary - Groundwater				All alternatives are not anticipated to impact groundwater. As a result, from a groundwater perspective **all alternatives are equally preferred**.			
Overall Summary – Natural Environment				For some of the criteria, including excess materials management, surface water and groundwater, all alternatives are equally preferred. Alternative RB1 is preferred or equally preferred from fisheries, designated natural features, and contamination perspectives. Alternative RB1A is preferred or equally preferred from fisheries, terrestrial ecosystems, and designated natural features perspectives. As a result, from a natural environment perspective **Alternatives RB1 and RB1A are equally preferred**.			
4.0 Structural Engineering							
4.1 Structural	4.1.1 Structural	• *Canadian Highway Bridge Design Code* • MTO *Structure*	a) Life span and durability of structure	New structure design life is 75 – 100 years			
			b) Treatment of existing bridge	Demolish existing bridge			

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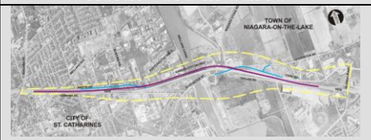
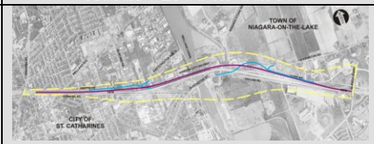
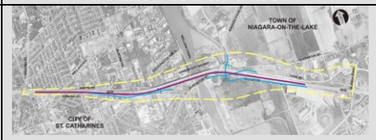
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design

Alternative Type				Replacement Bridge			
Alternative Identifier				**RB1**	**RB1A**	**RB2**	**RB2A**
Description				**Replacement Bridge to North - 875 m Curve**	**Replacement Bridge to North - 1700 m Curve**	**Replacement Bridge to South - 875 m Curve**	**Replacement Bridge to South - 1700 m Curve**
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		Rehabilitation Manual • MTO *Ontario Heritage Bridge Guidelines* • Design plans • Base mapping	c) Maintenance (including consideration of salt use for winter maintenance)	• Stainless steel or GFRP rebar can be used to protect the structures from salt use during winter maintenance • Higher quality waterproofing material • Minimized expansion joints • Provide increased accessibility for inspections • Ongoing asphalt patch and pave • Less time and costs spent on maintaining a single new structure, relative to widening or twinning alternatives			
			d) Flexibility for future bridge rehabilitation / expansion	• Impractical to accommodate future deck widening due to issues such as lateral thermal movements, inspection and drainage • Increased chances of lane reduction/closure during future rehabilitation/expansion work			
	4.1.2 Constructability	• Ontario *Geometric Design Standards for Ontario Highways* • Transportation Association of Canada *Geometric Design Guide for Canadian Roads* • Construction standards and specifications • Design plans • Base mapping	a) Potential need for special and/or unfamiliar construction techniques	• Minimal need for special and/or unfamiliar construction techniques; probable structure type could be constructed by local contractors			
			b) Potential construction cost and/or schedule risks	• Minimal risks to construction cost and/or schedule risks; probably less risk of overrunning cost • Suitable candidate for Design Build-Project for fastest possible delivery	• Minimal risks to construction cost and/or schedule risks; probably less risk of overrunning cost • Suitable candidate for Design Build-Project for fastest possible delivery • Additional separation between existing and twin structures east of the canal allows for easier construction and rehabilitation activities	• Suitable candidate for Design Build-Project for fastest possible delivery • Some potential to impact existing Homer Bridge due to proximity.	• Suitable candidate for Design Build-Project for fastest possible delivery • Most potential to impact existing Homer Bridge due to close proximity. • Skewed crossing of Welland Canal will require longer and deeper main span
		• Design plans • Foundations field investigations and draft report	c) Potential foundations risks	Relatively few concerns with respect to foundations.		Some potential to impact existing Homer Bridge foundations due to proximity.	Greatest Potential impacts to existing Homer Bridge due to close proximity.
	4.1.3 Staging	• Design plans • *Ontario Traffic Manual, Book 7: Temporary Conditions* • *Geometric Design Standards for Ontario Highways*	a) Construction staging impacts • Number of stages • Total duration • Lane restriction/reduction requirements • Potential for traffic disruption during construction	• 2 stages • 3 to 4 years of construction plus 1 year of demolition (conventional DBB) • No lane reduction • No traffic diversion during construction			
	4.1.4 Construction Materials	• *Canadian Highway Bridge Design Code* • MTO *Structure Rehabilitation*	a) Use of existing infrastructure	Existing bridge will be demolished where asphalt and steel may be salvaged for recycling.			

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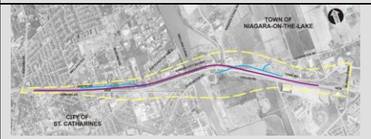
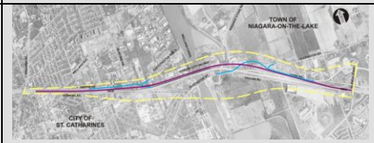
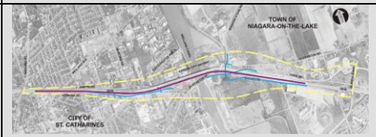
Alternative Type				Replacement Bridge			
Alternative Identifier				**RB1**	**RB1A**	**RB2**	**RB2A**
Description				**Replacement Bridge to North - 875 m Curve**	**Replacement Bridge to North - 1700 m Curve**	**Replacement Bridge to South - 875 m Curve**	**Replacement Bridge to South - 1700 m Curve**
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		Manual • Design plans • Base mapping					
	4.1.5 Critical Infrastructure Protection	• NCHRP Report 525 – Surface Transportation Security, Volume 3: Incorporating Security into the Transportation Planning Process • Discussions with OPP	a) Vulnerability of QEW and Welland Canal	Catastrophic failure of the bridge would cause major disruptions to both the QEW and Welland Canal.			
			b) Prevention of security incidents	Impossible to limit access to structure via vehicles both on and below the bridge. Difficult to prevent access to bridge piers from below (fencing, closed-circuit cameras and security are all possible countermeasures).			
			c) Protection of structure from catastrophic events (i.e., 'target hardening')	Potential to harden the bridge.			
			d) Redundancy	No redundancy; in the event that the bridge is unserviceable, traffic would need to use an alternate route.			
			e) Recovery (i.e., ability to respond to an emergency after a catastrophic event)	No notable challenges to recovery, as compared with other bridge alternatives.			
	4.1.6 Contract Delivery	• Industry Practice	a) Flexibility in contract delivery	Flexibility in contract delivery. Alternative delivery methods (e.g., design/build) are possible; separate contracts for demolition of existing and new construction are possible.			
Overall Summary – Structural Engineering				For many of the criteria there is no difference between the alternatives. Alternatives RB1 and RB1A have the least potential to impact the existing Homer Bridge, and Alternative RB1A also has better constructability compared to the other alternatives. Alternative RB2A is least preferred, as it has the greatest potential for impacts to the Homer Bridge, and has the greatest crossing skew of the canal. **As a result, Alternative RB1A is slightly preferred over Alternative RB1 from a structural engineering perspective due to the better constructability.**			
5.0 Transportation & Other Considerations							
5.1 Transportation	5.1.1 Flexibility for future improvements	• Base mapping • Design plans • Other Studies • Provincial policy papers (e.g., Places to Grow)	a) Qualitative assessment of future expansion/compatibility	Future capacity improvements would require twinning or widening (if widening is feasible) of the replacement bridge (or conversion of shoulders to general-purpose lanes).			
	5.1.2 Highway Geometrics	• *Geometric Design Standards for Ontario Highways* • *Transportation*	a) Compatibility with current highway design standards and practices.	• Meets current design standards and practices. Additional shoulder width required to meet sight distance requirements at	• Meets current design standards and practices.	• Meets current design standards and practices. Additional shoulder width required to meet sight distance requirements at	• Meets current design standards and practices.

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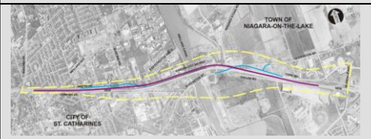
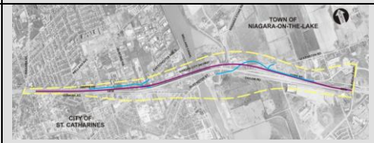
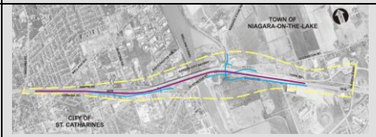
Alternative Type				Replacement Bridge			
Alternative Identifier				RB1	RB1A	RB2	RB2A
Description				Replacement Bridge to North - 875 m Curve	Replacement Bridge to North - 1700 m Curve	Replacement Bridge to South - 875 m Curve	Replacement Bridge to South - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		Association of Canada Geometric Design Guide for Canadian Roads • *Proposed Draft Concepts for New Rural Freeways* • Other MTO standards • Design plans • Base mapping		R=875 m curve.		R=875 m curve.	
	5.1.3 Traffic Operations	• Transportation planning and land use forecasting model • Design plans • Base mapping & field review	a) Impacts to traffic operations	Improved QEW operations are expected due to the addition of truck-climbing lane and improved roadside (i.e., shoulders).			
	5.1.4 Safety	• Transportation planning and land use forecasting model • Historical collision data • Design plans • Base mapping & field review	a) Ability to address existing deficiencies	• Addresses narrow shoulder width concerns and provides truck-climbing lane. • Improvement to vertical alignment. • No improvement to horizontal alignment.	• Addresses narrow shoulder width concerns and provides truck-climbing lane. • Improvements to vertical and horizontal alignments.	• Addresses narrow shoulder width concerns and provides truck-climbing lane. • Improvement to vertical alignment. • No improvement to horizontal alignment.	• Addresses narrow shoulder width concerns and provides truck-climbing lane. • Improvements to vertical and horizontal alignments.
			b) Impact on driver behavior / expectations	Some improvements expected due to widened shoulders and upgraded geometry.			
	5.1.5 Compatibility with road network (QEW and local)	• Local and regional transportation plans, official plans • Other EA studies • Design plans	a) Impacts to Local road network: • Local road realignment requirements • Construction staging requirements	• Relatively few impacts to local road network. • Realignments required for Dieppe Road, York Road, Queenston Road, and Queenston Street. • Partial closure of Queenston Road and closure of Coon Road.	• Relatively few impacts on local road network. • Realignments required for Dieppe Road, Eastchester Avenue East, York Road, Queenston Road, and Queenston Street. • Partial closure of Queenston Road and closure of Coon Road.	• Greatest impact on local road network. • Realignments required for Dieppe Road, Dunkirk Road, York Road, Queenston Street, Niagara Stone Road, and Taylor Road. • Partial extension of Queenston Road required. • Reconfiguration of Dunkirk / Bunting / Eastchester intersections likely required. • Impacts to existing Seaway	• Moderate impact on local road network. • Realignments required for Dieppe Road, Dunkirk Road, Taylor Road. • Cul-de-sac of a section of Dunkirk Road required. • Reconfiguration of Dunkirk / Bunting / Eastchester intersections likely required.

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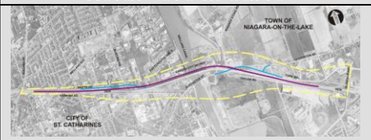
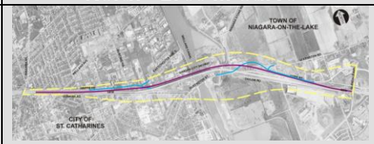
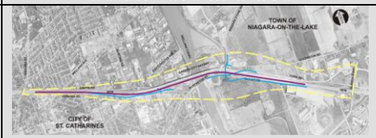
Alternative Type				Replacement Bridge			
Alternative Identifier				**RB1**	**RB1A**	**RB2**	**RB2A**
Description				**Replacement Bridge to North - 875 m Curve**	**Replacement Bridge to North - 1700 m Curve**	**Replacement Bridge to South - 875 m Curve**	**Replacement Bridge to South - 1700 m Curve**
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
						Haulage Road structure under Queenston Street.	
			b) Impact on QEW	Improved operations due to truck-climbing lane and improved cross section. Modifications to Niagara St. E-N/S and N/S-E ramps required.			
	5.1.6 Seaway and Airport Operations	• Input from the St. Lawrence Seaway Management Corporation and Transport Canada • Input from Niagara Regional Airport and Transport Canada	a) Potential impacts on St. Lawrence Seaway operations during construction	In-water pier construction may be required; however, no significant impacts are anticipated.			
			b) Impact on Niagara Regional Airport operations	• No major impacts anticipated, provided a low-superstructure bridge is constructed. It is acknowledged that the existing bridge encroaches into the Airport's outer surface height restriction, and that a replacement bridge to the north would bring the bridge closer to the Airport. • A high-superstructure bridge (e.g., cable-stayed) could have impacts on Airport operations.		• No major impacts anticipated, provided a low-superstructure bridge is constructed. It is acknowledged that the existing bridge encroaches into the Airport's outer surface height restriction. A replacement bridge to the south would keep the bridge further from the Airport than a north-side bridge. • A high-superstructure bridge (e.g., cable-stayed) could have impacts on Airport operations.
	5.1.7 Emergency Response	• Input from Ontario Provincial Police • Input from municipal emergency services • Design plans	a) Impacts to emergency access/routing	No impacts anticipated.			
			b) Potential challenges to incident management	Improved safety of emergency personnel responding to incidents on the bridge. No new challenges anticipated.			
	5.1.8 Utilities	• Existing Utility Records • NEB Regulations • MTO CMO requirements • Design plans • Base mapping	a) Type of utility impacted	Major municipal sewer, major municipal watermain, hydro transmission line.			
			b) Length and type (i.e., crossing or relocation) of direct impact to existing utility corridors	• 2 major municipal sewer crossings; 333 m potentially impacted; probable displacment of an important manhole. • 1 major existing municipal watermain crossing; 69 m potentially impacted. Future Bunting Road watermain potentially impacted. • 1 hydro transmission line crossing. • Numerous minor utilties impacts.	• 3 major municipal sewer crossings; 679 m potentially impacted; probable displacment of an important manhole. • 1 major existing municipal watermain crossing; 100 m potentially impacted. Future Bunting Road watermain potentially impacted. • 1 hydro transmission line crossing. • Numerous minor utilties impacts.	• 1 major municipal sewer crossing; 186 m potentially impacted. • 2 major existing municipal watermain crossings; 879 m potentially impacted. Future Bunting Road watermain potentially impacted. • 1 hydro transmission line crossing. • Numerous minor utilties impacts.	• 1 major municipal sewer crossing; 109 m potentially impacted. • 2 major existing municipal watermain crossings; 1093 m potentially impacted. Future Bunting Road watermain potentially impacted. • 1 hydro transmission line crossing. • Numerous minor utilties impacts.
Overall Summary – Transportation & Other Considerations				Alternative RB1A w**ill** require the least number of realignments to the local road network and does not require shoulder widening on the structure due to upgraded horizontal curvature. Alternative RB2 will require the greatest number of realignments to the local road network and requires shoulder widening on the structure, and is therefore least preferred. **As a result, Alternative RB1A is most preferred from a transportation perspective.**				

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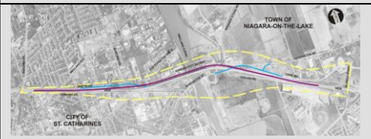
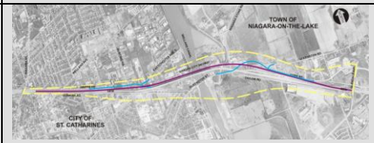
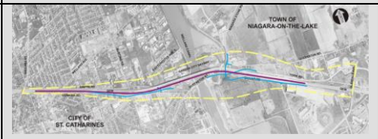
Alternative Type				Replacement Bridge			
Alternative Identifier				RB1	RB1A	RB2	RB2A
Description				Replacement Bridge to North - 875 m Curve	Replacement Bridge to North - 1700 m Curve	Replacement Bridge to South - 875 m Curve	Replacement Bridge to South - 1700 m Curve
SKETCH							
Environmental Factor /Criteria	**Data Source[1]**	**Measures**					
6.0 Cost							
6.1 Cost	6.1.1 Cost[3]	• MTO Parametric Estimating Guide • HiCo • Previous studies	a) Structure Capital Cost (Note: excludes contingencies & demolition of existing bridge)	$324M ($2011)	$324M ($2011)	$324M ($2011)	$324M ($2011)
		• MTO Parametric Estimating Guide • HiCo • Previous studies • MTO Structural Manual	b) Structure Lifecycle Cost (Structure Capital Cost + Future Maintenance) (Note: excludes contingencies)	$374M ($2011)	$374M ($2011)	$374M ($2011)	$374M ($2011)
		• MTO Parametric Estimating Guide • HiCo • Previous studies • MTO Structural Manual • Input from MTO Property Office	c) Total Construction Cost (Structure Capital Cost + Highway Costs + Property) (Notes: costs rounded; includes contingencies; 25% additional contingency added to high range)	$465M Structure Costs $127M Highway Costs $65M Property Costs **$665-815M Total Cost**	$465M Structure Costs $149M Highway Costs $90M Property Costs **$740-890M Total Cost**	$465M Structure Costs $112M Highway Costs $30M Property Costs **$630-780M Total Cost**	$465M Structure Costs $133M Highway Costs $30M Property Costs **$630-780M Total Cost**
Summary – Cost				Alternative RB1A is least preferred, as it has the highest total construction cost. Alternatives RB2 and RB2A have slightly lower costs than Alternative RB1. **As a result, Alternatives RB2 and RB2A are slightly preferred over alternative RB1 from a cost perspective.**			
Overall Summary				While Alternative RB1A is most preferred from structural engineering and transportation perspectives, it is also least preferred from socio-economic environment, cultural environment, and cost perspectives. Alternative RB1 is preferred from a natural environment perspective, and, though not the most preferred, is still desirable from structural engineering, transportation, and cost perspectives. **As a result, Alternative RB1 is the preferred Replacement Bridge Alternative.**		

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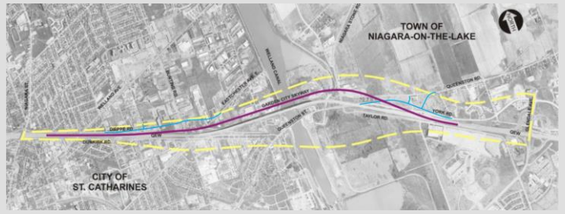
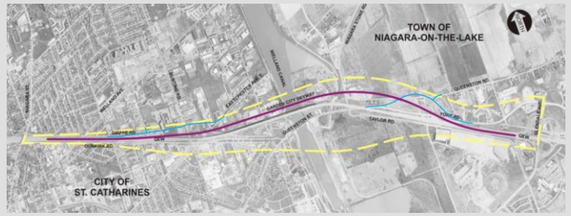
[3] Costs are preliminary in nature and subject to change in Detail Design

Replacement Tunnel Alternatives

Alternatives Evaluation - Replacement Tunnel Alternative

Alternative Type				Replacement Tunnel	
Alternative Identifier				RT1	RT1A
Description				Replacement Tunnel to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
1.0 Socio-Economic Environment					
1.1 Property and Access	1.1.1 Property and Property Access	a) Municipal land use information b) Approved development plans	a) Number of properties directly impacted	Number of impacted properties by type: Residential: 3 Commercial: 28 Industrial: 14 Open Space: 4 Utility: 1 Agricultural: 1 Total: 51 Includes 1 MTO property.	Number of impacted properties by type: Residential: 0 Commercial: 30 Industrial: 14 Open Space: 4 Utility: 1 Agricultural: 2 Total: 51 Includes 0 MTO properties.
			b) Number of residences potentially displaced	3 residences potentially displaced.	None anticipated.
			c) Qualitative assessment of changes to residential property access	No significant changes to residential property access, as all affected residential properties will be displaced by direct impacts.	Minor impacts to residential property access. Access to three residences on Queenston Road maintained, but Queenston Road will be closed to the east; access to this section of Queenston Road is from Niagara Stone Road only.
			d) Number of businesses potentially displaced	24 businesses potentially displaced.	26 businesses potentially displaced.
			e) Qualitative assessment of changes to business property access	Significant modifications to business property access required along Dieppe Road and Eastchester Avenue East.	
			f) Number of roads closed	Queenston Road closed from Niagara Stone Road easterly for approximately 300 m. Dieppe Road crossing of QEW closed.	Queenston Road closed from approximately 300 m east of Niagara Stone Road easterly for approximately 650 m. The 300 m section of Queenston Road from Niagara Stone Road easterly is cul-de-saced. Coon Road closed. Dieppe Road crossing of QEW closed.

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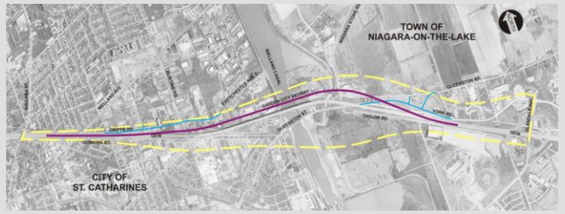
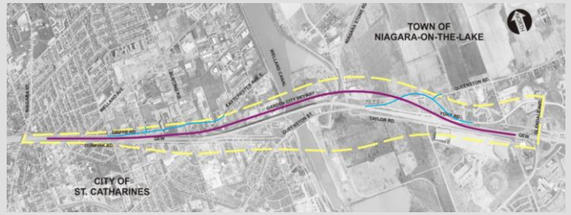
[3] Costs are preliminary in nature and subject to change in Detail Design.

Alternative Type				Replacement Tunnel	
Alternative Identifier				RT1	RT1A
Description				Replacement Tunnel to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH					
Environmental Factor /Criteria	**Data Source[1]**	**Measures**			
Summary – Property and Property Access				Alternatives RT1 and RT1A will impact a similar number of properties. Alternative RT1 will impact 3 residences and 24 businesses. Alternative RT1A will not impact any residences but will impact 26 businesses. While both alternatives result in road closures, Alternative RT1A results in the greatest road closure related impacts. Both Alternatives RT1 and RT1A will result in major modifications to business property access along Dieppe Road and Eastchester Avenue East. Due to displacements of residences Alternative RT1 does not significantly change residential property access, while Alternative RT1A will result in minor residential property access impacts. As a result, from a property and property access perspective **Alternative RT1 is slightly preferred**.	
1.2 Community Effects	1.2.1 Community facilities (cemeteries, schools, places of worship, recreation centres)	• Municipal land use information • Approved development plans	a) Number of cemeteries directly impacted or potentially displaced	None	
			b) Number of schools directly impacted or potentially displaced	None	
			c) Number of places of worship directly impacted or potentially displaced	One; Access road from tunnel to Coon Road may cause minor impact to St. George's Anglican Church driveway.	One; St. George's Anglican Church's western access to Queenston Road will be impacted, however, new access road will provide access to the church's east side.
			d) Number of recreation centres directly impacted or potentially displaced	One; Niagara Ball Hockey Club will potentially be displaced.	
			e) Qualitative assessment of changes to access to community facilities (cemeteries, schools, places of worship, recreation centres)	None	
	1.2.2 Recreational and Tourist Features	• Municipal land use information • Approved development plans	a) Number of parks and trails directly impacted	No parks impacted; impacts to trails during construction.	
		• Input from the St. Lawrence Seaway Management Corporation and Transport Canada	b) Impacts to recreational boating traffic within the Welland Canal familiarize	Short-term (12-24 hours) disruptions to marine traffic possible during construction, if immersed tube placement is made during shipping season.	
		• Input from the Ministry of Tourism and Culture	c) Impacts to the Tourism Information Centre	Direct impacts to TIC building; relocation required.	Relocation required, as TIC building would be located on the Niagara-bound side of the highway.
	1.2.3 Land Use Opportunities	• Municipal planning departments	a) Potential for new land use opportunities (development opportunities with tunnel and bridge options)	Tunnel will provide greater opportunities for new development (on the deck of the tunnel); however existing land uses will be displaced.	
	1.2.4 Agricultural Resources	• Topographic maps	a) Impact on local agricultural resources using quantitative measure of area (ha)	Potential for impact to lands designated for agriculture and not currently used for agriculture.	

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Alternative Type				Replacement Tunnel	
Alternative Identifier				RT1	RT1A
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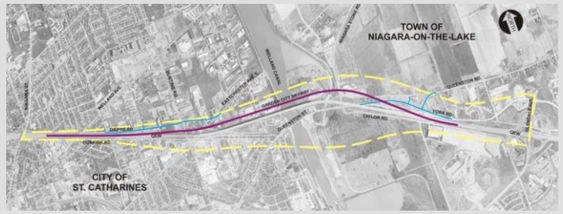
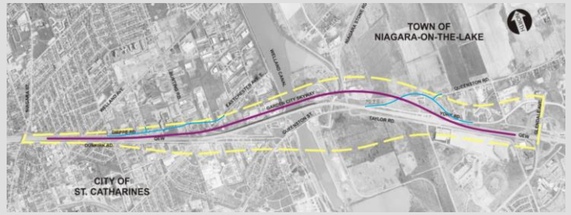
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
		• Municipal land use information • Approved development plans	b) Number of agricultural operations directly impacted	Potential for impact to lands designated for agriculture and not currently used for agriculture.	
	1.2.5 Approved local, Regional, and Provincial plans and policies	• Municipal land use information • Approved development plans • Official Plans • Secondary Plans • Niagara Escarpment Plan • Greenbelt Plan	a) Assessment of conformity with approved local, Regional, and Provincial plans and policies	Conforms to Greenbelt Plan polices regarding new infrastructure, and the Niagara Region Policy Plan.	
Summary – Community Effects				For many of the criteria there is no difference between the alternatives. Both alternatives result in minor impacts to the existing access to St. George's Anglican church, and both alternatives would displace the TIC. As a result, from a community effects perspective **Alternatives RT1 and RT1A are equally preferred**.	
1.3 Nuisance Effects	1.3.1 Noise	• Topographic maps • Municipal land use information • Approved development plans	a) Noise Impact: • Highway alignment shifting towards adjacent NSAs is expected to increase noise levels • Highway alignment shifting away from adjacent NSAs is expected to decrease noise levels. • The approximate number of houses represented by each NSA are: NSA 8: > 50 NSA 9: > 50 NSA 10: > 5 NSA 11: ~ 2 NSA 12: ~ 3 NSA 13: > 10	• Highway vertical alignment will cross Welland Canal below grade through tunnel which is expected to significantly decrease noise levels • Highway alignment shifts north away from NSA 8, NSA 9, NSA 10, NSA 11, which is expected to decrease noise levels (Highway alignment displaces NSA 12)	• Highway vertical alignment will cross Welland Canal below grade through tunnel which is expected to significantly decrease noise levels • Highway alignment shifts north away from NSA 8, NSA 9, NSA 10, NSA 11, NSA 12, which is expected to decrease noise levels • Highway alignment shifts towards NSA 13, which is expected to increase noise levels
	1.3.2 Air quality	• Topographic maps • Municipal land use information • Approved development plans	a) Qualitative assessment of impacts to air quality (Based on proximity of receptors to bridge/tunnel. More weight was given to residential receptors than to industrial areas as potential receptors. It was	New tunnel and access roads shift away from residences to the south. The tunnel portals are also well separated from residences. Effect is positive.	

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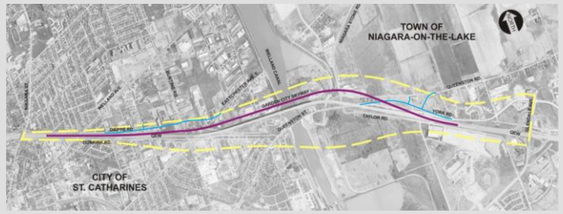
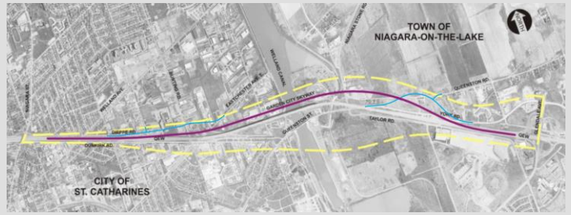
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
			assumed that receptors on Queenston Road would be removed to make way for the tunnels and not considered in the evaluation of those alternatives)		
	1.3.3 Vibration	• Topographic maps • Municipal land use information • Approved development plans	b) Qualitative assessment of vibration impacts	Operation: • No impacts expected Construction: • Vibration impacts due to tunnel boring may be perceptible as the closest residence is approximately 150m away from the alternative to the south.	
Summary – Nuisance Effects				While both alternatives will decrease noise levels at a number of NSAs, Alternative RT1A is less preferred as it will also increase noise levels at one NSA. The alternatives are equivalent in terms of air quality and vibration impacts. As a result, **Alternative RT1** is preferred from a nuisance effects perspective.	
Overall Summary – Socio-Economic Environment				From a property and property impacts perspective, Alternative RT1 is slightly preferred as it results in fewer impacts related to road closures. Both alternatives impact a similar number of properties. From a community effects perspective, the alternatives are comparable. Alternative RT1 is preferred from a nuisance effects perspective as it reduces noise impacts at a number of NSAs and avoids increasing noise levels at any NSAs, unlike Alternative RT1A which increases noise levels at one NSA. As a result, from a socio-economic environment perspective **Alternative RT1 is preferred**.	
2.0 Cultural Environment					
2.1 Archaeology	2.1.1 Archaeological sites	• Stage 1 Archaeological Assessment	a) Impact to known archaeological features or areas of archaeological potential	Impacts areas of archaeological potential.	
2.2 Heritage Features	2.2.1 Built heritage and cultural heritage landscapes	• Heritage Existing Conditions Report for the QEW Garden City Skyway study area • Cultural Heritage Evaluation Report for the QEW Garden City Skyway • Historical mapping and aerial photographs,	a) Number of listed built heritage resources (BHR) displaced or disrupted	5 BHR Note: this includes the displacement of the existing QEW Garden City Skyway.	2 BHR Note: this includes the displacement of the existing QEW Garden City Skyway.
			b) Number of cultural heritage landscape (CHL) resources displaced or disrupted	2 CHL	3 CHL

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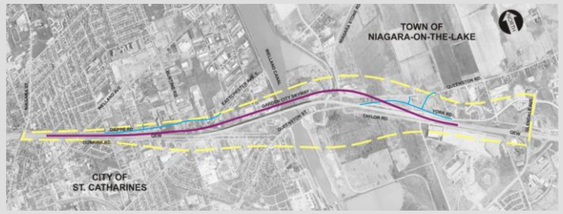
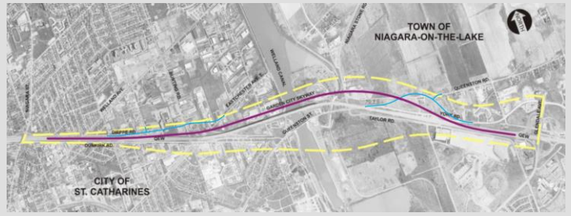
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
		cemetery lists, municipal, provincial and federal inventories, listings, plaques, easements and designations of National Historic Sites and under the Ontario Heritage Act • Input from other factor areas • Consultation with municipal and regional heritage planning staff or designates, historical societies and other heritage groups as necessary • Municipal heritage inventories for designated and listed built heritage structures • Ontario Genealogical Society for Cemeteries			
Overall Summary – Cultural Environment				All alternatives impact areas of archaeological potential. Given the number of impacts to cultural heritage resources Alternative RT1 has the most impact and Alternative RT1A has the least impact on cultural heritage resources. As a result, from a cultural environment perspective **Alternative RT1A is preferred**. It is important to note that the QEW Garden City Skyway Bridge holds high cultural heritage value and the loss of that bridge (due to replacement with a tunnel) make all of the tunnel alternatives very undesirable from a cultural heritage perspective.	

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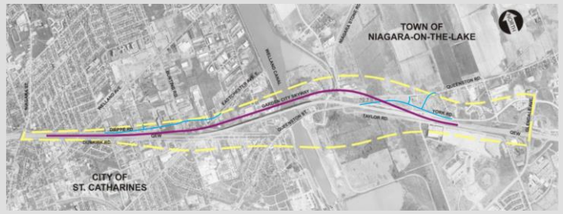
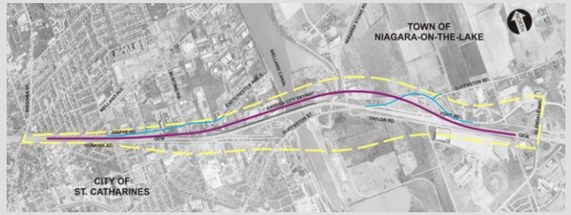
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
3.0 Natural Environment					
3.1 Fisheries and Aquatic Habitat	3.1.1 Fish and fish habitat, considering *Sensitivity of Fish and Fish Habitat* and *Relative Magnitude of Potential Effect*	• Topographic maps • Watershed Management Plans • Existing information gathered from MNR field studies and fish records, NPCA, Interest Groups, public consultation, municipalities • Reconnaissance-level field assessments • Provincial Policy Statement and associated MNR Natural Heritage Training Manual • The Fish Community of the Fourth Welland Canal: Welland to Port Colborne (MNR 1998) • MNR (Natural Resource Values Inventory Systems (NRVIS) mapping) • NHIC (MNR) and Species At Risk mapping (DFO) • Species at Risk Recovery Plans and Management Guidelines	a) Determination of Sensitivity of Fish and Fish Habitat based on evaluation of attributes such as: • Presence of any critical/specialized habitat. • Presence of habitat for species of conservation concern, including Species at Risk as identified by COSEWIC and COSSARO[2]. • Habitat resiliency based on thermal regimes (warm, cool, cold water) and flow regime (DFO Risk Management Framework 2006, MTO Environmental Guide for Fish and Fish Habitat 2006).	Four watercourses and 1 ponding area (Welland Canal and Embayment area, Pond area adjacent to Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek, Eight Mile Creek) traverse these tunnel and road alignments. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent.	
			b) Determination of Magnitude of Potential Effect using qualitative assessment as a relative measure of potential effects (e.g. piers, tunnel, need for channel realignment or culvert extensions).	<u>Replacement Tunnel to North</u> a) Welland Canal – open cut at crossing area. b) Welland Canal Embayment area – permanent infill of south section, casting basin and navigation channel requires area to be drained and excavated with impact to shoreline areas. c) Linear ponding area adjacent to Welland Canal – open cut requires removal of a section of the pond. d) Tributary of Welland Canal – 10 m permanent drop in elevation (where tunnel opens up) at existing crossing will require realignment of the tributary. e) Tributary of Eight Mile Creek – new culvert required f) Eight Mile Creek – extensions required on QEW culvert and north side of York Road culvert. <u>Re-alignment of York Road</u> • Tributary of Eight Mile Creek – new culvert required. Direct impacts of the open cut method for the Welland Canal crossing and the construction of the casting basin and navigation channel will include excavation of the channel bed, impact to the shoreline areas (disturbance and removal	<u>Replacement Tunnel to North</u> a) Welland Canal – open cut at crossing area. b) Welland Canal Embayment area – permanent infill of south section, casting basin requires area to be drained and excavated with impact to shoreline areas. c) Linear ponding area adjacent to Welland Canal – tunneling under ponding area. d) Tributary of Welland Canal – 10 m permanent drop in elevation (where tunnel opens up) at existing crossing will require realignment of the tributary. e) Tributary of Eight Mile Creek – culvert replacement at Queenston Road with longer culvert. f) Eight Mile Creek – extensions required on QEW culvert. <u>Re-alignment of York Road</u> • Tributary of Eight Mile Creek – new culvert required. Direct impacts of the open cut method for the Welland Canal crossing and the construction of the casting basin and navigation channel will include excavation of the channel bed, impact to the shoreline areas (disturbance and removal or riparian vegetation), displacement of water and partial

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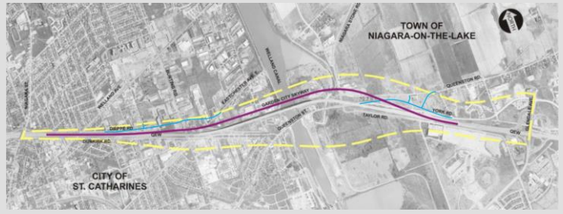
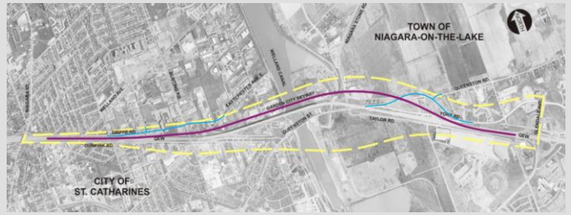
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
				or riparian vegetation), displacement of water, partial infill of the south section of the embayment area and removal of a section of the pond. Although the construction of these areas may take 5 years, the impacts are temporary and the pre-existing conditions will eventually be restored. The direct impacts of infilling the south section of the embayment area and removal of a section of the pond will result in some displacement of these open water features along with localized disturbance and removal of riparian vegetation. Direct impacts of the proposed re-alignment should be limited to temporary disturbance of the channel and localized disturbance and removal or riparian vegetation. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized disturbance and removal of riparian vegetation and temporary alteration of channel banks and bed. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.	infill of the south section of the embayment area. Although the construction of these areas may take 5 years, the impacts are temporary and the pre-existing conditions will eventually be restored. However the direct impacts of infilling the south section of the embayment area will result in some displacement of this open water feature along with localized disturbance and removal of riparian vegetation. There will be no direct impacts to the pond feature (tunneling under). Direct impacts of the proposed re-alignment should be limited to temporary disturbance of the channel and localized disturbance and removal or riparian vegetation. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized disturbance and removal of riparian vegetation and temporary alteration of channel banks and bed. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.
Summary – Fisheries and Aquatic Habitat				Alternatives RT1 and RT1A will result in similar impacts to fisheries and aquatic habitat. As a result, from a fisheries and aquatic habitat perspective **Alternatives RT1 and RT1A are equally preferred**. It is important to note that construction of a tunnel will be quite disruptive to fish and fish habitat and as a result the tunnel alternatives are undesirable from a fisheries and aquatic habitat perspective.	

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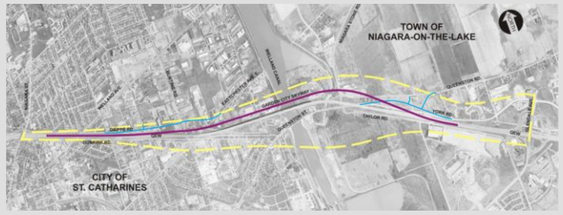
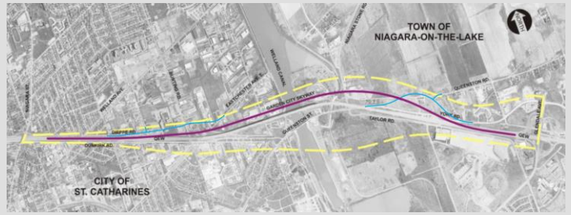
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
3.2 Terrestrial Ecosystems	3.2.1 Wetland vegetation communities, considering: • Sensitivity / Quality / Significance of Wetland Vegetation[2] • Habitat Relative Magnitude of Potential Effect	• Topographic maps • MNR NRVIS data • MNR District staff • NHIC/Biodiversity Explorer • Bird Studies Canada/Breeding Bird Atlas • Municipal Official Plans • Existing information gathered from MNR, NPCA, Interest Groups, public consultation, municipalities • Reconnaissance-level field inventories • Species at Risk Recovery Plans and Management Guidelines	a) Determination of *Sensitivity/Quality/Significance of Wetland* based on designated status (PSW, LSW, unevaluated), supported by evaluation of attributes such as: • Presence of species of conservation concern including Species At Risk as identified by COSEWIC and COSSARO • Presence of potential habitat for SAR, and • Habitat resiliency based on size, maturity, physical considerations (e.g. drainage, groundwater discharge, slope, etc.)	No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands 1 deciduous swamp community with open water components (Unit 11), 1 cultural woodland with deciduous swamp component (Unit 8) and 1 cultural meadow with meadow marsh components (Unit 9) within RT1 footprint No wetland-associated flora of conservation concern records or observations in areas that were accessible. **Low** potential for wetland-associated SAR flora within RT1 footprint based on habitat types observed. Affected wetland communities are small and generally of cultural origin and culturally influenced.	No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands 1 deciduous swamp community with open water components (Unit 11), 1 cultural woodland with deciduous swamp component (Unit 8) and 1 cultural meadow with meadow marsh components (Unit 9) within RT1A footprint No wetland-associated flora of conservation concern records or observations in areas that were accessible. **Low** potential for wetland-associated SAR flora within RT1A footprint based on habitat types observed. Affected wetland communities are small and generally of cultural origin and culturally influenced.
			b) Determination of Magnitude of Potential Effect using qualitative assessment of potential impact (edge encroachment versus fragmentation, change to wetland size and shape etc.)	<u>Replacement Tunnel to the North</u> • **Edge impacts to** a deciduous swamp community with open water components (Unit 11) • Removal of most of Unit 8 (cultural woodland with deciduous swamp components) • Temporary disturbance of cultural meadow community with meadow marsh components (Unit 9) for tunnel casting basin working area. <u>Realignment of York Road</u> • Minimal wetland impacts (some small wetland pockets within cultural meadow community north of York Road and south of Queenston Road) <u>Realignment of Dunkirk Road</u> • No known or anticipated impacts to wetland communities	<u>Replacement Tunnel to the North</u> • **Edge impacts** to a deciduous swamp community with open water components (Unit 11) • Removal of most of Unit 8 (cultural woodland with deciduous swamp components) • Temporary disturbance of cultural meadow community with meadow marsh components (Unit 9) for tunnel casting basin working area. <u>Realignment of York Road</u> • Minimal wetland impacts (some small wetland pockets within cultural meadow community north of York Road and south of Queenston Road) <u>Realignment of Dunkirk Road</u> • No known or anticipated impacts to wetland communities

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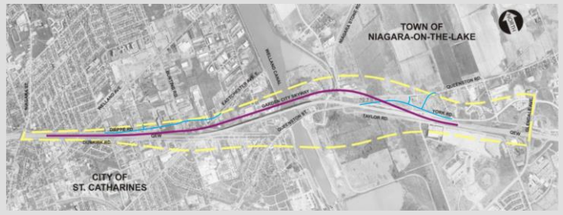
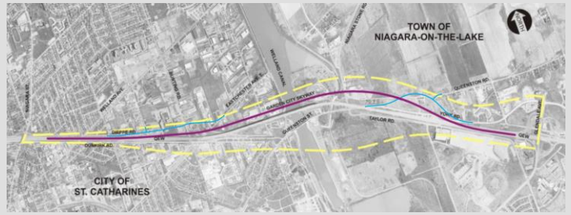
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
	3.2.2 Upland Vegetation Communities considering: • Sensitivity / Quality / Significance of Vegetation[2] • Relative Magnitude of Potential Effect		a) Determination of *Sensitivity/Quality/Significance of Upland Vegetation* (including cultural communities) based on evaluation of attributes such as: • Community rarity/sensitivity/tolerance and local representation/distribution on the landscape • Rarity of species (species of conservation concern including Species At Risk as identified by COSEWIC and COSSARO) • Presence of specialized habitat for species of conservation concern • Habitat resiliency based on size, maturity, physical considerations (e.g. drainage, slope, etc.)	• Affected upland communities are generally young or remnant deciduous forest, cultural woodlands and cultural meadows. • No mature, high quality forest communities were encountered in the vicinity of RT1 (based on areas accessible). • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.	• Affected upland communities are generally young or remnant deciduous forest, cultural woodlands and cultural meadows. • No mature, high quality forest communities were encountered in the vicinity of RT1A (based on areas accessible). • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.
			b) Determination of Magnitude of Potential Effect using qualitative assessment of potential impact (edge encroachment versus fragmentation, change to patch size and shape, etc.)	<u>Replacement Tunnel to the North</u> • Removal of a large portion of cultural woodland community (Unit 18) • Removal of most of Unit 8 (cultural woodland with deciduous swamp components) • Edge of cultural woodland community removed (Unit 6) • Edge of cultural meadow community between Queenston Road and York Road removed • **2 Butternut trees removed** within Unit 6 • Temporary disturbance of cultural meadow community with meadow marsh components (Unit 9) for tunnel casting basin working area. <u>Realignment of York Road</u> • Cultural meadow fragmented between Queenston Road and York Road <u>Realignment of Dunkirk Road</u> • Minimal upland vegetation impacts anticipated. Alignment is through developed lands.	<u>Replacement Tunnel to the North</u> • Removal of a large portion of cultural woodland community (Unit 18) • Fragmentation of Unit 5 • Removal of most of Unit 8 (cultural woodland with deciduous swamp components) • Cultural meadow community fragmented between Queenston Road and York Road • No anticipated impacts to 2 Butternut trees • Temporary disturbance of cultural meadow community with meadow marsh components (Unit 9) for tunnel casting basin working area. <u>Realignment of York Road</u> • Cultural meadow fragmented between Queenston Road and York Road • Cultural woodland (Unit 4) removed <u>Realignment of Dunkirk Road</u> • Minimal upland vegetation impacts anticipated. Alignment is through developed lands.

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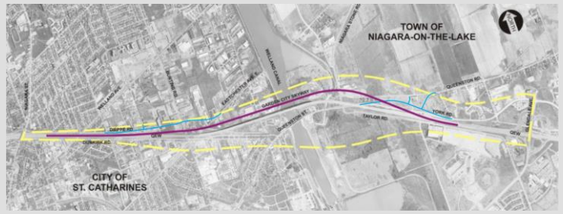
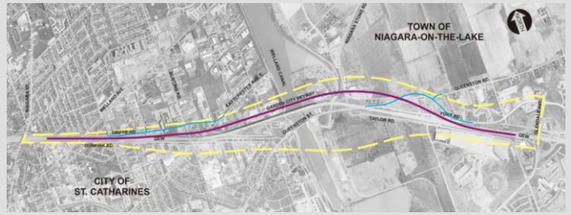
SKETCH				
Environmental Factor /Criteria	**Data Source[1]**	**Measures**		
	3.2.3 Wildlife and Habitat considering: • Sensitivity / Quality / Significance of Wildlife and Habitat[2] • Relative Magnitude of Potential Effect	a) Determination of *Sensitivity/Quality/Significance of Significant Wildlife* and *Habitat* based on evaluation of attributes such as: • Presence of Significant Wildlife Habitat (SWH; e.g. deer yards and heronries as identified by MNR or NPCA; other specialized habitat such as Important Bird Areas etc.), interior and deep interior forest habitat • Presence of species of conservation concern including SAR as identified by COSEWIC and COSSARO • Presence of *potential* habitat for SAR • Habitat resiliency based on size (including interior and deep interior forest habitat), maturity, physical considerations • Presence of movement corridors (linkages) between natural areas/nodes on regional and local levels	• No previously identified SWH within RT1 area **Alignment within known habitat for 4 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) • Snapping Turtle (SC) • Eastern Meadowlark (COSEWIC recommended for listing as THR) **Alignment within habitat for 8 potential SAR:** • Chimney Swift (THR) – high potential • Milksnake (SC) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential • Yellow-breasted Chat (SC) – low potential • Eastern Meadowlark (COSEWIC recommended for listing as THR) – moderate potential • Map Turtle (SC) – low potential	• No previously identified SWH within RT1A area **Alignment within known habitat for 4 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) • Snapping Turtle (SC) • Eastern Meadowlark (COSEWIC recommended for listing as THR) **Alignment within habitat for 8 potential SAR:** • Chimney Swift (THR) – high potential • Milksnake (SC) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential • Yellow-breasted Chat (SC) – low potential • Eastern Meadowlark (COSEWIC recommended for listing as THR) – moderate potential • Map Turtle (SC) – low potential
		b) Determination of Magnitude of Potential Effect considering: • Habitat type affected within footprint • Degree of habitat fragmentation • Habitat quality and sensitivity	<u>Replacement Tunnel to the North</u> • **Edge** impacts to cultural and low quality successional habitat • Temporary disturbance of low quality successional habitat (tunnel casting basin working area) • Potential impacts to overwintering turtles (potential Map Turtle and Snapping Turtle habitat) <u>Realignment of York Road</u> • **Fragmentation** of low quality successional habitat (i.e. mid-successional habitat that is too weedy for grassland birds [e.g. Bobolink] and becoming marginal for Eastern Meadowlark)	<u>Replacement Tunnel to the North</u> • **Edge** impacts to cultural and low quality successional habitat • Temporary disturbance of low quality successional habitat (tunnel casting basin working area) • Potential impacts to overwintering turtles (potential Map Turtle and Snapping Turtle habitat) • Fragmentation of low quality woodland and successional habitat <u>Realignment of York Road</u> • **Fragmentation** of low quality successional habitat (i.e. mid-successional habitat that is too weedy for grassland birds [e.g. Bobolink] and becoming marginal for Eastern Meadowlark)

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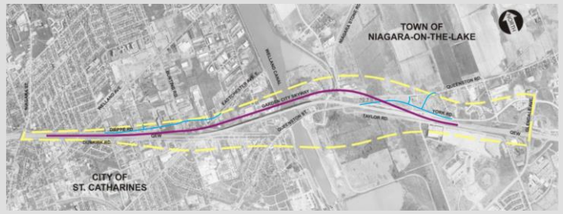
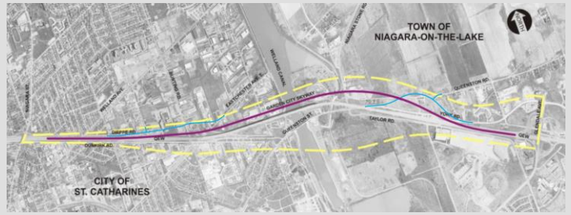
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
Summary – Terrestrial Ecosystems				Alternatives RT1 and RT1A will result in similar impacts to wetland and upland vegetation; however, Alternative RT1 will result in the removal of two Butternut trees. Alternatives RT1 and RT1A will result in similar impacts to wildlife and wildlife habitat. As a result, from a terrestrial ecosystems perspective **Alternative RT1A is preferred**.	
3.3 Designated Natural Features	3.3.1 Designated Natural Features include, for example, Provincially Significant Wetlands (PSWs), Areas of Natural and Scientific Interest (ANSIs), Environmentally Sensitive/Significant Areas (ESAs), Niagara Escarpment Plan Area, Greenbelt Plan Area, Regional Greenlands Systems. These features are defined by resource agencies, municipalities, the government and/or the public, through legislation, policies, or approved management plans, to have special or unique value.	• MNR NRVIS data • NHIC/Biodiversity Explorer • Municipal Official Plans • NPCA • Niagara Escarpment Plan (2005) • Greenbelt Plan (2005)	a) Qualitative assessment of related potential impact to functions and representation considering the nature and significance of designated areas within the identified alternatives. • Where feasible/applicable, the extent of the potential impact to designated areas will be quantitatively evaluated. • (Note: Impacts to designated natural features may also be captured within the evaluation of impacts to upland and wetland vegetation since these features are often designated by the province or municipality. Where overlap between evaluating impacts to designated natural features and upland/wetland vegetation exists, it will be clearly stated so that impacts are not 'double counted').	**No impacts** to Greenbelt Plan area South of Queenston Street and west of Homer Road.	
Summary – Designated Natural Features				**Both Alternatives are equally preferred** from a Designated Natural Features perspective as neither alternative results in impacts to the Greenbelt Plan area.	
3.4 Contaminated Sites	3.4.1 Known contaminated sites	• Contaminant Overview Study for the QEW Garden City Skyway study area • Contaminant Investigation Report for the QEW Garden City Skyway • MOE Waste Generator Database • MOE PCB Storage Site Database	a) Number of known contaminated sites impacted	There are 2 known contaminated properties within this proposed alignment.	There are 3 known contaminated properties within this proposed alignment.

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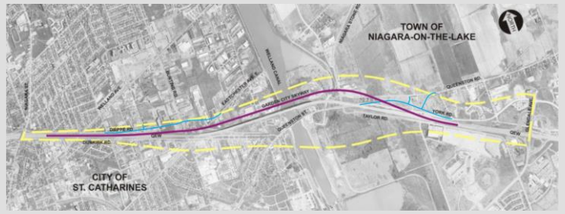
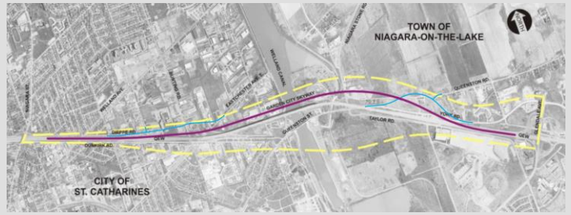
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
		• Technical Standards & Safety Authority • Aerial photographs • Municipal directories and assessment maps • OMB and NTS mapping • Historical plans, soils, hydrological and geological maps • Libraries, historical archives, land registry offices and municipal offices • MOE Waste Disposal Site Inventory • MOE Coal Gasification Plant Database • Ecolog ERIS Retail Fuel Storage Tanks Database • Brownfields Environmental Site Registry			
	3.4.2 Potentially contaminated sites	• Contaminant Overview Study for the QEW Garden City Skyway study area • Contaminant Investigation Report for the QEW Garden City Skyway • Review of aerial photography • Field investigations • MOE Coal Gasification Plant Database • Ecolog ERIS Retail Fuel Storage Tanks	b) Number of potentially contaminated sites impacted	There are 27 potentially contaminated properties within the proposed alignment.	There are 18 potentially contaminated properties within the proposed alignment.

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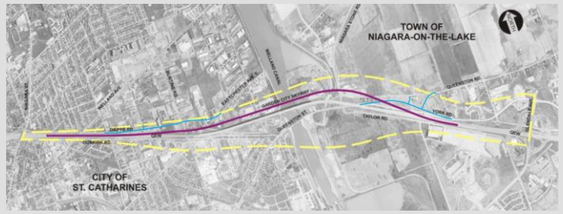
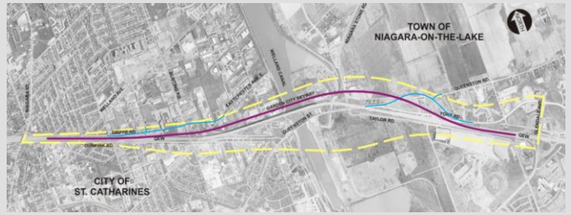
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
		Database • Brownfields Environmental Site Registry • MOE Waste Generator Database • MOE PCB Storage Site Database • Technical Standards & Safety Authority			
Summary – Contaminated Sites				Given the total number of known and potential contaminated properties impacted, Alternative RT1 will result in the most impacts to contaminated properties. Alternative RT1A will result in the fewest impacts to contaminated properties. As a result, from a contaminated sites perspective **Alternative RT1A is slightly preferred**.	
3.5 Excess Materials Management	3.5.1 Excess material management requirements with consideration for the quantity and type of materials.	• Approximate excess material management requirements based on design plans	a) Approximate quantity of excess materials (relative to other alternatives).	Very large quantities of excess materials relative to bridge alternatives (widening, twinning, replacement), including 1.3 million cubic metres of earth, plus existing Garden City Skyway bridge.	Very large quantities of excess materials relative to bridge alternatives (widening, twinning, replacement), including 1.1 million cubic metres of earth, plus existing Garden City Skyway bridge.
			b) Types of excess materials.	Earth (including canal sediment and bottom), concrete, steel and asphalt.	
Summary – Excess Materials Management				Alternative RT1A results in slightly less excess materials compared to Alternative RT1. As a result**, Alternative RT1A** is slightly preferred from an excess materials management perspective.	
3.6 Surface Water	3.6.1 Hydraulics	• MTO Highway Drainage Design Standards • MTO Drainage Management Manual • MTO Drainage Directives • Canadian Highway Bridge Design Code • NPCA Flood and Fill Line Regulation • HEC-RAS Model Manual	a) Hydraulic impact of the alternatives on the Welland Canal.	No impacts anticipated; no reduction in canal cross-section size.	
	3.6.2 Highway Drainage and Stormwater Management	• MTO Highway Drainage Design Standards • MTO Drainage	a) Impacts on existing highway drainage system (culverts, storm sewers, ditches).	2752 m of existing median storm sewer impacted. 1754 m of existing ditch impacted. 3 culverts (total length 135 m) require replacement or widening.	3247 m of existing median storm sewer impacted. 2664 m of existing ditch impacted. 3 culverts (total length 135 m) require replacement or widening.

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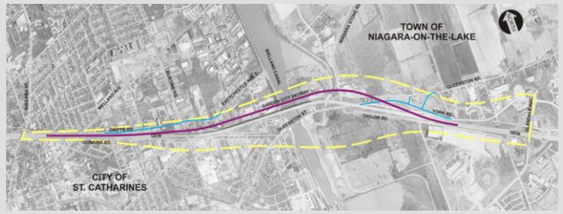
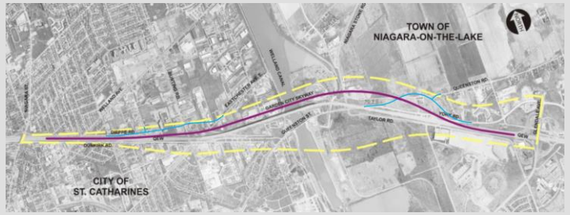
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
		Management Manual • MTO Drainage Directives • MOE Stormwater Management Planning and Design Manual • MTO Gravity Pipe Design Guidelines • NPCA SWM Guidelines	b) Ability to provide adequate stormwater management (quantity, quality, and erosion protection)	Would be challenging. Possible to provide adequate stormwater management; requires active (i.e., pumped) drainage for most of the new alignment. Additional property may be required for stormwater management pond(s).	
Summary – Surface Water				**Alternative RT1** results in fewer impacts to storm sewers and existing ditches, and as a result is preferred from a surface water perspective.	
3.7 Groundwater	3.7.1 Groundwater	• Design plans • Borehole logs • Aquifer vulnerability mapping	a) Qualitative assessment of impacts to groundwater	Much greater potential to impact groundwater as compared with bridge alternatives.	Much greater potential to impact groundwater as compared with bridge alternatives.
			b) Quantitative assessment of impacts to groundwater	Direct and potentially significant impacts to approximately 15.3 acres of highly vulnerable aquifer.	Direct and potentially significant impacts to approximately 11.4 acres of highly vulnerable aquifer.
Summary - Groundwater				**Alternative RT1A** impacts a smaller aquifer area than Alternative RT1 and is therefore preferred from a groundwater perspective.	
Overall Summary – Natural Environment				From a fisheries perspective, both alternatives are equally preferred. Alternative RT1A is preferred from a terrestrial ecosystem perspective as it avoids the removal of an endangered species. Alternative RT1A also impacts fewer known and potential contaminated areas, and generates slightly less excess materials. While Alternative RT1 results in fewer impacts to storm sewers and existing ditches, Alternative RT1A results in fewer groundwater impacts. As a result**, Alternative RT1A** is preferred from a natural environment perspective.	
4.0 Structural Engineering					
4.1 Structural	4.1.1 Structural	• *Canadian Highway Bridge Design Code* • MTO *Structure Rehabilitation Manual* • MTO *Ontario Heritage Bridge Guidelines* • Design plans • Base mapping	a) Life span and durability of structure	Structure design life is 100-125 years.	
			b) Treatment of existing bridge	Demolish existing bridge.	
			c) Maintenance (including consideration of salt use for winter maintenance)	Tunnel would be subject to regular maintenance consisting of; preventative maintenance, on-demand maintenance and preservation/repair maintenance. Extensive road salt use is not required through tunnel however regular Ice/Snow removal might be needed. Ice forms at locations of active leaking.	
			d) Flexibility for future bridge rehabilitation / expansion	Impossible to widen tunnel cross sections, thus any future capacity expansion would require new tunnel(s) or conversion of existing shoulders to general-purpose lanes. Future rehabilitation tunnel walls and ceiling will require relatively short-term lane closures.	
	4.1.2 Constructability	• Ontario *Geometric*	a) Potential need for special and/or unfamiliar construction techniques	Special construction techniques required, particularly immersed tube tunnel construction. Limited MTO and local contractor experience with this technique.	

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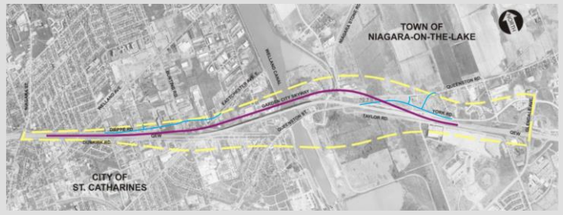
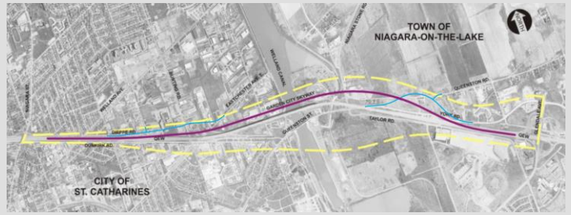
SKETCH				
Environmental Factor /Criteria	**Data Source[1]**	**Measures**		
	Design Standards for Ontario Highways • Transportation Association of Canada *Geometric Design Guide for Canadian Roads* • Construction standards and specifications • Design plans • Base mapping	b) Potential construction cost and/or schedule risks	High risk of cost and schedule overruns, based on similar experiences (e.g., 'Big Dig,' etc.). Also has potential for operating cost and maintenance overruns.	
4.1.3 Staging	• Design plans • *Ontario Traffic Manual, Book 7: Temporary Conditions* • *Geometric Design Standards for Ontario Highways*	a) Construction staging impacts • Number of stages • Total duration • Lane restriction/reduction requirements • Potential for traffic disruption during construction	• 3 stages (dry-dock construction, tunnel construction, existing bridge demolition) • 3 to 6 years of construction plus 1 year of demolition (conventional DBB) • No lane reduction • No traffic diversion during construction	
4.1.4 Construction Materials	• *Canadian Highway Bridge Design Code* • MTO *Structure Rehabilitation Manual* • Design plans • Base mapping	a) Use of existing infrastructure	Existing bridge will be demolished where asphalt and steel may be salvaged for recycling.	
4.1.5 Critical Infrastructure Protection	• NCHRP Report 525 – Surface Transportation Security, Volume 3: Incorporating Security into the Transportation Planning Process • Discussions with OPP	a) Vulnerability of QEW and Welland Canal	Tunnel is vulnerable to fire, and a tunnel fire could result in catastrophic failure of the structure. No major vulnerability to Welland Canal; destruction of the tunnel would not likely impact shipping operations. Prohibiting vehicles carrying hazardous materials from entering the tunnel could be considered	
		b) Prevention of security incidents	Impossible to limit access to structure via vehicles in the tunnel. Best potential to limit pedestrian access, as compared to bridge alternatives; fencing, closed-circuit cameras and security are all possible countermeasures.	
		c) Protection of structure from catastrophic events (i.e., 'target hardening')	Potential to harden the tunnel.	
		d) Redundancy	Some redundancy, as two separate structures are required, one for each direction. In the event that one structure is unserviceable, the other structure (provided it is serviceable) could be used for bi-directional traffic with reduced lanes. Ventilation for bi-directional traffic could be problematic.	
		e) Recovery (i.e., ability to respond to an emergency after catastrophic event)	In the event of a fire in the tunnel, visibility could be severely reduced, creating additional challenges for emergency personnel. Some potential for communications challenges in the tunnel in the event that in-tunnel radio antennae are damaged.	
4.1.6 Contract Delivery	• Industry Practice	a) Flexibility in contract delivery.	Flexibility in contract delivery. Alternative delivery methods (e.g., design/build) are possible; separate contracts for demolition of existing and new construction are possible.	

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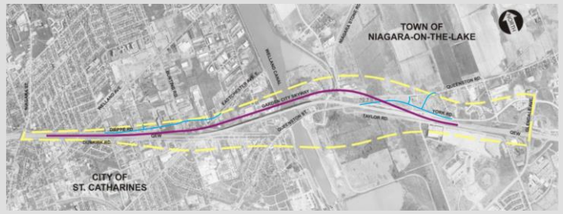
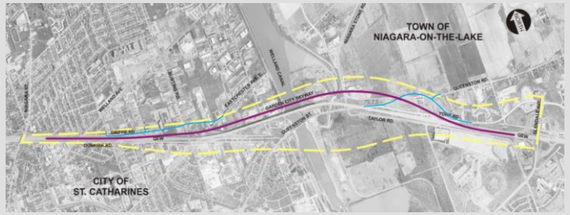
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
Overall Summary – Structural Engineering				There is no difference between the alternatives for any of the criteria. As a result, from a structural engineering perspective, **Alternatives RT1 and RT1A are equally preferred.**	
5.0 Transportation & Other Considerations					
5.1 Transportation	5.1.1 Flexibility for future improvements	• Base mapping • Design plans • Other Studies • Provincial policy papers (e.g., Places to Grow)	a) Qualitative assessment of future expansion/compatibility	Little flexibility for future improvements. Impossible to widen tunnel cross sections, thus any future capacity expansion would require new tunnel(s) or conversion of existing shoulders to general-purpose lanes.	
	5.1.2 Highway Geometrics	• *Geometric Design Standards for Ontario Highways* • *Transportation Association of Canada Geometric Design Guide for Canadian Roads* • *Proposed Draft Concepts for New Rural Freeways* • Other MTO standards • Design plans • Base mapping	a) Compatibility with current highway design standards and practices.	Meets current design standards and practices. Additional shoulder width required to meet sight distance requirements at R=875 m curve.	Meets current design standards and practices.
	5.1.3 Traffic Operations	• Transportation planning and land use forecasting model • Design plans • Base mapping & field review	a) Impacts to traffic operations.	Improved QEW operations are expected due to the addition of truck-climbing lane and improved roadside (i.e., shoulders).	
	5.1.4 Safety	• Transportation planning and land use forecasting model • Historical collision data • Design plans • Base mapping & field review	a) Ability to address existing deficiencies	Addresses narrow shoulder width concerns and provides truck-climbing lane. Improvements to vertical alignment. No improvement to horizontal alignment.	Addresses narrow shoulder width concerns and provides truck-climbing lane. Improvements to vertical and horizontal alignments.
			b) Impact on driver behavior / expectations	Relatively high potential impact; signing and lighting must be carefully designed based on human factors input.	
	5.1.5 Compatibility with road network (QEW and local)	• Local and regional transportation plans, official plans • Other EA studies	a) Impact on local road network: • Local road realignment requirements • Construction staging requirements	Results in major impact to local road network. Requires closure of existing Dieppe Road crossing of QEW; additional QEW crossing volumes likely borne by Bunting Road and Cushman Road. Realignments required for Dieppe Road, Eastchester	Results in major impact to local road network. Requires closure of existing Dieppe Road crossing of QEW; additional QEW crossing volumes likely borne by Bunting Road and Cushman Road. Realignments required for Dieppe Road, Eastchester

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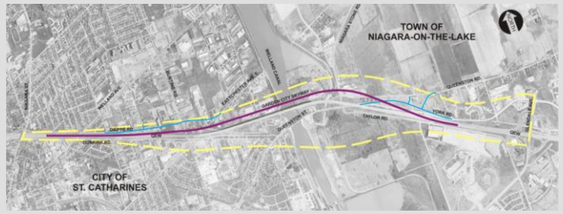
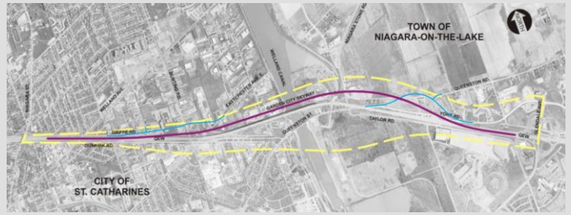
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
		• Design plans		Avenue East, York Road, and Queenston Road. Partial closure of Queenston Road and closure of Coon Road.	Avenue East, York Road, Queenston Road, and Coon Road. Partial closure of Queenston Road.
			b) Impact on QEW	Improved operations due to truck-climbing lane and improved cross section. Modifications to Niagara St. E-N/S and N/S-E ramps required.	
	5.1.6 Seaway and Airport Operations	• Input from the St. Lawrence Seaway Management Corporation and Transport Canada • Input from Niagara Regional Airport and Transport Canada	a) Potential impacts on St. Lawrence Seaway operations during construction	Short-term (12-24 hours) disruptions to marine traffic possible during construction, if immersed tube placement is made during shipping season.	
			b) Impact on Niagara Regional Airport operations	No impact; tunnels are the only alternatives that would not encroach into the Airport's outer surface elevation restriction.	
	5.1.7 Emergency Response	• Input from Ontario Provincial Police • Input from municipal emergency services • Design plans	a) Impacts to emergency access/routing	No significant impacts anticipated; however, one less crossing of the QEW (Dieppe Rd.) provides slightly less flexibility with emergency routing.	
			b) Potential challenges to incident management	Improved safety of emergency personnel responding to incidents on the QEW. In the event of a fire in the tunnel, visibility could be severely reduced, creating additional challenges for emergency personnel. Some potential for communications challenges in the tunnel in the event that in-tunnel radio antennae are damaged.	
	5.1.8 Utilities	• Existing Utility Records • NEB Regulations • MTO CMO requirements • Design plans • Base mapping	a) Type of utility impacted	Major municipal sewer, major municipal watermain, hydro transmission line. Numerous minor utilities impacts.	
			b) Length and type (i.e., crossing or relocation) of direct impact to existing utility corridors	3 major municipal sewer crossings; 737 m impacted; probable displacement of important manhole. 1 major existing municipal watermain crossing; 102 m impacted. Future Bunting Road watermain potentially impacted. 1 hydro transmission line crossing.	
Summary – Transportation & Other Considerations				**Alternative RT1A is slightly preferred** from a transportation perspective, as it has an upgraded horizontal alignment and no shoulder widening is required in the tunnel.	
6.0 Cost					
	6.1.1 Cost[3]	• MTO Parametric Estimating Guide • HiCo • Previous studies	c) Structure Capital Cost	$376 ($2011)	
		• MTO Parametric Estimating Guide • HiCo • Previous studies • MTO Structural Manual	d) Structure Lifecycle Cost	$468M ($2011)	
		• MTO Parametric Estimating Guide • HiCo	e) Total Construction Cost (includes property)	$870-1,070M (Includes $120M property costs.)	$875-1,075M (Includes $125M property costs.)

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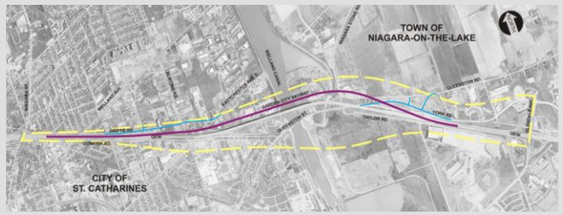
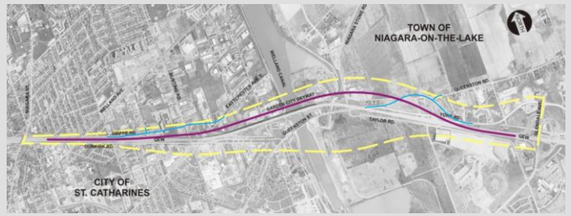
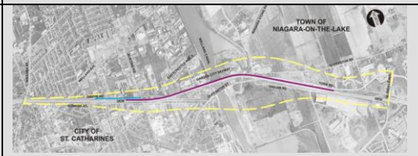
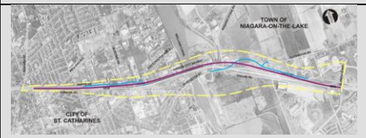
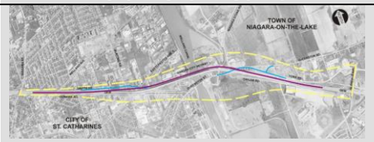
Alternative Identifier				RT1	RT1A
Description				Replacement Tunnel to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH					
Environmental Factor /Criteria		**Data Source[1]**	**Measures**		
		• Previous studies • MTO Structural Manual • Input from MTO Property Office			
Summary - Cost				Costs are essentially equivalent. As a result, **both Alternatives** are equally preferred from a cost perspective.	
Overall Summary				Alternative RT1 is preferred from a socio-economic environmental perspective, as it results in fewer impacts to property, road closures, and nuisance effects. However, Alternative RT1A is preferred from a cultural environment perspective, as it impacts a fewer number of cultural heritage resources (though it should be noted that due to direct impacts to the existing Garden City Skyway bridge, both tunnel alternatives are very undesirable from a cultural heritage perspective). Alternative RT1A is also preferred from a natural environment perspective, as it avoids the removal of an endangered species, impacts fewer contaminated areas, and results in fewer groundwater impacts. There are essentially no differences between the two alternatives from structural engineering or cost perspectives, and Alternative RT1A is slightly preferred from a transportation perspective. **As a result, Alternative RT1A is the preferred tunnel alternative.**	

[1] Sources of information for all factor areas include the design alternatives, existing conditions surveys and aerial photography
[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
[3] Costs are preliminary in nature and subject to change in Detail Design.

Second Stage of Evaluation

Alternatives Evaluation - Second Stage

Alternative Type				Widening	Twinning	Replacement Bridge	Replacement Tunnel
Alternative Identifier				W1	NT2A	RB1	RT1A
Description				Widen to the North	Twin to North - 1700 m Curve	Replacement Bridge to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
1.0 Socio-Economic Environment							
1.1 Property and Property Access	1.1.1 Property and Property Access	• Municipal land use information • Approved development plans	a) Number of properties directly impacted	Number of impacted properties by type: Residential: 0 Commercial: 12 Industrial: 4 Open Space: 4 (includes 1 MTO property) Utility: 0 Agricultural: 0 Total: 20	Number of impacted properties by type: Residential: 4 Commercial: 22 Industrial: 4 Open Space: 6 (includes 1 MTO property) Utility: 1 Agricultural: 1 Total: 38	Number of impacted properties by type: Residential: 4 Commercial: 18 Industrial: 4 Open Space: 4 (includes 1 MTO property) Utility: 1 Agricultural: 1 Total: 32	Number of impacted properties by type: Residential: 0 Commercial: 30 Industrial: 14 Open Space: 4 Utility: 1 Agricultural: 2 Total: 51
			b) Number of residences potentially displaced	None anticipated.	4 residences potentially displaced.	4 residences potentially displaced.	None anticipated.
			c) Qualitative assessment of changes to residential property access	No changes anticipated to residential property access.	No major changes to residential property access, as all affected residential properties will be displaced by direct impacts.	No significant changes to residential property access, as all affected residential properties will be displaced by direct impacts and/or right-of-way requirements.	Minor impacts to residential property access. Access to three residences on Queenston Road maintained, but Queenston Road will be closed to the east; access to this section of Queenston Road is from Niagara Stone Road only.
			d) Number of businesses potentially displaced	1 business potentially displaced.	10 businesses potentially displaced.	11 businesses potentially displaced.	26 businesses potentially displaced.
			e) Qualitative assessment of changes to business property access	No major changes to business property access; several businesses along Dieppe Road will require minor modifications to entrances.	Minor changes to business accesses along Dieppe Road; some modifications required.	Minor changes to business accesses along Dieppe Road; some modifications required (most businesses along Dieppe are directly impacted, and no access is required).	Major modifications to business property access required along Dieppe Road and Eastchester Avenue East.
			f) Number of roads closed	No road closures.	Coon Road closed. Queenston Road closed between Coon Road and Niagara Stone Road; Queenston Road realigned to connect to York Road near Coon Road.	Coon Road closed. Queenston Road closed between Coon Road and Niagara Stone Road; Queenston Road realigned to connect to York Road near Coon Road.	Queenston Road closed from approximately 300 m east of Niagara Stone Road easterly for approximately 650 m. The 300 m section of Queenston Road from Niagara Stone Road easterly is cul-de-saced. Coon Road closed. Dieppe Road crossing of QEW closed.

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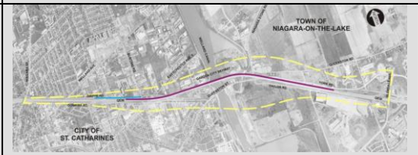
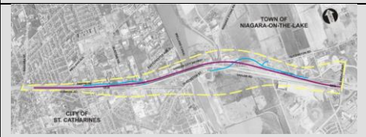
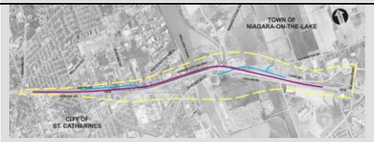
Alternative Identifier				W1	NT2A	RB1	RT1A
Description				Widen to the North	Twin to North - 1700 m Curve	Replacement Bridge to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
Summary – Property and Property Access				**Alternative W1 is preferred from a property and property access perspective**, as it results in the smallest impact to properties, and displaces the fewest residences and businesses. Alternatives NT2A and RB1 are similarly preferred, and preferred slightly less than Alternative W1. Alternative RT1A is significantly less preferred than the other alternatives, as it has the greatest number of property impacts, and displaces the most businesses. Further, Alternative RT1A results in the closure of the Dieppe Road crossing of the QEW; this is the only alternative that requires the closure of a QEW crossing road.		
1.2 Community Effects	1.2.1 Community facilities (cemeteries, schools, places of worship, recreation centres)	• Municipal land use information • Approved development plans	a) Number of cemeteries directly impacted or potentially displaced	None			
			b) Number of schools directly impacted or potentially displaced	None			
			c) Number of places of worship directly impacted or potentially displaced	None	Queenston Road access to St. George's Anglican Church is altered on the west side of Queenston Road; new access road will provide access to St. George's on the east side.	None	One; Queenston Road access to St. George's Anglican Church is altered on the west side of Queenston Road; new access road will provide access to St. George's on the east side.
			d) Number of recreation centres directly impacted or potentially displaced	One; Niagara Ball Hockey Club may potentially be displaced.	One; Niagara Ball Hockey Club will be displaced.	One; Niagara Ball Hockey Club will be displaced.	One; Niagara Ball Hockey Club will potentially be displaced.
			e) Qualitative assessment of changes to access to community facilities (cemeteries, schools, places of worship, recreation centres)	Impacts to access to the Niagara Ball Hockey Club during construction. Property directly impacted by widened bridge footprint; however, it may be possible to avoid displacement of the business.	None	None	None
	1.2.2 Recreational and Tourist Features	• Municipal land use information • Approved development plans	a) Number of parks and trails directly impacted	• One • No impacts to parks and minor impacts to trails during construction.	• No parks impacted • Impacts to trails during construction.	• No parks impacted • Trails along Welland Canal will be temporarily impacted during construction.	• No parks impacted • Impacts to trails during construction.
		• Input from the St. Lawrence Seaway Management Corporation and Transport Canada	b) Impacts to recreational boating traffic within the Welland Canal	No impacts anticipated.			Short-term (12-24 hours) disruptions to marine traffic possible during construction, if immersed tube placement is made during shipping season.
		• Input from the Ministry of Tourism and Culture	c) Impacts to the Tourism Information Centre	Impacts to TIC building and access; reconstruction and/or relocation required.	Relocation likely required, as TIC building would be located in the median.	Direct impacts to TIC building; relocation required.	Relocation required, as TIC building would be located on the Niagara-bound side of the highway.

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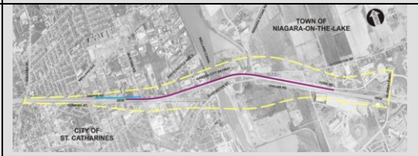
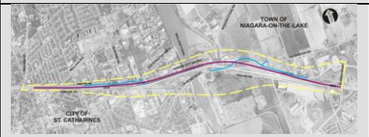
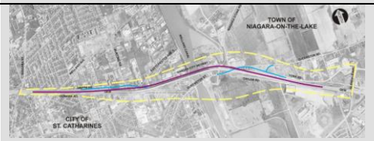
Alternative Type				Widening	Twinning	Replacement Bridge	Replacement Tunnel
Alternative Identifier				W1	NT2A	RB1	RT1A
Description				Widen to the North	Twin to North - 1700 m Curve	Replacement Bridge to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
	1.2.3 Land Use Opportunities	• Municipal planning departments	a) Potential for new development opportunities	Same opportunities for new development as with existing structure.	Some potential for new development between each bridge structure.	Some potential for new development in existing bridge footprint lands.	Tunnel will provide greater opportunities for new development (on the deck of the tunnel); however existing land uses will be displaced.
	1.2.4 Agricultural Resources	• Topographic maps • Municipal land use information • Approved development plans	a) Impact on local agricultural resources using quantitative measure of area (ha)	None			Potential for impact to lands designated for agriculture and not currently used for agriculture.
			b) Number of agricultural operations directly impacted	None			Potential for impact to lands designated for agriculture and not currently used for agriculture.
	1.2.5 Approved local, Regional, and Provincial plans and policies	• Municipal land use information • Approved development plans • Official Plans • Secondary Plans • Niagara Escarpment Plan • Greenbelt Plan	a) Assessment of conformity with approved local, Regional, and Provincial plans and policies	Conforms with Greenbelt Plan polices regarding new infrastructure; conforms to the Niagara Region Policy Plan.			
Summary – Community Effects				Alternative RT1A is the only alternative to impact recreational boating traffic in the Welland Canal, and the only alternative to impact local agricultural lands. Alternative W1 is the only alternative to directly impact an existing park, though the other alternatives will result in temporary impacts to trails during construction. All alternatives impact the Niagara Ball Hockey Club and the Travel Information Centre. Alternatives NT2A and RB1 provide potential new land use opportunities. Alternative W1 provides the same land use opportunities as the existing structure, and Alternative RT1A results in the displacement of existing land uses. Alternatives W1 and RB1 also avoid impacting access to St. George's Anglican Church, unlike the other two alternatives. As a result**, Alternative RB1** is the preferred alternative from a community effects perspective, as it avoids most impacts while providing potential new development lands. Alternative RT1A is least preferred from a community effects perspective.			
1.3 Nuisance Effects	1.3.1 Noise	• Topographic maps • Municipal land use information • Approved development plans	a) Noise Impact: • Highway alignment shifting towards adjacent NSAs is expected to increase noise levels • Highway alignment	• Highway alignment shifts north away from NSA 8, NSA 9, NSA 10, NSA 11, which is expected to decrease noise levels • Highway alignment shifts closer to NSA 12 which is expected to increase noise levels	• Highway alignment shifts north away from NSA 8, NSA 9, NSA 10, NSA 11, which is expected to decrease noise levels. • Highway alignment shifts closer to NSA 12, NSA 13, which is expected to increase noise levels	• Highway alignment shifts north away from NSA 8, NSA 9, NSA 10, NSA 11, which is expected to decrease noise levels (Highway alignment displaces NSA 12)	• Highway vertical alignment will cross Welland Canal below grade through tunnel which is expected to significantly decrease noise levels • Highway alignment shifts north away from NSA 8, NSA 9, NSA 10, NSA 11, NSA 12, which is

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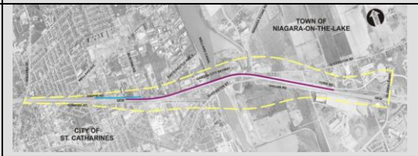
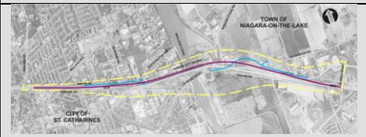
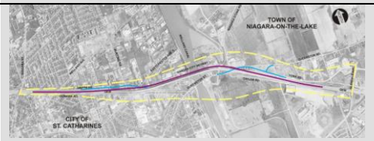
Alternative Type				Widening	Twinning	Replacement Bridge	Replacement Tunnel
Alternative Identifier				W1	NT2A	RB1	RT1A
Description				Widen to the North	Twin to North - 1700 m Curve	Replacement Bridge to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
			shifting away from adjacent NSA is expected to decrease noise levels. • The approximate number of houses represented by each NSAs are: NSA 8: > 50 NSA 9: > 50 NSA 10: > 5 NSA 11: ~ 2 NSA 12: ~ 3 NSA 13: > 10				expected to decrease noise levels • Highway alignment shifts towards NSA 13, which is expected to increase noise levels
	1.3.2 Air quality	• Topographic maps • Municipal land use information • Approved development plans	a) Qualitative assessment of impacts to air quality (Based on proximity of receptors to bridge/tunnel. More weight was given to residential receptors than to industrial areas as potential receptors)	• West bound lanes shift slightly away from residential areas to the south but closer to residences on Queenston Rd. near Niagara Stone Rd. Small mixed effect.	• West bound lanes shift away from residential areas to the south and towards residences on Queenston Rd., near Niagara Stone Rd. Small mixed effect.	• All lanes of traffic shift away from nearby residences to the south, but closer to any remaining residences on Queenston Rd., near Niagara Stone Rd. Small mixed effect.	• New tunnel and access roads shift away from residences to the south. The tunnel portals are also well separated from residences. Effect is positive.
	1.3.3 Vibration	• Topographic maps • Municipal land use information • Approved development plans	a) Qualitative assessment of vibration impacts	Operation: • No impacts expected Construction: • With diesel pile driving some vibration may be felt as residences are approximately 45m north of the alternative	Operation: • No impacts expected Construction: • With diesel pile driving some vibration may be felt as the residences are located approximately 25m south of the alternative.	Operation: • No impacts expected Construction: • With diesel pile driving some vibration may be felt as the alternative is north of the closest residences approximately 90m away.	Operation: • No impacts expected Construction: • Vibration impacts due to tunnel boring may be perceptible as the closest residence is approximately 150m away from the alternative to the south.
Summary – Nuisance Effects				Alternative RT1A results in a decrease in noise levels generally, as traffic will be crossing the Welland Canal through a tunnel below grade, though it will increase noise levels at one NSA. Alternative RB1 results in noise level decreases at a number of NSAs, and does not result in increased noise at any receptors. Alternative RT1A is the only alternative to result in a positive air quality effect; all other alternatives result in a small mixed effect. All alternatives may result in some construction-related vibration; However Alternative RT1A is located furthest from residences and therefore should have the least impact. As a result, **Alternative RT1A** is preferred from a nuisance effects perspective.			

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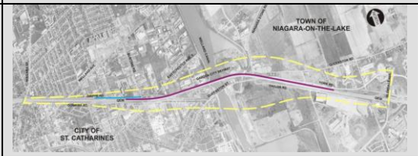
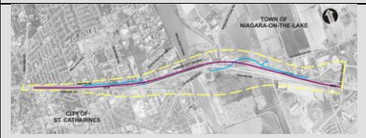
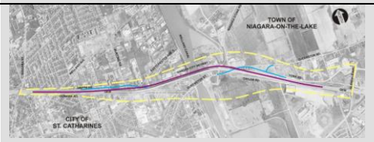
SKETCH							
Environmental Factor /Criteria	**Data Source[1]**		**Measures**				
Overall Summary – Socio-Economic Environment				Alternative W1 is preferred from a property and property impacts perspective as it impacts fewer residential and commercial properties than the other alternatives. While Alternative RB1 is preferred from a community effects perspective and Alternative RT1A is preferred from a nuisance perspective, it is anticipated that these impacts will be easier to mitigate than the property impacts. **As a result, Alternative W1 is preferred from a socio-economic perspective.**			
2.0 Cultural Environment							
2.1 Archaeology	2.1.1 Archaeological sites	• Stage 1 Archaeological Assessment	a) Impact to known archaeological features or areas of archaeological potential	Impacts areas of archaeological potential.			
2.2 Heritage Features	2.2.1 Built heritage and cultural heritage landscapes	• Heritage Existing Conditions Report for the QEW Garden City Skyway study area • Cultural Heritage Evaluation Report for the QEW Garden City Skyway • Historical mapping and aerial photographs, cemetery lists, municipal, provincial and federal inventories, listings, plaques, easements and designations of National Historic Sites and under the Ontario *Heritage Act* • Input from other factor areas • Consultation with municipal and regional heritage planning staff or	a) Number of listed built heritage resources (BHR) displaced or disrupted	2 BHR	5 BHR	6 BHR Note: this includes the displacement of the existing QEW Garden City Skyway.	2 BHR Note: this includes the displacement of the existing QEW Garden City Skyway.
			b) Number of cultural heritage landscape (CHL) resources displaced or disrupted	2 CHL	4 CHL	2 CHL	3 CHL

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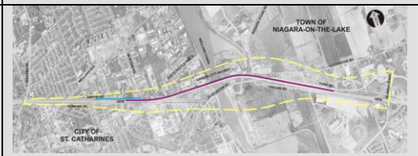
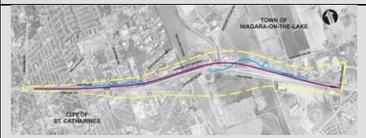
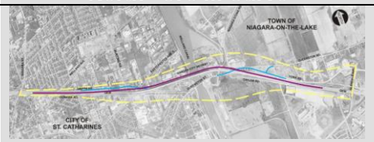
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		designates, historical societies and other heritage groups as necessary • Municipal heritage inventories for designated and listed built heritage structures • Ontario Genealogical Society for Cemeteries					
Overall Summary – Cultural Environment				Alternative NT2A maintains the existing heritage bridge. While Alternative W1 directly impacts fewer cultural heritage resources, it requires significant modifications to the existing bridge, a provincial heritage property of provincial significance. Alternatives RT1A and RB1 are least preferred, as they result in the removal of the existing bridge. **As a result, Alternative NT2A is preferred from a cultural environment perspective.**			
3.0 Natural Environment							
3.1 Fisheries and Aquatic Habitat	3.1.1 Fish and fish habitat, considering: • Sensitivity of Fish and Fish Habitat[2] • Relative Magnitude of Potential Effect	• Topographic maps • Watershed Management Plans • Existing information gathered from MNR field studies and fish records, NPCA, Interest Groups, public consultation, municipalities • Reconnaissance-level field assessments • Provincial Policy Statement and associated MNR	a) Determination of Sensitivity of Fish and Fish Habitat based on evaluation of attributes such as: • Presence of any critical/specialized habitat • Presence of habitat for species of conservation concern, including Species At Risk as identified by COSEWIC and COSSARO, • Habitat resiliency based on thermal regimes (warm, cool, cold water)	Four watercourses (Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek, and Eight Mile Creek) traverse this bridge alignment. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent.	Four watercourses (Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek, Eight Mile Creek) traverse these bridge and road alignments. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the	Three watercourses (Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek) traverse these bridge and road alignments. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent	Four watercourses and 1 ponding area (Welland Canal and Embayment area, Pond area adjacent to Welland Canal, Tributary of Welland Canal, Tributary of Eight Mile Creek, Eight Mile Creek) traverse these tunnel and road alignments. • No critical or specialized habitat in any of the watercourses. • No species of conservation concern. • Warmwater systems. • Direct fish use was determined in all the watercourses with the exception of the Tributary to Eight Mile Creek (dry at time of survey; perched culvert/fish barrier at Queenston Road). • Intermittent flow in all

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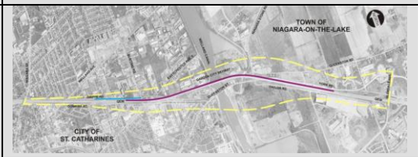
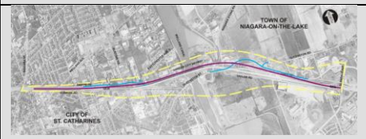
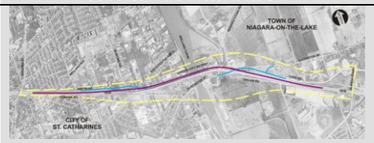
Alternative Identifier				W1	NT2A	RB1	RT1A
Description				Widen to the North	Twin to North - 1700 m Curve	Replacement Bridge to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		Natural Heritage Training Manual • The Fish Community of the Fourth Welland Canal: Welland to Port Colborne (MNR 1998) • MNR (Natural Resource Values Inventory Systems (NRVIS) mapping) • NHIC (MNR) and Species At Risk mapping (DFO) • Species at Risk Recovery Plans and Management Guidelines	and flow regime (DFO Risk Management Framework 2006, MTO Environmental Guide for Fish and Fish Habitat 2006). b) Determination of Magnitude of Potential Effect using qualitative assessment as a relative measure of potential effects (e.g. piers, tunnel, need for channel realignment or culvert extensions).	<u>Widen Bridge to North</u> • Welland Canal – 2 instream piers required. • Tributary of Welland Canal – likely spanned. • Tributary of Eight Mile Creek – extensions required on QEW culvert. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized removal and disturbance of riparian vegetation associated with the pier construction. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized disturbance and removal of riparian vegetation and temporary alteration of channel banks and bed. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.	Welland Canal which is permanent. <u>Twin Bridge to the North</u> • Welland Canal – requires 2 instream piers. • Tributary of Welland Canal – likely spanned. • Tributary of Eight Mile Creek – new culvert required • Eight Mile Creek – extension of the north side of the QEW culvert required <u>Re-alignment of York Road</u> • Tributary of Welland Canal – possible culvert extensions at Queenston Street. • Tributary of Eight Mile Creek – new culvert required. • Eight Mile Creek – extension of York Road culvert required. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized disturbance and removal of riparian vegetation associated with the pier construction.	<u>Replacement Bridge to North</u> • Welland Canal – requires 2 instream piers. • Tributary of Welland Canal – likely spanned. • Tributary of Eight Mile Creek – extensions required on York Road culvert. <u>Re-alignment of York Road</u> • Tributary of Welland Canal – possible extensions on Queenston Street culvert. • Tributary of Eight Mile Creek – new culvert required. Direct impacts of the 2 instream piers in the Welland Canal will result in displacement of a relatively small amount of channel bed. Spanning the Tributary of the Welland Canal should avoid any permanent instream impacts and will likely require only localized removal and disturbance of riparian vegetation associated with the pier construction. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized removal of riparian vegetation and temporary alteration of	watercourses (in the vicinity of the QEW) with the exception of the Welland Canal which is permanent. <u>Replacement Tunnel to North</u> • Welland Canal – open cut at crossing area. • Welland Canal Embayment area – permanent infill of south section, casting basin requires area to be drained and excavated with impact to shoreline areas. • Linear ponding area adjacent to Welland Canal – tunneling under ponding area. • Tributary of Welland Canal – 10 m permanent drop in elevation (where tunnel opens up) at existing crossing will require realignment of the tributary. • Tributary of Eight Mile Creek – culvert replacement at Queenston Road with longer culvert. • Eight Mile Creek – extensions required on QEW culvert. <u>Re-alignment of York Road</u> • Tributary of Eight Mile Creek – new culvert required. Direct impacts of the open cut method for the Welland Canal crossing and the construction of the casting basin and navigation channel will include excavation of the channel bed, impact to the shoreline areas (disturbance and removal or riparian vegetation),

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[2] Species of Conservation Concern assessment based on species lists at the time of evaluation (i.e. July 2011)
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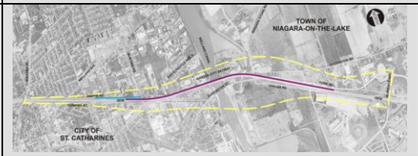
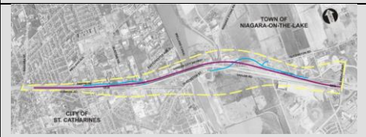
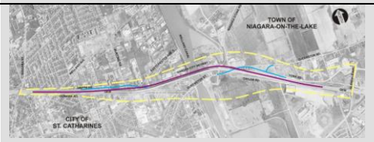
Description				Widen to the North	Twin to North - 1700 m Curve	Replacement Bridge to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
					Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized removal of riparian vegetation and temporary alteration of channel banks and bed. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.	channel banks and bed. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.	displacement of water and partial infill of the south section of the embayment area. Although the construction of these areas may take 5 years, the impacts are temporary and the pre-existing conditions will eventually be restored. However the direct impacts of infilling the south section of the embayment area will result in some displacement of this open water feature along with localized disturbance and removal of riparian vegetation. There will be no direct impacts to the pond feature (tunneling under). Direct impacts of the proposed re-alignment should be limited to temporary disturbance of the channel and localized disturbance and removal or riparian vegetation. Direct impacts of the proposed culvert works will result in additional enclosure of watercourse habitat, localized disturbance and removal of riparian vegetation and temporary alteration of channel banks and bed. Direct impacts and potential indirect impacts (e.g., erosion and sediment control) can be managed using appropriate mitigation and restoration measures.
Summary – Fisheries and Aquatic Habitat				Alternatives W1 and RB1 are slightly preferred over NT2A as they impact fewer watercourses. Alternative RT1A is the least preferred alternative as it will require the greatest impact to fisheries and aquatic habitat. **Therefore, Alternatives W1 and RB1 are similarly preferred.**			

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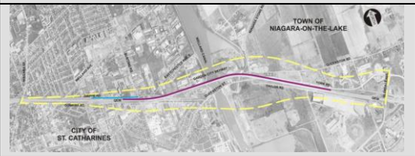
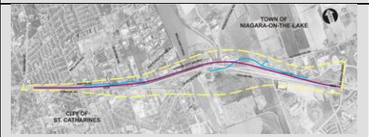
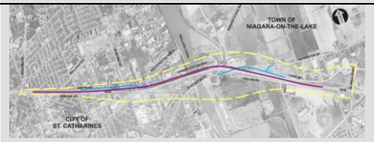
Alternative Identifier				W1	NT2A	RB1	RT1A
Description				Widen to the North	Twin to North - 1700 m Curve	Replacement Bridge to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
3.2 Terrestrial Ecosystems	3.2.1 Wetland vegetation communities, considering: • Sensitivity / Quality / Significance of Wetland Vegetation[2] • Habitat Relative Magnitude of Potential Effect	• Topographic maps • MNR NRVIS data • MNR District staff • NHIC/Biodiversity Explorer • Bird Studies Canada/Breeding Bird Atlas • Municipal Official Plans • Existing information gathered from MNR, NPCA, Interest Groups, public consultation, municipalities • Reconnaissance-level field inventories • Species at Risk Recovery Plans and Management Guidelines	a) Determination of *Sensitivity/Quality/Significance of Wetland* based on designated status (PSW, LSW, unevaluated), supported by evaluation of attributes such as: • Presence of species of conservation concern including Species At Risk as identified by COSEWIC and COSSARO • Presence of potential habitat for SAR, and • Habitat resiliency based on size, maturity, physical considerations (e.g. drainage, groundwater discharge, slope, etc.)	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • No known wetland communities within W1 alignment footprint • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Very low** potential for wetland-associated SAR within W1 footprint based on habitat types observed and general absence of wetland communities within the alignment footprint.	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • No known wetland communities within NT2A alignment. • Wetland potential within deciduous forest block north of Queenston Road (Unit 5). • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Very low** potential for wetland-associated SAR within NT2A footprint based on habitat types observed and general absence of wetland communities within the alignment footprint.	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • No known wetland communities within RB1 alignment footprint • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Very low** potential for wetland-associated SAR within RB1 footprint based on habitat types observed and general absence of wetland communities within the alignment footprint.	• No evaluated wetlands (PSW, LSW) within alignment footprint or immediately adjacent lands • 1 deciduous swamp community with open water components (Unit 11), 1 cultural woodland with deciduous swamp component (Unit 8) and 1 cultural meadow with meadow marsh components (Unit 9) within RT1A footprint • No wetland-associated flora of conservation concern records or observations in areas that were accessible. • **Low** potential for wetland-associated SAR flora within RT1A footprint based on habitat types observed. • Affected wetland communities are small and generally of cultural origin and culturally influenced.
			b) Determination of Magnitude of Potential Effect using qualitative assessment of potential impact (edge encroachment versus fragmentation, change to wetland size and shape etc.)	<u>Widen Bridge to the North</u> • No known or anticipated impacts to wetland communities ***No realignment of Niagara Stone Rd or Taylor Rd required** <u>Realignment of Dunkirk Rd</u> • No known or anticipated impacts to wetland communities	<u>Twin Bridge to the North</u> • No known or anticipated impacts to wetland communities <u>Realignment of Queenston Rd.</u> • No known or anticipated impacts to wetland communities • Fragmentation of Unit 5 <u>Realignment of Dunkirk Rd</u> • No anticipated impacts to wetland communities. Alignment runs through currently developed lands.	<u>Replace Bridge to the North</u> • No known or anticipated impacts to wetland communities <u>Realignment of Queenston Rd</u> • No known or anticipated impacts to wetland communities <u>Realignment of Dunkirk Rd</u> • No known or anticipated impacts to wetland communities ***No realignment of Niagara Stone Road or Taylor Road required**	<u>Replacement Tunnel to the North</u> • **Edge impacts** to a deciduous swamp community with open water components (Unit 11) • Removal of most of Unit 8 (cultural woodland with deciduous swamp components) • Temporary disturbance of cultural meadow community with meadow marsh components (Unit 9) for tunnel casting basin working area. <u>Realignment of York Rd</u> • minimal wetland impacts (some small wetland pockets within

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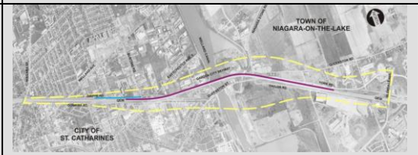
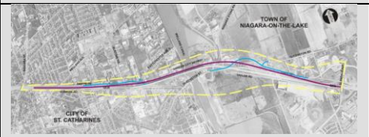
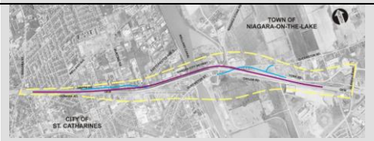
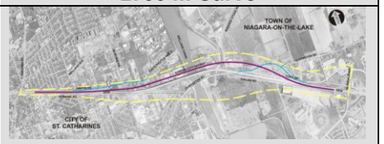
Alternative Type				Widening	Twinning	Replacement Bridge	Replacement Tunnel
Alternative Identifier				W1	NT2A	RB1	RT1A
Description				Widen to the North	Twin to North - 1700 m Curve	Replacement Bridge to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
							cultural meadow community north of York Rd and south of Queenston Road) <u>Realignment of Dunkirk Rd</u> • No known or anticipated impacts to wetland communities
	3.2.2 Upland Vegetation Communities considering: • Sensitivity / Quality / Significance of Vegetation[2] • Relative Magnitude of Potential Effect		a) Determination of *Sensitivity/Quality/Significance of Upland Vegetation* (including cultural communities) based on evaluation of attributes such as: • Community rarity/sensitivity/tolerance and local representation/distribution on the landscape • Rarity of species (species of conservation concern including Species At Risk as identified by COSEWIC and COSSARO) • Presence of specialized habitat for species of conservation concern • Habitat resiliency based on size, maturity, physical considerations (e.g. drainage, slope, etc.)	• Affected upland communities are generally young cultural woodlands and cultural meadows. • No mature, high quality forest communities were encountered in the accessible areas in the vicinity of W1. • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.	• Affected upland communities are generally young or remnant deciduous forest, cultural woodlands, cultural thickets and cultural meadows. • No mature, high quality forest communities were encountered in the accessible areas in the vicinity of NT2A. • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.	• No mature, high quality forest communities were encountered in the vicinity of RB1. • Upland communities are generally young or remnant deciduous forest, cultural woodlands, cultural thickets and cultural meadows. • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.	• Affected upland communities are generally young or remnant deciduous forest, cultural woodlands and cultural meadows. • No mature, high quality forest communities were encountered in the accessible areas in the vicinity of RT1A. • **2 Butternut trees** (END) are located at the edge of Unit 6. **Moderate to high potential** for this species to be encountered elsewhere in the study area. • **Low** potential for additional upland-associated SAR flora based on young and disturbed characteristics of the study area generally.

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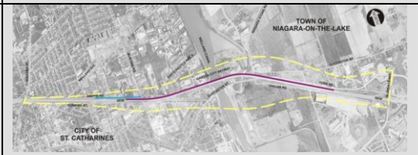
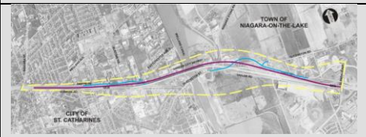
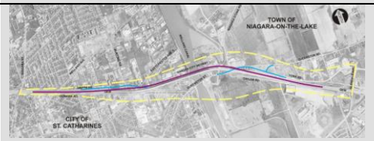
Description				Widen to the North	Twin to North - 1700 m Curve	Replacement Bridge to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
			b) Determination of Magnitude of Potential Effect using qualitative assessment of potential impact (edge encroachment versus fragmentation, change to patch size and shape, etc.)	Widen Bridge to the North • 2 small wooded blocks **removed** north of existing bridge, east of Welland Canal • **Edge** of 1 small cultural woodland removed (Unit 6) • Removal of cultural meadow habitat within existing ROW, north of the QEW • **Possible indirect impacts to 2 Butternut trees** ***No realignment of Niagara Stone Road or Taylor Road required.**	Twin Bridge to the North • **Removal** of 2 small cultural woodland communities north of existing bridge • **Fragmentation** of regenerating cultural meadow between York Road and Queenston Road • **Potential indirect impacts to 2 Butternut trees in Unit 6.** Realignment of Queenston Road • Removes edge of 1 cultural woodland (Unit 6) and 1 riparian deciduous forest (Unit 1) • **Fragmentation** of a deciduous forest (Unit 5) • **Fragmentation** of regenerating cultural meadow habitat Realignment of Dunkirk Road • No upland vegetation impacts anticipated. Alignment is through developed lands	Replace Bridge to the North • 2 small wooded blocks and 1 small cultural woodland (Unit 6) removed • **2 Butternut trees removed** • Edge removals of cultural meadow and cultural woodland communities (Units 8 and 18) Realignment of Queenston Road • **Fragmentation** of cultural meadow community between Queenston Road and York Road Realignment of Dunkirk Road • Minimal upland vegetation impacts anticipated. Alignment is through developed lands.	Replacement Tunnel to the North • Removal of a large portion of cultural woodland community (Unit 18) • Fragmentation of Unit 5 • Removal of most of Unit 8 (cultural woodland with deciduous swamp components) • **2 Butternut trees removed** • Cultural meadow community fragmented between Queenston Road and York Road • No anticipated impacts to 2 Butternut trees • Temporary disturbance of cultural meadow community with meadow marsh components (Unit 9) for tunnel casting basin working area. Realignment of York Road • Cultural meadow fragmented between Queenston Road and York Road • Cultural woodland (Unit 4) removed Realignment of Dunkirk Road • Minimal upland vegetation impacts anticipated. Alignment is through developed lands.
	3.2.3 Wildlife and Habitat considering: • Sensitivity / Quality / Significance of Wildlife and Habitat[2] • Relative Magnitude of Potential Effect		a) Determination of *Sensitivity/Quality/Significance of Wildlife* and *Habitat* based on evaluation of attributes such as: • Presence of Significant Wildlife Habitat (SWH; e.g. deer yards and heronries as identified by MNR or NPCA; other specialized habitat	No previously identified SWH within W1 area. **Alignment within known habitat for 2 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) **Alignment within habitat for 5 potential SAR:** • Barn Owl (END) – low potential • Chimney Swift (THR) – high potential • Yellow-breasted Chat (SC) – low	No previously identified SWH within NT2A area. **Alignment within known habitat for 3 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) • Eastern Meadowlark (COSEWIC recommended for listing as THR) **Alignment within habitat for 6 potential SAR:** • Chimney Swift (THR) – high	No previously identified SWH within RB1 area. **Alignment within known habitat for 4 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) • Snapping Turtle (SC) • Eastern Meadowlark (COSEWIC recommended for listing as THR) **Alignment within habitat for 6 potential SAR:**	No previously identified SWH within RT1A area. **Alignment within known habitat for 4 SAR**: • Monarch (SC) • Barn Swallow (COSEWIC recommended for listing as THR) • Snapping Turtle (SC) • Eastern Meadowlark (COSEWIC recommended for listing as THR) **Alignment within habitat for 8 potential SAR:**

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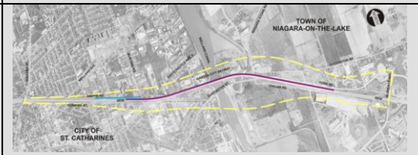
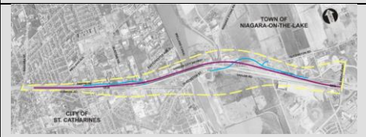
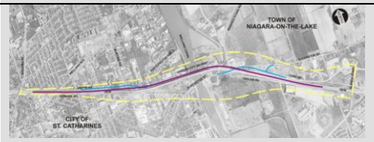
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
			such as Important Bird Areas etc.), interior and deep interior forest habitat • Presence of species of conservation concern including SAR as identified by COSEWIC and COSSARO • Presence of *potential* habitat for SAR • Habitat resiliency based on size (including interior and deep interior forest habitat), maturity, physical considerations • Presence of movement corridors (linkages) between natural areas/nodes on regional and local levels	potential • Milksnake (SC) – high potential • Ribbonsnake (SC) – moderate potential	potential • Milksnake (SC) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential • Yellow-breasted Chat (SC) – low potential	• Chimney Swift (THR) – high potential • Milksnake (SC) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential • Yellow-breasted Chat (SC) – low potential	• Chimney Swift (THR) – high potential • Milksnake (SC) – high potential • Ribbonsnake (SC) – moderate potential • Red-headed Woodpecker (SC) – moderate potential • Barn Owl (END) – low potential • Yellow-breasted Chat (SC) – low potential • Eastern Meadowlark (COSEWIC recommended for listing as THR) – moderate potential • Map Turtle (SC) – low potential
			b) Determination of Magnitude of Potential Effect considering: • Habitat type affected within footprint • Degree of habitat fragmentation • Habitat quality and sensitivity	<u>Widen Bridge to the North</u> • **Minor edge** impacts to **low** quality successional and cultural habitat ***No realignment of Niagara Stone Road or Taylor Road required.**	<u>Twin Bridge to the North</u> • **Fragmentation** of **low** quality successional habitat (i.e. mid-successional habitat that is too weedy for grassland birds [e.g. Bobolink] and becoming marginal for Eastern Meadowlark) • **Edge** impacts to **low** quality successional and cultural habitats <u>Realignment of Queenston Road</u> • **Further fragmentation** of **low** quality successional habitat (i.e. mid-successional habitat that is too weedy for grassland birds [e.g. Bobolink] and becoming marginal for Eastern Meadowlark) • **Fragmentation** of **low** quality	<u>Replace Bridge to the North</u> • **Edge** impacts to **low** quality successional and cultural habitat <u>Realignment of Queenston Road</u> • **Fragmentation** of **low** quality successional habitat (i.e. mid-successional habitat that is too weedy for grassland birds [e.g. Bobolink] and becoming marginal for Eastern Meadowlark)	<u>Replacement Tunnel to the North</u> • **Edge** impacts to cultural and low quality successional habitat • **Temporary disturbance** of low quality successional habitat (tunnel casting basin working area) • **Potential** impacts to overwintering turtles (potential Map Turtle and Snapping Turtle habitat) • **Fragmentation** of low quality woodland and successional habitat <u>Realignment of York Road</u> • **Fragmentation** of low quality successional habitat (i.e. mid-successional habitat that is too weedy for grassland birds [e.g.

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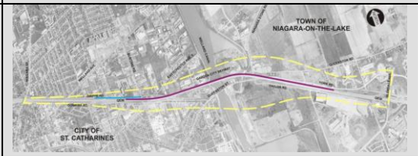
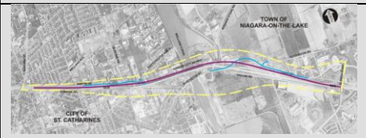
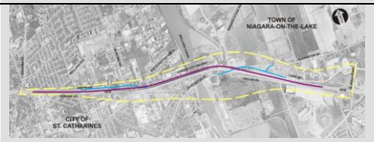
Description				Widen to the North	Twin to North - 1700 m Curve	Replacement Bridge to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
					successional woodland habitat ***No realignment of Niagara Stone Road required**		Bobolink] and becoming marginal for Eastern Meadowlark)
Summary – Terrestrial Ecosystem				Alternative RT1A has the greatest impact to wetland vegetation communities. Alternatives RB1 and RT1A are least preferred for upland vegetation communities, as they both result in the removal of 2 Butternut Trees. NT2A is less preferred than Alternative W1 as it results in greater fragmentation of upland habitat. Alternative W1 potentially impacts fewer SAR than Alternatives NT2A or RB1, while Alternative RT1A potentially impacts the greatest number of SAR. **Therefore, Alternative W1 is preferred.**			
3.3 Designated Natural Features	3.3.1 Designated Natural Features include, for example, Provincially Significant Wetlands (PSWs), Areas of Natural and Scientific Interest (ANSIs), Environmentally Sensitive/Significant Areas (ESAs), Niagara Escarpment Plan Area, Greenbelt Plan Area, Regional Greenlands Systems. These features are defined by resource agencies, municipalities, the government and/or the public, through legislation, policies, or approved management plans, to have special or unique value.	• MNR NRVIS data • NHIC/Biodiversity Explorer • Municipal Official Plans • NPCA • *Niagara Escarpment Plan* (2005) • *Greenbelt Plan* (2005)	a) Qualitative assessment of potential impacts to designated areas within the identified alternatives. • Where feasible/ applicable, the extent of the potential impact to designated areas will be quantitatively evaluated. • (Note: Impacts to designated natural features may also be captured within the evaluation of impacts to upland and wetland vegetation, or wildlife habitat. Where overlap between evaluating impacts to designated natural features and upland/wetland vegetation exists, it will be clearly stated so that impacts are not 'double counted'.)	**No impacts** to Greenbelt Plan area South of Queenston Street and west of Homer Road.			

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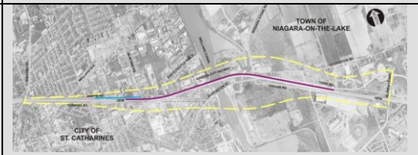
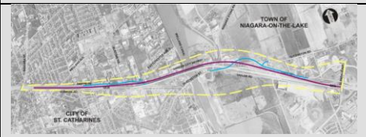
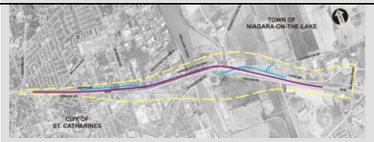
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
Summary – Designated Natural Features				As none of the alternatives impact designated natural features, **all alternatives are equally preferred** from a designated natural features perspective**.**			
3.4 Contaminated Sites	3.4.1 Known contaminated sites	• Contaminant Overview Study for the QEW Garden City Skyway study area • Contaminant Investigation Report for the QEW Garden City Skyway • MOE Waste Generator Database • MOE PCB Storage Site Database • Technical Standards & Safety Authority • Aerial photographs • Municipal directories and assessment maps • OMB and NTS mapping • Historical plans, soils, hydrological and geological maps • Libraries, historical archives, land registry offices and municipal offices • MOE Waste Disposal Site Inventory • MOE Coal Gasification Plant	a) Number of known contaminated sites impacted	There are 2 known contaminated sites within this proposed alignment.	There are 3 known contaminated properties within this proposed alignment.	There are 2 known contaminated properties within this proposed alignment.	There are 3 known contaminated properties within this proposed alignment.

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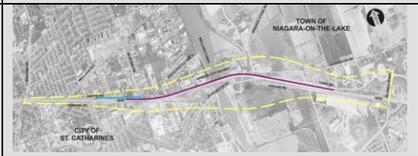
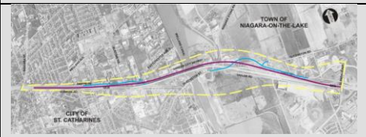
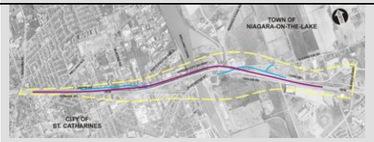
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		Database • Ecolog ERIS Retail Fuel Storage Tanks Database • Brownfields Environmental Site Registry					
	3.4.2 Potentially contaminated sites	• Contaminant Overview Study for the QEW Garden City Skyway study area • Contaminant Investigation Report for the QEW Garden City Skyway • Review of aerial photography • Field investigations • MOE Coal Gasification Plant Database • Ecolog ERIS Retail Fuel Storage Tanks Database • Brownfields Environmental Site Registry • MOE Waste Generator Database • MOE PCB Storage Site Database • Technical Standards & Safety Authority	a) Number of potentially contaminated sites impacted	There are 7 potentially contaminated sites within the proposed alignment located in one large industrial / commercial area west of the Garden City Skyway.	There are 18 potentially contaminated properties within the proposed alignment.	There are 17 potentially contaminated properties within the proposed alignment.	There are 18 potentially contaminated properties within the proposed alignment.

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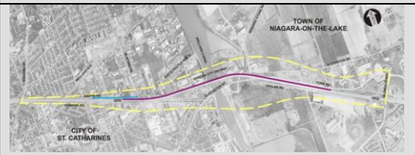
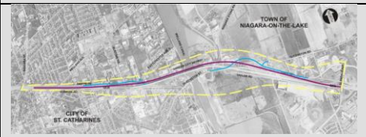
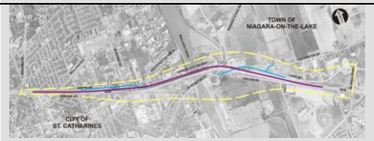
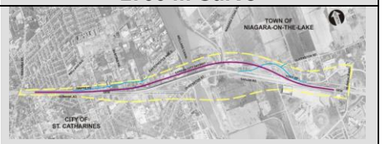
Alternative Type				Widening	Twinning	Replacement Bridge	Replacement Tunnel
Alternative Identifier				**W1**	**NT2A**	**RB1**	**RT1A**
Description				**Widen to the North**	**Twin to North - 1700 m Curve**	**Replacement Bridge to North - 875 m Curve**	**Replacement Tunnel to North - 1700 m Curve**
SKETCH							
Environmental Factor /Criteria	**Data Source[1]**		**Measures**				
Summary – Contaminated Sites				Impacts to known contaminated sites are comparable among all alternatives, with alternatives W1 and RB1 slightly preferred over Alternatives NT2A and RT1A. Alternative W1 has the fewest impacts to potentially contaminated sites. Alternatives NT2A and RT1A impact slightly more potentially contaminated properties than Alternative RB1. **Therefore, Alternative W1 is preferred as it has the least impacts to known and potential contaminated sites.**			
3.5 Excess Materials Management	3.5.1 Excess material management requirements with consideration for the quantity and type of materials.	• Design plans	a) Approximate quantity of excess materials (relative to other alternatives).	Requires disposal of existing bridge deck, approximately 20,000 m^3 of concrete and asphalt. Negligible amounts of other excess materials.	Requires disposal of existing bridge deck, approximately 20,000 m^3 of concrete and asphalt. Negligible amounts of other excess materials.	Moderate amounts of excess materials, including existing bridge deck, girders and substructure. Existing Garden City Skyway bridge materials would need to be disposed of and/or recycled.	Very large quantities of excess materials relative to bridge alternatives (widening, twinning, replacement), including 1.1 million cubic metres of earth, plus existing Garden City Skyway bridge
			b) Types of excess materials.	Steel-reinforced concrete, asphalt.	Steel-reinforced concrete, asphalt.	Steel-reinforced concrete, structural steel and asphalt.	Earth (including canal sediment and bottom), steel-reinforced concrete, structural steel and asphalt.
Summary – Excess Materials Management				Alternatives W1 and NT2A have similar quantities and types of excess materials to be managed, which is less than Alternative RB1. Alternative RT1A has the largest amount of excess materials to be managed. **Therefore, Alternatives W1 and NT2A are equally preferred.**			
3.6 Surface Water	3.6.1 Hydraulics	• MTO Highway Drainage Design Standards • MTO Drainage Management Manual • MTO Drainage Directives • Canadian Highway Bridge Design Code • NPCA Flood and Fill Line Regulation • HEC-RAS Model Manual	a) Hydraulic impact of the alternatives on the Welland Canal.	No impact; size of navigational channel opening far exceeds hydraulic requirements.			No impacts anticipated; no reduction in canal cross-section size.
	3.6.2 Highway Drainage and Stormwater Management	• MTO Highway Drainage Design Standards • MTO Drainage Management	a) Impacts on existing highway drainage system (culverts, storm sewers, ditches).	• 1565 m of existing median storm sewer impacted. • 670 m of existing ditch impacted. • 1 culvert (total length 51 m) requires replacement or widening.	• 1950 m of existing median storm sewer impacted. • 574 m of existing ditch impacted. • 1 culvert (total length 51 m) requires replacement or widening.	• 3396 m of existing median storm sewer impacted. • 1754 m of existing ditch impacted. • 3 culverts (total length 135 m) require replacement or widening.	• 3247 m of existing median storm sewer impacted. • 2664 m of existing ditch impacted. • 3 culverts (total length 135 m) require replacement or widening.

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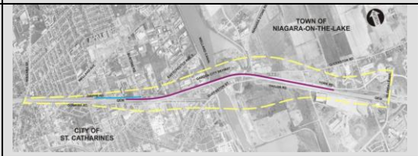
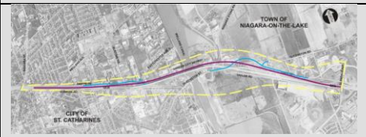
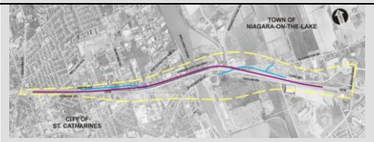
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		Manual • MTO Drainage Directives • MOE Stormwater Management Planning and Design Manual • MTO Gravity Pipe Design Guidelines • NPCA SWM Guidelines	b) Ability to provide adequate stormwater management (quantity, quality, and erosion protection)	No significant challenges anticipated, relative to other bridge alternatives; however, additional property may be required for stormwater management pond(s).			Most challenging relative to other alternatives. Possible to provide adequate stormwater management; requires active (i.e., pumped) drainage for most of the new alignment. Additional property may be required for stormwater management pond(s).
Summary – Surface Water				Alternatives W1, NT2A and RB1 avoid hydraulic impacts to the Welland Canal, and are equal in terms of their ability to provide adequate stormwater management. Alternative RB1 results in the greater impacts to the existing highway drainage system than Alternatives W1 or NT2A. Alternative RT1A is the least preferred, as it has the most impacts to existing drainage facilities, and will require active drainage systems throughout the lifetime of the tunnel. **As a result, Alternatives W1 and NT2A are similarly preferred from a surface water perspective.**			
3.7 Groundwater	3.7.1 Groundwater	• Design plans • Borehole logs • Aquifer vulnerability mapping	a) Qualitative assessment of impacts to groundwater	No notable impacts anticipated.			Much greater potential to impact groundwater as compared with the other alternatives.
			b) Quantitative assessment of impacts to groundwater	n/a			Direct and potentially major impacts to approximately 11.4 acres of highly vulnerable aquifer.
Summary - Groundwater				Alternatives W1, NT2A and RB1 are not expected to result in notable groundwater impacts. Alternative RT1A has direct impacts to a highly vulnerable aquifer, and thus has the greatest potential for groundwater impacts. As a result, from a groundwater perspective **Alternatives W1, NT2A and RB1 are equally preferred**.			
Overall Summary – Natural Environment				Alternative W1 is preferred over other alternatives because it has a relatively small footprint, and thus has the least Natural Environment impacts. Alternative RB1 is slightly less preferred than Alternative NT2A because it has a larger footprint; however, they are considered to be similarly preferred. Alternative RB1 also has a greater amount of excess materials than Alternatives NT2A or W1. Alternative RT1A is least preferred because it results in watercourse impacts, has the largest footprint, and has by far the largest amount of excess materials to be managed. **Therefore, Alternative W1 is preferred from a natural environment perspective.**			
4.0 Structural Engineering							
4.1 Structural	4.1.1 Structural	• *Canadian Highway Bridge Design Code* • MTO *Structure Rehabilitation Manual* • MTO *Ontario Heritage Bridge*	a) Life span and durability of structure	Existing structure design life is approximately 75 years (as determined by the Study Team) • New structure design life is 75-100 years • **Potentially incompatible design life**	• Existing structure design life is 75 years (as determined by the Study Team) • New structure design life is 75-100 years •	• New structure design life is 75 – 100 years	• Structure design life is 100-125 years.
			b) Treatment of existing	• Replace concrete deck	• Replace concrete deck with	• Demolish existing bridge	

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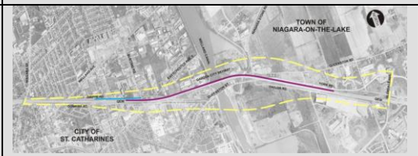
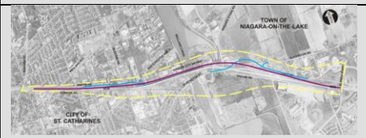
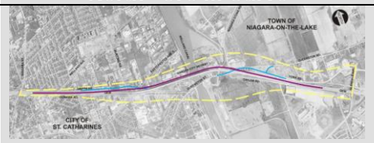
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		Guidelines • Design plans • Base mapping	bridge	• Replace/retrofit deteriorated steel • Ongoing maintenance and rehabilitation of existing and new structures	durable material • Replace deteriorated steel, clean and coat • Ongoing maintenance and rehabilitation of existing and new structures		
			c) Maintenance (including consideration of salt use for winter maintenance)	• Stainless steel or GFRP rebar can be used to protect the structures from salt use during winter maintenance • Ongoing asphalt patch and pave	• Stainless steel or GFRP rebar can be used to protect the (new and existing) structures from salt use during winter maintenance • Ongoing asphalt patch and pave	• Stainless steel or GFRP rebar can be used to protect the structures from salt use during winter maintenance • Higher quality waterproofing material • Minimized expansion joints • Provide increased accessibility for inspections • Ongoing asphalt patch and pave • Less time and costs spent on maintaining a single new structure, relative to widening or twinning alternatives	• Tunnel would be subject to regular maintenance consisting of; preventative maintenance, on-demand maintenance and preservation/repair maintenance. • Extensive road salt use is not required through tunnel however regular Ice/Snow removal might be needed. Ice forms at locations of active leaking • Ongoing asphalt patch and pave • Relatively low structural maintenance requirements • Requires continual pumping of stormwater from below-grade sections • Requires 24-hour illumination
			d) Flexibility for future bridge rehabilitation / expansion	**Pros**: • Ongoing deck repairs for the widened bridge is possible in 3 construction stages **Cons**: • Impractical to accommodate additional future deck widening due to issues such as lateral thermal movements, inspection and drainage • Severe lane reductions or bridge closures during future replacement of existing bridge • Replacing the existing structure in the future will be challenging and costly as the work significantly impacts the newer linked structure	• New twinning substructure can be designed to accommodate future expansions (ex. deck widening) • Having 2 bridge crossings reduces chances of closing the crossing during future rehabilitation/expansion work, or major accidents • New twinning structure can be designed to carry all 6 lanes such that either structure (new or existing) can carry all traffic during future expansion work	• Impractical to accommodate future deck widening due to issues such as lateral thermal movements, inspection and drainage • Increased chances of lane reduction/closure during future rehabilitation/expansion work	• Impossible to widen tunnel cross sections, thus any future capacity expansion would require new tunnel(s) or conversion of existing shoulders to general-purpose lanes. Future rehabilitation tunnel walls and ceiling will require relatively short-term lane closures.
	4.1.2 Constructability	• Ontario *Geometric Design Standards for Ontario*	a) Potential need for special and/or unfamiliar construction	• Minimal need for special and/or unfamiliar construction techniques	• Minimal need for special and/or unfamiliar construction techniques; probable structure type could be constructed by local contractors		• Special construction techniques required, particularly immersed tube tunnel construction. Limited

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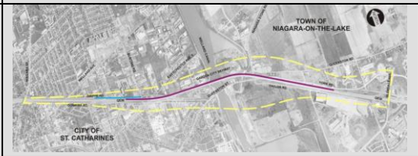
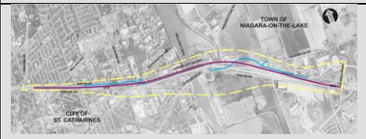
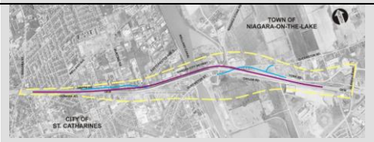
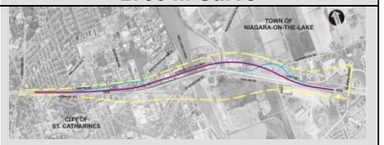
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		Highways • Transportation Association of Canada *Geometric Design Guide for Canadian Roads* • Construction standards and specifications • Design plans • Base mapping	techniques				MTO and local contractor experience with this technique.
			b) Potential construction cost and/or schedule risks	• Minimal risks to construction cost and/or schedule risks. With all rehabilitation and widening projects, there is a potential risk for cost overruns, however, considered to be minor here. • Least flexibility with bridge design, as new structural elements will be similar to existing.	• Minimal risks to construction cost and/or schedule risks. With all rehabilitation and widening projects, there is a potential risk for cost overruns, however, considered to be minor here. • A new bridge to the north would be further from the existing Homer Bridge and thus would have slightly fewer construction risks.	• Minimal risks to construction cost and/or schedule risks; probably less risk of overrunning cost • Suitable candidate for Design Build-Project for fastest possible delivery	• Highest risk of cost and schedule overruns, based on similar experiences (e.g., 'Big Dig,' etc.). Also has greatest potential for operating cost and maintenance overruns. Potential to impact canal walls and disrupt canal operations.
		• Design plans • Foundations field investigations and draft report	c) Potential foundations risks	• Potential conflicts with existing bridge foundations.	• Relatively few concerns with respect to foundations.	• Relatively few concerns with respect to foundations.	• Potential to impact canal walls due to deep cuts and less than ideal soil conditions for tunnel trench. Temporary storage of excavated materials for tunnel and casting basin could be challenging due to potential canal wall failures.
	4.1.3 Staging	• Design plans • *Ontario Traffic Manual, Book 7: Temporary Conditions* • *Geometric Design Standards for Ontario Highways*	a) Construction staging impacts • Number of stages • Total duration • Lane restriction/reduction requirements • Potential for traffic disruption during construction	• 4 stages • 5 years of construction • Lane reductions from 6 to 5 during first phase of construction.	• 1 or 2 stages • Construction duration of 3.5 years • No lane reductions	• 2 stages • 3 to 4 years of construction plus 1 year of demolition (conventional Design Bid Build (DBB)) • No lane reduction • No traffic diversion during construction	• 3 stages (dry-dock construction, tunnel construction, existing bridge demolition) • 3 to 6 years of construction plus 1 year of demolition (conventional DBB) • No lane reduction • No traffic diversion during construction
	4.1.4 Construction Materials	• *Canadian Highway Bridge Design Code* • MTO *Structure Rehabilitation Manual* • Design plans • Base mapping	a) Use of existing infrastructure	• Existing bridge will remain in service • Remove approximately 5 m of steel crossbeam on north side of structure • Maintain girders and substructure • Remainder will be removed and replaced.	• Existing bridge will remain in service	• Existing bridge will be demolished where asphalt and steel may be salvaged for recycling.	
	4.1.5 Critical Infrastructure Protection	• NCHRP Report 525 – Surface	a) Vulnerability of QEW and Welland Canal	Catastrophic failure of the bridge could cause major disruptions to both the QEW and Welland Canal.			Tunnel more vulnerable to fire than bridge alternatives; tunnel fire could result in catastrophic failure of the

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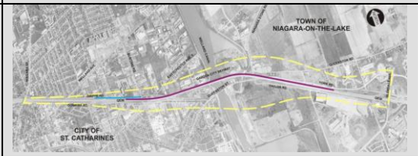
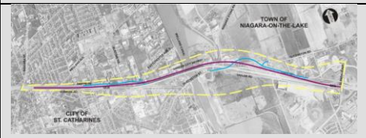
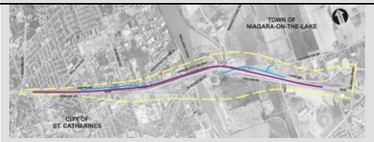
Description				Widen to the North	Twin to North - 1700 m Curve	Replacement Bridge to North - 875 m Curve	Replacement Tunnel to North - 1700 m Curve
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
		Transportation Security, Volume 3: Incorporating Security into the Transportation Planning Process • Discussions with OPP					structure. Least vulnerability to Welland Canal; destruction of the tunnel would not likely impact shipping operations. Prohibiting vehicles carrying hazardous materials from entering the tunnel could be considered.
			b) Prevention of security incidents	Impossible to limit access to structure via vehicles both on and below the bridge. Difficult to prevent access to bridge piers from below (fencing, closed-circuit cameras and security are all possible countermeasures).			Impossible to limit access to structure via vehicles in the tunnel. Best potential to limit pedestrian access, as compared to bridge alternatives; fencing, closed-circuit cameras and security are all possible countermeasures.
			c) Protection of structure from catastrophic events (i.e., 'target hardening')	Very limited potential for hardening of the bridge, due to retention of existing 'core' structure.	Very limited potential for hardening of the original bridge. Potential to harden the new bridge.	Potential to harden the bridge.	Potential to harden the tunnel.
			d) Redundancy	No redundancy; in the event that the bridge is unserviceable, traffic would need to use an alternate route.	Some redundancy, as two separate structures are required, one for each direction. In the event that one structure is unserviceable, the other structure (provided it is serviceable) could be used for bi-directional traffic with reduced lanes.	No redundancy; in the event that the bridge is unserviceable, traffic would need to use an alternate route.	Some redundancy, as two separate structures are required, one for each direction. In the event that one structure is unserviceable, the other structure (provided it is serviceable) could be used for bi-directional traffic with reduced lanes. Ventilation for bi-directional traffic could be problematic.
			e) Recovery (i.e., ability to respond to an emergency after a catastrophic event)	No new challenges to recovery, as compared with other bridge alternatives.			In the event of a fire in the tunnel, visibility could be severely reduced, creating additional challenges for emergency personnel. Some potential for communications challenges in the tunnel in the event that in-tunnel radio antennae are damaged.
	4.1.6 Contract Delivery	• Industry Practice	a) Flexibility in contract delivery.	• Limited flexibility in contract delivery. Alternative delivery methods (e.g., design/build) are possible; however, separate contracts for rehabilitation of the original bridge deck and new construction are not possible.	• Flexibility in contract delivery. Alternative delivery methods (e.g., design/build) are possible; separate contracts for rehabilitation and new construction are possible.	• Flexibility in contract delivery. Alternative delivery methods (e.g., design/build) are possible; separate contracts for demolition of existing and new construction are possible.	• Flexibility in contract delivery.

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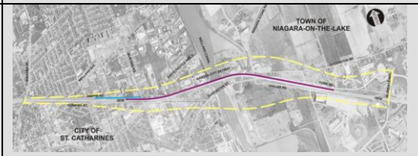
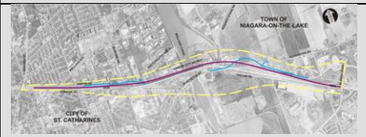
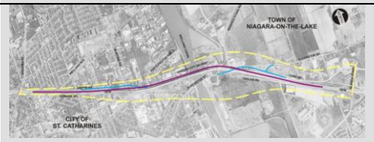
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
Overall Summary – Structural Engineering				Alternative NT2A is slightly preferred, but considered similar to, Alternative RB1 because it has the most structural flexibility for future improvements, has relatively few construction/foundation risks, and provides redundancy in the event that one of the bridges becomes unserviceable. Alternative W1 is less preferred than Alternatives NT2A or RB1 due to lane reductions during the first phase of construction, potential constructability/foundations risks and challenges to future expansion. Alternative RT1A is least preferred because it has the least structural flexibility for future improvements, has the greatest construction risk due to foundations/constructability issues, and construction costs are higher than the other alternatives. Alternative RT1A provides redundancy in the event that one of the tunnel structures becomes unserviceable. **Therefore, Alternative NT2A is slightly preferred over Alternative RB1.**		
5.0 Transportation & Other Considerations							
5.1 Transportation	5.1.1 Flexibility for future improvements	• Base mapping • Design plans • Other Studies • Provincial policy papers (e.g., Places to Grow)	a) Qualitative assessment of future expansion/compatibility	• Future capacity improvements would require twinning or additional widening of the bridge (or conversion of shoulders to general-purpose lanes). Additional widening may not be technically feasible or cost-effective.	• Future capacity improvements would require widening of the 'new' structure, but original bridge has sufficient deck area for up to two additional lanes.	• Future capacity improvements would require twinning or widening (if widening is feasible) of the replacement bridge (or conversion of shoulders to general-purpose lanes).	• Little flexibility for future improvements. Impossible to widen tunnel cross sections, thus any future capacity expansion would require new tunnel(s) or conversion of existing shoulders to general-purpose lanes.
	5.1.2 Highway Geometrics	• *Geometric Design Standards for Ontario Highways* • *Transportation Association of Canada Geometric Design Guide for Canadian Roads* • *Proposed Draft Concepts for New Rural Freeways* • Other MTO standards • Design plans • Base mapping	a) Compatibility with current highway design standards and practices.	• Does not address substandard (design speed = 90 km/h) vertical crest curve on main span. • Wide shoulders would be required to improve horizontal design speed to 120 km/h. • Improved highway cross section meets current standards (with exception noted above).	• New structure meets current design standards and practices. • Existing structure retains below-standard (design speed = 90 km/h) vertical crest curve, and requires additional shoulder width to meet sight distance requirements at R=875 m curve.	• Meets current design standards and practices. Additional shoulder width required to meet sight distance requirements at R=875 m curve.	• Meets current design standards and practices.
	5.1.3 Traffic Operations	• Transportation planning and land use forecasting model • Design plans • Base mapping & field review	a) Impacts to traffic operations.	• Once constructed, improved QEW operations are expected due to the addition of truck-climbing lane and improved roadside (i.e., shoulders).	Improved QEW operations are expected due to the addition of truck-climbing lane and improved roadside (i.e., shoulders).		

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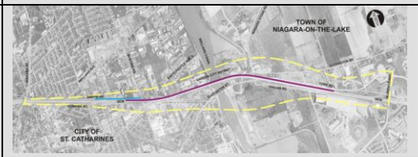
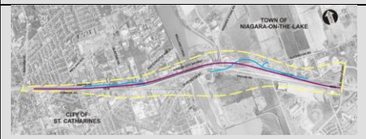
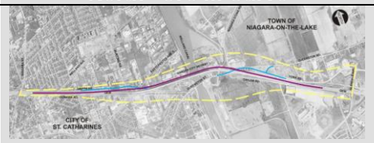
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
	5.1.4 Safety	• Transportation planning and land use forecasting model • Historical collision data • Design plans • Base mapping & field review	a) Ability to address existing deficiencies	• Addresses narrow shoulder width concerns and provides truck-climbing lane. • Does not provide improvements to vertical and horizontal alignments.	• Addresses narrow shoulder width concerns and provides truck-climbing lane. • Improvements to vertical and horizontal alignments for Toronto-bound traffic.	• Addresses narrow shoulder width concerns and provides truck-climbing lane. • Improvement to vertical alignment. • No improvement to horizontal alignment.	• Addresses narrow shoulder width concerns and provides truck-climbing lane. • Improvements to vertical and horizontal alignments.
			b) Impact on driver behavior / expectations	• Some improvements expected due to widened shoulders.	• Some improvements expected due to widened shoulders on both bridges and upgraded geometry on the new bridge.	• Some improvements expected due to widened shoulders and upgraded geometry.	• Relatively high potential impact; signing and lighting must be carefully designed based on human factors input.
	5.1.5 Compatibility with road network (QEW and local)	• Local and regional transportation plans, official plans • Other EA studies • Design plans	a) Impact on local road network: • Local road realignment requirements • Construction staging requirements	• Relatively minor impacts; realignment of Dieppe Road from Grantham Avenue to Bunting Road.	• Moderate impact on local road network. • Realignments required for Dieppe Road, Eastchester Avenue East, York Road, Queenston Road, and Queenston Street. • Partial closure of Queenston Road and closure of Coon Road.	• Relatively few impacts on local road network. • Realignments required for Dieppe Road, York Road, Queenston Road, and Queenston Street. • Partial closure of Queenston Road and closure of Coon Road.	• Major impact on local road network. Requires closure of existing Dieppe Road crossing of QEW; additional QEW crossing volumes likely borne by Bunting Road and Cushman Road. • Realignments required for Dieppe Road, Eastchester Avenue East, York Road, Queenston Road, and Coon Road. • Partial closure of Queenston Road.
			b) Impact on QEW	• Improved operations due to truck-climbing lane and improved cross section. • Minor modifications to Niagara St. E-N/S ramp required.	• Improved operations due to truck-climbing lane and improved cross section. • Modifications to Niagara St. E-N/S and N/S-E ramps required.		
	5.1.6 Seaway and Airport Operations	• Input from the St. Lawrence Seaway Management Corporation and Transport Canada • Input from Niagara Regional Airport and Transport Canada	a) Potential impacts on St. Lawrence Seaway operations during construction	• In-water pier construction may be required; however, no significant impacts are anticipated.			• Short-term (12-24 hours) disruptions to marine traffic possible during construction, if immersed tube placement is made during shipping season.
			b) Impact on Niagara Regional Airport operations	• No major impacts anticipated. It is acknowledged that the existing bridge encroaches into the Airport's outer surface height restriction, and that a widening of the bridge to the north would bring the bridge closer to the	• No major impacts anticipated, provided a low-superstructure bridge is constructed. It is acknowledged that the existing bridge encroaches into the Airport's outer surface height	• No major impacts anticipated, provided a low-superstructure bridge is constructed. It is acknowledged that the existing bridge encroaches into the Airport's outer surface height	• No impact; tunnels are the only alternatives that would not encroach into the Airport's outer surface elevation restriction.

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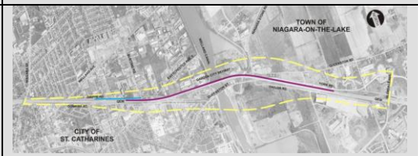
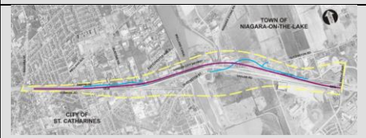
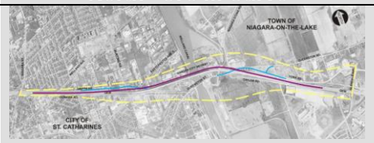
SKETCH							
Environmental Factor /Criteria		**Data Source[1]**	**Measures**				
				Airport.	restriction, and that a twin bridge to the north would bring the bridge closer to the Airport. • A high-superstructure bridge (e.g., cable-stayed) could have impacts on Airport operations.	restriction, and that a replacement bridge to the north would bring the bridge closer to the Airport. • A high-superstructure bridge (e.g., cable-stayed) could have impacts on Airport operations.	
	5.1.7 Emergency Response	• Input from Ontario Provincial Police • Input from municipal emergency services • Design plans	a) Impacts to emergency access/routing	Some potential for short-term impacts during first phase of construction; otherwise, no impacts anticipated.			• No significant impacts anticipated; however, one less crossing of the QEW (Dieppe Rd.) provides slightly less flexibility with emergency routing.
			b) Potential challenges to incident management	Improved safety of emergency personnel responding to incidents on the bridge. No new challenges anticipated.			• Improved safety of emergency personnel responding to incidents on the QEW. • In the event of a fire in the tunnel, visibility could be severely reduced, creating additional challenges for emergency personnel. Some potential for communications challenges in the tunnel in the event that in-tunnel radio antennae are damaged.
	5.1.8 Utilities	• Existing Utility Records • NEB Regulations • MTO CMO requirements • Design plans • Base mapping	a) Type of utility impacted	Major municipal sewer, major municipal watermain, hydro transmission line.			• Major municipal sewer, major municipal watermain, hydro transmission line. Numerous minor utility impacts.
			b) Length and type (i.e., crossing or relocation) of direct impact to existing utility corridors	• 1 major municipal sewer crossing; 93 m potentially impacted. • 1 major existing municipal watermain crossing; 24 m potentially impacted. Future Bunting Rd. watermain potentially impacted. • 1 hydro transmission line crossing. • Numerous minor utility impacts.	• 3 major municipal sewer crossings; 509 m potentially impacted; probable displacement of an important manhole. • 1 major existing municipal watermain crossing; 70 m potentially impacted. Future Bunting Rd. watermain potentially impacted. • 1 hydro transmission line crossing. • Numerous minor utility impacts.	• 2 major municipal sewer crossings; 333 m potentially impacted; probable displacement of an important manhole. • 1 major existing municipal watermain crossing; 69 m potentially impacted. Future Bunting Rd. watermain potentially impacted. • 1 hydro transmission line crossing. • Numerous minor utility impacts.	• 3 major municipal sewer crossings; 737 m impacted; probable displacement of important manhole. • 1 major existing municipal watermain crossing; 102 m impacted. Future Bunting Road watermain potentially impacted. • 1 hydro transmission line crossing. • Numerous minor utility impacts.

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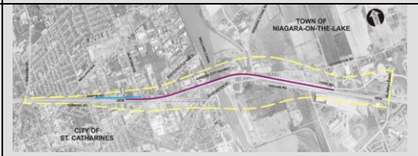
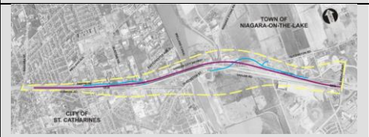
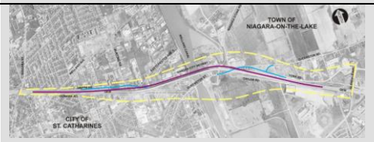
SKETCH							
Environmental Factor /Criteria	**Data Source[1]**	**Measures**					
Summary – Transportation & Other Considerations				With respect to highway geometry, Alternatives NT2A, RB1 and RT1A are preferred over Alternative W1 because they have the most potential to provide improved horizontal and vertical alignments for the QEW. Alternative NT2A has the most flexibility with respect to future capacity improvements. Alternative RT1A is the least preferred because it carries the greatest impact to local roads and utilities. **Therefore, Alternative NT2A is preferred from a transportation perspective.**		
6.0 Cost							
6.1 Cost	6.1.1 Cost[3]	• MTO Parametric Estimating Guide • HiCo • Previous studies	a) Structure Capital Cost (Note: excludes contingencies & demolition of existing bridge)	$278M ($2011)	$293M ($2011)	$324M ($2011)	$376 ($2011)
		• MTO Parametric Estimating Guide • HiCo • Previous studies • MTO Structural Manual	b) Structure Lifecycle Cost (Structure Capital Cost + Future Maintenance) (Note: excludes contingencies)	$397-472M ($2011)	$398M ($2011)	$374M ($2011)	$468M ($2011)
		• MTO Parametric Estimating Guide • HiCo • Previous studies • MTO Structural Manual • Input from MTO Property Office	c) Total Construction Cost (Structure Capital Cost + Highway Costs + Property) (Notes: costs rounded; includes contingencies; 25% additional contingency added to high range)	$366M Structure Costs $17M Highway Costs $15M Property Costs **$415-515M Total Cost**	$389M Structure Costs $82M Highway Costs $75M Property Costs **$575-725M Total Cost**	$465M Structure Costs $127M Highway Costs $65M Property Costs **$665-815M Total Cost**	$588M Structure Costs $141M Highway Costs $125M Property Costs **$875-1,075M Total Cost**
Summary – Cost				Alternative RT1A is least preferred as its costs are highest. Alternative W1 has the lowest total costs. **Therefore, Alternative W1 is preferred from a cost perspective.**			
Overall Summary				Alternative RT1A is the least preferred among the alternatives, as it has the greatest impact on all environments. It has the greatest property impacts, the greatest construction/foundation risks, the least flexibility for future improvements, and a much higher cost. Alternative W1 is less preferred than Alternatives NT2A and RB1. Although it is preferred with respect to Socio-economic and Natural Environment impacts, it is less desirable in terms of structural engineering due to risks associated with construction and foundations. It also has significant challenges in terms of flexibility for future improvements. As compared with the Alternative RB1, Alternative NT2A has the least impacts to Cultural Heritage, as the existing structure remains. Alternatives NT2A and RB1 have similar Natural and Socio-economic Environmental impacts. Also, there are relatively few risks in terms of constructability for both Alternatives NT2A and RB1. As compared with Alternative NT2A, Alternative RB1 has less risk of unexpectedly high long-term maintenance costs. Alternative NT2A has the greatest flexibility for future expansion.		

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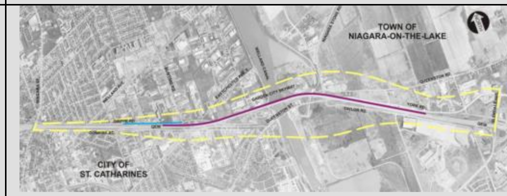
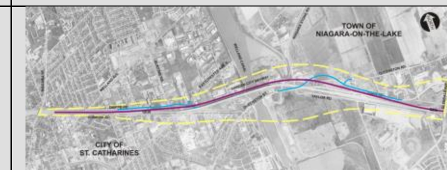
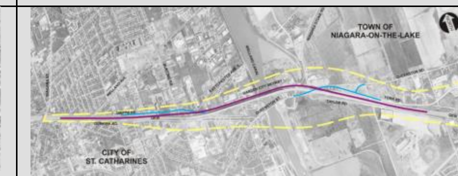
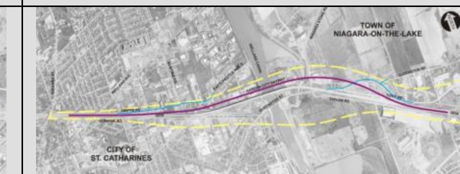
SKETCH						
Environmental Factor /Criteria	**Data Source[1]**	**Measures**				
			While Alternative NT2A has some advantages over the Alternative RB1, both alternatives have sufficient potential to be viable solutions for the study objectives. **Therefore, both Alternative NT2A and Alternative RB1 are carried forward for further development and evaluation.**			

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Ecololgical Community Mapping

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Legend

- ELC Unit
- Railway Track
- Waterbody
- Watercourse

EASTCHESTER AVENUE EAST

DIEPPE ROAD

BUNTING ROAD

18

QUEEN ELIZABETH WAY

DUNKIRK ROAD

17

SERVICE ROAD

CUSHMAN ROAD

WELLAND CANALS PARKWAY

QUEENSTON STREET

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

wsp

Garden City Skyway Environmental Assessment

Ecological Land Classification

0 50 100 Meters

1:3,000

N

Date: July 2017

Project No: 10M-00066-01

Figure No: 1

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Legend
- ELC Unit
- Waterbody
- Wetland
- Watercourse

CROSS STREET
EASTCHESTER AVENUE
STEWART ROAD
NIAGARA STONE ROAD
QUEENSTON ROAD
QUEEN ELIZABETH WAY
SOUTH SERVICE ROAD
YORK ROAD
DORR ROAD
WELLAND CANALS PARKWAY
QUEENSTON STREET

6
8
9
10
11
12
13
14
19
20
21

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

wsp

Garden City Skyway Environmental Assessment
Ecological Land Classification

0 50 100
Meters
1:4,000

N

Date: July 2017
Project No: 10M-00066-01
Figure No: 1

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Legend
- ELC Unit
- Waterbody
- Watercourse

NIAGARA STONE ROAD
QUEENSTON ROAD
YORK ROAD
COON ROAD
Eight Mile Creek
QUEEN ELIZABETH WAY
SOUTH SERVICE ROAD
TAYLOR ROAD
HOMER ROAD
STREET B

1 2 3 4 5 6 7 8 9 9 11 12 13 14 15 16 19 20 21

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Legend

- ELC Unit
- Waterbody
- Watercourse

QUEENSTON ROAD
Eight Mile Creek
1
AIRPORT ROAD
Six Mile Creek
YORK ROAD
GLENDALE AVENUE
COUNSELL STREET
WESTWOOD COURT
GRANTHAM TOWNLINE ROAD
QUEEN ELIZABETH WAY
TAYLOR ROAD
STREET B
GLENDALE AVENUE EAST

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

wsp

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