

Great Cataraqui River Utility Crossing Project

Table 1: Matrix of Potential Impacts and Mitigating Measures

CRITERIA	Alternative 1 (Water and Wastewater) 2 <sup>nd</sup> Crossing Existing Alignment (River St. to James St.)		Alternative 2 (Water and Wastewater) 2 <sup>nd</sup> Crossing La Salle Causeway		Alternative 3 (Water) 2 <sup>nd</sup> Crossing Gore - Elliott	Alternative 4 (Water) 2 <sup>nd</sup> Crossing Gore - Elliott		Alternative 7 (Wastewater) New Water Pollution Control Plant (west of River)
	Dredging / Pipe Laying	Bedrock Tunneling	Dredging / Pipe Laying	Bedrock Tunneling	Affixed to Bridge	Dredging / Pipe Laying	Bedrock Tunneling	
<b>NATURAL ENVIRONMENT</b>								
N1(a) – Impact on terrestrial systems and wildlife in the short-term (construction)	<ul style="list-style-type: none"> <li>1-2 acres of natural upland vegetation will be disturbed on shore for staging area: east side of river has small wooded area; previously disturbed.</li> <li>West side of river already disturbed manicured environment;</li> <li>Increased noise and light during construction can disturb wildlife.</li> <li>Localized impact is considered to be minimal.</li> </ul>		<ul style="list-style-type: none"> <li>Entire route is developed manicured environment.</li> <li>No impact.</li> </ul>		<ul style="list-style-type: none"> <li>No increase over impact associated with bridge planning, design, construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>1-2 acres of natural upland vegetation would be disturbed: east of river regenerating vegetation in Gore Road right-of-way would be removed.</li> <li>Project activities can be minimized during breeding times.</li> <li>Location of dewatering (if required) and disposal to be determined, but shall be in accordance with Ont. Reg. 347.</li> </ul>	<ul style="list-style-type: none"> <li>1-2 acres of natural upland vegetation would be disturbed: east of river portion of wooded area north of Gore Road may be used for tunnel shaft.</li> <li>Tunneling is a year round operation. More difficult to avoid breeding season disturbances.</li> </ul>	<ul style="list-style-type: none"> <li>The construction of a WPCP for the design flows requires a minimum land area of 30 hectares (75 acres), a portion of which is a 150 m buffer.</li> <li>The majority of upland environment on the Davis Estate property would be cleared.</li> <li>The area consists of a disturbed meadow, shrubs and regenerating trees.</li> <li>Contaminated soils would be removed.</li> </ul>
	<ul style="list-style-type: none"> <li>Project activities can be minimized during breeding times.</li> <li>Location of dewatering (if required) and disposal to be determined, but shall be in accordance with Ont. Reg. 347.</li> </ul>	<ul style="list-style-type: none"> <li>Tunneling is a year round operation. More difficult to avoid breeding season disturbances.</li> </ul>	<ul style="list-style-type: none"> <li>Location of dewatering (if required) and disposal to be determined, but shall be in accordance with Ont. Reg. 347.</li> </ul>					
N1(b) – Impact on terrestrial systems and wildlife in the long-term (operations & decommissioning)	<ul style="list-style-type: none"> <li>Little natural upland vegetation permanently lost.</li> <li>No loss of significant features or specimens.</li> <li>Reinstatement of vegetation is possible.</li> <li>Restoration of impacted areas to be required in tender documents.</li> <li>Operations/maintenance may include re-lining to extend design life, or abandonment in place.</li> </ul>		<ul style="list-style-type: none"> <li>No impact.</li> </ul>		<ul style="list-style-type: none"> <li>No increase over impact associated with bridge planning, design, construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>Vegetation could be reinstated.</li> <li>No long-term impact.</li> </ul>	<ul style="list-style-type: none"> <li>Use of wooded area for tunnel shaft would contribute to cumulative loss of upland environments in the vicinity of urban development.</li> </ul>	<ul style="list-style-type: none"> <li>Natural vegetation would be replaced largely by landscaped vegetation.</li> </ul>
	<ul style="list-style-type: none"> <li>Main repairs on land will occur in previously disturbed environments.</li> <li>No long-term impact.</li> </ul>	<ul style="list-style-type: none"> <li>Reinstatement east of river will likely require expanded access road to tunnel shaft.</li> <li>No long-term impact.</li> </ul>						
N2(a) – Impact on aquatic systems with an emphasis on fish habitat and water quality in the short-term (construction)	<ul style="list-style-type: none"> <li>Requires approximately 1100 metres of river crossing.</li> </ul>		<ul style="list-style-type: none"> <li>Requires approximately 450 metres of river crossing.</li> </ul>		<ul style="list-style-type: none"> <li>No increase over impact associated with bridge planning, design, construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>Requires approximately 1100 metres of river crossing.</li> </ul>	<ul style="list-style-type: none"> <li>A cattail marsh flooded year round may provide nursery habitat for species such as sunfish and spawning habitat for Northern Pike.</li> <li>Overhanging trees and shrubs provide fish cover along shoreline.</li> <li>Shoreline characterized by gravel, cobble covered with fines and dense submergent vegetation.</li> <li>Fill of low-lying areas required for plant.</li> <li>Potential suspension of contaminated sediment during construction of outfall to Outer Harbour.</li> </ul>	
	<ul style="list-style-type: none"> <li>Temporary destruction of spawning and rearing habitats for fish, and shoreline and water habitat of amphibians, aquatic birds and some mammals (e.g. muskrats.)</li> <li>Spring spawners may be affected depending upon time for new vegetation to become established.</li> <li>Limited fall spawning in the area for Lake Trout due to unsuitable substrate and/or silt covering substrate.</li> <li>Potential interference of fish movement including fall spawners such as Lake Trout.</li> <li>Use of silt curtains and cable arm clamshell bucket will minimize sediment disturbance and contain suspended solids and contaminated sediment.</li> <li>Use of sealed scows to transport sediment to shore will minimize release of sediment outside of silt curtains.</li> </ul>	<ul style="list-style-type: none"> <li>Tunnel construction will have minimal impact on fish habitat if shafts are not near water's edge.</li> <li>Minimal contaminated or uncontaminated sediments could become re-suspended during tunneling and on-land construction.</li> <li>Monitor fish habitat visually and test turbidity during construction for any changes in sedimentation or in-stream structure, sediment plumes, detached aquatic plants and disturbances to substrate.</li> </ul>	<ul style="list-style-type: none"> <li>Causeway rip rap may act as an artificial reef.</li> <li>No submergent vegetation has been observed.</li> <li>Potential interference of fish movement.</li> <li>Use of silt curtains and cable arm clamshell bucket will minimize sediment disturbance and contain suspended solids and contaminated sediment.</li> <li>Use of sealed scows to transport sediment to shore will minimize release of sediment outside of silt curtains.</li> </ul>	<ul style="list-style-type: none"> <li>Tunnel construction will have minimal impact on fish habitat if shafts are not near water's edge.</li> <li>Minimal contaminated or uncontaminated sediments could become re-suspended during tunneling and on-land construction.</li> <li>Monitor fish habitat visually and test turbidity during construction for any changes in sedimentation or in-stream structure, sediment plumes, detached aquatic plants and disturbances to substrate.</li> </ul>				

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N2(a) – Impact on aquatic systems with an emphasis on fish habitat and water quality in the short-term (construction)  Cont.	<ul style="list-style-type: none"> <li>In-water work should be avoided during high flow conditions and during periods of high winds causing increased wave action.</li> <li>All operating procedures (e.g., storage/disposal of excess material and waste water, equipment refueling, maintenance, etc.) and handling/storage of toxic materials (e.g., fuel, lubricants, and any chemicals, etc.) associated with the proposed work must be carried out to avoid contamination of surface waters.</li> <li>Monitor fish habitat visually and test turbidity during construction for any changes in sedimentation or in-stream structure, sediment plumes, detached aquatic plants and disturbances to substrate.</li> </ul>		<ul style="list-style-type: none"> <li>In-water work should be avoided during high flow conditions and during periods of high winds causing increased wave action.</li> <li>All operating procedures (e.g., storage/disposal of excess material and waste water, equipment refueling, maintenance, etc.) and handling/storage of toxic materials (e.g., fuel, lubricants, and any chemicals, etc.) associated with the proposed work must be carried out to avoid contamination of surface waters.</li> <li>Monitor fish habitat visually and test turbidity during construction for any changes in sedimentation or in-stream structure, sediment plumes, detached aquatic plants and disturbances to substrate.</li> </ul>			<ul style="list-style-type: none"> <li>Use of sealed scows to transport sediment to shore will minimize release of sediment outside of silt curtains.</li> <li>In-water work should be avoided during high flow conditions and during periods of high winds causing increased wave action.</li> <li>All operating procedures (e.g., storage/disposal of excess material and waste water, equipment refueling, maintenance, etc.) and handling/storage of toxic materials (e.g., fuel, lubricants, and any chemicals, etc.) associated with the proposed work must be carried out to avoid contamination of surface waters.</li> <li>Monitor fish habitat visually and test turbidity during construction for any changes in sedimentation or in-stream structure, sediment plumes, detached aquatic plants and disturbances to substrate.</li> </ul>		
N2(b) – Impact on aquatic systems with an emphasis on fish habitat and water quality in the long-term (operations/decommissioning)	<ul style="list-style-type: none"> <li>Future activities may include pipe re-lining to extend design life, or abandonment in place.</li> <li>No long-term impact.</li> <li>Low potential for pipe break and fish habitat disruption due to nature of pipe material (chemical not mechanical joints), weighting of pipe, and depth of construction (3 metres), which is unlikely to be disturbed.</li> <li>Concrete weights may act as an artificial reef that may attract fish to area.</li> <li>Removal of contaminated sediment from aquatic habitat.</li> </ul>	<ul style="list-style-type: none"> <li>Little chance of contaminated or uncontaminated sediments becoming re-suspended during maintenance, as future repairs would occur from within the tunnel.</li> </ul>	<ul style="list-style-type: none"> <li>Future activities may include pipe re-lining to extend design life, or abandonment in place.</li> <li>No long-term impact.</li> <li>Low potential for pipe break and fish habitat disruption due to nature of pipe material (chemical not mechanical joints), weighting of pipe, and depth of construction (3 metres), which is unlikely to be disturbed.</li> <li>Concrete weights may act as an artificial reef that may attract fish to area.</li> <li>Removal of contaminated sediment from aquatic habitat.</li> </ul>	<ul style="list-style-type: none"> <li>Little chance of contaminated or uncontaminated sediments becoming re-suspended during maintenance, as future repairs would occur from within the tunnel.</li> </ul>	<ul style="list-style-type: none"> <li>Potential for minor contamination during on-bridge repairs of pipe and supporting structure.</li> <li>No long-term impact.</li> </ul>	<ul style="list-style-type: none"> <li>Future activities may include pipe re-lining to extend design life, or abandonment in place.</li> <li>No long-term impact.</li> <li>Low potential for pipe break and fish habitat disruption due to nature of pipe material (chemical not mechanical joints), weighting of pipe, and depth of construction (3 metres), which is unlikely to be disturbed.</li> <li>Concrete weights may act as an artificial reef that may attract fish to area.</li> </ul>	<ul style="list-style-type: none"> <li>Little chance of sediments becoming re-suspended during maintenance, as future repairs would occur from within the tunnel.</li> </ul>	<ul style="list-style-type: none"> <li>Permanent loss of majority of fish habitat on site.</li> <li>Discharges to Outer Harbour to meet provincial regulations.</li> <li>Potential for overflows to Inner Harbour remains.</li> </ul>
N3(a) – Impact on wetland systems with an emphasis on vegetation communities and wetland functions. (Short-term during construction.)	<ul style="list-style-type: none"> <li>The crossing is located downstream of an identified Provincially Significant Wetland.</li> <li>Alignment intersects MNR identified wetland habitat.</li> </ul>		<ul style="list-style-type: none"> <li>There is no wetland habitat at the Causeway.</li> </ul>		<ul style="list-style-type: none"> <li>No increase over impact associated with bridge planning, design, construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>Emergent and submerged vegetation already affected by navigation channel.</li> <li>Up to 50 metres of shoreline habitat would be removed on both sides of River.</li> </ul>	<ul style="list-style-type: none"> <li>Surface run-off could impact Great Catarauqui Marsh during construction.</li> </ul>	<ul style="list-style-type: none"> <li>Over half the property lies beneath the flood line.</li> <li>A backwater channel with duckweed, water milfoil and algae would be filled.</li> <li>A cattail marsh would be filled.</li> </ul>

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N3(a) – Impact on wetland systems with an emphasis on vegetation communities and wetland functions. (Short-term during construction.)  Cont.	<ul style="list-style-type: none"> <li>Up to 50 metres of shoreline habitat would be removed on both sides of River.</li> <li>Degree of loss of riparian and aquatic vegetation would depend upon dock location and type of dock.</li> <li>An area with minimal aquatic vegetation and use of a floating dock are recommended.</li> <li>Dock siting and mitigating measures would be determined in consultation with Department of Fisheries and Oceans.</li> </ul>	<ul style="list-style-type: none"> <li>Construction impacts would be minimal due to use of tunnel construction method and assuming shafts are not near water's edge.</li> </ul>				<ul style="list-style-type: none"> <li>Degree of loss of riparian and aquatic vegetation would depend upon dock location and type of dock.</li> <li>An area with minimal aquatic vegetation, and use of a floating dock are recommended.</li> <li>Dock siting and mitigating measures would be determined in consultation with Department of Fisheries and Oceans.</li> </ul>	<ul style="list-style-type: none"> <li>Construction impacts would be minimal due to use of tunnel construction method and assuming shafts are not near water's edge.</li> </ul>	
N3(b) – Impact on wetland systems with an emphasis on vegetation communities and wetland functions. (Long-term operations/ decommissioning.)	<ul style="list-style-type: none"> <li>Impacts due to operation and decommissioning of the force main and water main are negligible and mitigable.</li> <li>No long-term impact.</li> </ul>		<ul style="list-style-type: none"> <li>No long-term impact.</li> </ul>		<ul style="list-style-type: none"> <li>No increase over impact associated with bridge planning, design, construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>Impacts due to operation and decommissioning of the force main and water main are negligible and mitigable.</li> <li>No long-term impact.</li> </ul>		<ul style="list-style-type: none"> <li>A portion of the wetland area south of Belle Island would be permanently destroyed.</li> </ul>
N4 – Long-term impact on atmospheric environment	<ul style="list-style-type: none"> <li>Improvement to sewage pumping station should reduce releases of greenhouse gases to the atmospheric environment.</li> <li>Improvements to the water booster station should reduce releases of greenhouse gases to the atmospheric environment.</li> </ul>		<ul style="list-style-type: none"> <li>Improvements to pumping station should reduce releases of greenhouse gases to the atmospheric environment.</li> <li>The electrical consumption will be greater than for Alternative 1 due to increased distance for sewage to be pumped.</li> </ul>		<ul style="list-style-type: none"> <li>No direct impact on atmospheric environment.</li> <li>Electricity consumption at the new Water Booster Pumping Station may have some minor impact on the broader environment.</li> </ul>	<ul style="list-style-type: none"> <li>Electricity consumption at the additional Water Booster Pumping Station may have some minor impact on the broader environment.</li> </ul>		<ul style="list-style-type: none"> <li>The potential exists for a decrease in greenhouse gas emissions from treatment processes from the new and old (Ravensview) plants combined.</li> <li>Trucking of sludge to Ravensview will increase emissions.</li> </ul>
<b>SOCIAL ENVIRONMENT</b>								
S1(a) – Disruption to community/ lifestyle - short-term (construction)	<ul style="list-style-type: none"> <li>Drilling and blasting would be employed under both construction methods on the west shore.</li> <li>Vibrations would be monitored and blasting modified as needed to ensure that safe levels are not exceeded.</li> <li>There are relatively few residences (&lt;20) that would be affected by construction noise, dust, vibration and trucking.</li> <li>Several commercial and industrial facilities would experience construction impacts.</li> <li>Trucking hours would be restricted and other requirements included in tender document to minimize impacts to community.</li> </ul>		<ul style="list-style-type: none"> <li>Drilling and blasting would likely be employed under both construction methods.</li> <li>Vibrations would be monitored and blasting undertaken to protect nearby buildings and facilities.</li> <li>Traffic in downtown Kingston would require rerouting for on-land works.</li> <li>Numerous residential and commercial/institutional buildings would be impacted by construction related noise, dust, vibration and trucking.</li> <li>Access to businesses on Wellington Street and Place D'Armes could be affected, as well as access to the Royal Military College on the east side.</li> <li>Trucking hours would be restricted and other requirements included in tender document to minimize impacts to community.</li> </ul>		<ul style="list-style-type: none"> <li>No increase over impact associated with bridge planning, design, construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>Drilling and blasting would likely be employed under both construction methods.</li> <li>Vibrations would be monitored and blasting modified as needed to ensure that safe levels are not exceeded.</li> <li>There are relatively few residences (&lt;20) that would be affected by construction related noise, dust, vibration and trucking east of the river.</li> <li>There is a marina and less than 10 homes that would be affected by construction related noise, dust, vibration and trucking west of the river.</li> <li>Library on Gore Road would experience some degree of impacts from construction activities.</li> <li>Trucking hours would be restricted and other requirements included in tender document to minimize impacts to community.</li> </ul>		<ul style="list-style-type: none"> <li>Homes abutting the Davis Estate property, and on Orchard St. and River St. would be affected by construction noise, dust, vibration and trucking.</li> <li>Several commercial and industrial facilities would experience construction impacts.</li> <li>Building a temporary access from River Street to Rideau Road could minimize impacts to residents of Orchard Street.</li> <li>Direct access via Belle Island Park could minimize disruption for residential area near existing pumping station.</li> </ul>

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S1(a) – Disruption to community/lifestyle - short-term (construction)  Cont.	<ul style="list-style-type: none"> <li>Several homes on Green Bay Road and James Street would be affected for approximately 6 months.</li> <li>Residents and businesses near west shore would be affected for a period of approximately 3 months.</li> <li>A range of trucking impacts is possible depending upon the location of the dock in relationship to the landfill to be used for sediment disposal.</li> <li>For the purpose of this analysis it is assumed that a site north of Gore Road can be used for the dock and that the main transport route would be Hwy. 15 and thus cause minimal disruption to nearby communities.</li> </ul>	<ul style="list-style-type: none"> <li>Several homes on James Street and Green Bay Road would be affected for a period of approximately 1 year.</li> <li>A temporary access on DND property would be used to avoid disturbance of Barriefield.</li> <li>Several homes on Orchard Street and River Street as well as local businesses and tenants of the Woolen Mill would be affected for a period of between 6-12 months for construction of the west shaft and pumping station upgrades.</li> <li>Building a temporary access road from River Street to Rideau Road could minimize impacts to residents and businesses west of the river.</li> </ul>	<ul style="list-style-type: none"> <li>This alternative could have significant impacts on traffic flow between the Pittsburgh community and the downtown area depending upon the location of the dock and trucking route.</li> </ul>	<ul style="list-style-type: none"> <li>This alternative could have significant impacts on traffic flow between the Pittsburgh community and the downtown area depending upon the location of the shaft on west shore and trucking route.</li> </ul>		<ul style="list-style-type: none"> <li>Residences, marina, and library would be affected by construction for up to 6 months.</li> </ul>	<ul style="list-style-type: none"> <li>Residences and library would be affected by construction for approximately 1 year.</li> </ul>	<ul style="list-style-type: none"> <li>Construction would be in excess of 1 year.</li> <li>Trucking hours would be restricted and other requirements included in tender document to minimize impacts to community.</li> </ul> <p><b>Alternative 7 (Wastewater) New Water Pollution Control Plant (west of River)</b></p>
S1(b) – Disruption to community/lifestyle - long-term (operations and decommissioning)	<ul style="list-style-type: none"> <li>No change to current operating methods.</li> <li>No long-term impact.</li> </ul>		<ul style="list-style-type: none"> <li>No change to current operating methods at existing pumping station.</li> <li>Some odour and minimal traffic would be associated with second pumping station at Douglas Fluhrer Park.</li> <li>Repairs to new on-land force main and water main would cause traffic impacts.</li> </ul>		<ul style="list-style-type: none"> <li>No increase over impact associated with bridge planning, design, construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>A negligible increase in traffic and noise could be experienced at Gore Road associated with operations and maintenance of the new booster station.</li> </ul>		<ul style="list-style-type: none"> <li>There would be increased truck/vehicular traffic through the neighbourhood.</li> <li>A northern entrance via Belle Island Park would help mitigate this impact.</li> <li>On-going odour control would be required.</li> </ul>
S2 – Impact on active and passive recreational areas and facilities	<ul style="list-style-type: none"> <li>Construction noise, dust and vibration could affect the Emma Martin Park and Canoe Club operations, and other shoreline recreational activities.</li> <li>No permanent loss of public open space or recreation areas.</li> </ul>		<ul style="list-style-type: none"> <li>On-land construction and installation of a second pumping station would likely impact Douglas Fluhrer Park, with possible removal of up to 2 acres parkland.</li> <li>Construction noise, dust and vibration could affect shoreline parks and recreational activities.</li> <li>Bicycles and pedestrian crossing of the Causeway may be restricted during construction.</li> </ul>		<ul style="list-style-type: none"> <li>No increase over impact associated with bridge planning, design, construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>Marina on west shore and small park at base of slope on east shore would be affected by construction impacts for approximately 6 months.</li> <li>River will be partially barricaded with silt screens throughout dredging operation.</li> <li>Navigation will be maintained, but some recreational boating in the immediate vicinity of the alignment would be restricted.</li> <li>No long-term impact.</li> </ul>	<ul style="list-style-type: none"> <li>Recreational area amongst woods on east shore would be affected if tunnel shaft located there.</li> <li>Construction impacts would last up to 1 year.</li> <li>Potential loss of small portion of recreational area due to tunnel shaft (note, the area is already designated for development.)</li> </ul>	<ul style="list-style-type: none"> <li>Parks south and north of the site would be affected by construction impacts for in excess of 1 year.</li> <li>Any recreational areas filled and used for the plant would be permanently removed from use.</li> <li>Odours may impact park and shoreline boating activities.</li> </ul>
S3(a) – Compatibility with planning policies/regulations - municipal	<ul style="list-style-type: none"> <li>This option does not require additional land or changes in land uses from what are currently in place at the existing terminus points.</li> <li>Proposal is compatible with the existing municipal Official Plans.</li> <li>The option is consistent with the current CSO Strategy and Pollution Control Plan.</li> </ul>		<ul style="list-style-type: none"> <li>Both the Old City of Kingston and Pittsburgh Township official plans allow underground utilities as proposed within the alignment for this alternative.</li> <li>Municipal/local approvals may be challenging depending upon the proposed location of the new pumping station.</li> <li>Some modifications to the new CSO plan may be required.</li> </ul>		<ul style="list-style-type: none"> <li>No additional approvals required other than those associated with bridge planning, design, construction and operation.</li> <li>Timing of bridge approval is unknown.</li> <li>The site for the water booster station will require approval.</li> </ul>	<ul style="list-style-type: none"> <li>Land in the vicinity of Highway 15 and Gore Road is planned for further development. A new water main would help to service this expansion area.</li> <li>The site for the water booster station will require approval.</li> </ul>	<ul style="list-style-type: none"> <li>The site for a temporary dock and dewatering facility will require approval.</li> <li>The sites for the tunnel shafts will require approval.</li> </ul>	<ul style="list-style-type: none"> <li>An Official Plan Amendment would be required with a lengthy approval process.</li> <li>The CSO Strategy and Pollution Control Plan would require significant additional study and modification.</li> </ul>
S3(b) – Compatibility with planning policies/regulations - provincial	<ul style="list-style-type: none"> <li>Provincial Certificate of Approval (CofA) is required for the new pipe facilities and improved River Street Pumping Station.</li> </ul>		<ul style="list-style-type: none"> <li>The province will require heritage in addition to C of A.</li> <li>Contaminated soils along the Wellington Street alignment could pose approval constraints.</li> <li>C of A required for new sewage pumping station.</li> </ul>		<ul style="list-style-type: none"> <li>No additional approvals required other than those associated with bridge planning, design, construction and operation, except for the C of A for new booster station.</li> <li>Timing of bridge approval is unknown.</li> </ul>	<ul style="list-style-type: none"> <li>Provincial Certificate of Approval (CofA) is required for the new pipe facilities and water booster station, and pumping station improvements.</li> <li>Any activities near the water's edge would be of interest to the province due to potential impacts on the wetlands.</li> </ul>		<ul style="list-style-type: none"> <li>A treatment plant would necessitate completion of a Schedule "C" Environmental Assessment and significant approvals from the province.</li> </ul>

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	Dredging / Pipe Laying	Bedrock Tunneling	Dredging / Pipe Laying	Bedrock Tunneling	Affixed to Bridge	Dredging / Pipe Laying	Bedrock Tunneling	
S3(b) – Compatibility with planning policies/regulations – provincial, Cont.	<ul style="list-style-type: none"> <li>Approvals required for dredging, dewatering, and disposal of sediment; and for the docking facilities.</li> </ul>		<ul style="list-style-type: none"> <li>Approvals required for dredging, dewatering, and disposal of sediment; and for the docking facilities.</li> </ul>			<ul style="list-style-type: none"> <li>Approvals required for dredging, dewatering, and disposal of sediment; and for the docking facilities.</li> </ul>		
S3(c) – Compatibility with planning policies/regulations - federal	<ul style="list-style-type: none"> <li>Federal EA approvals, easements, and rights-of-way will be required from several departments including Department of Fisheries and Oceans (incl. Coast Guard), Transport Canada, Environment Canada, and National Defense.</li> </ul>		<ul style="list-style-type: none"> <li>Federal EA approvals, easements, and rights-of-way will be required from several departments including Department of Fisheries and Oceans (incl. Coast Guard), Transport Canada, Environment Canada, and National Defense.</li> <li>Contaminated soils along the Wellington Street alignment could pose approval constraints.</li> <li>Approvals would likely be lengthier to achieve than Alternative 1 due to density of development, traffic, contaminated soils, and heritage issues.</li> </ul>		<ul style="list-style-type: none"> <li>No additional approvals required other than those associated with bridge planning, design, construction and operation.</li> <li>Timing of bridge approval is unknown.</li> </ul>	<ul style="list-style-type: none"> <li>Federal EA approvals, easements, and rights-of-way will be required from several departments including Department of Fisheries and Oceans (incl. Coast Guard), Transport Canada, Environment Canada, and National Defense.</li> <li>Approval likely more difficult to achieve than Alternative 1 due to the Heritage status of the Great Catarauqui River north of Belle Island, proximity to a Class 3 wetland, and significant archaeological potential.</li> </ul>		<ul style="list-style-type: none"> <li>Federal approvals and land purchase/lease would be required for filling and use of the wetland/water lot and for the outfall.</li> <li>The federal government would be interested in any impact the plant might have on the Catarauqui River and archaeological resources in the area.</li> <li>Approximately 1 year should be allowed in the implementation schedule for such approvals.</li> </ul>
	<ul style="list-style-type: none"> <li>Contaminated materials handling and disposal, fish and fish habitat, and easements will be significant issues to be addressed during detailed design.</li> <li>Approximately 6 months should be allowed in the implementation schedule for federal approvals.</li> </ul>	<ul style="list-style-type: none"> <li>Approximately 3 months should be allowed in the implementation schedule for federal approvals.</li> </ul>	<ul style="list-style-type: none"> <li>Contaminated materials handling and disposal, fish and fish habitat, and easements will be significant issues to be addressed during detailed design.</li> <li>Approximately 8 months should be allowed in the implementation schedule for federal approvals.</li> </ul>	<ul style="list-style-type: none"> <li>Approximately 5 months should be allowed in the implementation schedule for federal approvals.</li> </ul>		<ul style="list-style-type: none"> <li>Contaminated materials handling and disposal, fish and fish habitat, and easements will be significant issues to be addressed during detailed design.</li> <li>Approximately 6 months should be allowed in the implementation schedule for such approvals.</li> </ul>	<ul style="list-style-type: none"> <li>Approximately 3 months should be allowed in the implementation schedule for such approvals.</li> <li>This construction method does not affect matters of Federal interest.</li> </ul>	
S4 – Impacts to archaeological or heritage features or sites of significance within infrastructure corridor	<ul style="list-style-type: none"> <li>The corridor has moderate to high archaeological potential.</li> <li>Stage 2 archaeological assessment may be required.</li> </ul>		<ul style="list-style-type: none"> <li>The archaeological potential along most of the western portions of the corridor is very high.</li> <li>Fort Frontenac has national significance and the Rideau Canal is a heritage waterway.</li> <li>Stage 2 archaeological assessment would be required for on-land works.</li> </ul>		<ul style="list-style-type: none"> <li>No increase over impact associated with bridge planning, design, construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>This route has moderate to high archaeological potential.</li> <li>The Kingston Outer Station site and the Music site are located less than 500 meters north of crossing on the west side.</li> <li>The Gore Road side of the River has high archaeological potential.</li> <li>Stage 2 archaeological assessment may be required.</li> </ul>		<ul style="list-style-type: none"> <li>The archaeological potential of this area is regarded as high for pre-contact resources because of the association of the area with the Catarauqui River and what was a former wetland area immediately to the north.</li> <li>Given the nature of the location and the known interments on neighboring Belle Island, the potential for encountering human First Nation burials is regarded as high for this area.</li> </ul>
	<ul style="list-style-type: none"> <li>This route will intersect or come very close to the underwater wreck identified as a scuttled barge or scow (BbGc-37).</li> <li>The barge could be avoided by using flexible pipe and appropriate pipe routing.</li> </ul>	<ul style="list-style-type: none"> <li>Archaeological resources will not be affected by bedrock tunneling operations.</li> <li>The tunnel shaft at Barriefield may have some archaeological values.</li> </ul>	<ul style="list-style-type: none"> <li>Potentially significant impact on several heritage resources in the area.</li> </ul>	<ul style="list-style-type: none"> <li>Archaeological resources will not be affected by bedrock tunneling operations.</li> <li>The tunnel shafts at RMC and Douglas Flurhrer Park may have significant archaeological values</li> </ul>		<ul style="list-style-type: none"> <li>Potential impact on heritage resources.</li> </ul>	<ul style="list-style-type: none"> <li>Archaeological resources will not be affected by bedrock tunneling operations.</li> <li>Tunnel shafts on both sides of the river may have some archaeological values.</li> </ul>	
<b>ECONOMY</b>								
E1 – Impact on development	<ul style="list-style-type: none"> <li>Waterfront development and the sale of waterfront properties may be impeded during construction.</li> <li>Construction will last approximately 6 months.</li> </ul>		<ul style="list-style-type: none"> <li>Construction of the tunnel and shafts will last approximately 1 year.</li> </ul>		<ul style="list-style-type: none"> <li>Construction may conflict with Public Works Government Services Canada future plans for Causeway rehabilitation.</li> </ul>	<ul style="list-style-type: none"> <li>No increase over impact associated with bridge planning, design, construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>There is no long-term impact on development potential on either side of the river.</li> </ul>	<ul style="list-style-type: none"> <li>The plant would likely negatively impact the development potential of adjacent properties west of the River.</li> </ul>
E2 – Impact on businesses and institutions	<ul style="list-style-type: none"> <li>Rideau, Catarauqui, Orchard and River Streets will experience increased traffic congestion due to construction activities on the west side of the river.</li> <li>Noise, dust and vibration may disturb tenants of the Woolen Mill and other nearby businesses.</li> <li>Parking for the Woolen Mill may also become more difficult.</li> <li>Restrictions can be placed on the parking of contractor vehicles.</li> <li>Traffic will increase at the RMC campus north of Hwy. 2.</li> </ul>		<ul style="list-style-type: none"> <li>Impaired access to businesses on Wellington Street and Place D’Armes as well as to Royal Military College.</li> <li>Noise, dust and vibration may disturb several businesses and institutions in the area.</li> <li>Traffic impacts during periodic repair of on-land portion of force main and water main.</li> </ul>		<ul style="list-style-type: none"> <li>No increase over impact associated with bridge planning, design, construction and operation.</li> </ul>	<ul style="list-style-type: none"> <li>Impact to marina and related business on west side of river during construction.</li> <li>Removing sediment via other location on River would minimize duration of impact.</li> </ul>	<ul style="list-style-type: none"> <li>Greater impact to marina and related business both during construction and operation of the new tunnel facility, as shaft likely located near shore/business.</li> <li>Montreal Street may experience increased traffic due to construction activities on the west side of the river.</li> <li>Access to the Pittsburgh Library may be inconvenienced due to construction on the east</li> </ul>	<ul style="list-style-type: none"> <li>Rideau, Montreal, and Catarauqui Streets would experience increased traffic due to construction activities, which could impact area businesses.</li> <li>Restaurants with open-air patios may be affected by plant odours during plant operation.</li> </ul>

Table 1: Matrix of Potential Impacts and Mitigating Measures

CRITERIA	Alternative 1 (Water and Wastewater) 2 <sup>nd</sup> Crossing Existing Alignment (River St. to James St.)		Alternative 2 (Water and Wastewater) 2 <sup>nd</sup> Crossing La Salle Causeway		Alternative 3 (Water) 2 <sup>nd</sup> Crossing Gore - Elliott	Alternative 4 (Water) 2 <sup>nd</sup> Crossing Gore - Elliott		Alternative 7 (Wastewater) New Water Pollution Control Plant (west of River)
	Dredging / Pipe Laying	Bedrock Tunneling	Dredging / Pipe Laying	Bedrock Tunneling	Affixed to Bridge	Dredging / Pipe Laying	Bedrock Tunneling	
	<ul style="list-style-type: none"> <li>Impacts would be experienced for up to 6 months.</li> </ul>	<ul style="list-style-type: none"> <li>Impacts would be experienced for up to 1 year.</li> </ul>	<ul style="list-style-type: none"> <li>This alternative would have significant impact on traffic flow between Pittsburgh and the downtown areas, due to the restricted working area on the causeway, and to a lesser extent on Highway #2.</li> <li>Impacts would be experienced for up to 6 months.</li> </ul>	<ul style="list-style-type: none"> <li>Impacts would be experienced for up to 1 year.</li> </ul>				
E3 – Capital Cost	<ul style="list-style-type: none"> <li>Common water and wastewater system improvements – \$6.4 million.</li> <li>The total estimated capital cost is \$13.6 million, including construction and land acquisition and the above common elements.</li> </ul>	<ul style="list-style-type: none"> <li>The total estimated capital cost is \$23.1 million, including construction and land acquisition and the above common elements.</li> </ul>	<ul style="list-style-type: none"> <li>Approx. \$25.1 million.</li> <li>Add costs of force main and additional pumping station, subtract half the dredging cost, and add 5% contingency over Alt. 1 for dealing with heritage features.</li> </ul>	<ul style="list-style-type: none"> <li>Approx. \$34.7 million combined.</li> <li>The estimated capital cost is \$27 million (ww) or \$10.9 (w), including construction and land acquisition.</li> </ul>	<ul style="list-style-type: none"> <li>The estimated capital cost is \$8.7 million, and includes construction and land acquisition.</li> </ul>	<ul style="list-style-type: none"> <li>Approx. \$6.5 million.</li> <li>Subtract 25% contingency for hazardous materials handling, and add 5% contingency for heritage and natural resource management.</li> </ul>	<ul style="list-style-type: none"> <li>The estimated capital cost is \$20 million, including construction and land acquisition.</li> </ul>	<ul style="list-style-type: none"> <li>The estimated capital cost is \$94 million, and includes construction and land acquisition.</li> <li>Cost excludes site remediation of contaminated soils.</li> </ul>
E4 – Life Cycle (Present Value) Cost	<ul style="list-style-type: none"> <li>The present value or estimated life cycle cost is \$22.2 million, and includes operation, maintenance and decommissioning.</li> <li>The design life of the force main and water main is taken as 40 years.</li> </ul>	<ul style="list-style-type: none"> <li>The present value or estimated life cycle cost is \$41.2 million, and includes operation, maintenance and decommissioning.</li> <li>The design life of the force main and water main is taken as 40 years.</li> </ul>	<ul style="list-style-type: none"> <li>Approximately \$40.9 million.</li> </ul>	<ul style="list-style-type: none"> <li>The present value of the estimated life cycle cost is \$50 million, and includes operation, maintenance and decommissioning.</li> <li>The design life of the force main and water main is taken as 40 years.</li> </ul>	<ul style="list-style-type: none"> <li>The estimated present value of the Life Cycle Cost is \$17 million, and includes construction, operation and maintenance, and decommissioning.</li> <li>The design life of the water main is taken as 40 years.</li> </ul>	<ul style="list-style-type: none"> <li>Approx. \$10.6 million.</li> </ul>	<ul style="list-style-type: none"> <li>The estimated present value of the Life Cycle Cost is \$35 million, and includes construction, operation and maintenance, and decommissioning.</li> <li>The design life of the water main is taken as 40 years.</li> </ul>	<ul style="list-style-type: none"> <li>The present value of the estimated life cycle cost is \$158 million, and includes construction, operation and maintenance, and decommissioning.</li> <li>The design life of the WPCP is taken as 40 years.</li> </ul>
E5 – Dependency on consumables	<ul style="list-style-type: none"> <li>Improvements to existing River Street Pumping Station and James Street Booster Station will reduce energy consumption.</li> <li>Opportunity to maintain both force mains in concurrent operation would reduce electrical consumption further.</li> </ul>		<ul style="list-style-type: none"> <li>Improvements to existing River Street Pumping Station and James Street Booster Station will reduce energy consumption.</li> <li>Length of force main would generate greater amounts of SO<sub>2</sub> and therefore greater use of odour and control measures.</li> <li>Opportunity to maintain both force mains in concurrent operation would reduce electrical consumption further.</li> </ul>		<ul style="list-style-type: none"> <li>There will be a marginal increase in hydro consumption due to the addition of the new BPS, and also due to heat tracing required to prevent freezing.</li> </ul>	<ul style="list-style-type: none"> <li>Improvements to existing River Street Pumping Station will reduce energy consumption.</li> <li>Opportunity to maintain both force mains in concurrent operation would reduce electrical consumption further.</li> <li>Increased energy consumption associated with new water booster station.</li> </ul>		<ul style="list-style-type: none"> <li>Average treatment plants with tertiary treatment require significant energy and chemical inputs as well as sludge treatment.</li> </ul>
		<ul style="list-style-type: none"> <li>Heating, ventilation, and lighting of tunnel may be required.</li> </ul>		<ul style="list-style-type: none"> <li>Heating, ventilation, and lighting of tunnel may be required.</li> </ul>			<ul style="list-style-type: none"> <li>Heating, ventilation, and lighting of tunnel may be required.</li> </ul>	
E6 – Potential savings	<ul style="list-style-type: none"> <li>Opportunity to merge water and wastewater solutions.</li> <li>Potential to install 3<sup>rd</sup> pipe for future utility installations.</li> </ul>	<ul style="list-style-type: none"> <li>Opportunity to sell space within the tunnel.</li> </ul>	<ul style="list-style-type: none"> <li>Opportunity to merge water and wastewater solutions.</li> <li>Potential to install 3<sup>rd</sup> pipe for future installations.</li> </ul>	<ul style="list-style-type: none"> <li>Opportunity to sell space within the tunnel.</li> </ul>	<ul style="list-style-type: none"> <li>This is the least costly means to cross the river with a water main.</li> <li>There is no cost effective means to merge this solution with a wastewater solution.</li> </ul>	<ul style="list-style-type: none"> <li>There is no cost effective means to merge this solution with a wastewater solution.</li> <li>Potential to install 2<sup>nd</sup> pipe for future installations.</li> </ul>	<ul style="list-style-type: none"> <li>Opportunity to sell space within the tunnel.</li> </ul>	<ul style="list-style-type: none"> <li>There is no cost effective means to merge this solution with a water solution.</li> </ul>
<b>TECHNICAL MERIT</b>								
T1 – Constructability	<ul style="list-style-type: none"> <li>November 2000 sediment samples met Ont. Reg. 347 requirements for disposal at a confined landfill.</li> <li>Complexity and costs would increase if large quantities of hazardous materials were encountered.</li> <li>X, y, z profiling of the sediment should be carried out before confirming dredging method.</li> <li>If dewatering is required, a lined settling basin or the addition of stabilizers may be required (e.g. hydrated lime).</li> </ul>	<ul style="list-style-type: none"> <li>Typical geotechnical risks of tunnel construction.</li> <li>Faults and fissures may be present.</li> <li>Additional geotechnical investigations should be carried out to confirm potential impacts upon the type of method used (i.e. drill &amp; blast versus tunnel boring machine.)</li> <li>Greater potential for delays due to greater unknowns in tunneling construction.</li> </ul>	<ul style="list-style-type: none"> <li>November 2000 sediment samples met Ont. Reg. 347 requirements for disposal at a confined landfill.</li> <li>Complexity and costs would increase if large quantities of hazardous materials were encountered.</li> <li>X, y, z profiling of the sediment should be carried out before confirming dredging method.</li> <li>If dewatering is required, a lined settling basin or the addition of stabilizers may be required (e.g. hydrated</li> </ul>	<ul style="list-style-type: none"> <li>Typical geotechnical risks of tunnel construction.</li> <li>Faults and fissures may be present.</li> <li>Additional geotechnical investigations should be carried out to confirm potential impacts upon the type of method used (i.e. drill &amp; blast versus tunnel boring machine.)</li> <li>Contaminated soils and heritage resources along Wellington and Ontario Street alignment would increase construction complexity considerably.</li> </ul>	<ul style="list-style-type: none"> <li>The water main could be easily incorporated into the bridge construction program.</li> </ul>	<ul style="list-style-type: none"> <li>Sediment sampling undertaken by MOE in 1985 immediately north of Belle Is. Indicates elevated levels of several contaminants. It is unknown how far north the contamination extends.</li> <li>Complexity and costs would increase if large quantities of contaminated materials were encountered.</li> <li>X, y, z profiling of the sediment should be carried out before confirming dredging method.</li> </ul>	<ul style="list-style-type: none"> <li>Typical geotechnical risks of tunnel construction.</li> <li>Faults and fissures may be present.</li> <li>Additional geotechnical investigations should be carried out to confirm potential impacts upon the type of method used (i.e. drill &amp; blast versus tunnel boring machine.)</li> </ul>	<ul style="list-style-type: none"> <li>Site size and water elevation pose significant construction constraints.</li> </ul>

CRITERIA	Alternative 1 (Water and Wastewater) 2 <sup>nd</sup> Crossing Existing Alignment (River St. to James St.)		Alternative 2 (Water and Wastewater) 2 <sup>nd</sup> Crossing La Salle Causeway		Alternative 3 (Water) 2 <sup>nd</sup> Crossing Gore - Elliott	Alternative 4 (Water) 2 <sup>nd</sup> Crossing Gore - Elliott		Alternative 7 (Wastewater) New Water Pollution Control Plant (west of River)
	Dredging / Pipe Laying	Bedrock Tunneling	Dredging / Pipe Laying	Bedrock Tunneling	Affixed to Bridge	Dredging / Pipe Laying	Bedrock Tunneling	
			lime).			<ul style="list-style-type: none"> <li>If dewatering is required, a lined settling basin or the addition of stabilizers may be required (e.g. hydrated lime).</li> </ul>		
T2 – Phasing flexibility	<ul style="list-style-type: none"> <li>Phase 1: laying of pipe.</li> <li>Phase 2: improvements to WBS and PS</li> <li>Phase 3: rehabilitation of existing pipe crossing.</li> </ul>	<ul style="list-style-type: none"> <li>Phase 1: tunnelling</li> <li>Phase 2: improvements to WBS and PS</li> <li>Phase 3: rehabilitation of existing pipe crossing.</li> </ul>	<ul style="list-style-type: none"> <li>Phase 1: laying of pipe.</li> <li>Phase 2: improvements to WBS and PS</li> <li>Phase 3: rehabilitation of existing pipe crossing.</li> </ul>	<ul style="list-style-type: none"> <li>Phase 1: tunnelling</li> <li>Phase 2: improvements to WBS and PS</li> <li>Phase 3: rehabilitation of existing pipe crossing.</li> </ul>	<ul style="list-style-type: none"> <li>No opportunity for phasing, as it is dependent upon bridge construction.</li> <li>There is opportunity to construct additional storage on the east side of the river, near James Street, to buy additional time to allow this option to proceed, although the interim solution does not fully address the problem definition.</li> </ul>	<ul style="list-style-type: none"> <li>Phase 1: dredging and construction of new water booster station.</li> <li>Phase 2: improvements to PS</li> <li>Phase 3: rehabilitation of existing pipe crossing.</li> </ul>	<ul style="list-style-type: none"> <li>Phase 1: tunnelling and construction of new water booster station.</li> <li>Phase 2: improvements to PS</li> <li>Phase 3: rehabilitation of existing pipe crossing.</li> </ul>	<ul style="list-style-type: none"> <li>There is only marginal opportunity for phasing, as the plant would have to be constructed to handle the current and short term flows immediately.</li> <li>Long-term capacity improvements could be phased.</li> <li>Property acquisition and clean-up must occur at the outset.</li> </ul>
T3 – Long-term operational ease and reliability	<ul style="list-style-type: none"> <li>Improvements at existing pumping station and construction of second crossing would improve system reliability and minimize (eliminate) overflows to the River.</li> <li>Regular flushing and cleaning is required.</li> <li>Systems are equally reliable.</li> </ul>		<ul style="list-style-type: none"> <li>Improvements at existing pumping station and construction of second crossing would improve system reliability and minimize (eliminate) overflows to the River.</li> <li>Regular flushing and cleaning is required.</li> </ul>		<ul style="list-style-type: none"> <li>Second link to east side of river would improve system reliability.</li> <li>Additional booster pumps would require operations involvement.</li> <li>This alternative would strengthen the overall grid on the Pittsburgh side.</li> <li>An open-air water main is easier to access and repair.</li> </ul>	<ul style="list-style-type: none"> <li>Second crossing would improve water system reliability.</li> </ul>		<ul style="list-style-type: none"> <li>The plant should operate with reliably after commissioning.</li> <li>More complex system to operate and maintain compared to other alternatives.</li> </ul>
	<ul style="list-style-type: none"> <li>Can be inspected and maintained using flow diversion.</li> </ul>	<ul style="list-style-type: none"> <li>Can be inspected and maintained easily.</li> <li>Requires grit removal system to minimize sediment build-up.</li> </ul>	<ul style="list-style-type: none"> <li>Can be inspected and maintained using flow diversion.</li> </ul>	<ul style="list-style-type: none"> <li>Land portion of new force main would be difficult to access.</li> <li>Can be inspected and maintained easily.</li> </ul>		<ul style="list-style-type: none"> <li>Can be inspected and maintained using flow diversion.</li> </ul>	<ul style="list-style-type: none"> <li>Can be inspected and maintained easily.</li> </ul>	
T4 – Operational flexibility	<ul style="list-style-type: none"> <li>Redundancy of the force mains and water main (new and rehabilitated) allows both to be isolated for inspection and repair, and to be used in high flow conditions.</li> </ul>		<ul style="list-style-type: none"> <li>Redundancy of the force mains and water main (new and rehabilitated) allows both to be isolated for inspection and repair, and to be used in high flow conditions.</li> </ul>		<ul style="list-style-type: none"> <li>Redundancy of the water main (new and rehabilitated) allows both to be isolated for inspection and repair, and to be used in high flow conditions.</li> </ul>	<ul style="list-style-type: none"> <li>Redundancy of the water main (new and rehabilitated) allows both to be isolated for inspection and repair, and to be used in high flow conditions.</li> </ul>		<ul style="list-style-type: none"> <li>Operational flexibility can be built into the plant design.</li> </ul>
T5 – Other technical merits or demands	<ul style="list-style-type: none"> <li>No additional training required.</li> </ul>	<ul style="list-style-type: none"> <li>Staff training in the operation and maintenance of a tunnel would be required.</li> </ul>	<ul style="list-style-type: none"> <li>May reduce staffing demands at River Street PS.</li> <li>Existing staff could manage operations and maintenance of second pumping station.</li> </ul>		<ul style="list-style-type: none"> <li>Water main suspended from bridge is unique. It requires heat tracing to prevent freezing, which is unfamiliar to operating personnel.</li> <li>Staff would require additional training.</li> </ul>	<ul style="list-style-type: none"> <li>Existing staff could manage operations and maintenance of second booster station.</li> </ul>		<ul style="list-style-type: none"> <li>Existing pumping station staff and new staff would be required to operate new plant.</li> <li>Training and upgrade of certification level would likely be required of operator staff.</li> </ul>
			<ul style="list-style-type: none"> <li>No additional training required.</li> </ul>	<ul style="list-style-type: none"> <li>Staff training in the operation and maintenance of a tunnel would be required.</li> </ul>		<ul style="list-style-type: none"> <li>No additional training required.</li> </ul>	<ul style="list-style-type: none"> <li>Staff training in the operation and maintenance of a tunnel would be required.</li> </ul>	