City of Kingston
Third Crossing of the Cataraqui River

Volume 1 - Preliminary Design Summary Report




Final Report: June 2017

JLR File No.: 27143

PARSONS | dtah | J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS | Golder Associates | CSW

SIGNATURE PAGE

The following main report as well as the specialist reports and drawings located in the Appendices of this report meet the professional service requirements of the City of Kingston Request for Proposal No. EN-2015-08, dated October 7, 2015, for Preliminary Design for the Third Crossing of the Cataraqui River:

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NOTICE TO READER

The following main report highlights key points of the detailed specialist reports only; for complete information as well as limitations, it is necessary for the reader to examine the complete report, including the information contained in the discipline reports and drawings located in the Appendices of this report.

The following main report and the Appendices of this report are in process of being reviewed by Parks Canada and other Expert Federal Authorities in support of the Federal Environmental Impact Assessment framework, pursuant to Section 67 of the Canadian Environmental Assessment Act. As such, the following main report and the Appendices of this report, as of the date noted herein, have neither been endorsed nor approved by Parks Canada and other Expert Federal Authorities.

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EXECUTIVE SUMMARY

1. Project Background

The City of Kingston (City) has retained a Project Team co-led by J.L. Richards & Associates Limited (JLR) and Parsons Inc. to undertake the Preliminary Design (pre-design) and Federal Environmental Impact Assessment (EIA) of the Third Crossing of the Cataraqui River (project). The bridge corridor forms part of the Rideau Canal (Canal), a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site, National Historic Site, Canadian Heritage River and Federally regulated navigable waterway.

The current project is pursuant to an Ontario Municipal Class Environmental Assessment (Class EA), which was engaged in 2009. The Class EA proceeded as a Schedule 'C' Class EA as per the Ontario Municipal Class EA process. As the riverbed is owned by the Federal Government, the Class EA was also in process of addressing the Federal EA framework, until Federal changes to the Canadian Environmental Assessment Act (CEAA) in 2012 suspended this requirement.

The Class EA determined that the LaSalle Causeway was operating at capacity, and that travel volumes would continue to increase, based on urban growth and related travel volume demand forecasts done at the time. If this problem was left unaddressed, the increasing travel volumes would cause local traffic to divert north to use the Highway 401 crossing, thereby leading to further out-of-way travel, additional delays and potential local-regional traffic conflicts on Highway 401.

The Class EA proceeded in two stages. Stage 1 focused on evaluating the need for additional transportation capacity across the Cataraqui River, and the assessment of the following alternative solutions:

1. **Retain the status quo or 'do nothing':** This option was not viable since the LaSalle Causeway is operating at capacity and is expected to experience increased congestion during peak traffic periods as population and employment growth continues.

2. **Increase the capacity of the LaSalle Causeway:** A series of Transportation Demand Management and Transportation Systems Management strategies along the LaSalle Causeway-Highway 2 corridor were seen as a viable interim solution only (and subject to future traffic monitoring by the City).

3. **Increase the capacity of Highway 401 from Montreal Street to Highway 15:** This option was not viable, given the primary role of Highway 401 as an inter-city freeway; the trip demand patterns of vehicles that favour crossing the Cataraqui River via the LaSalle Causeway; and the related out-of-way travel and additional delays that would result from diverting local traffic 6 kilometres (km) north.

4. **Implement a new crossing at a location between the LaSalle Causeway and Highway 401 by either a tunnel or bridge:** The tunnel option was not viable due to extensive technical constraints and environmental impacts as well as prohibitive capital costs. Thus, based on an assessment of nine possible river crossing options, the preferred solution was a bridge crossing linking John Counter Boulevard and Gore Road. This mid-central location provides improved transportation network connectivity through the City, and also offers opportunities to enhance the City's historic association with the Canal.

Stage 2 completed the Class EA by focusing on three bridge design concepts, shoreland road and landscape designs, mitigation measures, capital and maintenance costs and the Environmental Study Report (ESR). The ESR recommended the Arch With V-Piers design concept, based on the following overall aesthetic expression for the bridge that focuses on the use of contemporary geometry, materials and detailing that will stand the test of time, but also enable the bridge to 'age gracefully':

1. The double V-piers reduce in-water effects and their slender, open look minimizes visual impacts.

2. The 150 metre (m) pier-to-pier distance of the arch span provides unencumbered through-navigation for the Canal's navigable channel and adjacent rowing lanes.

3. The arch over the navigable channel and adjacent rowing lanes highlights the bridge as a 21st Century 'gateway' to-from the Canal and the City's Inner Harbour to the south.

4. The bridge has an s-curve alignment which reduces noise and visual effects and provides a softer landscape for abutting residential lands on the east shore; and provides gradually shifting view perspectives for bridge users as they navigate the s-curve.

5. The bridge clearance above the water accommodates existing topographic conditions on both shorelines and exceeds the 6.7 m vertical by 15 m horizontal Federally regulated navigable clearance requirement for the Canal.

The recommended bridge deck cross-section in the ESR comprised the following main features:

1. A 4-lane vehicular roadway, complete with median. It should be noted that the ESR confirmed a staged approach could also work (involving a 2-lane or 3-lane bridge for vehicular traffic) with a substructure that could accommodate widening the bridge deck to 4 lanes in the future (subject to future traffic monitoring by the City).
2. A 3.6 m wide multi-use trail on the south side of the bridge for active transportation.
3. 1.5 m wide commuter cycling lanes for westbound and eastbound travel.
4. A barrier separating the multi-use trail and commuter cycling lane on the south side of the bridge.
5. A series of observation look-out/interpretive areas provided along the south side of the bridge.

The bridge deck features extended on-shore, with:

1. Multi-use trail linkages to improve active transportation network connectivity north and south of the bridge.
2. Extensive landscaping and observation look-out/interpretive areas provided near-shore.
3. Signalized intersections at John Counter Boulevard-Montreal Street; Gore Road-Point St. Mark Drive-Gore Road Library entrance; and Gore Road-Highway 15.
4. A two-way stop sign controlled intersection at John Counter Boulevard-Ascot Lane.
5. Associated turning lanes at the intersections noted above.

The ESR identified dredging a channel for construction barge access as the preferred solution to facilitate in-water bridge construction, based on the following:

1. The excavated channel could introduce a different habitat to a marine environment that is currently dominated by Milfoil, a type of submerged vegetation.
2. Dredging would reduce capital costs in comparison to the temporary work bridge option, which was also assessed during the Class EA.
3. Dredging could accommodate a potential east-west watermain within the excavated channel, which was being planned by Utilities Kingston (UK) during the Class EA.
4. Dredging would require only one in-water disturbance and one related set of mitigation measures as part of its installation, since it was anticipated that the excavated channel would not be backfilled in order to accommodate the UK watermain.

The ESR identified the following preliminary opinion of probable capital and maintenance costs for the various bridge deck scenarios (in 2011 dollars and excluding applicable taxes):

1. The preliminary opinion of probable capital cost was:
   a) $121 million (M) for the 2-lane bridge.
   b) $179M for the 3-lane bridge (4-lane substructure).
   c) $196M for the 4-lane bridge.
2. The preliminary opinion of probable maintenance cost was up to $4,000 per lane km.

The ESR identified a series of potential environmental interactions associated with the 100-plus year design life cycle of the bridge, from construction through to operations and decommissioning. The following two tools were recommended in the ESR for the City to prepare and implement during future project phases to mitigate potential adverse environmental effects:

1. A Cultural-Natural Heritage Protection Plan (C-NHPP), which would include best management practices, including the extensive mitigation and enhancement measures recommended in the ESR.
2. A Community Action Plan (CAP) that would establish protocols for use by the City for notifying the general public of any service interruptions and addressing public issues arising

from bridge construction activities as well as the subsequent use and maintenance of the bridge.

The Class EA was approved in 2013 by the Province of Ontario, signifying that the project could proceed to the implementation phase. As such, the current project represents the next phase in the City's Action Plan, which outlines the process needed to advance the project to 'shovel-ready' status.

2. Public and Stakeholder Consultation

Decision making and consultation activities during the current project phase have been facilitated by the following committees:

1. A Senior Management Committee to oversee the overall project direction.
2. A Technical Advisory Committee comprised of City staff, Project Team members as well as various Provincial and Federal government departments to provide technical guidance and act as a sounding board for technical decision making.
3. A First Nations Consultation Sub-Committee to facilitate consultations with First Nations communities having an interest in the project as well as associated government agencies.
4. A Public Engagement Committee to provide guidance and input for public consultation activities.

In addition, a comprehensive consultation plan has been implemented to facilitate meaningful input from the public and various agencies. Public consultation has been facilitated through:

1. Maintaining an up-to-date project website.
2. Preparing regular project updates through various social media platforms.
3. Facilitating three Public Open Houses to provide information on the background to the project; the progress of the pre-design work, and the draft project findings and recommendations.
4. Engaging in consultations on specific project issues with City staff and other stakeholders, including:

City of Kingston

a) Utilities Kingston
b) Public Works
c) Parks and Recreation
d) Kingston Transit
e) Kingston Hydro
f) Accessibility Advisory Committee

Other Stakeholders

a) Parks Canada
b) Infrastructure Ontario
c) Cataraqui Region Conservation Authority
d) Hydro One
e) Cogeco Cable Canada Inc.
f) Kington Rowing Club

3. Design Evolution and Innovation

The proposed design and construction of the bridge has evolved since the Class EA phase. As highlighted in the sections that follow, this is due to updated transportation analyses; more in-depth fieldwork activities; optimizations of various bridge design elements; additional stakeholder consultations; potential environmental impacts; and capital cost considerations.

3.1 Bridge and Approach Roadway Components

The proposed width of the bridge deck is 16.5 m consisting of:

1. Two lanes for vehicular traffic in response to the recommendation in the recent Kingston Transportation Master Plan update. Based on the current design speed [70 kilometres per hour (km/hr)] and future posted speed (60 (km/hr) on the bridge, the width of each lane is 3.5 m. There is also a 2 m wide shoulder adjacent to each vehicular traffic lane to assist with snow clearing and other maintenance activities and accommodate commuter cyclists.
2. A 4 m wide multi-use pathway on the south side of the bridge deck to provide for active transportation and look-out / interpretive areas. At the arch, the width of the multi-use pathway increases to 9.5 m to provide a look-out / interpretive area over the navigation channel and adjacent rowing lanes.
3. Three 0.5 m wide barriers for public safety: on the north side of the bridge (1); separating the roadway and the multi-use pathway (2); and on the south side of the bridge (3).

The bridge will have a 225 millimetre (mm) thick reinforced concrete deck with waterproofing and 80 mm of asphalt on the wearing surface. Four (possibly five) haunched in plan plate girders will support the reinforced concrete deck. The plate girders can either be curved to match the horizontal alignment or kinked to simplify fabrication. The girders will be supported by a combination of diaphragms, cross-frames and lateral bracing to provide lateral stability during construction and for live load sharing.

There will be two storm sewer pipes under the bridge deck, one along the north barrier and one along the barrier separating the roadway and the multi-use pathway. These storm sewer pipes, which will run from each side of the arch, will drain stormwater off the bridge into stormwater management facilities on either shore, adjacent to the approach roadways.

The proposed horizontal alignment of the bridge maintains the s-curve for reasons cited in the Class EA. But the s-curve has been modified to consist of two large radii horizontal curves, which will preclude the need for costly superelevation (banking) on the bridge.

The proposed vertical profile of the bridge was also refined since the Class EA. Firstly, the crest will be centered on the arch span with the low points located off the bridge. This will not only make the arch the focal point of the bridge, it will also better facilitate stormwater management and optimize the number of deck drains needed on the bridge. Secondly, the vertical profile will be lowered by 2.8 m at the crest, which will reduce capital costs in response to lower pier heights and reduced embankment fill requirements on the approaches.

The initial preferred pier design consisted of two separate concrete V-piers with two tie beams. The V-piers were to be supported by a large pier cap at the base of the pier, from which several large diameter caissons would be drilled into bedrock. Though the pier cap would increase the ice loading potential pushing against the pier, of the V-pier design options assessed, this initial design was deemed simplest to construct, more economical and structurally viable, and it provided a more open and transparent design. As noted later, the pier design was revisited in response to bridge constructability, capital cost and environmental mitigation considerations.

The proposed arch will be paired outward tilting tied arches. Each arch will have 18 multi-strand cables connected to the transverse floorbeams, which will support the bridge deck. The proposed arch top chord is shaped with parallel cross struts between the arch chords and parallel hangers.

The abutments will be reinforced concrete with a spread footing founded on an engineered granular backfill pad. Both abutments will have conventional concrete wingwalls.

The design of the approach roadways has not changed significantly since the Class EA. However, the John Counter Boulevard-Ascot Lane intersection has been designed to accommodate future signalization, should it be required based on traffic monitoring by the City. In addition, the roadway lighting will be contemporary and elegant in appearance with accent lighting that highlights key bridge corridor components in a subtle, yet aesthetically pleasing effect at night.

The proposed Cultural-Natural Heritage Protection and Enhancement Plan (C-NHPEP) as part of this current project phase advances the best management practices and design measures recommended during the Class EA to further protect, restore and enhance the cultural and natural heritage landscape within the bridge corridor both during and after construction. Focusing on post-construction design measures and consistent with the Class EA:

1. The on-shore look-out / interpretive areas and active travel / commuter cycling provisions will be carried forward.

2. The surrounding lands and shorelines will be extensively restored and enhanced using native plant materials to create both a natural and parkway setting. Furthermore, should water access via the east side of the project corridor be preferred by the Contractor during the construction phase, the associated water dockage provisions could be transformed post-construction into a permanent boat launch facility, subject to further review and consideration by those authorities having jurisdiction.

3. On-land wildlife micro-habitats such as bat and duck boxes, turtle nesting areas and snake hibernacula will be provided.

4. In recognition of the impact area from the permanent bridge on the structure and function of the Greater Cataraqui Marsh Provincially Significant Wetland (PSW), the C-NHPEP also includes provisions for wetland rehabilitation of the near-shore area on the west side of the bridge corridor. These provisions include the installation of habitat enhancements (e.g. reptile basking structures, submerged and emergent logs) and in-water re-vegetation using dominant wetland species.

The proposed CAP similarly establishes a community outreach framework for the City to use both during and after bridge construction for notifying the public (e.g. about upcoming service interruptions); educating the public (e.g. about monitoring activities in support of in-water and on-shore restoration works); and addressing public issues (e.g. through a Bridge Liaison Officer).

3.2 Bridge Constructability and Related Impact Considerations

The Class EA context in which dredging was recommended as the preferred in-water bridge construction option has also subsequently evolved, as highlighted below:

1. UK confirmed an alternative route for the proposed watermain that was originally intended to be located within the dredged channel.

2. Based on more in-depth fieldwork activities, the composition of the dredgeate could lead to severe suspension and sloughing of in-river sediment during construction; and changes in sediment dynamics and increased turbidity in the water column after construction.

3. Critical outcomes from specific consultations with Parks Canada during the current project phase yielded the following:

    a) The context of the bridge corridor within the Greater Cataraqui Marsh PSW ecosystem, particularly its role as a coastal wetland, and its status as one of Parks Canada's larger protected heritage areas.

    b) The proposed 4.3 hectare (ha) impact area from the dredging option, which is significantly larger than the proposed 0.6 ha impact area from the temporary work bridge option.

    c) The lower risk concerning the potential long-term effects from the temporary work bridge option on the Cataraqui River substrate, vegetation, habitat and water quality.

Based on the above considerations as well as extensive bridge constructability assessments by the Project Team in consultation with City staff, the current project is recommending the temporary work bridge as the preferred in-water bridge construction option. The temporary work bridge will be approximately 11 m wide, and supported on piles every 10 to 12 m. It will be advanced incrementally in conjunction with the construction of the permanent bridge from shore to the navigation channel on both sides. Localized excavation of the riverbed will still be required, but only at the v-pier locations which, as noted later, are being carried forward to frame the arch span as the focal point of the bridge. As such, the overall impact footprint will be significantly minimized.

It would take up to three months to remove the temporary work bridge following construction of the permanent bridge. The temporary piles could either be removed completely or cut below the top of the riverbed and left in place.

3.3 Pier Design Innovation

Based on the preferred V-pier design, main arch span and bridge deck configuration, and temporary work bridge option, a Schedule 'C' capital cost estimate was prepared. Relative to the cost estimates prepared during the Class EA, these current project components, in conjunction with consumer price index increases to present day, resulted in significant escalations to anticipated capital costs.

In response, the Project Team designed an innovative pier alternative. While the V-piers would remain to frame the arch span as the focal point of the bridge, the remaining piers would consist of 16 inverted U-frame piers with an outside face angle that both matches and gradually increases in height toward the tilted arch span.

Upon review with City and Parks Canada staff, this alternative was considered a 'triple win', in that:

1. The temporary work bridge is preferred over the dredged channel from an environmental impact and protection perspective with regards to construction methodology (first win).

2. Although the span arrangement would increase from 14-to-19-spans, the overall environmental footprint from the U-frame piers would still be lower compared to the initial V-pier design. This alternative pier design, in conjunction with the temporary work bridge, also yields a more reasonable cost estimate that is commensurate with the City's current financial resources (second win).

3. From functional and aesthetic perspectives, the functionality of the bridge would not be compromised due to the alternative pier design, and the bridge deck features would be retained to enhance user experiences along the Canal; and aesthetically, the inverted U-frame piers would still provide a cohesive overall rhythm towards the arch span as the focal point of the bridge (third win).

The alternative pier design has been advanced as the preferred structural arrangement for the current project. As such, the bridge will be supported on 92 conventional pot bearings, 88 for the plate girder approach spans up to the arch and 4 for the arch itself. To minimize maintenance and operation costs and increase durability, the bridge will have only four expansion joints. To the east of the arch, the expansion joints will be strip seal joints; to the west of the arch, the expansion joints will be multi-cell modular joints.

The U-frame piers will consist of two 1800 mm diameter caissons rock socketed into the bedrock with a steel liner. The V-piers at the arch will be supported on eight 2100 mm caissons with a footing. With the high ice loading that can develop on the arch pier footing, a pier nosing will be installed on the ends of the footings to break-up the ice.

3.4 Supplemental Innovation Considerations

Key additional innovative features which were evaluated during the current project phase include:

1. Flexibility in the design of the superstructure to allow different erection methods for the arch and the approach spans, depending on the means and methods of the Contractor.

2. Bridge Service Life considerations which focus on the overall life cycle of the bridge so that the initial design ensures optimized performance and related operations / maintenance / rehabilitation costs, and which can include:

   a) Designing the arch components from completely sealed components to enhance the long term life and durability of the structure.

   b) Structural health monitoring system (SHMS) provisions, such as but not limited to a weather station; permanent displacement survey prisms; displacement sensors; Global Positioning System (GPS) sensors; accelerometers; and leak detection systems.

   c) A hanger system comprised of multi-strand cables and anchorages with adjustment nuts, which would enable quick and easy adjustment (and replacement) of the cable forces throughout the life of the bridge.

   d) The use for stainless steel / galvanized and GFRP reinforcing steel rather than carbon steel in areas prone to high corrosion.

   e) Employing a four coat system and the potential metalizing of the arch components.

   f) The use of LED light fixtures to reduce energy consumption, and optimize associated maintenance and replacement costs.

   g) The use of sustainable de-icing and anti-icing systems.

4. Property Impacts

Property considerations are necessary in three locations with respect to the bridge and approach roadways: the east approach (on land); the bridge span (over water); and the west approach (on land).

The east side of the bridge corridor utilizes an unopened road allowance at the west end of Gore Road (north of the Point St. Mark neighbourhood) and the City-owned Gore Road Library property at the northwest corner of Highway 15 and Gore Road. All east side lands required for the construction and operation of the approach roadway, active transportation provisions and landscape works, embankment leading to the bridge abutment, bridge footprint and stormwater management areas will be contained within City-owned property.

The Cataraqui River bed is owned by the Federal government and managed by Parks Canada. As such, it will be necessary to recognize the footprint of the bridge both within and over the river as well as the construction and operation of the bridge through a future land lease and construction agreement(s) with Parks Canada.

The west side of the bridge corridor predominantly uses an existing unopened road allowance at the west end of John Counter Boulevard. The City has already purchased the former Music Marina property on the north side of the road allowance near-shore, up to the River Park Subdivision. This property will partially accommodate construction staging and laydown area requirements as well as future stormwater management provisions. Additional lands will also be required:

1. On the south side of the road allowance to accommodate construction staging and laydown areas, the re-located John Counter-Boulevard-Ascot Lane intersection as well as active transportation and landscape works.

2. At the John Counter Boulevard-Montreal Street intersection for widening John Counter Boulevard to accommodate eastbound turning and through lanes.

5. Permitting Status and Expectations

Parks Canada is responsible on behalf of the Federal government for managing and protecting the Canal as a National Historic Site and Canadian Heritage River. Parks Canada is also responsible on behalf of the UNESCO World Heritage Committee for protecting the Canal as a UNESCO World Heritage Site.

Following the acceptance of the ESR by the Province in 2013, the Parks Canada 'Directive on Impact Assessment' was prepared in 2015. It outlines the legislative and policy requirements and accountabilities for the assessment of impacts of proposed projects within Parks Canada protected heritage places, which includes the Canal. In keeping with its mandated priorities, Parks Canada's Environmental Impact Assessment (EIA) process examines how a project may lead to adverse effects on natural and cultural resources, specifically:

1. Adverse effects to characteristics of the environment important to key visitor experience.
2. Adverse effects to health and socio-economic conditions of First Nations and non-First Nations communities.
3. Adverse effects to First Nations communities' current use of lands and resources for traditional purposes.

The continuation of the Federal EIA process is part of the scope of this current project phase. Given the nature of the bridge project and the sensitivity of the project area, Parks Canada has determined that the Detailed Impact Analysis (DIA) framework is to be used for the Federal EIA. The DIA is the most comprehensive level of assessment, intended for complex projects that require applied analysis of project interactions with valued components that may affect a particularly sensitive environmental setting or threaten one or more sensitive valued components. The City and Project Team are currently working with Parks Canada on achieving an agreement-in-principle regarding the DIA as part of this current project phase.

Following the formal approval of the DIA during the future final design phase, the City will be required to enter into an agreement with the Government of Canada (represented by Parks Canada) to ultimately proceed to construct and subsequently operate the bridge for the duration of its life cycle, pursuant to the Federal Real Property and Federal Immovables Act. Approvals from the Cataraqui Region Conservation Authority (CRCA) would also be required for the construction work, pursuant to its role in administering Ontario Regulation 148/06: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.

In addition, there are also a number of permits and approvals that will be required from various regulatory authorities in support of the design work as it proceeds from the current project phase to the final design phase. Such approvals are related to various non-passive fieldwork activities in support of the design work, which could also include authorizations pursuant to:

1. The Endangered Species Act.
2. The Permit To Take Water requirements under the Ontario Water Resources Act.
3. Ontario Regulation 148/06.

6. Anticipated Construction Schedule

Construction of the bridge could include different techniques for its various components depending on the means and methods of the Contractor. It is estimated that the construction duration for bridge and road approaches will be three years. Best management practices and mitigation measures will be in place to either reduce or eliminate the potential negative effects of specific project construction activities on the surrounding natural and cultural heritage environment.

7. Cost Estimate and Cost Escalation Considerations

The Class EA identified the preliminary opinion of probable capital cost of a 2-lane bridge (in 2011 dollars and excluding applicable taxes) at $121M. For the current project phase, estimated capital costs were updated as the refinements to the bridge design and constructability program advanced.

As referenced earlier, the Schedule 'C' capital cost estimate prepared in support of the initial bridge design and preferred temporary work bridge construction option resulted in a significant escalation to anticipated capital project costs, in the range of $200M (in 2017 dollars), as shown in **Figure 1**.

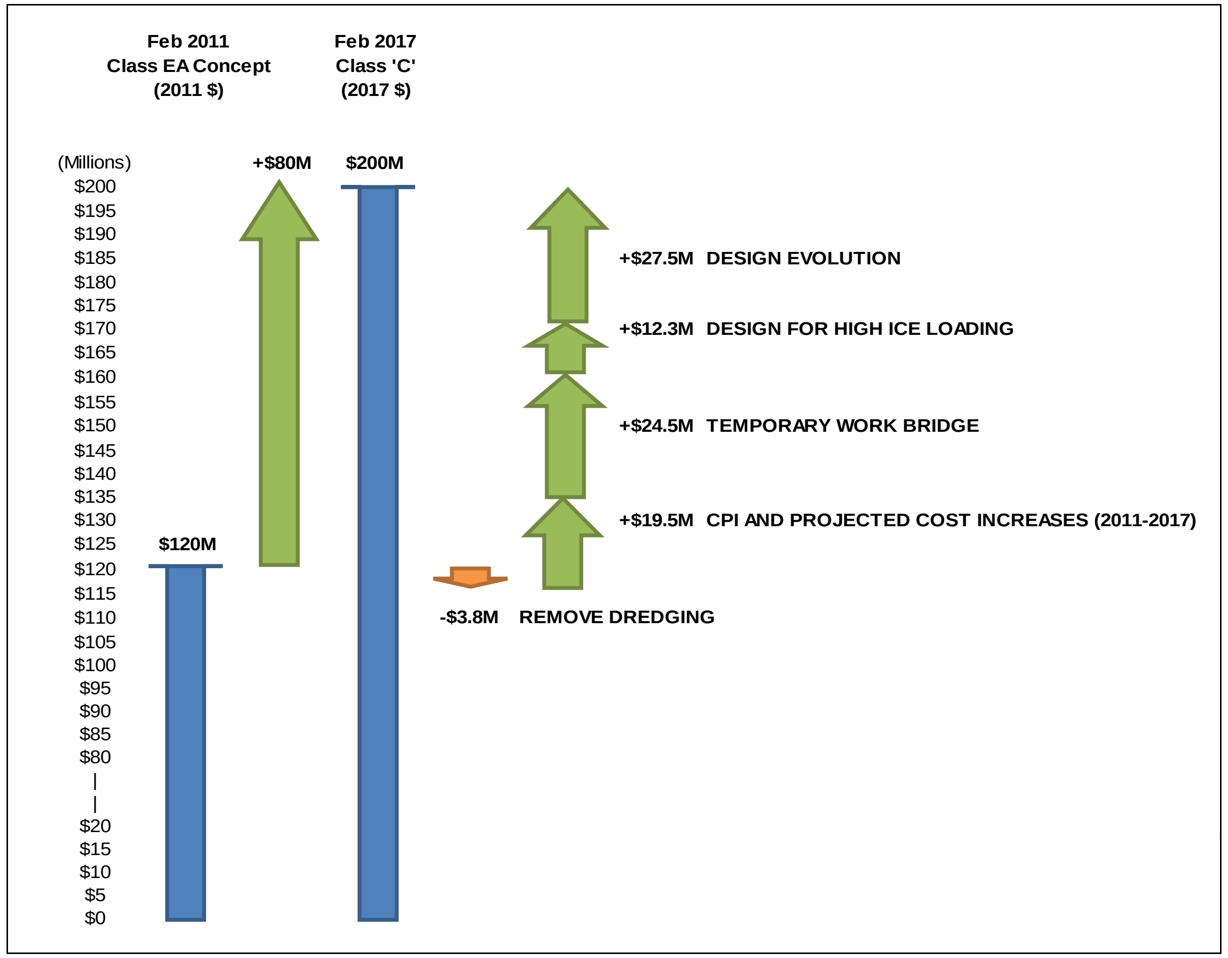


Figure 1 – Capital Cost Escalation Considerations

As also referenced earlier, the refined pier design has offered an opportunity for a 'triple win', focusing on reduced environmental impacts; retained aesthetic design and user experience considerations; and reduced capital project costs. Regarding the latter, and as shown in **Table 1**, the Class 'B' cost estimate prepared for the refined design and temporary work bridge construction option shows a capital project cost (in 2017 dollars and excluding applicable taxes) of $161M, a $40M decrease compared to the Schedule 'C' capital cost estimate for the initial design.

Table 1: Class 'B' Cost Estimate	
Sub-Total for Structure Construction	$106,500,000
Sub-Total for Construction of Bridge Approaches	$11,500,000
Sub-Total for Landscaping	$3,400,000
Sub-Total for Construction Costs	**$121,400,000**
Mobilization (3%)	$3,600,000
Engineering and Contract Administration (12.5%)	$15,200,000
Quality Management (3.0%, 2.5% Structural)	$3,100,000
Contingency (15%, 10% Landscape)	$18,000,000
Total Estimated Construction Cost	**$161,300,000**

Proportionate costs relative to construction costs (75%) and indirect costs (25%) are shown in **Figure 2**.

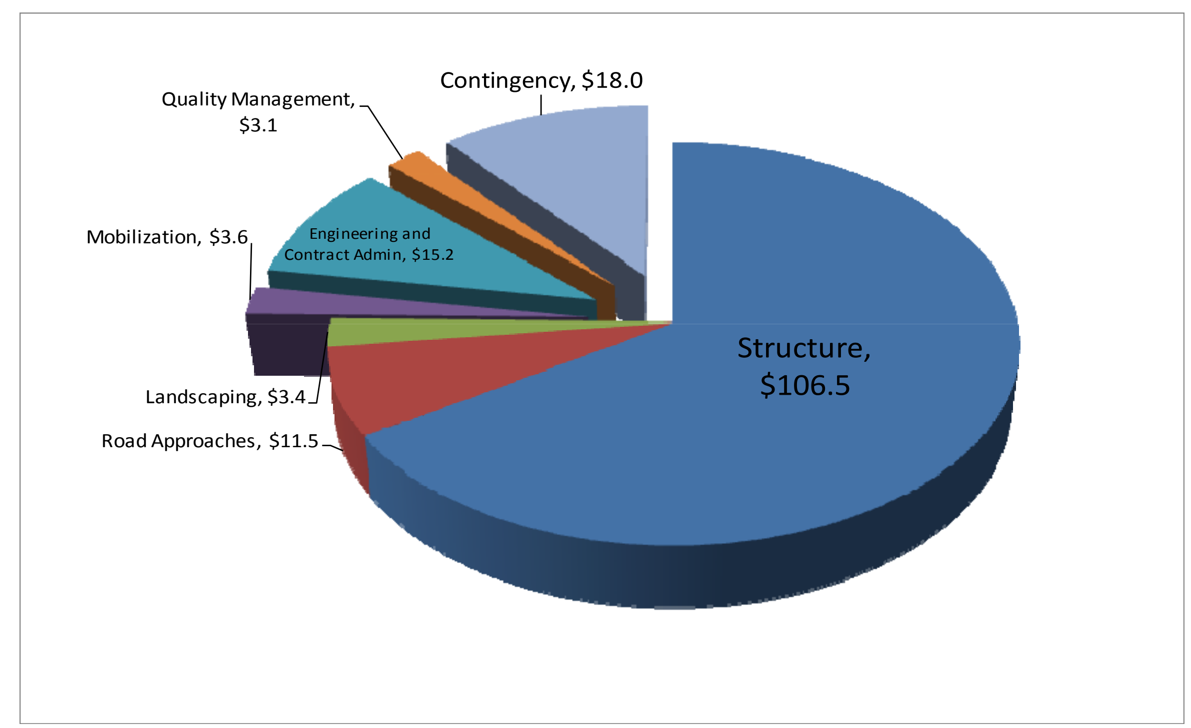


Figure 2 – Refined Bridge Design Capital Cost Breakdown

To put this refined Class 'B' cost estimate into further perspective, **Figure 3** shows the capital cost progression from the Arch With V-Piers design concept in the ESR to the current refined bridge design.

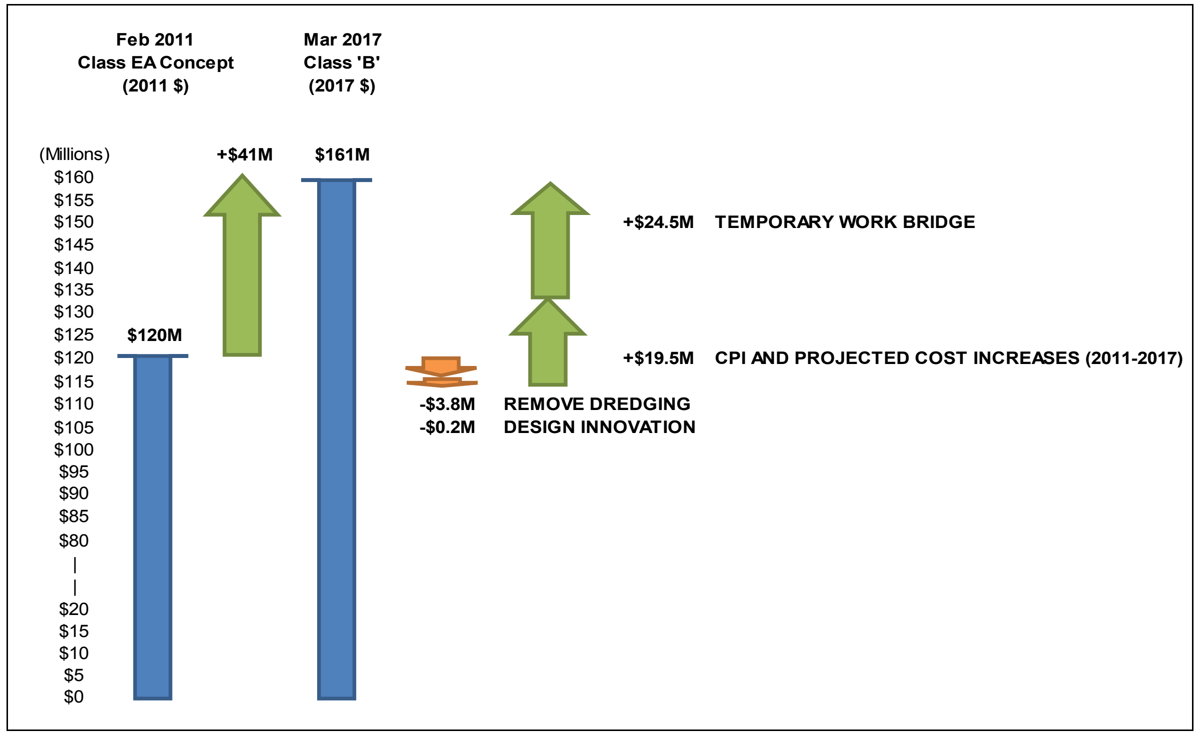


Figure 3 – Class EA Capital Cost Progression

Figure 3 shows that through design innovation, the cost to the project (from 2011), other than inflation and the preferred temporary work bridge construction option, is expected to remain the same.

8. Life Cycle Cost Considerations

A life cycle cost analysis was undertaken to determine the future capital and maintenance costs for the bridge through its service life of 100 years. With regular maintenance, it is expected that the design life of the bridge could extend well beyond 100 years.

The analysis includes costs associated with the repair and replacement of certain bridge elements to achieve the overall minimum 100 year design life. It focuses on minor rehabilitations every 15 years and major rehabilitations every 25 to 30 years. A summary of the analysis is provided in **Table 2** and **Table 3**. It shows the cost of all future capital and maintenance costs at present net value (in 2017 dollars) for the item using economic principles and a discount rate. The discount rate accounts for inflation and interest.

Table 2: Net Present Cost of Bridge Structure with Different Discount Rates

Discount Rate	Net Present Cost (2017)
3%	$156,500,000
5%	$137,900,000
7%	$126,500,000

Table 3: Net Present Cost of Road Approaches with Different Discount Rates

Discount Rate	Net Present Cost (2017)
3%	$20,300,000
5%	$16,300,000
7%	$14,300,000

9. Phase 4 Next Steps

The following activities will remain from the completion of the current project phase to the start of construction:

1. Continue stakeholder and First Nations consultations.
2. Finalize the Federal EIA with Parks Canada.
3. Confirm the need to prepare addenda to the ESR in light of current bridge design and constructability refinements.
4. Determine the preferred project delivery model.
5. Determine project financing.

6. Prepare final design drawings and specifications for construction.
7. Prepare detailed construction phasing, scheduling and cost estimates.
8. Obtain all permits and approvals required for construction.
9. Execute the land lease and construction agreement(s) with Parks Canada.
10. Obtain property easements and acquisitions for the project.
11. Procure the project (Pre-qualification, Proposal / Tendering, Agreements).

Additional studies that should be conducted during the detailed design stage include, but are not limited to, the following:

1. **Geotechnical Investigations:** The in-water test holes put down as part of the current project design phase were advanced at selected pier locations based on the previous 14-span V-pier arrangement. The refined bridge arrangement maintains the same abutment locations and overall bridge length, but now comprises 19 inverted U-frame piers. As such, most of the test holes are no longer within the footprint of the inverted U-frame pier locations. Though the relevance and applicability of the geotechnical assessments to the refined bridge arrangement is re-confirmed, additional field investigations should be carried out at the proposed U-frame pier locations during the detail design phase to confirm bedrock surface elevation and founding soil and bedrock conditions.

2. **Scour Study:** The effects of scour on bridge piers should be developed more fully during the detailed design process based on local bed conditions as well as refinements to the proposed pier design, pier construction and riverbed restoration techniques.

3. **Ice Study:** As part of the preliminary design, ice impact load was considered at two different locations, the high elevation of 74.9 m which corresponds to the maximum of the average water levels between the months of December to April; and the low elevation of 73.0 m which corresponds to the ice loading on the footing. Due to the adoption of the inverted U-shape pier for majority of the piers, it is anticipated that ice loading can be minimized. However, it is recommended that refined studies be carried out during detailed design to refine ice loading at the inverted U-shape and the V-piers that frame the arch. Consideration should be given to using pier nosing / ice breaker design and cut-water to minimize ice loading.

4. **Hydrology and Hydraulics Review:** The permanent bridge piers and associated rock scour protection that may be required will potentially amount to 3000-4000 m^2 of impacted floodplain area. On shore, within the current design, 1000-2000 m^2 of impacted floodplain is expected. With modifications to the design near the waterfront, it is possible that the total impact on east and west shorelines could be reduced to less than 1000 m^2. Therefore, in total, the impacted area is predicted to be less than 5000 m^2.

   The CRCA has recommended that a Hydrology and Hydraulics review be undertaken to demonstrate the potential effects (if any) of the 5000 m^2 impact area within the 1.5 million m^2 upstream area during a 1:100 year flood event. This work should be deferred to the detail design phase when the permanent bridge pier design and associated rock scour protection measures are further refined and confirmed.

5. **Archaeological Investigations:** The private lands on either side of John Counter Boulevard do not appear to have been extensively disturbed and may contain areas where archaeological potential still remains. Since archaeologists have no right of access to conduct archaeological testing on private lands, further assessment of the west side lands continues to be suspended, and should be resumed if the project proceeds to the detail design phase, and the affected private lands are acquired by the City.

   Regarding the east side lands, archeological site BbGc-127 and the identified survey marker should be further documented, and appropriate protocols put in place in advance of the project construction phase for:

   a) The removal through archaeological excavation of archeological site BbGc-127.

   b) The temporary removal of the identified survey marker for subsequent reinstatement in situ during the site restoration and rehabilitation sub-phase.

6. **Geo-Environmental Investigations:** Additional sampling and analyses of sediments both on-shore and in-water should be undertaken in order to further determine sediment contamination levels and ensure appropriate protocols are in place for both management and disposal measures in accordance with regulatory requirements during the site preparation and construction sub-phases.

7. **Natural Heritage Investigations:** Additional fieldwork of natural heritage resources (terrestrial and marine) should be undertaken to both further confirm the presence of sensitive natural heritage features and identify necessary design refinements to the C-NHPEP.

8. **Traffic Calming:** It is understood that vehicles moving eastbound along the bridge could turn southbound at Point St. Mark Drive and proceed through the Point St. Mark neighbourhood to avoid using the Highway 15-Gore Road intersection. Similarly, vehicles moving northbound on Highway 15 could turn west at Point St. Mark Drive to avoid using the Highway 15-Gore Road intersection. In response to this issue (referred to as traffic 'short-cutting'), there are five alternative traffic calming measures, listed below from 'least intrusive' (i.e. options 1 to 3) to 'most intrusive' (i.e. options 4 and 5):

   a) Turning restriction signs.

   b) Curb bump-outs within the Point St. Mark neighbourhood.

   c) Speed humps within the Point St. Mark neighbourhood.

   d) Directional closures at the Gore Road-Point St. Mark Drive entrance.

   e) Full closure at the Gore Road-Point St. Mark Drive entrance [with provisions for emergency vehicle and active transportation (e.g. cyclists, pedestrians) access].

   Typically, consideration would be given to implementing the above-noted traffic calming options in a progressive manner, as described above. However, the feedback received to date from Point St. Mark residents indicates concern that the least intrusive options would not solve the issue, whereas the most intrusive options would be too severe. As such, it is recommended that the City and Point St. Mark residents continue to advance collaborations on traffic calming options during the future detail design stage.

9. **Coordination with Highway 15 Upgrades:** Preliminary drawings have been developed for the three intersections within the project corridor, excluding the Gore Road-Highway 15 intersection, which is being determined under a separate Class EA study. As part of the Third Crossing Preliminary Design project, lane arrangements selected for the Gore Road-Highway 15 intersection have been co-ordinated with the Highway 15 Class EA work to ensure a cohesive design for this intersection. As such, it is recommended that collaborations continue to advance in this regard during the future detail design stage.

10. Other studies and investigations as deemed necessary by those authorities having jurisdiction.

1.0 INTRODUCTION

The City of Kingston (City) has retained a Project Team co-led by J.L. Richards & Associates Limited (JLR) and Parsons Inc. to undertake the enclosed Preliminary Design (pre-design) and Federal Environmental Impact Assessment (EIA) Report of the Third Crossing of the Cataraqui River (Report). The focus of the Report is a bridge over the Cataraqui River and associated shoreland works within the City that will link John Counter Boulevard on the west side and Gore Road on the east side (project). The Universal Transverse Mercator (UTM) coordinates, taken near the mid-point of the project corridor, is generally UTM 18T 382402 metres (m) East, 4901531 m North. At this location, the Cataraqui River forms part of the Rideau Canal (Canal), a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site (designated in 2007), National Historic Site (designated in 1925), Canadian Heritage River (designated in 2000) and Federally regulated navigable waterway.

The project is pursuant to an Ontario Municipal Class Environmental Assessment (Class EA), which was engaged in 2009 on behalf of the City by a team, also led by JLR. The Class EA was approved in 2013 by the Province of Ontario, signifying that the project could proceed to the implementation phase. As such, the enclosed Report represents the next phase in the City's Action Plan, which outlines the process needed to advance the project to 'shovel-ready' status.

As summarized in **Table 1.1**, the Project Team that prepared the enclosed Report consists of the following firms:

Table 1.1: Project Team

Team Partner	Team Role
J. L. Richards & Associates Limited	Project Management and Coordination, Transportation Planning and Engineering, Project Constructability Review and Cost Estimates, Permits and Approvals, Public and First Nations Consultation, Financial Plan Liaison
Parsons Inc. dtah	Bridge Design, Project Constructability Review and Cost Estimates
Golder Associates Ltd. JASCO Applied Sciences	Geotechnical Engineering, Hydrogeological and Geo-environmental Sciences, Natural Environment Sciences, Cultural and Heritage Sciences and Construction and Transportation Bio Acoustic and Transportation Human Noise assessments. The above disciplines provided input to the project design for these specific specialty areas in terms of project design, project construction cost estimates and Permits and Approvals.
CSW Landscape Architects Ltd.	Landscape Architecture
Leslie Higginson Surveying Ltd.	Legal and Topographic Survey

The enclosed Report outlines the following:

1. Refinements to the preferred bridge, roadway and landscape concept from the Class EA.
2. A review of potential environmental interactions and proposed measures to mitigate potential adverse environmental effects associated with the construction and operation phases of the refined concept.

1.1 Project Committees

As shown in **Table 1.1.1**, decision making and consultation activities during this current project phase have been facilitated by the following committees:

1. A Senior Management Committee to oversee the overall project direction.
2. A Technical Advisory Committee to provide technical guidance and act as a sounding board for technical decision making.
3. A First Nations Consultation Sub-Committee to facilitate consultations with First Nations communities having an interest in the project.
4. A Public Engagement Committee to provide guidance and input for public consultation activities.

1.2 Public Consultation

A comprehensive consultation plan has been implemented to facilitate meaningful input from the public and various agencies during this project phase. Public consultation has been facilitated through:

1. Maintaining an up-to-date project website at www.cityofkingston.ca/third-crossing.
2. Preparing regular project updates through various social media platforms.
3. Facilitating three Public Open Houses at the following key milestones:
   a) On September 29, 2016 at the LaSalle Secondary School which provided background information on the project and the progress of the pre-design work to date.
   b) On April 26, 2017 at the Loyalist College and Vocational Institute (LCVI), and on April 27, 2017 at the Ėcole Sir John A. Macdonald. These Public Open Houses presented the draft Report findings and recommendations.
4. Meeting with various staff with the City and other stakeholders on September 8, 2016 as part of a Sustainability Charrette on sustainability-specific design considerations for the project. The feedback report from the charrette is included in **Appendix A**.
5. Engaging in consultations on specific project issues with:
   a) Utilities Kingston (UK) staff on February 24, 2016 to discuss the status of the Kingston Water Master Plan Update, as it relates to potential water servicing accommodations within the project corridor.
   b) Kingston Hydro staff on February 26, 2016 and Hydro One Networks Inc. staff on March 29, 2016 regarding long-term strategic planning for the three Hydro One marine electrical cables [3-phase 44 kilovolt (kV) line] that currently cross the Cataraqui River in the project corridor area.
   c) UK staff on March 7, 2016 to discuss street, traffic and bridge lighting design issues and requirements.
   d) Kingston Transit staff on March 9, 2016 regarding current and long-term strategic planning for public transit within the project corridor.
   e) Senior staff with the City's Public Works Department on March 9, 2016 to discuss future bridge maintenance requirements.
   f) Cogeco Cable Canada Inc. staff on April 14, 2016 to discuss Cogeco's current and long-term utility distribution network planning within the project corridor.
   g) Parks Canada staff on April 15, 2016 regarding the pre-design work plan and activities undertaken to date.
   h) Infrastructure Ontario staff on June 9, 2016 to discuss the Business Plan.
   i) Senior staff with the City and Utilities Kingston on June 23, 2016 regarding the pre-design work plan and activities undertaken to date.
   j) Parks Canada staff on July 15 and 27, 2016 to discuss the Scoping Document in support of the Federal EIA.
   k) Senior staff with the City's Parks and Recreation Department on July 22, 2016 regarding current and long-term parks and recreation planning within the project corridor.

Table 1.1.1: Roles and Responsibilities of Project Committees

Committee	Structure	Roles and Responsibilities	Meetings To Date
Senior Management Committee	• senior City staff • senior Project Team members	• project oversight and administration • manage project budget and schedule • risk management and mitigation	• various meetings
Technical Advisory Committee	• various City Departments • senior Project Team members • Parks Canada • Fisheries & Oceans Canada (DFO) • Ontario Ministry of Natural Resources & Forestry • Ontario Ministry of Environment & Climate Change (MOECC) • Cataraqui Region Conservation Authority (CRCA)	• technical guidance on design refinements • vetting technical decision-making • identifying approval requirements	• March 11, 2016 • April 26, 2016 • June 1, 2016 • July 13, 2016 • August 17, 2016 • September 21, 2016 • November 16, 2016 • May 11, 2017
First Nations Consultations Sub-Committee	• senior City staff • senior Project Team members • special advisors	• led by the City • represents City and JLR Project Team • maintain a link with First Nations communities	• consultations undertaken through document sharing
Public Engagement Committee	• senior City staff • senior Project Team members	• Provide Input on Public Consultation Activities • Review Consultation Reports • Attend Public Open Houses	• various meetings

l) Infrastructure Ontario staff on August 25, 2016 as part of a Risk Workshop in support of the Business Plan.

m) A representative of the City's Municipal Accessibility Advisory Committee (MAAC) on September 19, 2016 to discuss accessibility and the City's Facility Accessibility Design Standards relating to the project.

n) The following stakeholders after the November 16, 2016 Technical Advisory Committee meeting on focused project issues:

   i. meetings with Parks Canada staff regarding bridge constructability, on-shore and in-water compensation related to bridge construction activities, and bridge design matters on November 29, 2016; February 2 and 16, 2017; and March 14 and 27, 2017;

   ii. a meeting with representatives of the Kingston Rowing Club on March 29, 2017 to discuss bridge design and constructability as well as rowing matters within the project corridor; and

   iii. meetings with a representative from the CRCA on March 21, 2017 and April 26, 2017 to discuss bridge design and constructability matters as well as proposed on-land and in-water protection, restoration and enhancement measures.

1.3 First Nations Consultation

The Crown, which is made up of the Federal and Provincial levels of government, has an obligation, based on its own inherent honour, to consult on matters affecting Aboriginal interests raised by First Nations. In 2010, the Supreme Court of Canada in the Rio Tinto ruling confirmed that the purpose of consultation with First Nations was not only based on the honour of the Crown but also, because of that honour, related to the onerous demands of the trial process. Accordingly, it has been established that consultations must be undertaken with the awareness not only of the constitutional fiduciary duty of the Crown to protect Aboriginal interests but also that the process stand as a surrogate for a full court process. As such, the 'Duty to Consult' is a means to ensure First Nations' interests and rights are identified and respected. It also helps the Crown to make better more durable decisions and strengthen its relationships with the First Nations of Canada.

Procedural aspects of First Nations consultation processes are often delegated to the project proponent. The project proponent is typically best-suited to speak to technical and environmental aspects of the project and where appropriate, is best-placed to address concerns raised by First Nations communities. As the proponent for this project, the City has been delegated the procedural aspects of First Nations consultation.

First Nations history in the region of Kingston is complex, in that the establishment of a European presence occurs far earlier here as compared to most other cities in Ontario. The City has sought to be recognized as a municipality which takes the Duty to Consult with First Nations communities as a serious obligation. This is due in no small part to the City's interest in understanding the rich and complex historic and continuing experience of First Nations as part of its overall cultural awareness. Consistent with this commitment, the City undertook consultations through document sharing with the following First Nations communities and associated government agencies as part of this current project phase:

1. Ardoch Algonquin First Nation.
2. Mississaugas of Alderville First Nation.
3. Mohawk Nation Council of Chiefs.
4. Mohawks of the Bay of Quinte.
5. Shabot Obaadjiwan First Nation.
6. Huron-Wendat Nation.
7. Algonquins of Ontario.
8. Algonquins of Pikwàkanagàn.
9. Mohawk Council of Akwesansne.
10. Metis Nation of Ontario.
11. Six Nations Grand River.
12. Department of Aboriginal Affairs & Northern Development.
13. Ontario Ministry of Aboriginal Affairs.

2.0 BACKGROUND INFORMATION

2.1 Municipal Class Environmental Assessment

The project is pursuant to a Class EA, which was engaged in 2009 on behalf of the City by a team led by JLR. Its purpose was to evaluate the need for and the feasibility of implementing additional transportation capacity across the Cataraqui River within the City. As shown on **Drawing 2.1.1**, the Class EA study area extended along the shoreline adjoining the Cataraqui River from the existing LaSalle Causeway-Highway 2 crossing in the City's downtown area in the south, to the existing Highway 401 crossing, 6 kilometres (km) to the north.

The Class EA proceeded as a Schedule 'C' Class EA as per the Ontario Municipal Class EA process. As the riverbed in the Class EA study area is owned by the Federal Government, the Class EA was also in process of addressing the Federal EA framework, until Federal changes to the Canadian Environmental Assessment Act (CEAA) in 2012 suspended this requirement.

The Class EA determined that the LaSalle Causeway was operating at capacity, and that travel volumes would continue to increase, based on urban growth and related travel volume demand forecasts done at the time. Thus, if left unaddressed, the increasing travel volumes would cause local traffic to divert north to use the Highway 401 crossing, thereby leading to further out-of-way travel, additional delays and potential local-regional traffic conflicts on Highway 401.

As per City requirements, the Class EA proceeded in two stages. Stage 1, which was completed in late May 2010, focused on Phases 1 and 2 of the Ontario Municipal Class EA framework, namely, the evaluation of the need for and the feasibility of implementing additional transportation capacity across the Cataraqui River (or 'Phase 1'), and the assessment of the following alternative solutions (or 'Phase 2'):

1. **Retain the status quo or do nothing:** This option was not a viable solution since:

    a) The LaSalle Causeway is operating at capacity and is expected to experience increased congestion during peak traffic periods as population and employment growth continues.

    b) It was also determined that focusing solely on active transportation (cycling and walking) and public transit, though laudable, would not be able to address the entire capacity on the LaSalle Causeway over the immediate-to-long-term.

2. **Increase the capacity of the LaSalle Causeway:** Though it was determined that widening the LaSalle Causeway-Highway 2 corridor was not a viable solution, traffic modelling done at the time confirmed that a series of Transportation Demand Management and Transportation Systems Management strategies could be a viable interim solution, subject to future monitoring of traffic conditions by the City.

3. **Increase the capacity of Highway 401 from Montreal Street to Highway 15:** Despite its capacity and expansion from four to six lanes, the Highway 401 crossing was not a viable solution, given its primary role as an inter-city freeway; the trip demand patterns of vehicles that favour crossing the Cataraqui River via the LaSalle Causeway to the south; and the related out-of-way travel and additional delays that would result from diverting local traffic 6 km north to use the Highway 401 crossing.

4. **Implement a new crossing at a location between the LaSalle Causeway and Highway 401 by either a tunnel or bridge:** As shown on **Drawing 2.1.2**, the Class EA study area was subdivided into six corridor areas with nine possible crossing alignment options based on potential connections to existing roads. The corridor areas were evaluated based on technical feasibility, transportation effectiveness and potential social, cultural, environmental and financial impacts. Area 2 and Area 4 were then short-listed for further assessment. Based on this exercise:

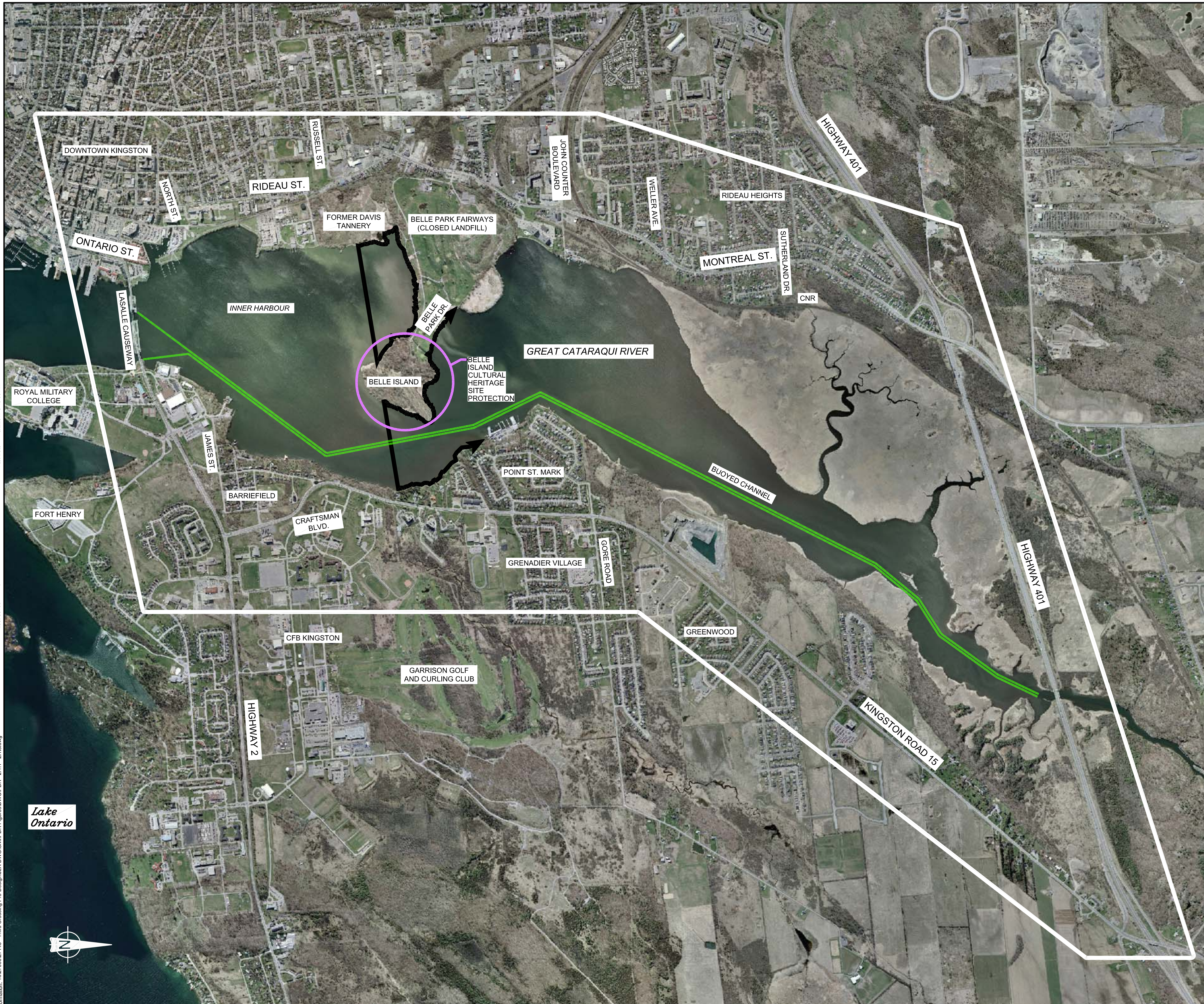
    a) A tunnel was not considered a viable alternative solution, given:

        i. vertical profile constraints, as the rock elevation is roughly 20 m to 40 m below the riverbed, and the acceptable geometric design criteria of a 6 percent (%) slope (or less) to match the existing elevation and intersections cannot be achieved;

        ii. substantial dredging of the riverbed and dewatering as well as excavations at both the west and east shores would be needed, resulting in severe environmental impacts;

        iii. capital costs would be prohibitive [in the range of $350 million (M) to $450M);

        iv. the transportation of dangerous goods may not be allowed through the tunnel for public safety reasons; and



THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

EA STUDY AREA

Mark Van Buren, P.Eng.
Director of Engineering and Deputy Commissioner

Dan Franco, P.Eng
Project Engineer

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

KINGSTON

Project No.: 27143

Drawing No.: 2.1.1

Sheet No.:

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Scale: N.T.S.

Utility Circ. No.

Code:

Load:

NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

No.	Description	By	Date (dd/mm/yy)
1	ISSUED FOR PRELIMINARY DESIGN SUMMARY REPORT	S.S.	03/05/17

LEGEND

RECOMMENDED WELLINGTON ST. EXTENSION ALTERNATIVE AS PER 2006 ENVIRONMENTAL STUDY REPORT

LIMIT OF RIDEAU CANAL RESERVE LANDS (APPROXIMATE LOCATION)

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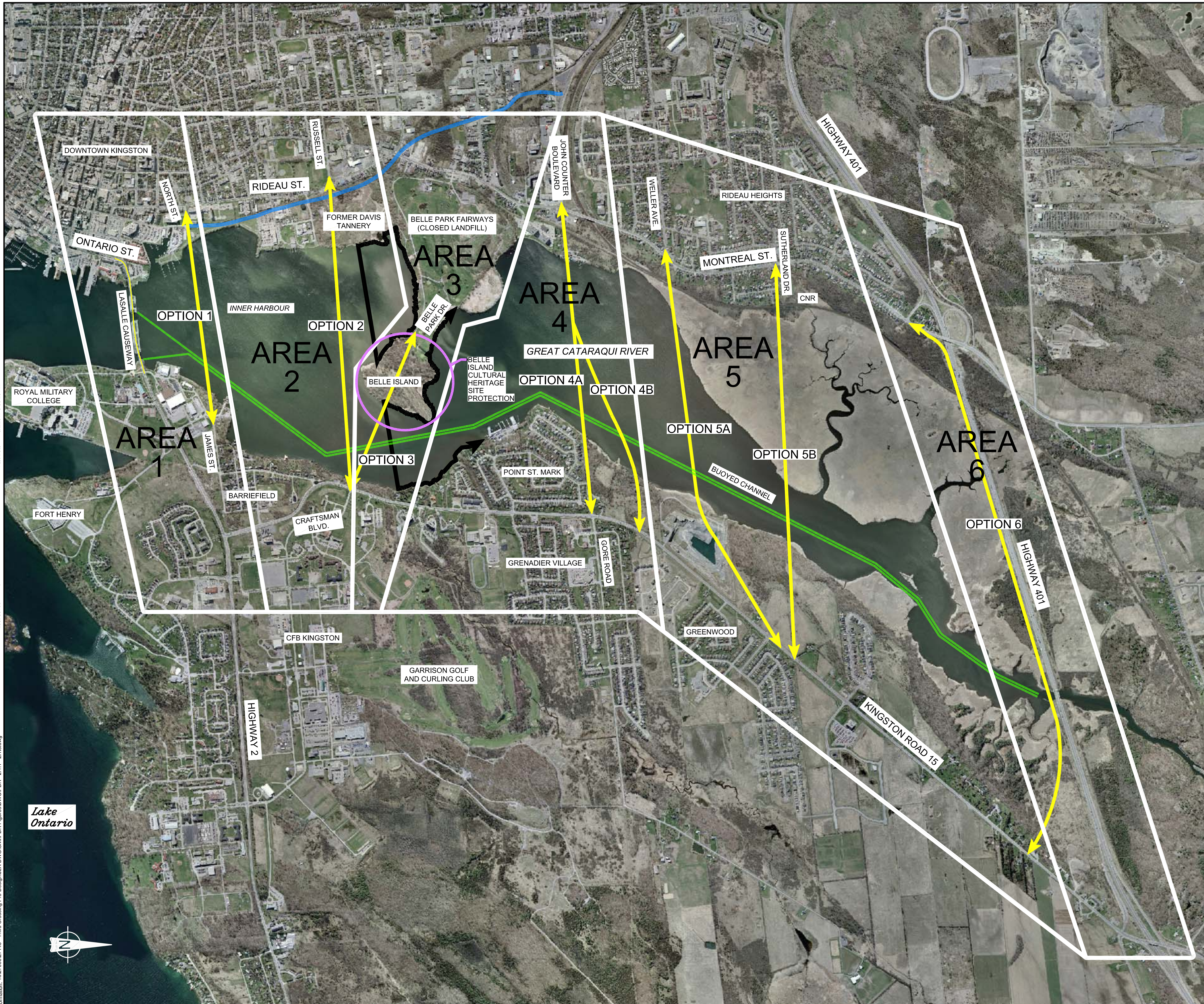

THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

EA CORRIDOR AREAS

Mark Van Buren, P.Eng.
Director of Engineering and Deputy Commissioner

Dan Franco, P.Eng.
Project Engineer

KINGSTON

J.L.Richards
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Project No.:	27143
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REVISIONS

No.	Description	By	Date (dd/mm/yy)
1	ISSUED FOR PRELIMINARY DESIGN SUMMARY REPORT	S.S.	03/05/17

LEGEND

- RECOMMENDED WELLINGTON ST. EXTENSION ALTERNATIVE AS PER 2006 ENVIRONMENTAL STUDY REPORT
- POTENTIAL LINKAGES
- LIMIT OF RIDEAU CANAL RESERVE LANDS (APPROXIMATE LOCATION)

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v. neither cyclists nor pedestrians would be allowed through the tunnel, also for public safety reasons.

b) The preferred solution, as shown on **Drawing 2.1.3**, was a bridge crossing at the John Counter Boulevard-Gore Road alignment, which:

i. by providing a mid-central arterial road corridor through the City, offers opportunities to improve urban transportation network connectivity in order to:

(a) relieve existing and future traffic congestion;

(b) enhance the delivery of municipal services such as public transit and utility infrastructure;

(c) promote walking and cycling as viable alternative modes of transportation; and

(d) accommodate planned future residential and employment growth on the east and west sides of the Cataraqui River; and

ii. by being both within the jurisdictional limits of the Canal and proximate to its southern boundary at Belle Island, offers opportunities to enhance the City's historic association with the Canal.

Stage 2 completed the Class EA by focusing on three bridge design concepts, shoreland road and landscape designs, mitigation measures, capital and maintenance costs and the Environmental Study Report (ESR). As shown on **Drawing 2.1.4**, the ESR recommended the Arch With V-Piers design concept, based on the following:

1. The double v-piers reduce in-water effects and their slender, open look minimizes visual impacts.

2. The 150 m pier-to-pier distance of the arch span provides unencumbered through-navigation for the Canal's navigable channel and adjacent rowing lanes.

3. The arch over the navigable channel and adjacent rowing lanes highlights the bridge as a 21st Century gateway to-and-from the Canal and Inner Harbour to the south.

4. The bridge has an s-curve alignment which reduces noise and visual effects and provides a softer landscape for abutting residential lands on the east shore.

5. The bridge clearance above the water accommodates existing topographic conditions on both shorelines and exceeds the minimum 6.7 m vertical by 15 m horizontal Federally regulated navigable clearance requirement for the Canal.

As shown on **Drawing 2.1.5**, a 22.9 m wide bridge deck was recommended in the ESR, which comprises the following:

1. A 4-lane vehicular roadway (two 3.5 m wide lanes for westbound travel and two 3.5 m wide lanes for eastbound travel) with a 1.8 m wide median, the need for which was based on traffic demand forecasts and an assessment of various planned road network improvement scenarios in proximity to the project corridor.

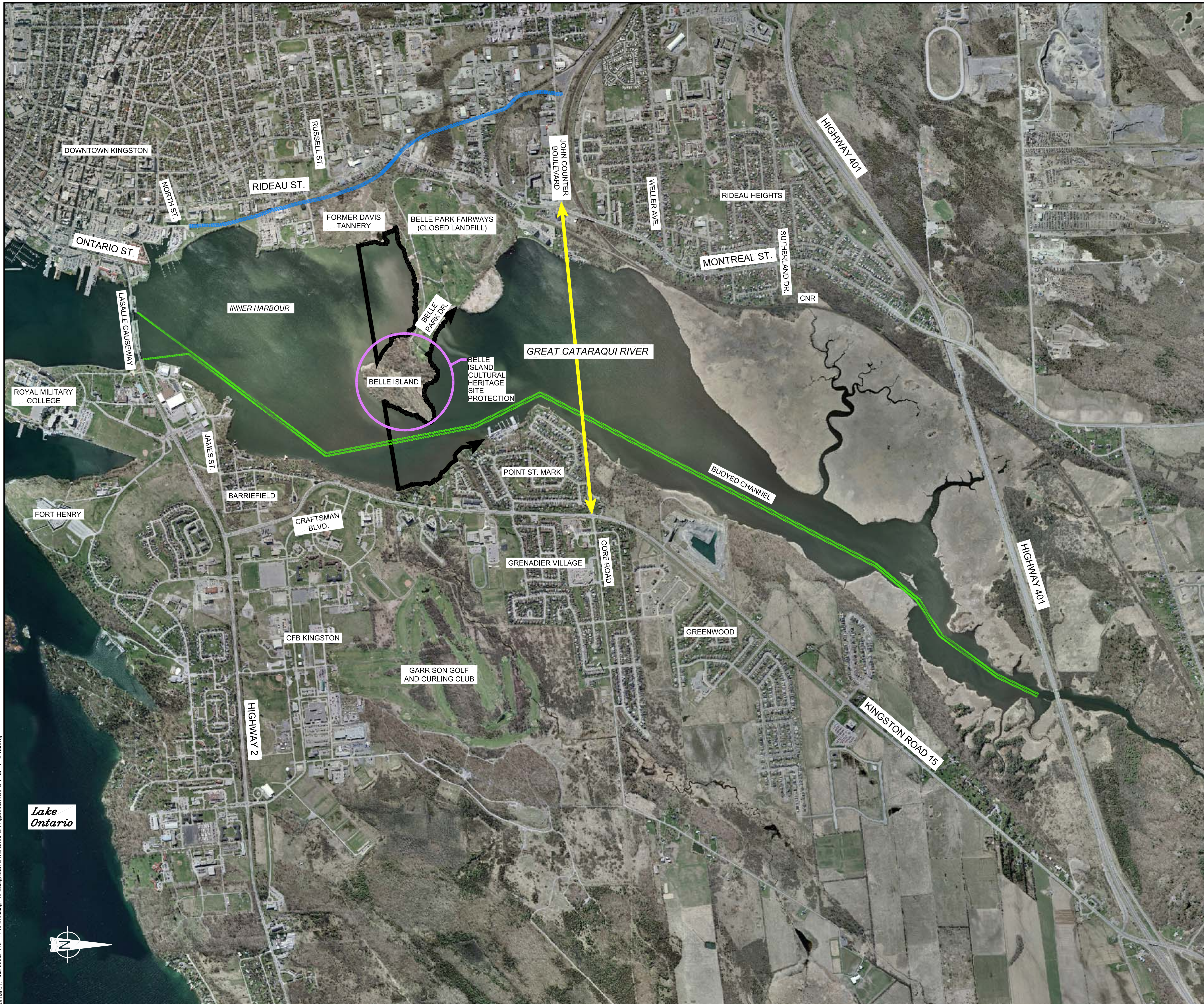
2. A 3.6 m wide multi-use pathway on the south side of the bridge for active transportation.

3. A 1.5 m wide commuter cycling lane on the north side of the bridge for westbound travel, and a 1.5 m wide commuter cycling lane on the south side of the bridge for eastbound travel.

4. A 0.5 m wide area for a barrier separating the multi-use pathway and commuter cycling lane on the south side of the bridge.

5. A series of observation look-out/interpretive areas provided along the south side of the bridge to maximize opportunities for bridge users to both enjoy views of and learn about the Canal, Belle Island and the Greater Cataraqui Marsh.

As shown on **Drawing 2.1.5**, the ESR confirmed a staged approach could work (i.e. involving a 2-lane or 3-lane bridge for vehicular traffic) with a substructure that could accommodate widening the bridge deck to accommodate 4 lanes for vehicular traffic in the future. The viability of these options would be confirmed, subject to future monitoring of traffic conditions by the City.



THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

PROJECT SITE LOCATION

Mark Van Buren, P.Eng. *Director of Engineering and Deputy Commissioner*	Dan Franco, P.Eng. *Project Engineer*

KINGSTON

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

Project No.: 27143	
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REVISIONS

No.	Description	By	Date (dd/mm/yy)
1	ISSUED FOR PRELIMINARY DESIGN SUMMARY REPORT	S.S.	03/05/17

LEGEND

- RECOMMENDED WELLINGTON ST. EXTENSION ALTERNATIVE AS PER 2006 ENVIRONMENTAL STUDY REPORT
- POTENTIAL LINKAGE
- LIMIT OF RIDEAU CANAL RESERVE LANDS (APPROXIMATE LOCATION)

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THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

ARCH WITH V-PIERS
CONCEPT PLAN VIEW

Mark Van Buren, P.Eng.
Director of Engineering and Deputy Commissioner

Dan Franco, P.Eng.
Project Engineer

KINGSTON

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Project No.:	27143
Drawing No.:	2.1.4
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REVISIONS

No.	Description	By	Date (dd/mm/yy)
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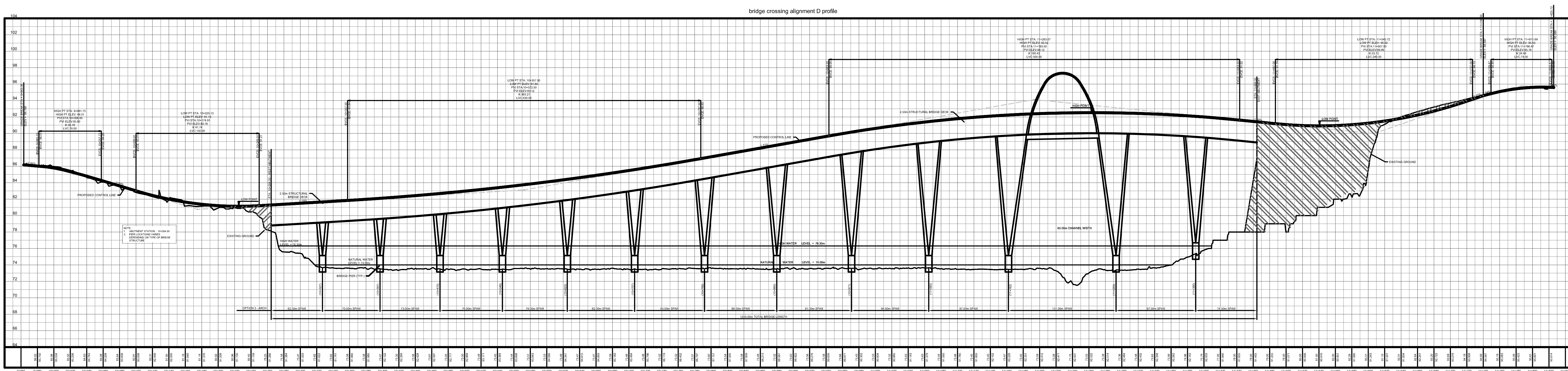
A: RENDERING (LOOKING SOUTH)



B: PROFILE AND PIER LOCATIONS (LOOKING NORTH)

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THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

BRIDGE ALIGNMENT AND DECK CONFIGURATIONS (3 LAND AND 4 LANE OPTIONS)

Mark Van Buren, P.Eng.
Director of Engineering and Deputy Commissioner

Dan Franco, P.Eng.
Project Engineer

KINGSTON

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Project No.:	27143
Drawing No.:	2.1.5
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REVISIONS

No.	Description	By	Date (dd/mm/yy)
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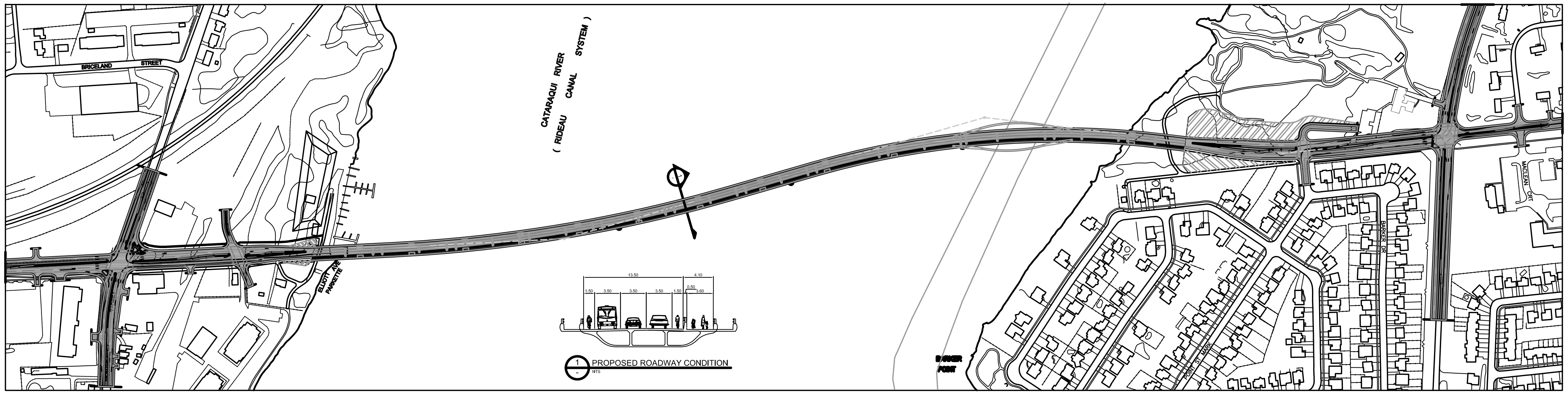
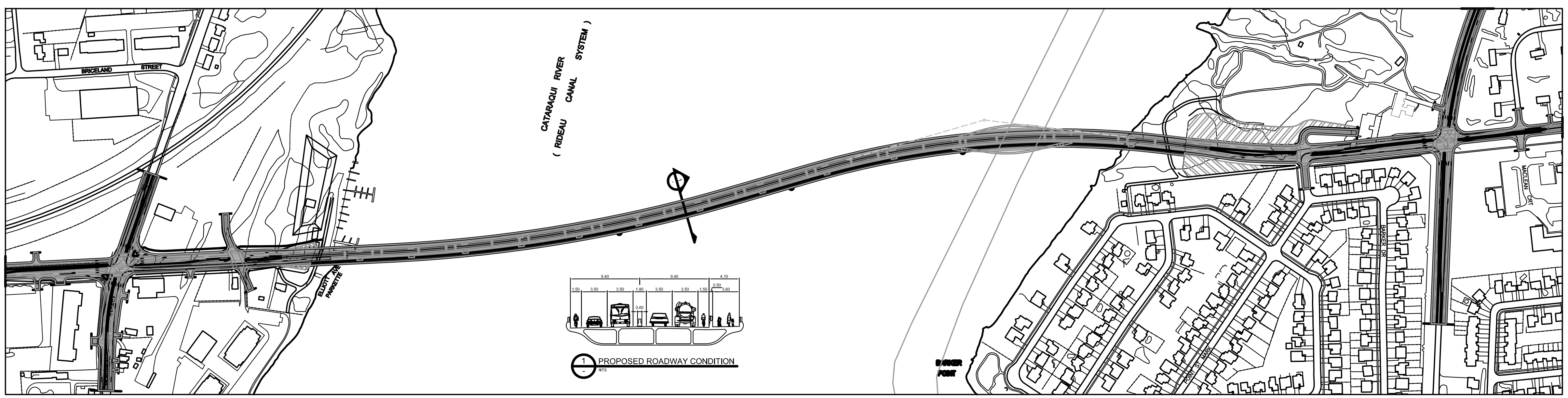


A: 3-LANE BRIDGE DECK STAGING OPTION



B: 4-LANE BRIDGE DECK

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As shown on **Drawing 2.1.6**, the ESR identified dredging a channel for construction barge access as the preferred solution to facilitate in-water bridge construction, based on the following:

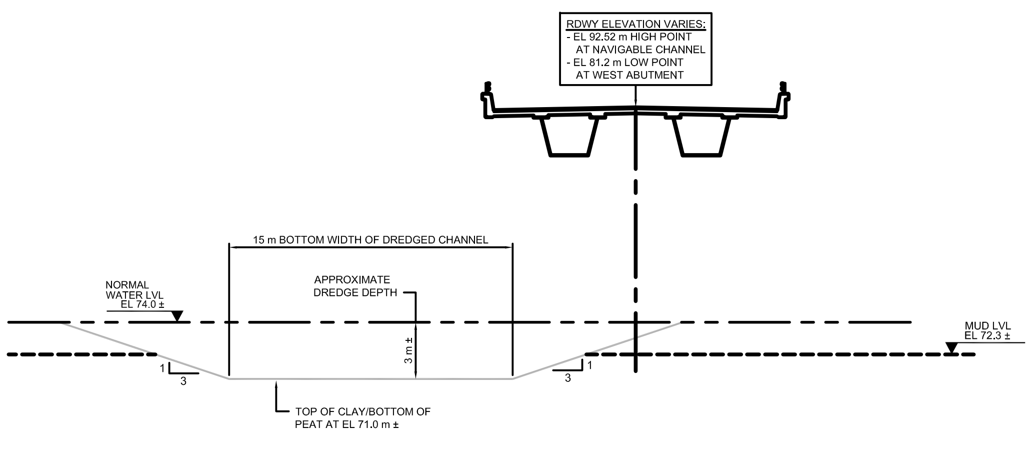
1. The excavated channel could represent a mitigation measure in response to potential project effects, in that it would introduce a more pelagic habitat (particularly for larger species) to a marine environment that is currently dominated by Milfoil, a type of submerged vegetation.
2. Dredging would reduce capital costs in the range of 8% to 12% in comparison to the temporary work bridge option, which was also assessed as part of the Class EA.
3. Dredging could accommodate a potential east-west watermain within the excavated channel, which was being planned by UK at the time of the Class EA as part of the Master Plan for Water Supply for the City of Kingston Urban Area.
4. Dredging would require only one in-water disturbance and one related set of mitigation measures as part of its installation, since it was anticipated that the excavated channel would not be backfilled due to the installation of the east-west watermain.

As shown on **Drawing 2.1.7**, the ESR recommended the following roadway and landscape improvements for the west side lands:

1. For westbound travel:
    a) Two 3.5 m wide vehicular lanes on John Counter Boulevard along with a 3.25 m wide by 20 m long left-turn bay at the Village On The River apartment access on the south side of John Counter Boulevard; and shared through/right-turn access into the River Park subdivision on the north side of John Counter Boulevard (i.e. Ascot Lane).
    b) A 3.25 m wide by 60 m long left-turn bay and a right-turn bay at Montreal Street.
2. For eastbound travel, two 3.5 m wide vehicular lanes on John Counter Boulevard along with a 3.25 m wide by 20 m long left-turn bay at the River Park subdivision access; and shared through/right-turn access into the Village On The River apartments.
3. Provisions for a median barrier separating the westbound and eastbound vehicular lanes.
4. The John Counter Boulevard-Montreal Street intersection would be signalized, and the John Counter Boulevard-Ascot Lane intersection would be two-way stop sign controlled.
5. Two shoreland observation look-out/interpretive areas on the north and south sides of the bridge to maximize opportunities for those on-land to both enjoy views of and learn about the Canal, Belle Island and the Greater Cataraqui Marsh.
6. Both the 3.6 m wide multi-use pathway and 1.5 m wide commuter cycling lane on the south side of the bridge continue along the south side of John Counter Boulevard to Montreal Street and connect with the existing Elliott Avenue Parkette recreational trail on-land by a 3.6 m wide multi-use pathway.
7. The 1.5 m wide commuter cycling lane on the north side of the bridge continues along the north side of John Counter Boulevard to Montreal Street and also connects with the existing Elliott Avenue Parkette on-land by a 3.6 m wide multi-use pathway under the bridge.
8. A sidewalk on the north side of John Counter Boulevard, which extends from the multi-use pathway access to Montreal Street.

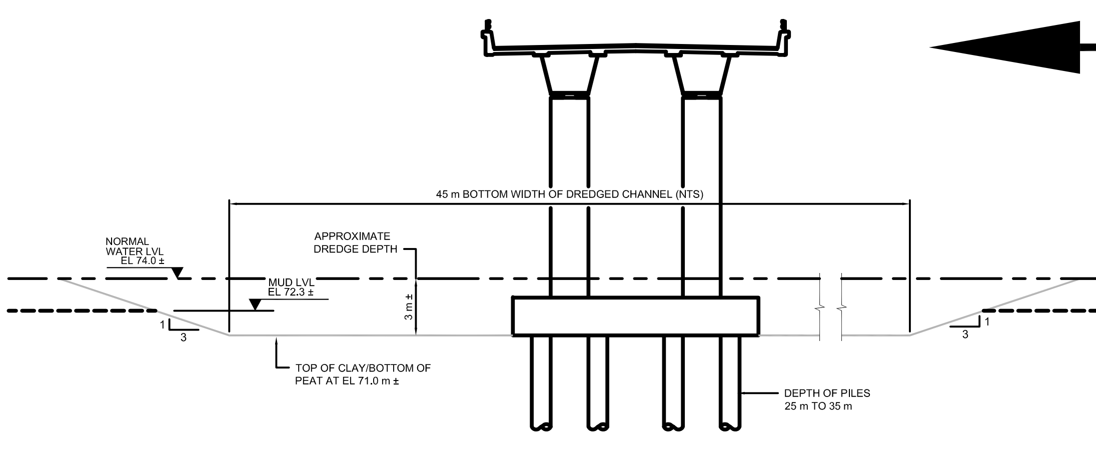
As shown on **Drawing 2.1.8**, the ESR recommended the following roadway and landscape improvements for the east side lands:

1. For westbound travel, two 3.5 m wide vehicular lanes on Gore Road along with a 3.25 m wide by 20 m long left-turn bay at Point St. Mark Drive and a right turn option at the Gore Road Library.
2. For eastbound travel, two 3.5 m wide vehicular lanes on Gore Road along with:
    a) A 3.25 m wide by 60 m long left-turn bay, through lane/left-turn lane and right-turn lane option east of Point St. Mark Drive at Highway 15.
    b) A 3.25 m wide by 20 m long left-turn bay at the Gore Road Library.
    c) A right-turn option at Point St. Mark Drive.



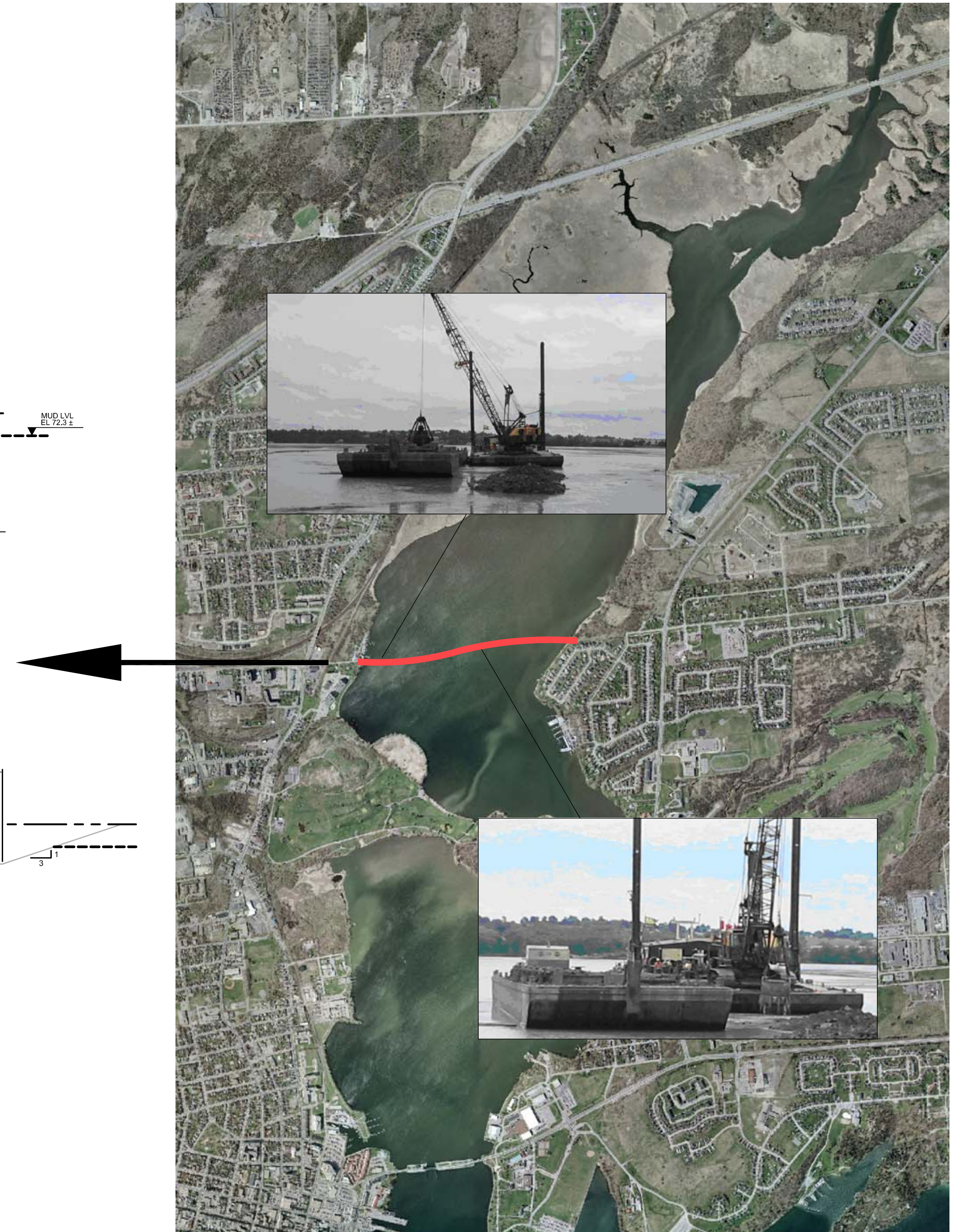
DREDGING OPTION - SECTION BETWEEN PIERS

NTS



DREDGING OPTION - SECTION AT PIER

NTS



THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

IN - WATER BRIDGE CONSTRUCTION OPTION: DREDGING

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Director of Engineering and Deputy Commissioner

Dan Franco, P.Eng.
Project Engineer

KINGSTON

J.L.Richards
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Project No.:	27143
Drawing No.:	2.1.6
Sheet No.:	
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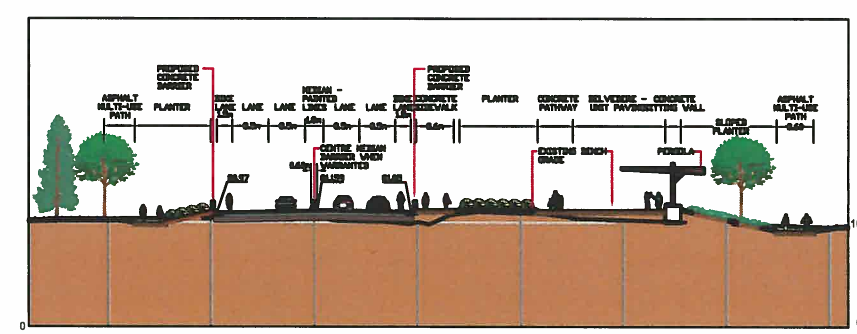
Tentative Property Requirements



SECTION A-A

THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

ROAD AND LANDSCAPE CONCEPT
WEST SIDE

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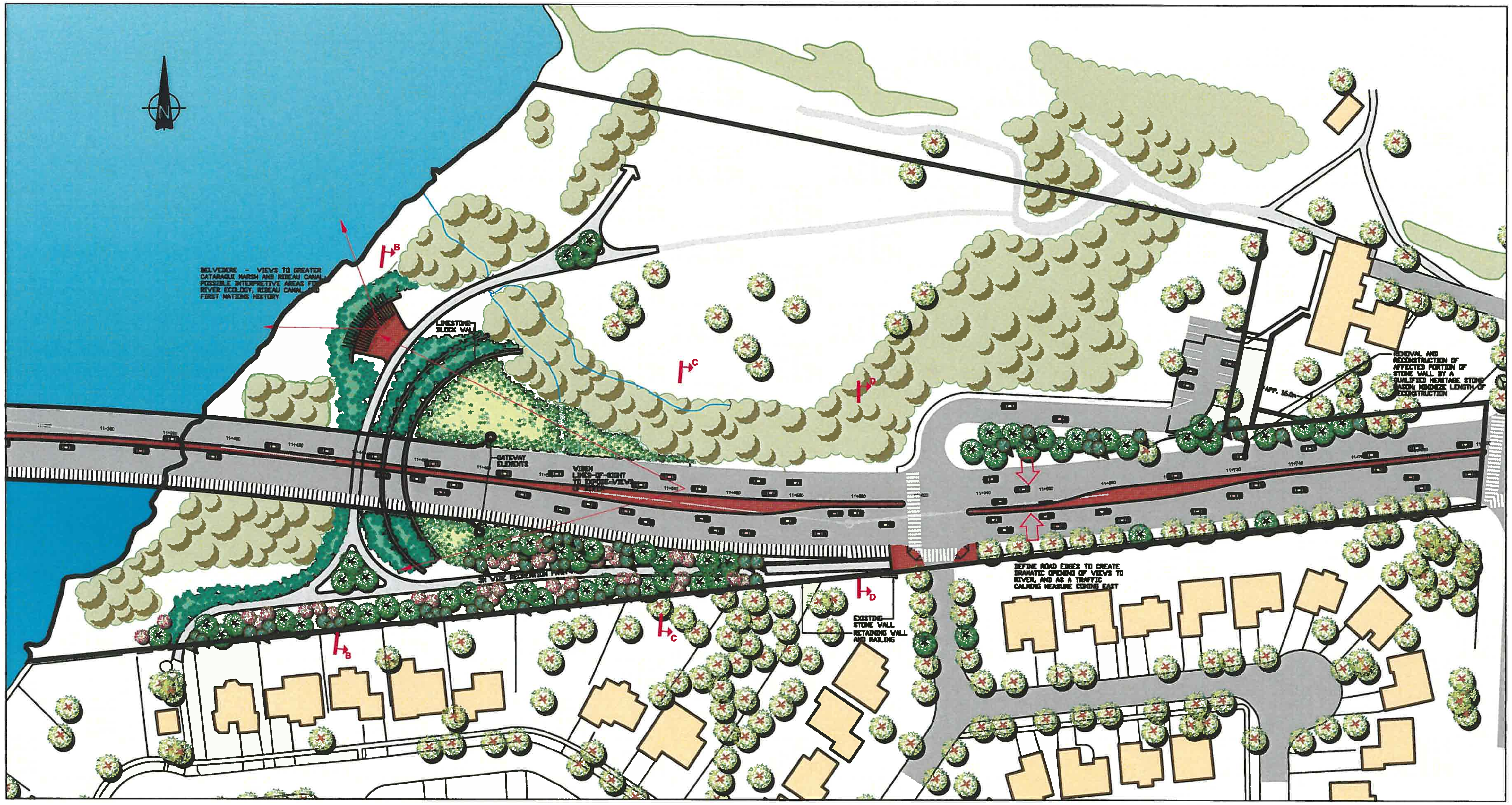

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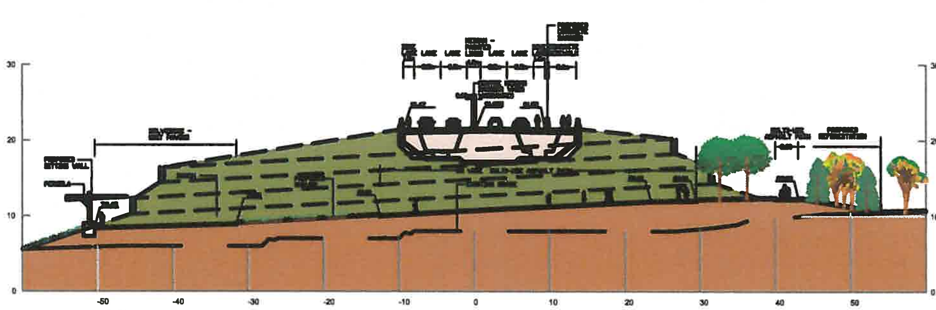

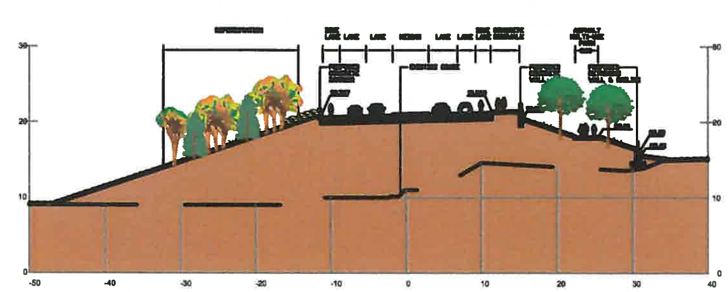

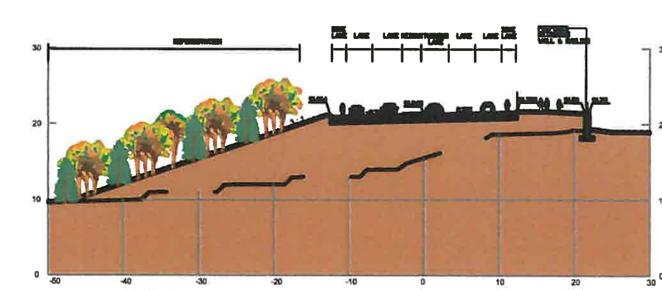

THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

ROAD AND LANDSCAPE CONCEPT EAST SIDE

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J.L.Richards
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Project No.:	27143
Drawing No.:	2.1.8
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3. Provisions for a median barrier separating the westbound and eastbound vehicular lanes.

4. The signalization of the Gore Road-Point St. Mark Drive-Gore Road Library intersection and the Gore Road-Highway 15 intersection.

5. The 3.6 m wide multi-use pathway on the south side of the bridge is shown:

   a) Continuing along the south side of Gore Road west of Point St. Mark Drive and connecting to the existing trail into Point St. Mark.

   b) Extending under the bridge to connect with the trail network on the Gore Road Library property.

6. A 1.5 m commuter cycling lane is proposed on both sides of Gore Road.

7. The existing 1.5 m wide sidewalk would remain on the south side of Gore Road east of Point St. Mark Drive to Highway 15.

8. In regards to the Gore Road Library property:

   a) A proposed on-land observation look-out/interpretive area is shown to maximize opportunities for the public to both enjoy views of and learn about the Gore Road Library, Canal, Belle Island and the Greater Cataraqui Marsh.

   b) As the proposed roadway improvements would impact a portion of the traditional dry stone wall located on-site, it is recommended that the affected portion of this wall should be realigned (as shown conceptually on **Drawing 2.1.8**) and incorporated into the landscape improvements to mitigate associated cultural heritage impacts.

9. The incorporation of the two drainage routes that collect groundwater from the Point St. Mark residential neighbourhood and direct it to the Cataraqui River.

Stormwater collection and management would include on-shore treatment (for sediment removal) and release in accordance with regulatory requirements. Catchbasins along the curb lines would collect the stormwater which would then be piped to a stormwater management facility (either above grade or underground) on-land, where the release rate of the water would be limited to pre-development conditions.

As shown on **Drawing 2.1.9**, four sound attenuation barriers were recommended in the ESR at the following locations to reduce the predicted sound levels from the project at noise-sensitive areas:

1. Adjacent to the River Park subdivision along the north side of John Counter Boulevard:

   a) A 3 m high by 110 m long wall and/or berm extending west from the John Counter Boulevard-Ascot Lane intersection.

   b) A 3 m high by 96 m long wall and/or berm extending east from the John Counter Boulevard-Ascot Lane intersection.

2. Adjacent to the Point St. Mark subdivision along the south side of Gore Road:

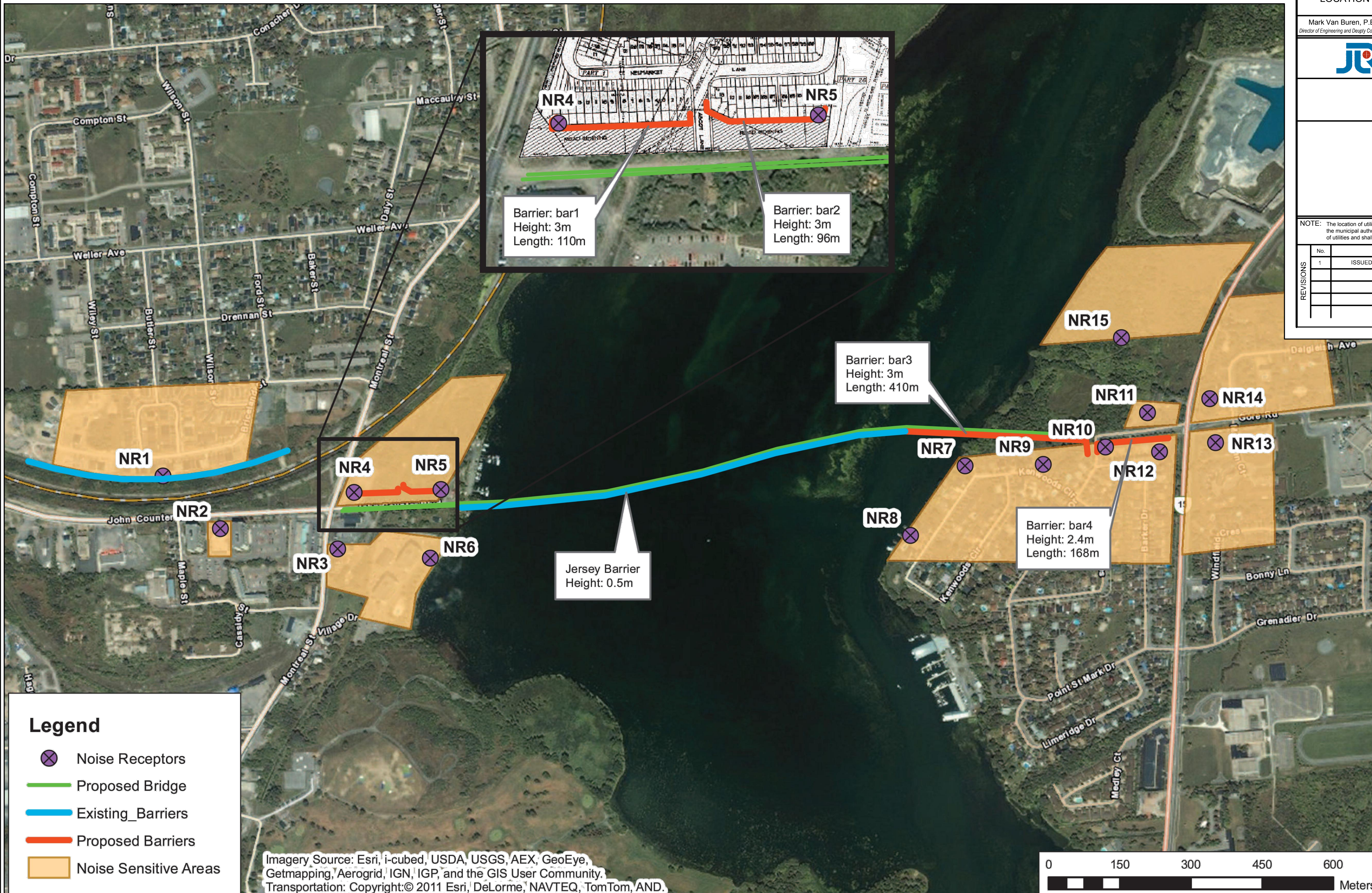
   a) A 3 m high by 410 m long wall extending west from the Gore Road-Point St. Mark intersection onto the south side of the bridge deck and ending proximate to the Canal's navigable channel.

   b) A 2.4 m high by 96 m long wall extending east from the Gore Road-Point St. Mark intersection and ending proximate to the Gore Road-Highway 15 intersection.

The following are highlights from the ESR regarding how the bridge would get built over a three year timeframe:

1. The east and west side lands within the project corridor would undergo site preparation, and dredging of the riverbed east-to-west would commence in 150 m to 200 m segments. Given the limited vacant land on either shore, the Gore Road Library property on the east side, and lands adjacent to the John Counter Boulevard right-of-way on the west side would serve as the main sites for construction staging and lay-down areas as well as future stormwater management provisions.

2. The bridge substructure would then be constructed. Rock socketed piles would be driven into the bedrock. Once the silt and overburden was removed from inside the pile, the concrete would get delivered by barge or a line pump from shore.



THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

LOCATION OF NOISE BARRIERS

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J.L.Richards ENGINEERS·ARCHITECTS·PLANNERS

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3. In terms of the bridge superstructure, the steel girders pier-to-pier would then get installed along with the precast concrete bridge deck panels. Due to limited vacant land within the project corridor, a portion of the bridge components would most likely be fabricated off-site and delivered by barge or road.

In regards to the preliminary opinion of probable capital and maintenance costs for the various Arch With V-Piers conceptual bridge deck scenarios (in 2011 dollars and excluding applicable taxes), the ESR determined that:

1. The preliminary opinion of probable capital cost would be:

    a) $121M for the 2-lane bridge scenario.

    b) $179M for the 3-lane bridge (4-lane substructure) scenario.

    c) $196M for the 4-lane bridge scenario.

2. The preliminary opinion of probable maintenance cost was estimated to be up to $4,000 per lane km.

The ESR identified a series of potential environmental interactions associated with the 100-plus year design life cycle of the bridge, from construction through to operations and decommissioning. The following two tools were recommended in the ESR for the City to prepare and implement during future project phases to mitigate potential adverse environmental effects:

1. A Cultural-Natural Heritage Protection Plan (C-NHPP), which would include the extensive mitigation and enhancement measures recommended in the ESR.

2. A Community Action Plan (CAP) that would establish protocols for use by the City for notifying the general public of any service interruptions and addressing public issues arising from bridge construction activities as well as the subsequent use and maintenance of the bridge.

City Council approved the ESR in May 2012, following which, as part of the mandatory public and agency review period, four Part II Orders (commonly referred to as ‘bump-up requests’) were received by the MOECC. The MOECC reviewed the ESR and liaised with those who had filed the Part II Orders. In June 2013, the MOECC notified the City that the ESR had been officially accepted by the Province, and that the project could proceed to the implementation phase, subject to the following conditions prior to commencing construction:

1. That the City continue to liaise with the Mohawk Nation Council of Chiefs on bridge design issues.

2. That the City consult with the MOECC to confirm bridge construction protocols, mitigation measures as well as approval and permit requirements.

2.2 City of Kingston Action Plan

On February 19, 2013, City staff presented Council with an Action Plan (Report to Council No. 13-097) which was updated on September 19, 2015 (Report to Council No. 15-268). The Action Plan outlines the next steps needed to advance the project to ‘shovel-ready’ status, namely:

1. The recent completion of the Development Charges By-Law update and the 2015 Kingston Transportation Master Plan (KTMP), the latter of which confirmed that a 2-lane bridge and a 2-lane cross-section for the approach roadways are needed.

2. The undertaking of this current project design phase.

3. The preparation of a Business Plan which is focusing on cost-benefit and economic impact analyses of the project; project funding sources; and a preferred project delivery model. The Business Plan is being undertaken on parallel timelines with the undertaking of this current project design phase, but as a separate assignment.

4. The preparation of the final design for the project prior to construction.

2.3 Canadian Environmental Assessment Act (CEAA) Process

As noted earlier, the riverbed within and adjacent to the project corridor is owned by the Federal Government. As such, the Class EA was in process of addressing the Federal EA framework, until Federal changes to the CEAA in 2012 suspended this requirement.

Section 67 of the CEAA 2012 provides discretion regarding how to conduct an analysis to determine whether or not a project is likely to cause significant adverse environmental effects. Following the acceptance of the ESR by the Province in 2013, Parks Canada’s Directive on Impact Assessment was prepared in 2015. It outlines the legislative and policy requirements and accountabilities for the assessment of impacts of proposed projects within Parks Canada protected heritage places, which includes the Canal. In keeping with its mandated priorities, Parks Canada's EIA process examines how a project may lead to adverse effects on:

1. Natural resources, including Species at Risk, air, ground and surface water, soils, habitat features, as well as plants and animals found in the vicinity of a project or otherwise potentially affected by the project.

2. Cultural resources, including potential adverse effects to heritage value and character defining elements of known cultural resources, and risks to areas with high potential to contain cultural resources where no inventory has yet been completed.

In addition, the Parks Canada EIA process requires consideration of how the effects of a proposed project on natural resources may in turn cause:

1. Adverse effects to characteristics of the environment important to key visitor experience (how the project is anticipated to affect activities and/or visitors' enjoyment and connection to place, in relation to defined objectives for the protected heritage place).

2. Adverse effects to health and socio-economic conditions of First Nations and non-First Nations communities.

3. Adverse effects to First Nations communities' current use of lands and resources for traditional purposes

The Federal EIA process is part of the scope of this current project design phase, and shall continue into future project phases leading up to construction. Given the nature of the project and the sensitivity of the project area, Parks Canada's Director of Waterways has determined that the Detailed Impact Analysis (DIA) framework is to be used for the Federal EIA. The DIA is the most comprehensive level of assessment, intended for complex projects that require applied analysis of project interactions with valued components that may affect a particularly sensitive environmental setting or threaten one or more sensitive valued components.

Parks Canada, in consultation with the City and Project Team, prepared a Scoping Document for the DIA, which is included in **Appendix B**. The Scoping Document provides guidance on the following phases of the project that shall be addressed in the DIA:

1. Site preparation.

2. Construction.

3. Site restoration and rehabilitation.

4. Operation.

Decommissioning is not included as part of the scope of the DIA since it is anticipated that the bridge will have a life span of more than 100 years. As such, details regarding decommissioning works are not available at this time. If and when decommissioning is required, such works will be subject to impact assessment as per regulations current to that time.

The DIA shall describe and assess potential interactions (including timing, frequency, duration, residual effects, cumulative effects and mitigation) between the phases of the project noted above and various environmental components, focused within the project corridor. As outlined in **Table 2.3.1**, the environmental components are categorized as:

1. Valued Components, which represent the main focus of the DIA based on Parks Canada's mandate.

2. Secondary Components, which represent the secondary focus of the DIA, but are also reflective of Parks Canada's mandate.

Table 2.3.1: Valued and Secondary Components

Valued Components	Secondary Components
1. Greater Cataraqui Marsh Provincially Significant Wetland (PSW)	1. Groundwater quality and quantity
2. Fish and fish habitat	2. Terrain, geology and soils
3. Migratory birds and their habitat	3. Terrestrial wildlife
4. Species at Risk	4. Terrestrial vegetation
5. Surface water quality and quantity	5. Air quality and climate change
6. Hydrologic processes	
7. Aquatic habitat quality	
8. Aquatic wildlife and vegetation	
9. Surrounding cultural landscape	
10. Submerged cultural resources	
11. Rideau Canal's Commemorative Integrity	
12. Rideau Canal's Outstanding Universal Value	
13. Visitor experience and recreation	
14. Aesthetic values	
15. Navigation	

The nature and extent of consultations with First Nations communities (in accordance with the Duty to Consult protocol) and the general public shall also be documented as part of the DIA process.

Parks Canada has provided guidance to the City and Project Team during the DIA process. Parks Canada is also being assisted by the following Expert Federal Authorities:

1. Fisheries and Oceans Canada (DFO), pursuant to its role in administering the Fisheries Act.
2. Transport Canada (TC), in accordance with its role in administering the Navigation Protection Act.
3. Environment and Climate Change Canada (ECCC).

Finally, it should be noted that the ESR may be used if some or all of the DIA components are already provided in order to minimize duplication. As such, the evaluation, consultation and decision-making process for the DIA is being summarized through this Report. With this in mind, **Table 2.3.2** describes both the temporal and geographic scope for the DIA:

Table 2.3.2: DIA Temporal and Geographic Scope

	Temporal Scope			
	Preparation Phase	**Construction Phase**	**Operation Phase**	**Geographic Scope**
Valued Components:				
Greater Cataraqui Marsh PSW	1. Stage 1 / Stage 2 of the Class EA (see Figure 3 in Appendix B) 2. Pre-design scope: see Figure 4.2 in Appendix B			
Fish and Fish Habitat				
Migratory Birds and Habitat				
Species at Risk				
Surface Water Quality and Quantity				
Aquatic Habitat Quality				
Aquatic Wildlife and Vegetation				
Cultural Landscape				
Rideau Canal's Commemorative Integrity				
Rideau Canal's Outstanding Universal Value				
Visitor Experience and Recreational Opportunities	1. Stage 1 / Stage 2 of the Class EA (see Figure 3 in Appendix B) 2. Pre-design scope: pre-design concept			
Aesthetic Values				
Navigation				
Hydrologic Processes	1. Stage 1 / Stage 2 of the Class EA (see Figure 3 in Appendix B) 2. Pre-design scope: see Figure 4.1 in Appendix B			
Submerged Cultural Resources				
Secondary Components:	1. Stage 1 / Stage 2 of the Class EA (see Figure 3 in Appendix B) 2. Pre-design scope: see Figures 4.1 and 4.4 in Appendix B			
Groundwater Quality and Quantity				
Terrain, Geology, and Soils				
Terrestrial Wildlife	1. Stage 1 / Stage 2 of the Class EA (see Figure 3 in Appendix B) 2. Pre-design scope: see Figure 4.2 in Appendix B			
Terrestrial Vegetation				
Air Quality and Climate Change	1. Stage 2 of the Class EA (see Figure 3 in Appendix B) 2. Pre-design scope: see Figure 4.3 in Appendix B			

2.4 Mission Statement and Vision

The purpose of this current project design phase is to inform future project phases in accordance with the City's Action Plan. This also includes the continuation of the DIA process, pursuant to Section 67 of CEAA 2012. As such, the Project Team has prepared a Mission Statement, Vision and Values in **Table 2.4.1** to guide this multi-faceted process.

Table 2.4.1: Mission Statement, Vision and Values

A. Mission Statement	Continue to empower affected stakeholders in engaging in the pre-design of a new state-of-the art bridge which, by linking John Counter Boulevard and Gore Road over the Cataraqui River and the Canal, is functional and aesthetically appropriate within an established regulatory framework, and which advocates trust, and cultural, environmental, social and fiscal responsibility.
B. Vision	Through innovative planning, design, and consultation, the pre-design phase of the project will continue to reinforce the City's proud historic association with the Canal and its goal of becoming Canada's most sustainable City.
C. Values	
C.1 Cultural and Natural Heritage Integrity	1. Complement the heritage values of the Canal as a UNESCO World Heritage Site, National Historic Site of Canada and Canadian Heritage River. 2. Respect the customs and traditions integral to the distinctive cultures of First Nations communities. 3. Respect the history of engineering innovation with the Canal within a 21st Century design context. 4. Enhance the natural landscape of the corridor shore lands. 5. Ensure that impacts on Species at Risk are minimized and that there is no net loss of fish habitat and no net loss of wetland structure and function.
C.2 Healthy Community	1. Provide safe, cost-effective (in terms of capital, maintenance and lifecycle costs), convenient and accessible pedestrian, cycling, public transit and automotive circulation and connections. 2. Ensure through-navigation as a valued means by which to promote public understanding, appreciation and enjoyment of the Canal and the City's unique heritage and cultural character. 3. Achieve a design that is appropriate to and compatible with adjacent land uses, the immediate natural setting and the broader Belle Island and Canal contexts. 4. Provide functional and attractive lighting for motorists, public realms and bridge accentuation and which also mitigates light impacts on the natural environment. 5. Enhance day and night views towards the bridge by river users, non-motorists and motorists and maximize day and night viewing opportunities to the setting from the bridge for non-motorists and motorists.

Table 2.4.1: Mission Statement, Vision and Values	
C.2 Healthy Community	6. Maximize opportunities for the public to learn about the Canal, Belle Island and the Greater Cataraqui Marsh through such means as interpretive signage and public art.
C.3 Design Functionality and Integrity	1. Incorporate the constant gradual s-curve bridge alignment in order to reduce noise and visual impacts on Point St. Mark; provide softer landscaping options on the east shore; and reflect the 'urban-natural' transition point of the project corridor. 2. Incorporate the different elevations on both shores, while minimizing visual impacts. 3. Incorporate the arch over the navigable channel and adjacent rowing lanes to highlight the bridge as a 21st Century 'gateway' to-and-from the Canal and Inner Harbour to the south. 4. Optimize the approach spans in order to minimize the related impacts to the natural environment. 5. Incorporate into the bridge deck and approach roadway design: a 2-lane cross-section for vehicular traffic; commuter cycling provisions on both sides of the vehicular cross-section; and a multi-use pathway network (on the south side of the bridge deck and on-land). 6. Confirm opportunities to incorporate utilities into the overall project design. 7. Incorporate safe and functional intersection designs at Montreal Street, Ascot Lane, Point St. Mark Drive and Highway 15.
C.3 Design Functionality and Integrity	8. Incorporate observation look-out / interpretive nodes on the bridge deck and on-land to maximize opportunities for the public to learn about the Canal, Belle Island and the Greater Cataraqui Marsh. 9. Ensure the landscape improvements accentuate the public realm and provide a natural destination point. 10. Employ an integrated evaluation of net and cumulative environmental effects and prepare mitigation and enhancement design measures over the entire life cycle of the bridge. 11. Ensure the design integrates constructability and fabrication measures in order to reduce capital and future maintenance costs, environmental impacts as well as optimize the construction schedule. 12. Optimize the service life of the bridge by paying close attention to material quality and selection as well as life cycle costs in relation to identified capital and maintenance budget ratios.

3.0 BRIDGE AND APPROACH DESIGN CRITERIA

3.1 Parks Canada Bridge Design Guidelines

The Heritage Values and Guiding Principles for the Cataraqui River Sector of the Rideau Canal was prepared in 2010 in support of the Class EA process. It focuses the key heritage values of the lower Cataraqui section of the Canal on its historic, ecological and visual inter-relationships with the waterway and shorelands; the through-navigation of the Canal system itself; and its extensive wetlands and other natural heritage elements. These key heritage values are then reflected in the following strategic principles that serve to guide and inform the design of proposed development projects in the lower Cataraqui section of the Canal:

1. Recognize Parks Canada's jurisdiction of the Canal.
2. Protect natural and cultural heritage resources.
3. Maintain through-navigation of the Canal system.
4. Undertake First Nations consultations in accordance with the Federal Duty to Consult protocol.
5. Maintain view sheds and visual linkages.
6. Enhance public understanding and visitor experience of the Canal.

Parks Canada has also prepared bridge design guidelines that further articulate the strategic principles noted above for the lower Cataraqui section of the Canal. A draft of the design guidelines was originally prepared in 2010 by Parks Canada in support of the Class EA process. The draft guidelines were finalized on August 2, 2016 and incorporate the Heritage Values and Guiding Principles for the Cataraqui River Sector of the Rideau Canal noted above. Key highlights are summarized as follows:

1. The Canal warrants a world-class bridge design that:
    a) Respects the natural and cultural heritage values of this part of the Canal as well as First Nations customs and traditions.
    b) Is appropriate to and compatible with its natural setting to the north, the urbanized environment of the City to the south, east and west, and the Belle Island context, also to the south.
    c) Responds to the Canal's history of engineering innovation and bridge design, but is an expression of its own time.
    d) Supports a safe, enjoyable and memorable experience for bridge and Canal users.
2. Aesthetically, the bridge should respond to the significance of the Canal by achieving a landmark quality that is aesthetically pleasing. In more particular terms, it should:
    a) Be an honest expression of its function.
    b) Have a simple, economical form.
    c) Be in scale with and compatible with its surroundings.
    d) Minimize visual impact by maximizing transparency and lightness.
    e) Use order, symmetry and rhythm to create harmony and visual balance.
    f) Provide contrast and complexity through surface textures, colour and the play of light and shadow.
    g) Use high-quality, durable and compatible materials.
    h) Consider opportunities to introduce local stone and wood, particularly limestone.
    i) Achieve timelessness through regular maintenance and by avoiding extremes of fashion or overt historicist references.
3. Key views should be taken into consideration, including:
    a) Views to the bridge from the Canal's navigable channel and from the north and south.
    b) Views to the Cataraqui Marsh and the slopes of the river valley from the Canal's navigable channel.

c) Views from the bridge to the Canal's navigable channel, the Cataraqui Marsh, the slopes of the river valley, Belle Island, the northern entrance to the Inner Harbour and the Kingston skyline.

4. The bridge design should take advantage of interpretive opportunities and views of the Cataraqui Marsh and the northerly portion of the Canal's navigable channel using signage, public art, viewing nodes and interpretive media along the bridge to educate and enhance the visitor experience.

5. The bridge design should maximize viewing opportunities from the bridge, including:

   a) Providing lookout vantage points or nodes along the bridge deck with seating, interpretive signage and public art.

   b) Providing minimum height barriers and open railings.

   c) Investigating the possibility of providing interpretation for boaters passing under the bridge.

6. The bridge design should enhance the pedestrian experience of the bridge by:

   a) Providing continuous open railings to optimize views.

   b) Using custom design to provide distinctive enhanced visual effects.

   c) Enhancing barrier-free design by providing lower inner barriers, custom-designed railings and innovative barrier wall terminations.

   d) Providing functional, high-quality and well-designed diffuse lighting that is simple and subtle.

   e) Ensuring that signage is well-integrated and planned with no overhead signs, both on the bridge and its approaches.

These guidelines will be used in support of the current project design phase and the continuation of the DIA into future project phases leading up to construction.

3.2 Design Codes

The design of the bridge will be undertaken in accordance with:

1. The Canadian Highway Bridge Design Code (CHBDC) CSA S6-14.
2. Ministry of Transportation Ontario (MTO) Structural Manual.
3. MTO's Geometric Design Standards for Ontario.
4. The Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads.
5. The Post-Tensioning Institute (PTI): Recommendation for Stay Cable Design, Testing and Installation.
6. MTO Structural Manual.
7. Ontario Provincial Standards for Roads and Public Works.
8. Geometric Design Standards for Ontario (GDSOH).
9. FHWA, Wind Induced Vibration of Stay Cables, RDT 05-004.
10. Technical documents and/or memorandums issued by FHWA.

More specific bridge design requirements are as follows:

1. **Traffic Data:** The project corridor and adjoining roadways are classified as a future arterial road in the City's Official Plan. The annual average daily traffic (AADT) results in the roadway being a Highway Class A. The design speed of the roadway is 70 kilometres per hour (km/hr).

2. **Design Life:** The CHBDC requires a design life for new bridges of at least 75 years. The ESR stated that this bridge would have a design life exceeding 100 or even 120 years in terms of its structural elements and materials, intended function and maintenance requirements. As such, the bridge will be designed for a minimum 100-year design life. Structural components that cannot achieve a 100-year design life will be designed to be easily replaced. These components include: bearings, structural steel coating, asphalt and

waterproofing, electrical components, expansion joints, stay cables, etc. The replacement costs for these components have been included in the Life Cycle Cost Analysis in Section 8.19 of this Report.

3. **Loading:** The loading requirements for the bridge are as follows:

a) **Dead Loads:** The dead load of the bridge will include the weight of all components of the structure and appendages fixed to the structure. The material densities for common structural components are listed in **Table 3.2.1** and the superimposed dead loads are listed in **Table 3.2.2**.

Table 3.2.1: Unit Weights of Structural Components

Material	Unit Weight
Reinforced Concrete	24 kilonewton / cubic metre (kN/m^3)
Structural Steel	77 kN/m^3
Stay Cable Strand (Greased and Sheathed)	1.22 kilograms / metre (kg/m) (15.7mm dia. Seven-Wire Strand)

Table 3.2.2: Superimposed Dead Loads

Superimposed Dead Load	Unit Weight
Traffic Barrier – Median	5.5 kilonewton / metre (kN/m)
Traffic Barrier – Exterior	5.3 kN/m
Pedestrian Railing	1.4 kN/m
Drainage	2.6 kN/m
Paint	0.25 kN/m
Waterproofing and Asphalt	23.3 kN/m
Noise Barrier	1.4 kN/m

b) **Live Loads:** The bridge will be designed for the CL-625-ONT truck load and the CL-625-ONT lane load. The bridge will be designed to have two or three design lanes along the roadway whichever produces the governing loads. The multi-use pathway will be subjected to pedestrian loading of up to 4.0 kilopascals (kPa) and/or Maintenance Vehicle loading which has a gross loading of 80 kN.

c) **Seismic Loads:** The bridge has a classification of an irregular 'Major-Route Bridge' and a Site Class of D based on the site properties. Based on the fundamental period, the bridge is within Seismic Performance Category 2 and as such the seismic design will be based on the Performance Based Design method for the following performance levels:

i. 475 years event (10% probability in 50 years) – the service level is 'Immediate': "Bridge shall be fully serviceable for normal traffic and repair work does not cause any service disruption - and the damage level is 'Minimal'.";

ii. 975 years event (5% probability in 50 years) – the service level is 'Limited': "Bridge shall be usable for emergency traffic and be repairable without requiring bridge closure. At least 50% of the lanes, but not less than one lane shall remain operational. If damaged, normal service shall be restored within a month - and the damage level is 'Repairable'. Based on CSA S6-14, the design for this performance level is optional, unless required by the Owner or Regulatory Authority."; and

iii. 2475 years event (2% probability in 50 years) – the service level is 'Service Disruption': "The bridge shall be usable for restricted emergency traffic after inspection. The bridge shall be repairable. Repairs to restore the bridge to full service might require bridge closure - and the damage level is 'Extensive'."

The minimum analyses requirements for this bridge are Elastic Dynamic Analysis and Inelastic Static Push-Over Analysis.

4. **Wind Loads:** Based on the CHBDC, the bridge shall be designed based on the wind pressure associated with a return period of 50 years for which the hourly mean reference wind pressure, for a structure with a maximum span length less than 125 m, is 465 pascals (Pa) at this site. However, since the bridge is designed for a 100-year service life, it is prudent to design the bridge for a wind pressure of 520 Pa, based on a return period of 100 years.

5. **Ice Loads:** The effective crushing strength of ice is based on the principle that the ice breaks up and moves at melting temperature; is internally sound; and moves in large pieces. The 100 year ice thickness at the project corridor is estimated at 0.84 m. As such, the crushing strength of ice at the project corridor is estimated at 1100 kPa. The crushing strength will be used to calculate the dynamic ice force and the ice impact forces on the piers. A pressure of 5 kPa will be used for ice jams, as the clear opening between the piers is greater than 30 m.

   The ice impact load was considered at two different locations, the high elevation of 74.9 m which corresponds to the maximum of the average water levels between the months of December to April; and the low elevation of 73.0 m which corresponds to the ice loading on the footing. It is recommended that refined studies be carried out during detailed design to refine ice loading. Consideration should be given to using pier nosing and cut-water to minimize ice loading.

   The expected ice accretion thickness at this site as per the CHBDC is 31 millimetres (mm).

6. **Superimposed Deformations:** The bridge superstructure is classified as Type B: steel beams with concrete deck. For the City, the maximum mean daily temperature is 30° Celsius (C) and the minimum mean daily temperature is -30°C. An effective construction temperature of 10°C will be used for the design to balance the anticipated thermal movements of the structure.

7. **Vessel Collisions:** The bridge is classified as a Class 2 Bridge, signifying that the bridge has ‘regular importance’, and must remain open to emergency and security vehicles after a vessel collision. The design vessel for the calculation of the vehicle collision load is the Kawartha Voyageur which is 36 m long, 7 m wide and has 1.3 m draught. This is the largest vessel that regularly uses the Canal system. The total gross tonnage of the Kawartha Voyageur is 264 tonnes and it has a maximum speed of 7.6 knots (14.1 km/hr). The vessel collision load was applied to all piers.

8. **Barriers:** Based on the AADT, design speed, and geometry of the bridge, a TL-4 Performance Level traffic barrier is required. This will be required for the north barrier and the intermediate barrier. The south barrier will be subjected to pedestrian and cyclist loading as any maintenance vehicles will be travelling at slow speeds and, as such, will be designed to accommodate the CHBDC specified loading. The vehicular barrier on the north side will be extended to accommodate cyclists.

9. **Noise Walls:** All required noise walls will be designed in accordance with the CHBDC (as a light slender structure) and CAN/CSA-Z107.9, Standard for Certification of Noise Barriers.

10. **Scour:** The top of the riverbed is subject to scour and should be accounted for in the design. It is expected that scour protection will be required at the foundations.

11. **Cable Replacement/Loss:** As per the PTI, the structure will be designed to accommodate the replacement or loss of any cable.

12. **Highway and Municipal Roads:** Road design geometry in Ontario is based on MTO Geometric Design Standards for Ontario and the TAC Geometric Design Guide for Canadian Roads. Bridge geometry, as it pertains to the roadway elements, generally reference MTO standards. There are numerous geometric factors involved in highway design, including governing codes and standards, engineering design consensus and the impacts of such components as roadway/highway classifications, design speeds, traffic volume, curve radii and side clearances.

13. **Municipal Assets:** Examples of municipal assets that are to be designed in accordance with the City’s Technical Standards and Ontario’s Provincial Standards (where municipal standards are absent) include: road granular and asphalt pavement materials; buried infrastructure (pipes, manholes, catchbasins, services and other appurtenances); concrete curb, gutter and sidewalks; retaining walls; signage; and roadway painting and fencing.

The bridge will be designed to have redundancy with multiple load paths available. If it is not capable of providing multiple load paths, then internal redundancies will be detailed.

For this current project phase, the following material properties and strengths were used, as shown in **Table 3.2.3**.

Table 3.2.3 Material Properties for Third Crossing

Material	Location	Strength
Concrete	Deck	30 MPa
	Piers/Abutments	30 MPa
	Caissons	30 MPa
Reinforcing	Carbon Steel Stainless Steel	f_y = 400 MPa f_y = 420 MPa
Structural Steel	Approach Spans and Arches	f_y = 350 MPa (350 WT/350 AT)
Cables		f_{pu} = 1,860 MPa (15.7 mm dia. 7-wire strand – 140 mm^2 area)

3.3 Accessibility

In order to ensure that the project addresses both functional and accessible design elements, the Project Team met with a representative of the City's MAAC, and reviewed the current project design work through the lens of the City's Facility Accessibility Design Standards (FADS). As highlighted below, the FADS, which are currently under review by the City, apply mainly to accessible exterior circulation routes and associated elements for the project:

1. Accessible exterior circulation routes shall address the full range of individuals that may use them (e.g. wheelchairs, scooters, those pushing strollers, those travelling in pairs). As such:

   a) The City's existing minimum standard width of 1.5 m may be used.

   b) The running slope shall not be steeper than 1:25 (or 4%), unless accessible ramps are provided.

   c) Cane-detectable curbs at least 75 mm high shall be provided along the edges of planting beds and in areas where variations in grading are potentially hazardous.

   d) The cross slope shall not be steeper than 1:50 (or 2%).

   e) Exterior lighting shall be in compliance with Illuminating Engineering Society of North America (IESNA) Standards except in outdoor park settings, where routes are not normally illuminated, additional illumination is not required.

   f) Level rest areas shall be spaced no more than 30 m apart.

   g) Gratings and grills shall be located to one side.

Each of the components noted above include more specific design standards regarding such matters as the use of colour contrasting, directional signage, plantings (e.g. overhang), bench seating and street furniture design. Such standards, while of critical importance to the project, are beyond the scope of the current project design phase. It is recommended that the FADS continue to be reviewed and incorporated into the design work, should the project advance to the detail design phase.

3.4 Sustainable Design Strategies

The sustainable development of infrastructure is critical due to on-going concerns regarding its economic, environmental, and socio-cultural impacts on communities, and the need to provide holistic evaluations that guide the best investments of limited resources. The City and other major stakeholders have included sustainable development as major focal point for this project. As such, it is prudent to evaluate the overall life cycle of the bridge to ensure that the initial design optimizes performance and related costs (operations, maintenance and rehabilitation) in tandem.

1. Sustainable Development Charrette

A Sustainable Development Charrette was held on September 8, 2016 with representatives from the City, Project Team and other stakeholders. Its intent was to distill the overall sustainable development focus to specific goals, desired outcomes, and associated performance measures for the project. Each attendee was asked to consider design objectives from the perspectives of 'the City (Owner)', 'the community' and 'feasibility / local applicability' to decide which of the objectives should be viewed as having the highest priority. The design objectives and number of attendee responses (in parentheses) are shown in **Table 3.4.1.1**.

Table 3.4.1.1: Prioritized Sustainability Objectives from the Charrette

Owner Priorities	Community Priorities	Most Feasible/ Applicable
Safety (11)	Safety (13)	Improve Access and Mobility (12)
Improve Access and Mobility (10)	Engage Community Values and Sense of Place (13)	Safety (9)
Engage Community Values and Sense of Place (10)	Improve Access and Mobility (9)	Engage Community Values and Sense of Place (9)
Innovation (10)	Increase Lifecycle Efficiency (9)	Innovation (9)
Improve Local Economy (8)	Improve Local Economy (8)	Maintain Biodiversity (7)
Increase Lifecycle Efficiency (9)	Maintain Biodiversity (6)	Increase Lifecycle Efficiency (7)
Maintain Biodiversity (6)	Reduce Emissions to Air (5)	Optimize Waste Stream (4)
Optimize Waste Stream (2)	Innovation (5)	Improve Local Economy (4)
Reduce Energy Use (2)	Maintain or Improve Hydrological Regime Characteristics (1)	Reduce Virgin Material Use (2)
Maintain or Improve Hydrological Regime Characteristics (2)	Optimize Waste Stream (0)	Reduce Energy Use (2)
Reduce Emissions to Air (0)	Reduce Energy Use (0)	Maintain or Improve Hydrological Regime Characteristics (2)
Reduce Virgin Material Use (0)	Reduce Virgin Material Use (0)	Reduce Emissions to Air (1)

Numerous sustainability activities that are relevant to the project were also discussed at the charrette and possible key performance indicators for each activity were determined. Using these key performance indicators and supporting documentation, the potential scores in accordance with established sustainability design guidelines (e.g. TAC Sustainability Considerations for Bridges Guide; Institute for Sustainable Infrastructure: Envision) could be used to both calculate and monitor the extent to which sustainability for the project is being achieved. The feedback report from the charrette is included in **Appendix A.**

3.5 Specifications

The following major construction specifications and standards will govern the construction of the bridge:

1. Reinforcing Steel Institute of Canada, Reinforcing Steel Manual of Standard Practice (2004).
2. CSA, Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete (A23.1/A23.2).
3. CSA, Precast Concrete – Materials and Construction (A23.4).

4. CSA, Carbon-Steel Bars for Concrete Requirements (G30.18).
5. CSA, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel (G40.20/G40.21).
6. CSA, Design and Construction of Building Components with Fibre-Reinforced Polymers (S806).
7. Ontario Provincial Standards for Roads and Public Works.
8. MTO, Standard Special Provisions.
9. MTO, Non-Standard Special Provisions.
10. City of Kingston Standards and Specifications.
11. Standard details and specification from relevant utilities will be used, as required.
12. PTI, Recommendations for Stay Cable Design, Testing and Installation.
13. PTI, Specification for Grouting of Post-Tensioned Structures M55.1.
14. PTI/ASBI, Guide Specification for Grouted Post-Tensioning M50.3.
15. AASHTO / American Welding Society, D1.5 Bridge Welding Code.
16. ACI, Guide to Cold Weather Concreting (ACI 306R).
17. ACI, Guide to Curing Concrete (ACI 308R).
18. ACI, Guide to Hot Weather Concreting (ACI 305R).
19. ACI, Guide to Mass Concrete (ACI 207R).
20. ACI, Protection of Metals in Concrete Against Corrosion (ACI 222R).
21. Concrete Reinforcing Steel Institute, Specialty Steel Product Guide.
22. FHWA, Post-Tensioning Installation and Grouting Manual.
23. National Electrical Manufacturers Association Standards.

The schedule of items will be broken down in multiple sections. A preliminary item list of the sections for the bridge is as follows:

1. The General section, which will cover the general contract items such as traffic / pedestrian control plans, sediment and erosion control plan, field offices etc.
2. The Structural section, which will include all work associated with the bridge from the foundations, piers, abutments, structural steel girders, arch components, concrete bridge deck, barriers, joints, bearings, deck drains and pipes, etc.
3. The Roadway section, which will contain all items related to the approaches such as excavation, granular material, asphalt pavement, sidewalks and curbs, etc.
4. The Traffic section, which will include all work associated with the traffic handholes, concrete encased ducts, detector loops and traffic lights.
5. The Storm Sewers / Sanitary Sewers / Watermains section, which will contain all items related to the pipes, manholes, catchbasins, adjustments to existing manholes, etc.
6. The Electrical / Lighting section, which will include all the embedded work for the streetlighting, streetlights on the bridge and approaches including all posts and fixtures.
7. The Drainage section, which will contain all work associated with the stormwater management facility off of the bridge and drainage piping, catchbasins, etc. off the bridge.
8. The Landscaping section, which will include all items related to the vegetation, pathways, interpretive signs, etc.
9. The Utilities section, which will contain all utility requirements. It should be noted that specifications related to certain utility assets (e.g. electrical, telecommunications, etc.) may be subject to other specifications. In cases where either the design is not being completed by the utility provider or it abuts the utility itself, the provider must be consulted to confirm the specifications.

4.0 DIA AREA CONDITIONS

The Scoping Document prepared by Parks Canada (see **Appendix B**) provides guidance for the Federal DIA. It states that the DIA boundary shall be based on the Class EA study area, with a more focused assessment of the project corridor. This section of the Report discusses conditions within the DIA area.

4.1 Land Uses and Utilities

There are a wide range of environmental and land use features within the DIA area. These features, which are discussed throughout this Report, are highlighted below and are supplemented with **Drawing 4.1.1** to **Drawing 4.1.5**, which highlight the City's current Official Plan designations and overlay policies for the DIA area[1]:

1. The 'Central Business District' designation for the City's downtown core area, which serves to support and enhance the multi-faceted centre of the City and the surrounding region. It includes and accommodates the wide range of retail services, business offices, entertainment, cultural and recreational facilities, tourism and hospitality facilities, as well as institutional, open space and residential uses in the downtown core area.

2. The Cataraqui River, which has a water depth averaging 1.2 m except at the buoyed channel and the southern portion of the Inner Harbour. Watercraft navigation is an important feature of the DIA area, typified most directly by the Inner Harbour and Outer Harbour, the Her Majesty's Canadian Ship (HMCS) Cataraqui Facility immediately north of the LaSalle Causeway, the Kingston Marina (located in the Inner Harbour), Rideau Marina (located south of the Point St. Mark residential neighbourhood) and the Canal's navigable channel and the rowing lanes that run adjacent on either side of it. Most of these features are captured in the 'Harbour Area' designation, which also accommodates various water-related activities ranging from marine retail, mooring facilities, yacht clubs and rowing clubs (Kingston Rowing Club, Queen's University Rowing Club), to dry docks, marine salvage and repair services, tourism and hospitality uses.

3. The 'District Commercial' designation just south of Emma Martin Park and the Kingston Rowing Club on the west side of the Cataraqui River, which recognizes the character of the Woolen Mill as a designated cultural heritage property, its waterfront site and unique mix of land uses ranging from artisan workshops to businesses, professional offices and a restaurant.

4. Areas designated 'Residential' that pertain, in particular, to:

   a) The St. Lawrence Ward Heritage Area immediately adjacent to the downtown area to the north, which is one of the oldest areas of the City.

   b) The Barriefield Village Conservation District on the east side of the Cataraqui River, which contains historic residences, buildings, laneways and landscapes that reflect a 19th Century village setting.

   c) The Greenwood and Grenadier Village residential neighbourhoods, also located on the east side of the Cataraqui River.

   d) Within the project corridor specifically, the Village On The River apartments and the River Park subdivision along John Counter Boulevard (west side) and the Point St. Mark residential neighbourhood (east side).

5. The 'Environmental Protection Area' designation and associated natural heritage policy overlays, which includes:

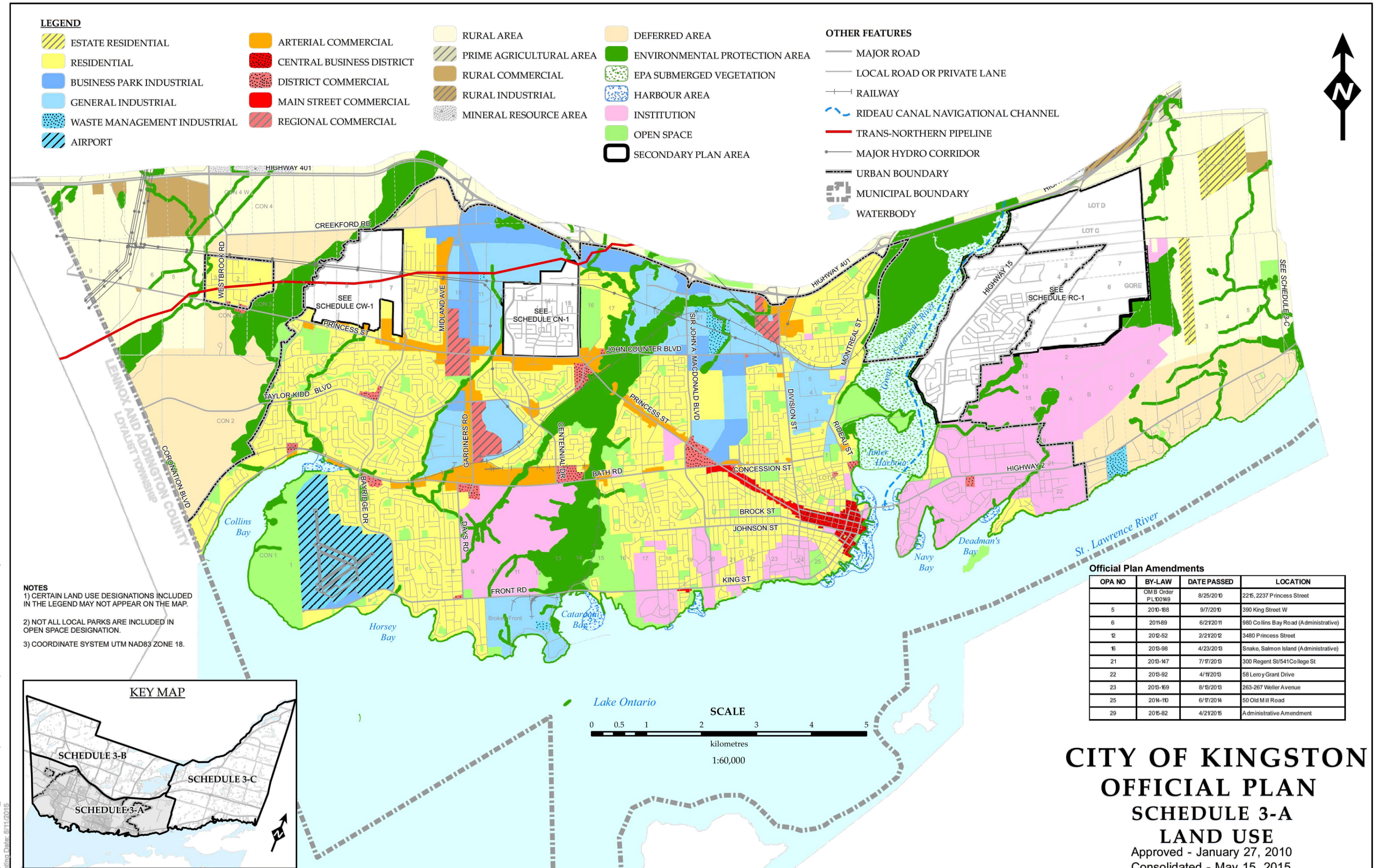
   a) The Greater Cataraqui Marsh in recognition of its designation as a Provincially Significant Wetland and Provincially Significant Coastal Wetland.

   b) 'Riparian Habitat' areas extending from the confluence of the Cataraqui River and Lake Ontario up to and including the tributaries and channels within the Greater Cataraqui Marsh.

   c) The Provincially significant and contributory woodland areas along both sides of the Cataraqui River.

   d) An area extending 30 m from either shoreline of the Cataraqui River to encourage the protection of a 'ribbon of life' along the waterfront (note parks and pathways may be permitted in affected designated areas).

[1] As of the date of this Report, the City has recently passed By-law 2017-57, which is an Official Plan Amendment resulting from a statutory five-year review of the Plan. The Official Plan Amendment, which affects all lands within the City, has been submitted to the Ontario Ministry of Municipal Affairs and Housing, and will be in full force and effect after it has been reviewed and approved by same.



Official Plan Amendments

OPA NO	BY-LAW	DATE PASSED	LOCATION
	OMB Order PL100149	8/25/2010	2215, 2237 Princess Street
5	2010-188	9/7/2010	390 King Street W
6	2011-89	6/21/2011	980 Collins Bay Road (Administrative)
12	2012-52	2/21/2012	3480 Princess Street
16	2013-98	4/23/2013	Snake, Salmon Island (Administrative)
21	2013-147	7/17/2013	300 Regent St/541 College St
22	2013-92	4/11/2013	58 Leroy Grant Drive
23	2013-169	8/13/2013	263-267 Weller Avenue
25	2014-110	6/17/2014	50 Old Mill Road
29	2015-82	4/21/2015	Administrative Amendment

CITY OF KINGSTON OFFICIAL PLAN
SCHEDULE 3-A LAND USE

Approved - January 27, 2010
Consolidated - May 15, 2015

THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

CITY OF KINGSTON OFFICIAL PLAN
SCHEDULE 3-A LAND USE

Mark Van Buren, P.Eng — *Director of Engineering and Deputy Commissioner*
Dan Franco, P.Eng. — *Project Engineer*

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

KINGSTON

Project No.: 27143
Drawing No.: 4.1.1
Sheet No.:
Des: Chk'd:
Dwn: Chk'd:
Scale: N.T.S.
Utility Circ. No.
Code:
Load:

NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

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THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

CITY OF KINGSTON OFFICIAL PLAN
SCHEDULE 7-A
NATURAL HERITAGE AREA 'A'

Mark Van Buren, P.Eng.
Director of Engineering and Deputy Commissioner

Dan Franco, P.Eng.
Project Engineer

KINGSTON

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Project No.:	27143
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Sheet No.:	
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NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

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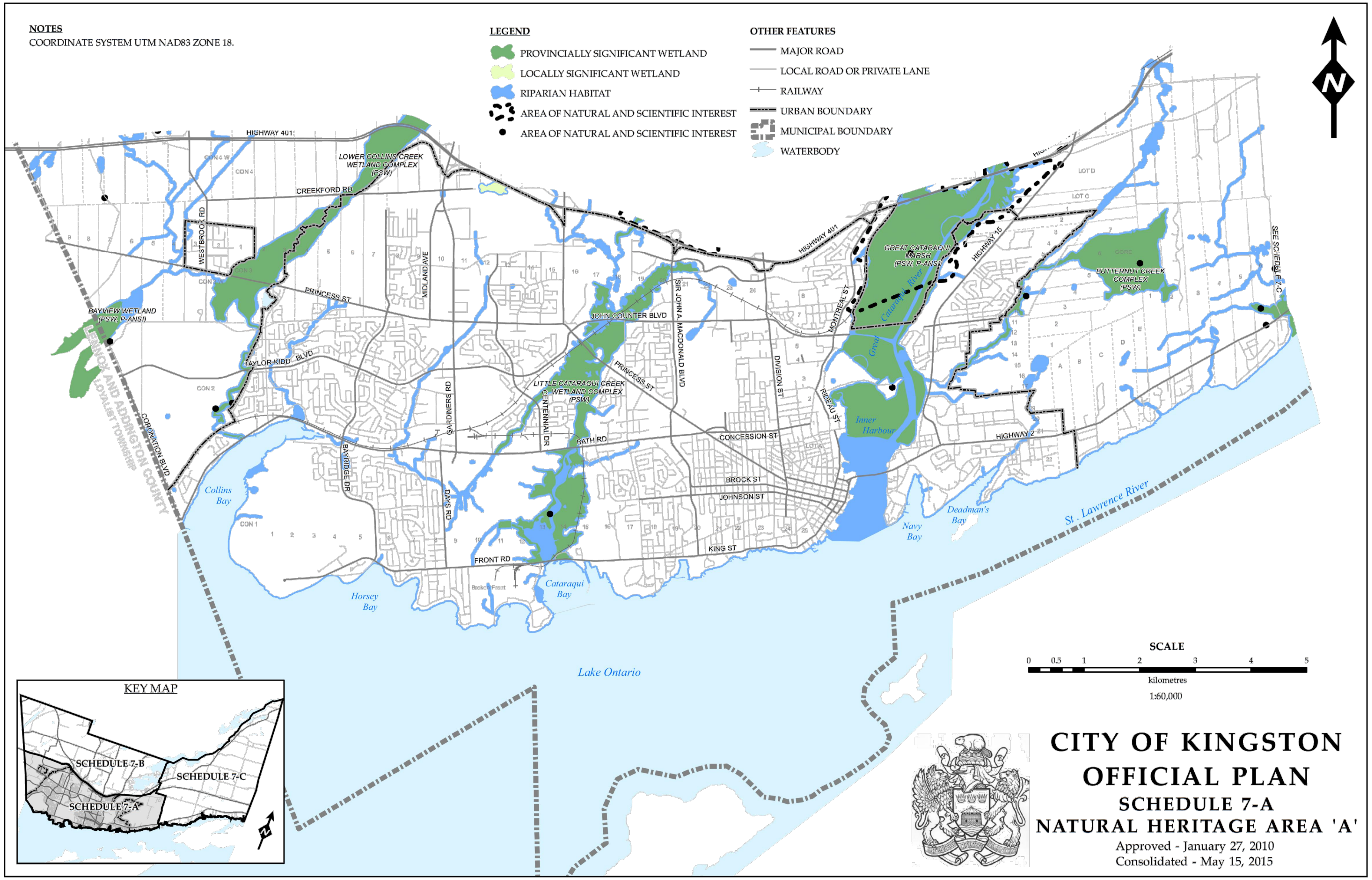

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THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

CITY OF KINGSTON OFFICIAL PLAN
SCHEDULE 8-A
NATURAL HERITAGE AREA 'B'

Mark Van Buren, P.Eng. Director of Engineering and Deputy Commissioner	Dan Franco, P.Eng. Project Engineer

KINGSTON

J.L.Richards
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Project No.:	27143
Drawing No.:	4.1.3
Sheet No.:	
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Utility Circ. No.	
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Load:	

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REVISIONS

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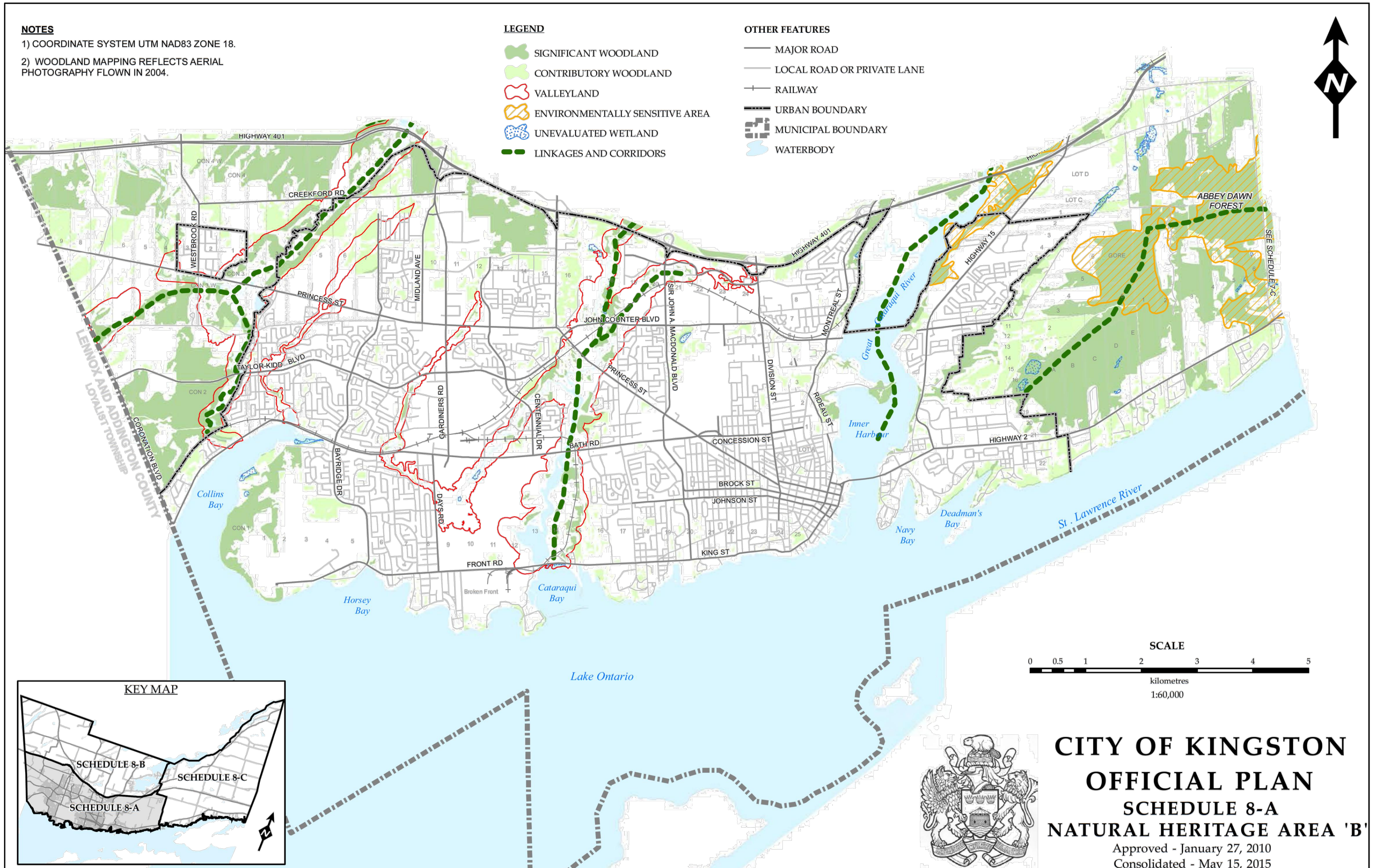

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THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

CITY OF KINGSTON OFFICIAL PLAN
SCHEDULE RC-1
RIDEAU COMMUNITY SECONDARY PLAN

Mark Van Buren, P.Eng.
Director of Engineering and Deputy Commissioner

Dan Franco, P.Eng.
Project Engineer

Project No.: 27143
Drawing No.: 4.1.4
Sheet No.:
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Utility Circ. No.
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NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

No.	Description	By	Date (dd/mm/yy)
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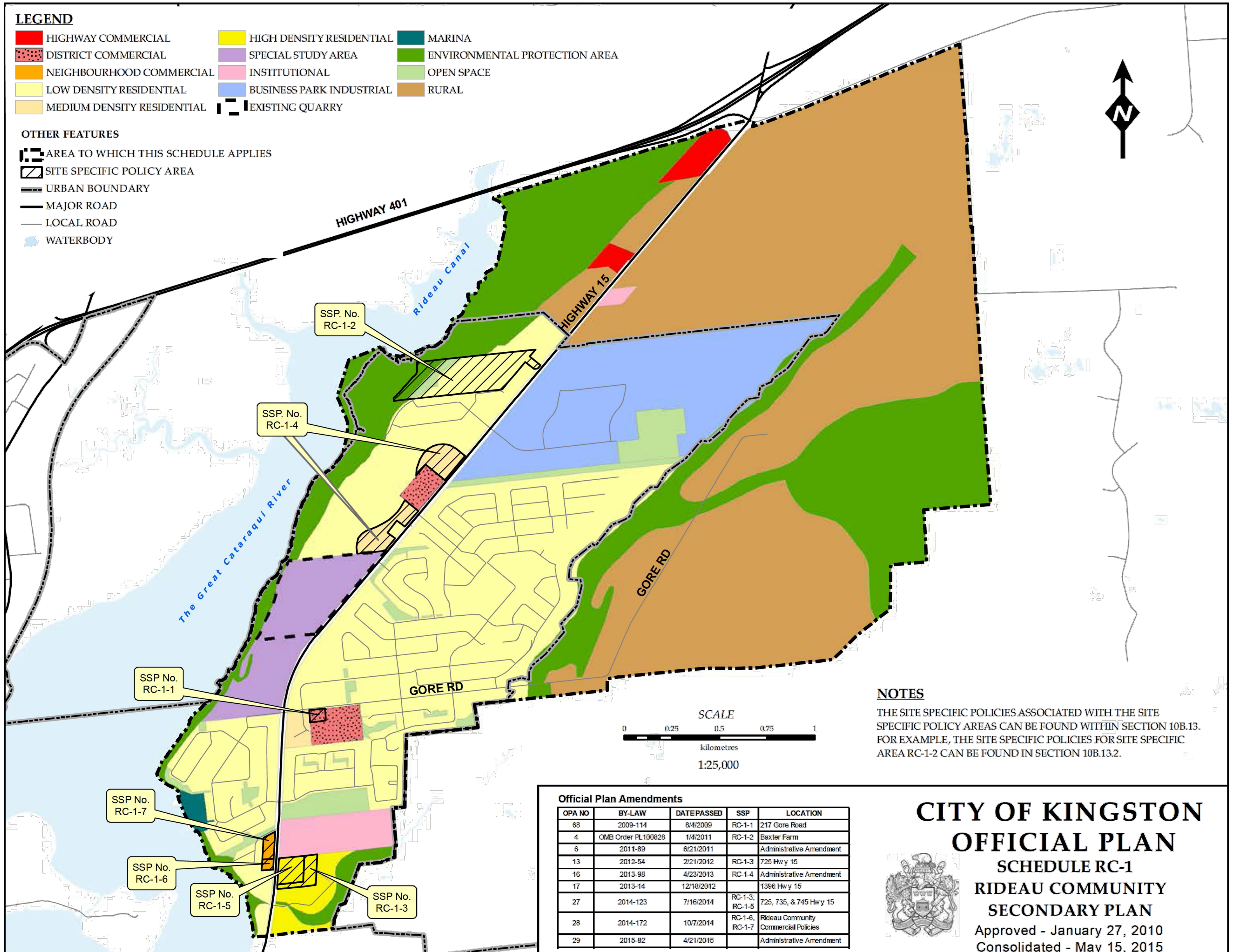

NOTES

THE SITE SPECIFIC POLICIES ASSOCIATED WITH THE SITE SPECIFIC POLICY AREAS CAN BE FOUND WITHIN SECTION 10B.13. FOR EXAMPLE, THE SITE SPECIFIC POLICIES FOR SITE SPECIFIC AREA RC-1-2 CAN BE FOUND IN SECTION 10B.13.2.

Official Plan Amendments

OPA NO	BY-LAW	DATE PASSED	SSP	LOCATION
68	2009-114	8/4/2009	RC-1-1	217 Gore Road
4	OMB Order PL100828	1/4/2011	RC-1-2	Baxter Farm
6	2011-89	6/21/2011		Administrative Amendment
13	2012-54	2/21/2012	RC-1-3	725 Hwy 15
16	2013-98	4/23/2013	RC-1-4	Administrative Amendment
17	2013-14	12/18/2012		1396 Hwy 15
27	2014-123	7/16/2014	RC-1-3; RC-1-5	725, 735, & 745 Hwy 15
28	2014-172	10/7/2014	RC-1-6, RC-1-7	Rideau Community Commercial Policies
29	2015-82	4/21/2015		Administrative Amendment

CITY OF KINGSTON OFFICIAL PLAN

SCHEDULE RC-1 RIDEAU COMMUNITY SECONDARY PLAN

Approved - January 27, 2010
Consolidated - May 15, 2015

Map Document: K:\D08_Official Plan Comprehensive Review\Map Schedule Consolidation\2015- May 15\Sch RC-1 Rideau_Community.mxd
Printing Date: 6/29/2015

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THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

CITY OF KINGSTON OFFICIAL PLAN
SCHEDULE 5 PATHWAYS

Mark Van Buren, P.Eng.	Dan Franco, P.Eng.
Director of Engineering and Deputy Commissioner	Project Engineer

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Project No.:	27143
Drawing No.:	4.1.5
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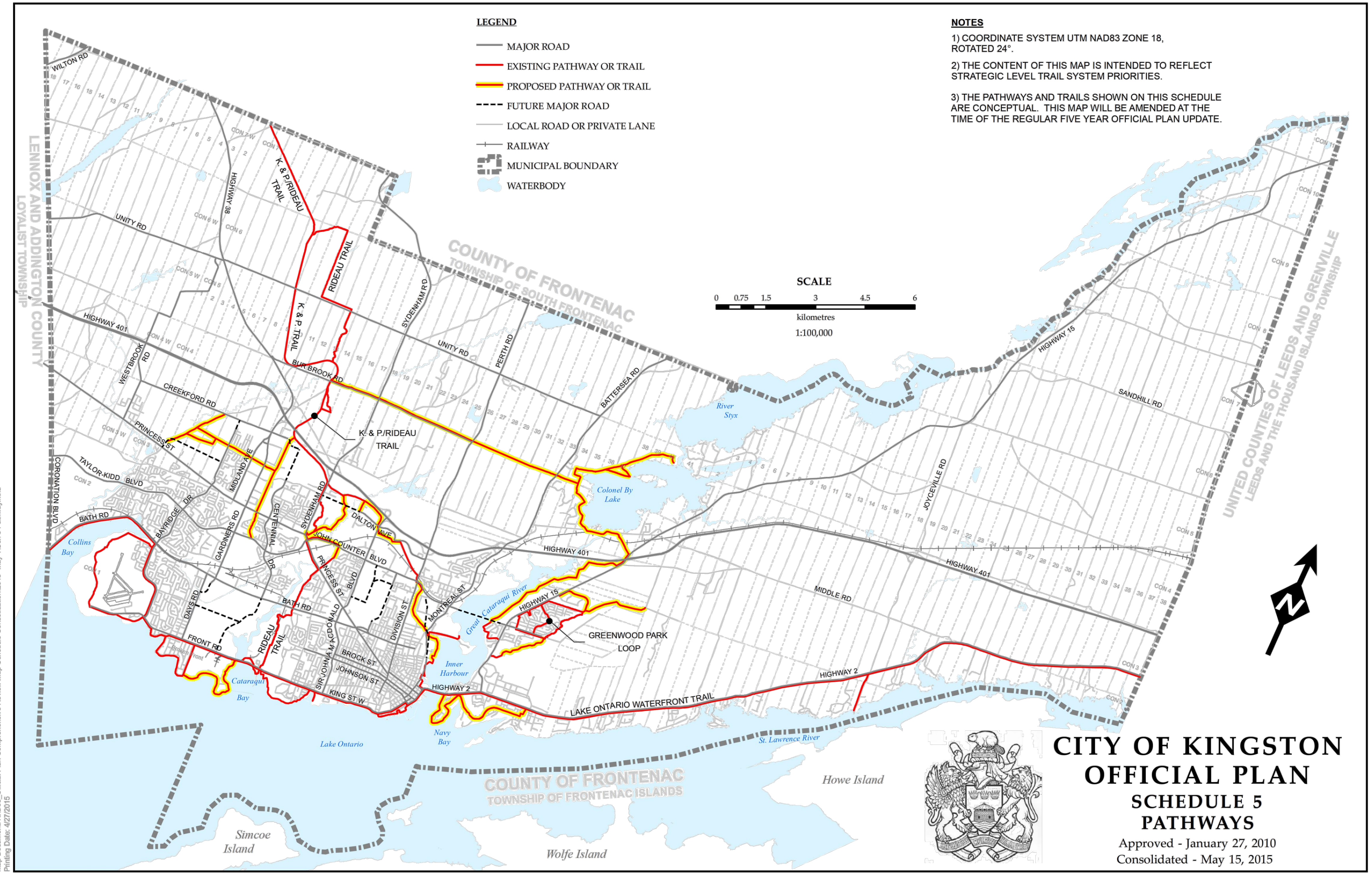

CITY OF KINGSTON OFFICIAL PLAN

SCHEDULE 5 PATHWAYS

Approved - January 27, 2010
Consolidated - May 15, 2015

Map Document: K:\D08_Official Plan Comprehensive Review\Map Schedule Consolidation\2015- May 1\Sch 5 Pathway.mxd
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Consultant's Information: K:\27000\27143 - Third Crossing Pre-Design\JLR DWGs\Civil\PDR Figures\DWG\PDR - 4.1.1 - 4.1.5.dwg

6. The 'Open Space' designation, which includes park and open space areas as well as lands adjacent to the 'Environmental Protection Area' designation, such as Douglas Fluhrer Park, Emma Martin Park, Belle Park and Belle Island on the west side of the Cataraqui River.

7. A 'General Industrial' node south of the Canadian National Railway (CNR) line, east of Division Street and west of Montreal Street that contains older, heavy industrial uses.

8. The 'Business Park Industrial' designation for the St. Lawrence Business Park, which is also part of the Rideau Community Secondary Plan area and is located north of the Greenwood neighbourhood on the east side of the Cataraqui River. The St. Lawrence Business Park is intended to provide prominent locations for corporate administrative, research and development and related business industrial uses in a prestige, business park setting.

9. A 'Special Study Area' designation in the Rideau Community Secondary Plan area, which is subject to further planning and development analyses and includes:

   a) The Gore Road Library, which is located at the northwest corner of Gore Road and Highway 15 within the project corridor. The Gore Road Library is a designated cultural heritage property.

   b) The Pittsburgh quarry operation located north of the Gore Road Library.

10. The 'Institutional' designation, which serves to support and accommodate the City's major institutions, some of which are further designated as cultural heritage properties. Within the DIA area, the major institutions include:

   a) The Rideaucrest Home Long-Term Care Facility located on Rideau Street on the west side of the Cataraqui River.

   b) Fort Frontenac at the eastern end of Ontario Street adjacent the LaSalle Causeway which refers to both the archaeological remains of the 17th century French fort (Fort Frontenac National Historic Site) and the present-day Department of National Defence barracks that occupy part of the same site.

   c) Canadian Forces Base (CFB) Kingston on the east side of the Cataraqui River which includes land and buildings for military purposes, armories, training facilities, administrative offices, residential accommodation, recreation facilities such as the Garrison Golf and Curling Club and complementary commercial support services.

   d) The Royal Military College (RMC), which is also part of the CFB Kingston land base and offers a wide variety of educational programs in Arts, Science, and Engineering at both the undergraduate and graduate levels.

   e) Fort Henry and the Kingston fortifications comprising Fort Frederick and the Murney, Shoal and Cathcart Martello Towers, which are part of the inscribed property of the UNESCO World Heritage Site for the Canal as well as National Historic Sites.

11. There are areas that either are or may be contaminated by a prior or current use, which are focused on the west side of the Cataraqui River at the former Davis Tannery site southwest of Belle Park and the Federal dredged sediment disposal site along the north shore of Belle Island.

12. The navigable channel within the Cataraqui River, which starts at the LaSalle Causeway and extends northwards as part of the Canal. Within the DIA area, the designated site of the Canal begins at Belle Island and follows the high-water marks on either shore, north to and beyond the limits of the DIA area.

13. There are a series of paths and trails for active transportation in various states of planned development. These include:

   a) A north-south route extending from the downtown-LaSalle Causeway along the west shoreline of the Cataraqui River and continuing northwest through City Centre Business Park and north of John Counter Boulevard and around Belle Park Fairways, ending north of John Counter Boulevard at Weller Avenue.

   b) A north-south route extending through the Point St. Mark residential neighbourhood and along the east shoreline of the Cataraqui River to and beyond Highway 401.

   c) Routes internal to Barriefield Village as well as the Grenadier Village and Greenwood Park subdivisions east of Highway 15.

   d) Though not shown on **Drawing 4.1.5**, the 2016 Waterfront Master Plan identifies the aforementioned recommended extensions to the pathway network within the project corridor from the Class EA, and links to those other areas noted above, particularly along the east and west shorelines of the Cataraqui River north and south of the project corridor.

There are also a series of commuter cycling lanes in various states of planned development. These include:

e) Routes along the main roads in the downtown area and extending north along Montreal Street up to and beyond Highway 401 with east-west routes connecting to Montreal Street at John Counter Boulevard and Benson Street-Dalton Avenue on the west side of the Cataraqui River.

f) Routes extending from the downtown, across the LaSalle Causeway and continuing along Highway 2 and Highway 15 on the east side of the Cataraqui River.

14. As shown on **Drawing 4.1.6** and **Drawing 4.1.7**, the major utilities highlighted below are present within the project corridor. This information was collected through specific consultations with utility providers:

a) **Hydro One:** Hydro One provides distribution voltage to parts of the City east of the Cataraqui River. From the Frontenac Transmission Station located on Division Street, 44 kV high voltage transmission lines carry power east towards the river. Within the project corridor along John Counter Boulevard from Montreal Street to the west shoreline, the high voltage transmission lines are located on overhead poles which are owned by Kingston Hydro. Two drop poles near the shoreline are connected to parallel transmission lines that extend underground to the west shoreline. These transmission lines connect to two pairs of submarine electrical cables (3-phase 44 kV line) which extend to the east shoreline, providing a major source of electrical service to the east end of the City. At the east shoreline, two sets of underground transmission lines follow the Gore Road corridor to Highway 15.

b) **Hydro One Lighting:** Hydro One owns and maintains overhead streetlighting east of the Cataraqui River.

c) **Kingston Hydro:** Kingston Hydro maintains distribution voltage and streetlighting on overhead poles along John Counter Boulevard, which provide electrical service to the River Park subdivision and other properties in the vicinity.

d) **UK (Lighting and Signalization):** UK maintains traffic signals at the John Counter Boulevard / Montreal Street intersection and the Gore Road / Highway 15 intersection as well as overhead streetlighting west of the Cataraqui River.

e) **UK (Sanitary):** The 900 mm Rideau Heights trunk sanitary main currently runs parallel to the west shoreline in close proximity to the proposed future west bridge abutment. In addition, a sanitary forcemain exists on the east shore within the Gore Road right-of-way.

f) **UK (Water):** Underground watermains are present within the John Counter Boulevard and Gore Road rights-of-way.

g) **Storm Sewers:** There is no piped storm system east of Montreal Street on the west approach. Storm sewers currently exist within the Gore Road right-of-way.

h) **Bell Canada:** Overhead and shallow buried services are located within the John Counter Boulevard and Gore Road rights-of-way.

i) **Cogeco Cable:** Overhead and shallow buried services are located within the John Counter Boulevard and Gore Road rights-of-way.

Gas infrastructure is not located within the project corridor.

THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

EXISTING INFRASTRUCTURE (WEST)

Mark Van Buren, P.Eng.
Director of Engineering and Deupty Commissioner

Dan Franco, P.Eng.
Project Engineer

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

PARSONS

KINGSTON

Project No.:	27143
Drawing No.:	4.1.6
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No.	Description	By	Date (dd/mm/yy)
1	ISSUED FOR PRELIMINARY DESIGN SUMMARY REPORT	S.S.	03/05/17

LEGEND:

□	DENOTES	SURVEY MONUMENT PLANTED
■	"	SURVEY MONUMENT FOUND
SSIB	"	SHORT STANDARD IRON BAR
SIB	"	STANDARD IRON BAR
IB	"	IRON BAR
CM	"	CONCRETE MONUMENT
OSM	"	ORIGINAL STONE MONUMENT
RIB	"	ROUND IRON BAR
WIT	"	WITNESS
M	"	MEASURED
1407	"	M. PETER ALLEN O.L.S.
MTO	"	MINISTRY OF TRANSPORTATION ONTARIO
S&SK	"	SMITH & SMITH KINGSTON O.L.S.
857	"	CHARLES W. FAIRHALL O.L.S.
712	"	GRANGE W. ELLIOTT O.L.S.
ANC	"	ANCHOR
BB	"	BELL BOX
BF	"	BOARD FENCE
BD	"	BOLLARD
BS	"	BOTTOM OF SLOPE
CG	"	CURB & GUTTER
CB	"	CATCH BASIN
DICB	"	DITCH INLET CATCH BASIN
CL	"	CENTRE LINE
CLF	"	CHAIN LINK FENCE
B	"	BUILDING
D	"	DITCH
EG	"	EDGE OF GRAVEL
EP	"	EDGE OF PAVEMENT
ET	"	EDGE OF TREES
FH	"	FIRE HYDRANT
FP	"	FENCE POST
G	"	GROUND

C	DENOTES	CONCRETE
GR	"	GRAVEL
GV	"	GAS VALVE
HL	"	HYDRO LINE
HP	"	HYDRO POLE
LP	"	LIGHT POLE
MH	"	MANHOLE
MW	"	MONITORING WELL
OHTL	"	OVERHEAD TRANSMISSION LINE
P	"	PAVEMENT
PT	"	PAINT
RW	"	RETAINING WALL
SW	"	SIDEWALK
TC	"	CONIFEROUS TREE
TD	"	DECIDUOUS TREE
TS	"	TOP OF SLOPE
UGH	"	UNDERGROUND HYDRO
UGW	"	UNDERGROUND WATER
UGG	"	UNDERGROUND GAS
WE	"	WATER'S EDGE
WF	"	WIRE FENCE
WV	"	WATER VALVE
GV	"	GAS VALVE
GM	"	GAS METER
CUL	"	CULVERT
INV	"	INVERT
——S——		SANITARY SEWER
——ST——		STORM SEWER
——H——		UNDERGROUND HYDRO
——W——		WATERMAIN
——G——		GAS

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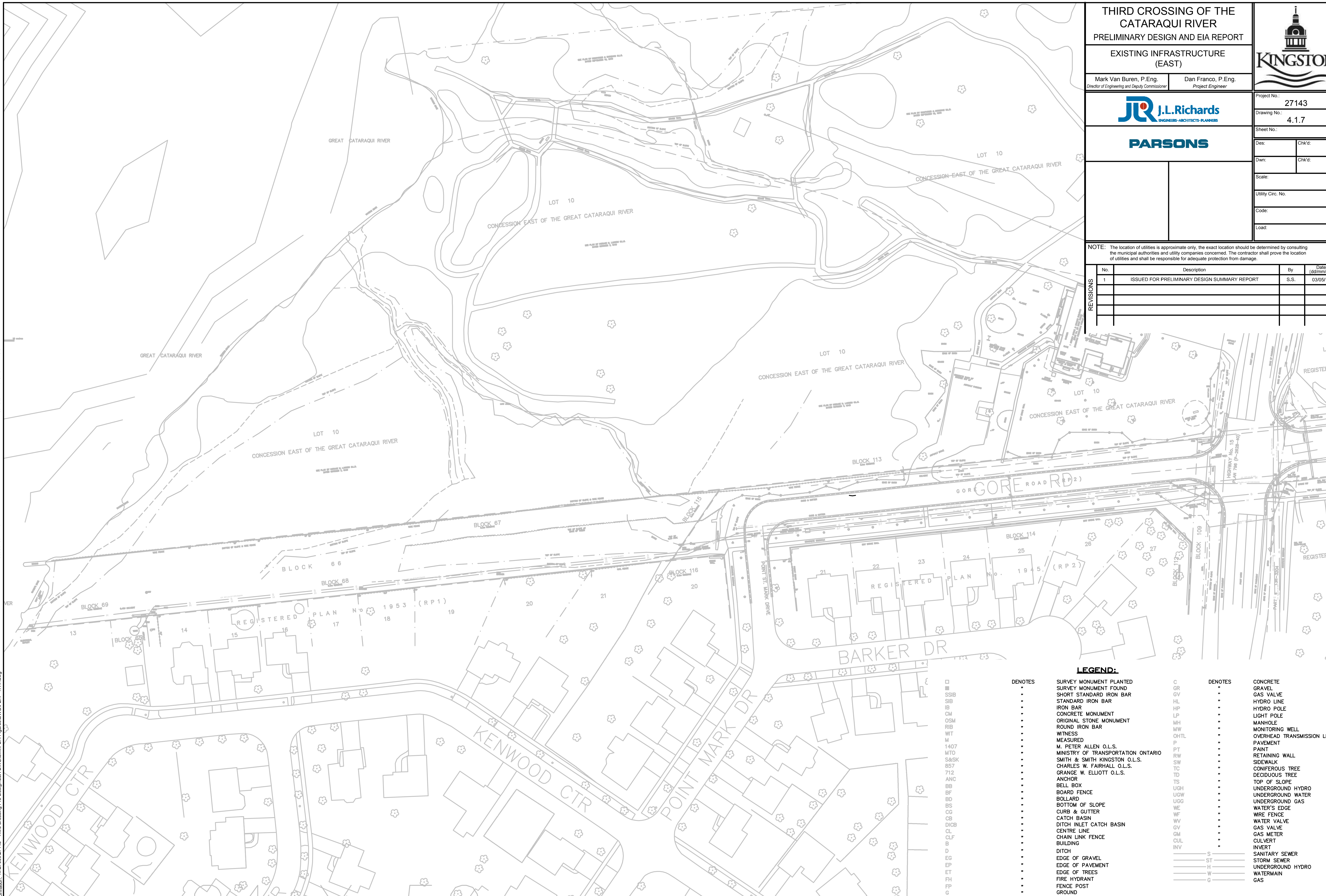

THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

EXISTING INFRASTRUCTURE (EAST)

Mark Van Buren, P.Eng.
Director of Engineering and Deputy Commissioner

Dan Franco, P.Eng.
Project Engineer

J.L.Richards ENGINEERS·ARCHITECTS·PLANNERS

PARSONS

KINGSTON

Project No.: 27143
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G	"	GROUND

C	DENOTES	CONCRETE
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GV	"	GAS VALVE
HL	"	HYDRO LINE
HP	"	HYDRO POLE
LP	"	LIGHT POLE
MH	"	MANHOLE
MW	"	MONITORING WELL
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INV	"	INVERT
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——ST——		STORM SEWER
——H——		UNDERGROUND HYDRO
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4.2 Ecological Conditions

This section of the Report highlights ecological conditions within the DIA area. It is based on background information reviews, liaison with various regulatory bodies and fieldwork activities undertaken during the Class EA and current project design phase. The supporting report is found in **Appendix C**.

1. General

As shown on **Drawing 4.2.1**, within the DIA area, the following natural heritage features are identified:

1. The Greater Cataraqui Marsh is a PSW that extends from the Woolen Mill / Barriefield area in the southern portion of the DIA area to just north of Highway 401. It is also a Provincially Significant Coastal Wetland which means: its water levels are largely controlled by a Great Lake (Lake Ontario); it is a wetland that is within the floodplain of a Great Lake (Lake Ontario); and it is on a tributary to a Great Lake (Lake Ontario).

   The Greater Cataraqui Marsh PSW is internationally important as one of the most intact drowned-river mouth Great Lakes Coastal Wetlands in North America. The mean size for all 122 Great Lakes Coastal Wetlands in Lake Ontario and the St. Lawrence River is 150 hectares (ha), while the Greater Cataraqui Marsh PSW is 504 ha. The Canal's navigable channel is excluded from these designations.

2. Most of the identified Provincially significant and contributory woodlands in the DIA area are in narrow, fragmented strips, except for areas on the former Davis Tannery site, Belle Park Fairways, along the visible cattail portion of the Greater Cataraqui Marsh north of John Counter Boulevard and Belle Island whereon its old oak grove is well-documented for its ecological significance.

3. Areas of Natural and Scientific Interest (ANSI), which are areas having identified life science or earth science values, are focused on the visible cattail portion of the Greater Cataraqui Marsh and the buffering woodlands on both sides of the Cataraqui River more than 120 m north of the project corridor.

4. The Cataraqui River, its seven tributaries, and the Greater Cataraqui Marsh PSW (including its visible cattail portion north of John Counter Boulevard) provide significant habitat for a wide range of terrestrial and aquatic wildlife species, including feeding areas for migratory waterfowl, over 200 bird species (at least 21 of which are dependent on the marsh for nesting habitat), at least 26 sport and forage fish species that use the river system for spawning, nursing and rearing, and 16 amphibian and reptile species.

5. Available data on mammal populations is more limited, but at least 25 species have been observed or reported.

6. Further to the above, the Cataraqui River and its shoreline are considered animal movement corridors. The river provides a linkage for fish species moving from Lake Ontario and the St. Lawrence River to upstream areas. The 30 m riparian area along the river, referred to earlier as a 'ribbon of life' in the City's Official Plan, also enables wildlife to move along the shorelines between habitats.

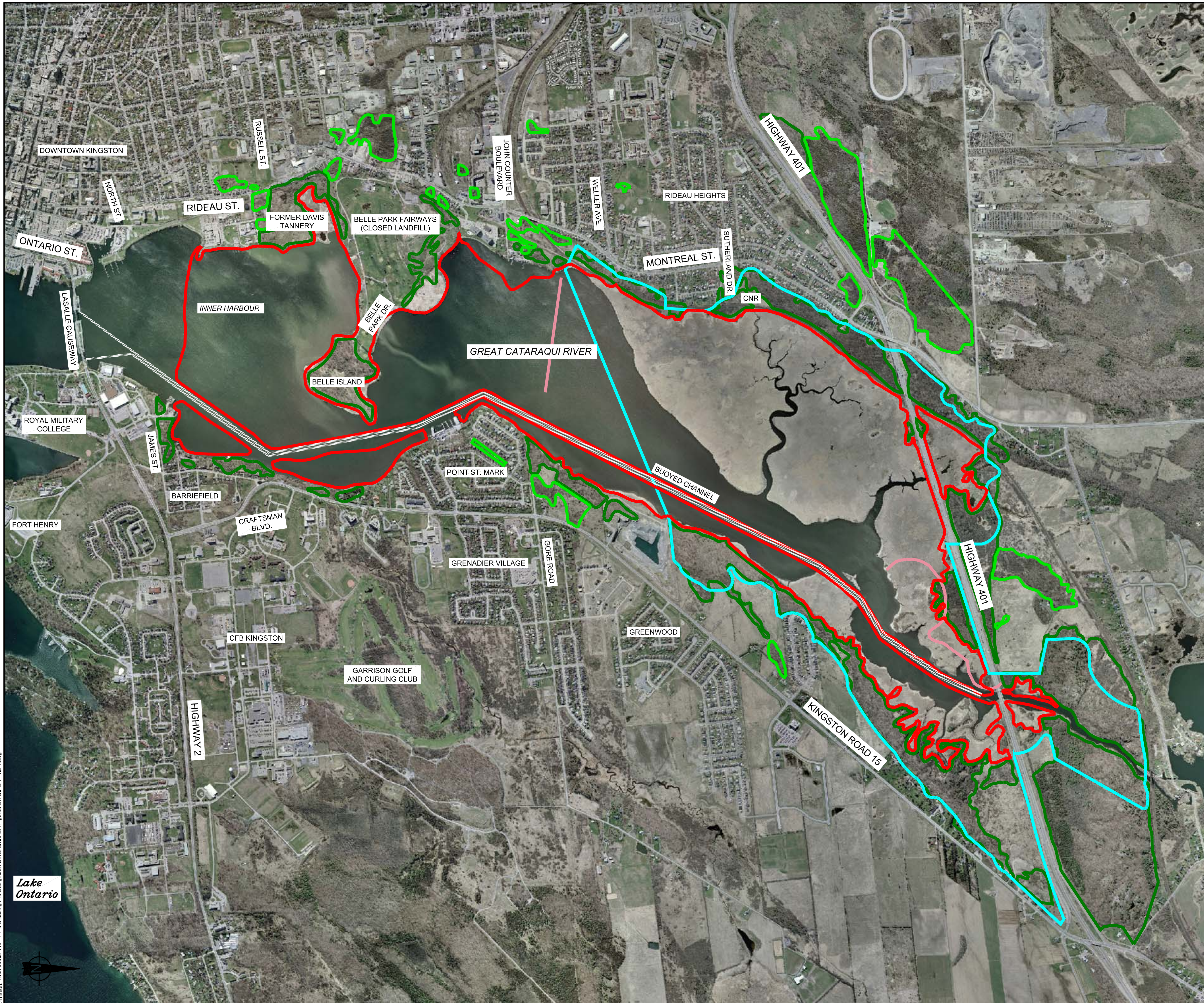
2. Project Corridor

The more detailed accounting of ecological conditions within the project corridor is divided into the following four sub-sections:

1. Ecological Land Classifications.
2. Faunal Species Inventory Findings.
3. Greater Cataraqui Marsh Wetland vegetation.
4. Marine ecology.

(A) Ecological Land Classifications

Ecological Land Classification (ELC) is an integrated approach to surveying and classifying land and resources. Its goal is to reduce complex natural variation to a reasonable number of meaningful ecosystem units. Development of the ELC mapping during the Class EA involved background information reviews, liaison with various regulatory bodies, a number of site visits (June 14, 2008; May 26 and June 11, 2009; and July 25, July 28, August 27 and September 3, 2010), and aerial reconnaissance. This assessment was then supplemented during the current project design phase by additional background information reviews and fieldwork, the latter of which occurred on June 13 and July 2, 2016.



THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

ECOLOGICAL CONDITIONS

Mark Van Buren, P.Eng.
Director of Engineering and Deputy Commissioner

Dan Franco, P.Eng.
Project Engineer

KINGSTON

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Project No.: 27143
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Legend

- Provincially significant Greater Cataraqui Marsh wetland
- Exclusions from wetland habitat (channels)
- Significant woodlands (from CRCA 2006)
- Contributory woodlands (from CRCA 2006)
- Provincially significant ANSI (Norris, pers. comm.)

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As shown on **Drawing 4.2.2**, there are no ELC community types on the west side lands. This has remained unchanged since the Class EA. The land is dominated by cultural influences, including John Counter Boulevard, which slopes down to the Cataraqui River shoreline and is used as a boat launch; single dwellings; light industries; the River Park subdivision; and the Village On The River apartments. Manitoba Maple is the main tree species present, growing along the road rights-of-way and on the residential properties. Ornamental garden plants are also present on some of the residential lots. European Buckthorn is the main shrub in the area. The bulk of the ground cover plants are weedy species typically found along road edges, such as Ragweed, Burdock, Sow Thistle and Mullein. No trees that are listed in either the Provincial Endangered Species Act (ESA) or the Federal Species at Risk Act (SARA) are present.

As also highlighted on **Drawing 4.2.2**, there are four ELC community types found on the east side lands, which have remained unchanged since the Class EA:

1. A 'Cultural Thicket' (CUT) community type is found within the Gore Road right-of-way. It is characterized as having a shrub cover greater than 25% and a tree cover of less than 25%.

   There are a few large diameter Sugar Maple, Red Oak, White Oak and Bur Oak trees that are likely over 100 years old, and a number of shrub-sized White Ash and Manitoba Maple, but the overall dominant species that characterizes this area is European Buckthorn. Other shrub species include Tartarian Honeysuckle, Staghorn Sumac, and Riverbank Grape. The ground cover is mostly weedy non-native species such as Knapweed, Burdock, Trefoil, Fragrant Bedstraw (native), Thistles, Dames Rocket, Crown Vetch, and Garlic Mustard.

   Many of the dominant plant species present are considered Category I invasive species[2].

   Site disturbances include an underlay of large rock fill, making much of the Gore Road right-of-way roughly 6 m to 8 m higher in elevation than the woodlot to the north.

   The shoreline component (about the first 20 m) of the Gore Road right-of-way is dominated by tree cover, but this area is too small to be considered a separate ELC community. The main tree species along the shoreline is Crack Willow, but Manitoba Maple and European Buckthorn are also noted down to the shoreline. Off-shore, there is little wetland vegetation, possibly due to the deposited rock fill and the existing limestone pavement. A fringe of Narrow-leaved Cattails extends to the north and south.

   A second CUT patch is located west of the Gore Road Library, and extends into the off-leash dog park. Weedy species are common. Riverbank Grape is abundant along with Buckthorn and Staghorn Sumac, though there is no clear dominant species. Manitoba Maple is the most common tree.

2. 'Dry-Fresh Sugar Maple – White Ash Deciduous Forest' (FOD5-8) is found north of the Gore Road right-of-way and extends northward in fragmented segments to the Pittsburgh quarry operation. This forest type is typical of lands that have a history of disturbance.

   The dominant canopy tree species is Sugar Maple, with lesser amounts of White Ash. Manitoba Maple, Ironwood, Black Cherry, Shagbark Hickory, Basswood, Red Oak and White Oak are also present. It appears, based on historic photographs from 1945, 1953, 1962 and 1978, that much of the FOD5-8 forest area was used for agricultural purposes. This would coincide with the mostly young age of the woodlot, with many of the trees in the 30-year range. There are a few older trees in the 80-100 year range that, in the historic aerial photographs, are isolated within the agricultural areas.

   This woodlot has a high degree of edge due to its uneven shape, and has high fragmentation due to the numerous trails within it. Common trees in the edge include Manitoba Maple and White Ash, but European Buckthorn dominates, with Garlic Mustard as a common understory plant. Overall, the Buckthorn-dominated edge areas are almost greater in size than the area dominated by Sugar Maple.

   The woodlot also contains two drainage routes (shown as circles on **Drawing 4.2.2**). The drainage routes collect groundwater from the Point St. Mark residential neighbourhood and direct it to the Cataraqui River. The more easterly drainage route discharges at the base of the rock fill, near the current Gore Road-Point St. Mark Drive intersection. The other drainage route discharges within the FOD5-8 area, roughly 50 m west and 20 m north of the first discharge point at the base of the rock fill. During the site visits as part of the Class EA, the drainage routes were seen to be dry only once. During the site visits in support of the current project design phase, more than one seep was observed. As such, this area qualifies as significant wildlife habitat, including the forest ecosite that contains them.

[2] Category I species are those species that can dominate a site to the exclusion of all other species and remain on-site indefinitely.

LEGEND

FOD5-8 - DECIDUOUS FOREST

CUT - CULTURAL THICKET

CUW - CULTURAL WOODLAND

CUM - CULTURAL MEADOW

A: WEST SIDE LANDS
(NO ELC COMMUNITY TYPES)

B: EAST SIDE LANDS

THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

ELC COMMUNITY TYPES

Mark Van Buren, P.Eng. *Director of Engineering and Deputy Commissioner*	Dan Franco, P.Eng. *Project Engineer*

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

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Project No.:	27143
Drawing No.:	4.2.2
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The shoreline component of the FOD5-8 area has an approximate 15 m wide verge of wetland vegetation that is too small to be considered a separate ELC community type.

3. A ‘Cultural Woodland’ (CUW) area is found in the southwest quadrant of the Gore Road-Point St. Mark Drive intersection. This area is also too small (less than 0.5 ha) to be considered a separate ELC type, but it is noted here. Like the nearby FOD5-8 woodland, Sugar Maple and White Ash are common, but numerous other tree species are also present, many of which were likely planted. The ground cover and shrub layers are mostly weedy non-native species.

4. The two ‘Cultural Meadow’ (CUM) patches, like most cultural meadows within urban settings, are dominated by weedy species and both have a history of disturbance. The more easterly CUM area adjacent to Highway 15 is part of the off-leash dog park.

Combined, the ELC communities on the east side lands are small (less than 40 ha). However, they are within 30 m of the Cataraqui River which is a waterbody, and associated with significant natural and cultural heritage features. As such, these woodlands are identified as Provincially significant and contributory in the current Official Plan.

(B) Faunal Species Inventory Findings

Information on endangered or threatened species was gathered concurrent with the ELC fieldwork during both the Class EA and the current project design phase. Highlights are as follows:

1. A total of 73 bird and waterfowl species have been identified, of which there are currently four at risk bird species having a moderate-to-high probability of occurring within the project corridor:

   a) The Barn Swallow, which is listed as ‘threatened’ under the Provincial ESA, with no status under the Federal SARA. This species was observed foraging within the project corridor. Potentially suitable nesting habitats in privately owned buildings and the rock cut along the CNR line (west side) were also noted.

   b) The Chimney Swift, which is listed as ‘threatened’ under the Provincial ESA (species and habitat protection) and Federal SARA (species protection). Although this species was not observed during the fieldwork, it is known to occur within the project corridor. Potentially suitable nesting habitats in privately owned buildings (abandoned chimneys) and large cavity trees were also noted.

   c) The Common Nighthawk, which is listed as ‘special concern’ under the Provincial ESA and ‘threatened’ under the Federal SARA. Although this species was not observed during the fieldwork, it is known to forage over open habitat areas within the project corridor.

2. Although very few turtles were observed during the fieldwork, it is recognized that the project corridor supports turtles, most notably:

   a) The Blanding’s Turtle, which is listed as ‘threatened’ under the Provincial ESA (species and habitat protection) and Federal SARA (species protection). Although this species was not observed, it is known to occur within the project corridor. Potentially suitable nesting habitats along and close to the Cataraqui River shoreline (in open areas, gravel shoulders, parking lots and residential lawns) were also noted.

   b) The Northern Map Turtle, which is listed as ‘special concern’ under the Provincial ESA and Federal SARA. This species was observed within the project corridor. Potentially suitable nesting habitats close to the Cataraqui River shoreline (in open areas, gravel shoulders, parking lots and residential lawns) were also noted.

   c) The Snapping Turtle, which is also listed as ‘special concern’ under the Provincial ESA and Federal SARA. Predated nests and eggs were observed within the project corridor.

3. The project corridor was assessed during the current project design phase for its potential to support bat maternity roosts. Potentially suitable habitat is present for:

   a) The Small-footed Bat, in the rock faces and talus along the CNR line (west side). This species is listed as ‘endangered’ under the Provincial ESA (species and habitat protection), with no status under the Federal SARA.

   b) The Little Brown Bat and the Northern Bat, in the large cavity trees on the Gore Road Library property (east side) as well as the large cavity trees near-shore and in privately owned buildings (west side). Both species are listed as ‘endangered’ under the Provincial ESA (species and habitat protection) and Federal SARA (species protection).

c) The Tri-coloured Bat, in the foliage and leaf clumps in all treed areas within the project corridor. This species is listed as 'endangered' under the Provincial ESA (species and habitat protection) and Federal SARA (species protection).

4. The Butternut Tree is listed as 'endangered' under the Provincial ESA (species and habitat protection) and Federal SARA (critical habitat has yet to be established). This species is often found in hedgerows, along stream banks, on wooded valley slopes and in deciduous and mixed forests. Although Butternut Trees were not observed in publicly accessible areas within the project corridor during the fieldwork, they may be present on privately owned lands.

5. 12 taxa of butterflies and dragonflies were identified during the fieldwork as part of the current project design phase. Of these species, the Monarch Butterfly is listed as 'special concern' under the Provincial ESA and Federal SARA. Although this species was not observed, butterflies generally may use virtually any of the areas within the project corridor as migratory stopover habitat, particularly the east side lands where there is a mixture of forest and open areas.

6. Other fauna species present are those normally found in a near urban site and are mostly considered habitat generalists (e.g. Beaver, Eastern Chipmunk, Red Squirrel, White-tailed Deer, Eastern Gartersnake, American Toad, etc.). There is some species movement, including Red Fox that may hunt in the area as well.

(C) Greater Cataraqui Marsh Wetland Vegetation

Drawing 4.2.3 illustrates four vegetation communities within the project corridor, which were documented during the Class EA in a manner generally consistent with both wetland evaluation protocols and the Ontario Wetland Evaluation System (OWES):

1. The majority of the project corridor passes over only one vegetation type (suW1) and the balance over open water areas (OW). The suW1 community is a vegetation community with only one vegetation form (submerged vegetation), dominated by Milfoil. The OW areas are non-vegetated areas, which in this area is due to the maintenance of dredged channels for watercraft. As noted above, these areas are not part of the Greater Cataraqui Marsh PSW.

2. The suW2 community is found along the west shoreline. It consists of two vegetation forms (submerged vegetation and floating-leaved plants), dominated by Milfoil and Waterlilies.

3. The reM3 community is made up of two vegetation forms (robust emergents and narrow-leaved emergents), dominated by Cattails and Grasses.

4. The reM6 community consists of two vegetation forms (robust emergents and ground cover), dominated by Cattails and Purple Loosestrife. It is proximate to Belle Island.

The Class EA concluded that these vegetation communities had changed very little over the past 20 years. This assessment has been reviewed during the current project design phase and its relevance to date is re-confirmed.

(D) Marine Ecology

The Cataraqui River is roughly 1,150 m wide at the project corridor and has water depths ranging from about 1.2 m over the majority of the section to approximately 4.5 m at the navigable channel. Water flow speed is estimated to be 0.4 metres / second (m/s). The riverbed substrate consists of soft, unconsolidated muck. The shoreline substrate includes bedrock, boulders, cobbles, gravels and fines. Some areas are hardened with large boulders and/or rip rap. The shorelines also have a variety of riparian vegetation types such as wetland, forested areas that are limited mainly to the east shoreline, manicured parkland with scattered trees and manicured grass to the water's edge. The shorelines are exposed to wave action from boats passing through the navigable channel.

The Cataraqui River, as part of the Greater Cataraqui Marsh PSW, is listed as having a regional significance in terms of fish spawning and rearing potential. Fish habitat is considered to be warm-water, though salmonids are known to migrate north towards Kingston Mills.

LEGEND

SuW1	SUBMERGED VEGETATION
OW	OPEN WATER
SuW2	SUBMERGED VEGETATION; FLOATING - LEAVED PLANTS
reM3	ROBUST EMERGENTS; NARROW-LEAVED EMERGENTS
reM6	ROBUST EMERGENTS; GROUND COVER
(red/black dashed line)	FIELDWORK AREA
(yellow line)	PROJECT SITE LOCATION

THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

GREATER CATARAQUI MARSH VEGETATION COMMUNITIES

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As shown on **Drawing 4.2.4**, in order to assess the potential impacts from a bridge on aquatic habitat, the project corridor was divided into west side, mid channel and east side zones during the Class EA. Information on fish and fish habitat was collected by:

1. 5 shoreline and 12 offshore transects to confirm substrate, riparian and aquatic vegetation and available cover conditions.

2. Fish community sampling using a boat electroshocker and bag seine net. The boat sampling was done during the night on April 12, July 19 and October 17, 2010. The seine netting was completed during the day at four sites on July 20 and October 18, 2010. All fish were identified, measured [fork length (FL) or total length (TL) depending on the species] and released unharmed prior to continuing to the next site.

The fieldwork results from the Class EA were reviewed during the current project design phase and their relevance to date is re-confirmed. These results are summarized in **Table 4.2.1**, and the profiles of the shoreline habitat are shown on **Drawing 4.2.4**. The habitat within the project corridor is fairly homogenous, consisting of a slow moving glide with fine sediments and dense submergent vegetation. The aquatic vegetation along the shoreline within the bay created by Belle Island consists mainly of extremely dense floating and submergents with a thin band of emergent cattails. Offshore, but still within the bay at the mid channel sites, the vegetation is chocked with dense submergent vegetation. The navigable channel contains the deepest habitat, but lacks aquatic vegetation. The presence and role of the Canal’s channel helps to reduce the density of aquatic vegetation within the channel and along the east side of the Cataraqui River.

The only spawning activity observed during the field sampling consisted of Yellow Perch which were found spawning throughout the mid channel sites during the spring visit. However, the presence of young-of-the-year (YOY) Pumpkinseed, Bluegill, Largemouth Bass and the occasional Rock Bass and Brown Bullhead suggests that these species are also spawning within the project corridor.

Overall, the fish species found during the Class EA fieldwork were mainly common warm to cool water sport and forage fish that prefer slow moving water bodies and spawn within aquatic vegetation or algae. The sportfish captured were Northern Pike, White Sucker, Yellow Bullhead, Brown Bullhead, Rock Bass, Pumpkinseed, Bluegill, Largemouth Bass, Black Crappie and Yellow Perch.

In addition, based on records reviewed during the current project design phase, the Cataraqui River is known to provide habitat for the American Eel as it migrates to spawning areas. This species is listed as ‘endangered’ under the Provincial ESA, with no status under the Federal SARA.

4.3 Cultural Heritage Conditions

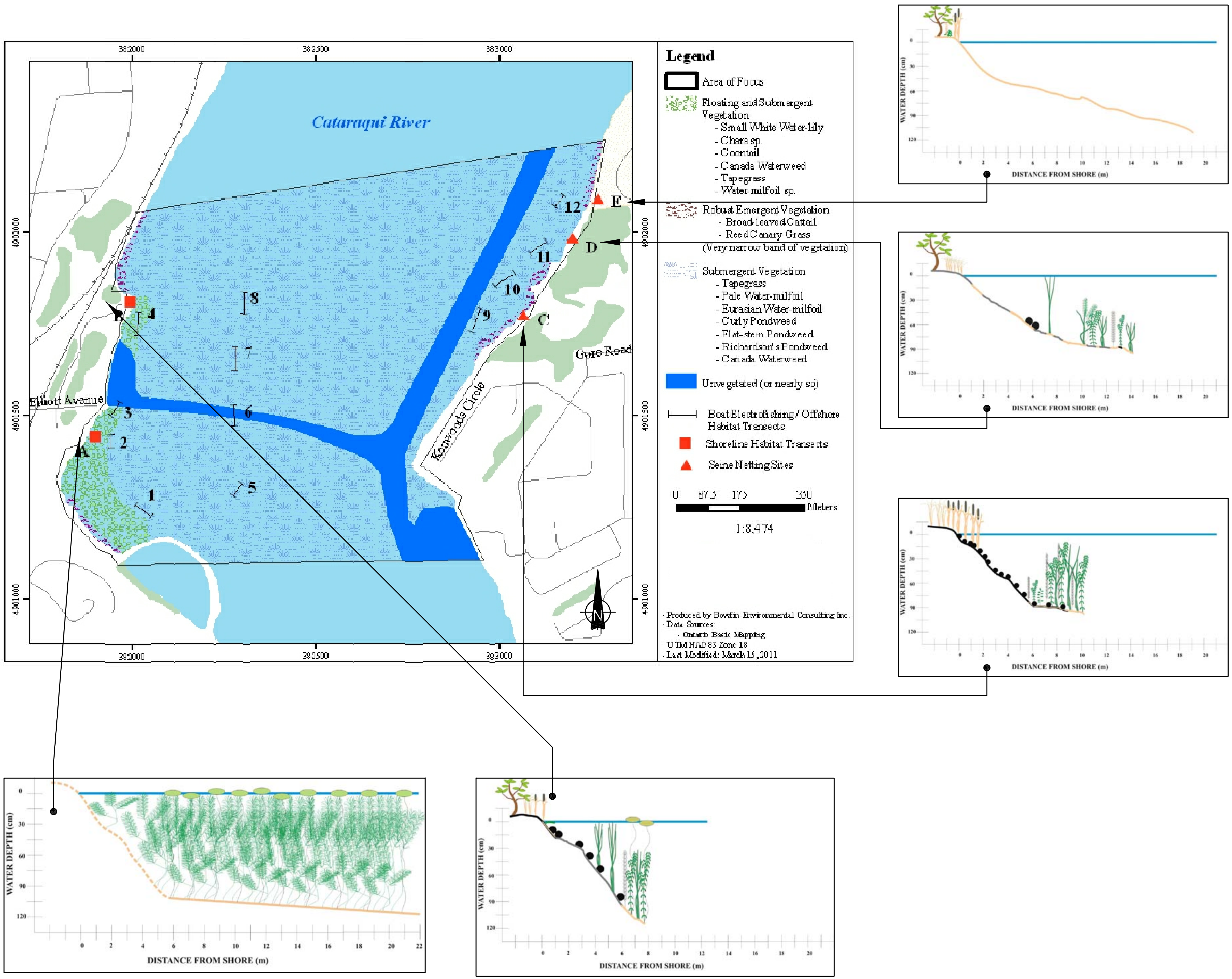
This section of the Report highlights cultural heritage conditions within the DIA area. It is based on background information reviews, liaison with various regulatory bodies and fieldwork activities (on June 14 and 23, 2011) undertaken during the Class EA. This assessment has been reviewed during the current project design phase and its relevance to date is re-confirmed. The supporting reports are included in **Appendix D**.

1. General

As shown on **Drawing 4.3.1**, there are 72 identified cultural heritage sites within the DIA area, highlights of which are as follows:

1. The LaSalle Causeway, which is a municipally listed property and its Bridge Office and Shop portion is also a Federal heritage building.

2. The Canal, which is a 202 km long waterway, built by the Royal Engineers between 1826 and 1832 to provide a secure alternate supply route in the event of a military blockade by the Americans. The Canal is a UNESCO World Heritage Site (designated in 2007), National Historic Site (designated in 1925), Canadian Heritage River (designated in 2000) and Federally regulated navigable waterway (which is officially closed to watercraft from Thanksgiving to Victoria Day). Within the DIA area, the designated site of the Canal (for all three designations) begins at Belle Island and follows the high-water marks on either shore, north to and beyond the limits of the DIA area. The inscribed property of the UNESCO World Heritage Site includes the Canal National Historic Site as well as the Fort Henry and Kingston fortifications (Fort Frederick and the Murney, Shoal and Cathcart Martello Towers) National Historic Sites in the southern portion of the DIA area.



THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

AQUATIC VEGETATION AND FISH SAMPLING SITES

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Table 4.2.1: Summary of Shoreline Habitat Profiles and Fish Sampling Results

	West Side Zone						Mid Channel Zone				East Side Zone						
	Shoreline Transect		Offshore Transect				Offshore Transect				Shoreline Transect			Offshore Transect			
	A	B	1	2	3	4	5	6	7	8	C	D	E	9	10	11	12
Shoreline Habitat Profile	White water-lily and stonewort at shoreline. 100% in-stream cover. Substrate was soft / mucky.	Reed canary grass, cattails, flowering rush buckthorn, nannyberry, staghorn sumac at shoreline. 20% in-stream cover near-shore, up to 60% offshore. Substrate was firm.									Reed canary grass and broad-leaved cattail at shoreline. 30% in-stream cover near-shore, up to 70% offshore. Substrate was firm with a mix of boulders / fines.	Reed canary grass, hog-peanut, black medick, common buckthorn, dogwood, red oak, crack willow and white ash at shoreline. 20% in-stream cover near-shore, increasing to 50% offshore. Substrate was firm with a mix of boulders / fines.	Reed canary grass, cattails, fern, nannyberry, white ash, field bindweed, meadowsweet at shoreline. Sparse in-stream cover observed in Fall only. Substrate was firm.				
Spring Fish Sampling:																	
No. of Fish			174	163	155	107	173	179	198	95	N/A	N/A	N/A	165	106	72	85
Summer Fish Sampling:																	
No. of Fish			59	81	125	106	81	108	68	90	102	99	242	54	26	29	20
Fall Fish Sampling:																	
No. of Fish			97	69	194	55	147	183	26	61	155	232	160	167	161	436	299

Note:

1. The percentage of sportfish captured with the boat electrofisher and seine net were 83% and 86%, respectively.
2. The boat electrofishing catch across all the offshore transects was represented mainly by Yellow Perch (35%), Pumpkinseed (34%), Brook Silversides (10%) and Bluegill (8%).
3. The seine net catch at the shoreline transects was represented mainly by Yellow Perch (67%), Round Goby (9%), Pumpkinseed (7%) and Largemouth Bass (6%).

THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

CULTURAL HERITAGE CONDITIONS

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3. On the east side of the Cataraqui River:

   a) The Barriefield Village Conservation District which encompasses the entire village, including its buildings, landscape features, topography, and archaeological sites and resources. Buildings are not individually designated, but are protected as elements of the district. Management of the district is governed by a Conservation Plan, which strives to: maintain the low density residential profile of the Village; avoid destruction of its built and landscape fabric; maintain the visibility of St. Mark's Church; and preserve its viewscapes from the Village towards the Cataraqui River and St. Lawrence River, Fort Henry and downtown Kingston.

   b) As noted above, the Fort Henry site and RMC site comprise many overlapping designations, including a portion of the Canal's UNESCO World Heritage Site designation at Fort Henry, four National Historic Sites (Fort Henry, Point Frederick Buildings, Navy Bay and Kingston Fortifications), 35 Federal heritage buildings and numerous plaques erected by Federal, Provincial, municipal and private authorities. The heritage value of these sites includes important viewscapes, both between the various sites and to-and-from other significant landmarks, such as Kingston Harbour, City Hall and the Barriefield Village Conservation District.

   c) There are three Federal heritage buildings at CFB Kingston on the east side of Highway 15 and two other farmhouse properties that are municipally designated on both sides of Highway 15, north of Gore Road.

4. On the west side of the Cataraqui River:

   a) Fort Frontenac which refers to both the archaeological remains of the 17th century French fort (Fort Frontenac National Historic Site), and the present-day Department of National Defence barracks (formerly Tête du Pont Barracks) that occupy part of the same site, at the eastern end of Ontario Street.

   b) Within the area bound by Ontario Street, Queen Street, Montreal Street, and North Street there are 45 identified cultural heritage properties, including municipal listings and designations, plaques erected by various government authorities and private organizations, and a Federal heritage building. Well-known heritage properties include the Kingston Armouries, Wellington Terrace, St. Paul's Anglican Church and burial ground, Cataraqui School, and the Wellington Street Brewery.

   c) The area north of North Street has comparatively few identified heritage properties. The City has designated five properties (including the old stone Imperial Oil building, the Woolen Mill, the stone Depot School, the Grand Trunk Railway Station property and the stone Grand Trunk Railway Terrace) and listed six properties.

2. Project Corridor

The more detailed accounting of cultural heritage conditions within the project corridor is divided into the following three sub-sections:

1. The Rideau Canal.
2. The Gore Road Library.
3. The west side lands.

(A) The Rideau Canal

UNESCO World Heritage Site designations are based on 10 criteria. The Canal's designation in 2007 was based on two of these criteria[3], namely:

1. That it remains the best preserved example of a slackwater Canal in North America demonstrating the use of European slackwater technology in North America on a large scale. It is the only Canal dating from the great North American Canal-building era of the early 19th century that remains operational along its original line with most of its original structures intact.

2. That it is an extensive, well preserved and significant example of a Canal which was used for a military purpose linked to a significant stage in human history, that of the fight to control the north of the American continent.

[3] There are eight other UNESCO World Heritage Site designation criteria that do not apply to the Canal. These criteria relate to the interchange of human values within cultural areas, traditional human settlements, living traditions having outstanding universal significance, or areas representing natural, ecological, or biological phenomena.

The Statement of Outstanding Universal Value for the Rideau Canal UNESCO World Heritage Site further reflects these two criteria, wherein it states that:

> "The Rideau Canal is a large strategic Canal constructed for military purposes which played a crucial contributory role in allowing British forces to defend the colony of Canada against the United States of America, leading to the development of two distinct political and cultural entities in the north of the American continent, which can be seen as a significant stage in human history."

Parks Canada is responsible on behalf of the Federal government for managing and protecting the Canal as a National Historic Site and Canadian Heritage River. Parks Canada is also responsible on behalf of the UNESCO World Heritage Committee for ensuring that the Outstanding Universal Value is maintained and enhanced, and that the integrity (wholeness and intactness) and authenticity (expression of value through attributes such as use, function, location and setting) of the Canal is protected and preserved.

Parks Canada's mandate regarding the Canal is further reflected in its Commemorative Integrity Statement (CIS), which was approved in 2000 in support of the Canal's designation as a National Historic Site. The CIS reflects the Canal's unique historic and natural environment, including its rich and varied landscapes. It identifies the following three strategies to ensure the protection and enhancement of this section of the Canal:

1. Maintaining through-navigation of the Canal system to help assure the preservation of the Canal's unique historic environment and cultural resources.

2. Safeguarding the heritage character of corridor shore-lands from inappropriate development or uses.

3. Safeguarding the landmarks, viewscapes and natural ecosystem features of the Canal's islands, shore-lands and wetlands that are related to the construction of the Canal and which are part of the Canal's unique historical environment.

In the spirit of both guiding the bridge design process and confirming its own role as an approval authority, the bridge design guidelines highlighted in Section 3 of this Report articulate the heritage values and strategic principles of the section of the Canal within which the project corridor is located.

(B) The Gore Road Library

The Gore Road Library is located at the northwest corner of Gore Road and Highway 15. It was acquired by the City in 1997, and designated as a cultural heritage property in 2007 under By-Law No. 2007-166. The cultural heritage value of the property lies in its physical and design values:

1. The physical / design value of the property resides in the 19th century stone house as a finely crafted example of the vernacular Classical Revival style; in the dry stone wall, which is one of only a few surviving examples of 19th Century dry stone walls in the area; the remains of the formal gardens around the house; and in the remnants of farming activities, including barns, barn foundations and orchards.

2. The historical / associative value of the property lies in its historic associations with the Ruttan and the Hay families.

3. The contextual value of the property pertains to its landmark status along Highway 15 as a Library, park, off-leash dog park, and its views of the Canal.

By-Law No. 2007-166 lists heritage attributes of the property which must be conserved in order to retain its heritage value. These include: i) the interior and exterior of the stone house; ii) the dry stone wall; iii) the evidence of historic garden and farming activities; iv) the intangible associations with the Ruttan and the Hay families; v) the pathways and views of the Canal; vi) the role of the property as a Library and centre for community activities; and vii) its status as a landmark along Highway 15.

(C) The West Side Lands

There are neither cultural heritage properties on the City's heritage list, nor any properties with potential cultural heritage value on the west side lands from John Counter Boulevard west up to Montreal Street.

4.4 Landscape and Viewscape Conditions

This section of the Report highlights landscape and viewscape conditions within the DIA area. It is based on background information reviews and site visits undertaken during the Class EA. This assessment has been reviewed during the current project design phase and its relevance to date is re-confirmed. The supporting reports are included in **Appendix D**.

There are two landscape character types within the DIA area. The lower Cataraqui section of the Rideau Canal south from Highway 401 to the northern entrance of Kingston's Inner Harbour near Belle Island is a rare example of the waterway where the natural environment was not altered during Canal construction. Over the intervening 178 years, the extensive wetlands of the Great Cataraqui Marsh, as well as the river valley's sloped physiography and forested landscapes adjacent to the Canal's navigable channel have remained largely intact. This natural setting has contributed to the unique historical, ecological and visual environment of this section of the waterway, which is further reinforced in Parks Canada's 'Rideau Corridor Strategy Landscape Character Assessment & Planning and Management Recommendations of the Rideau Corridor'.

As shown on **Figure 4.4.1** to **Figure 4.4.3**, as boaters proceed from the Highway 401 crossing southward (roughly 4 km north of the Inner Harbour entrance), the visible cattail portion of the Greater Cataraqui Marsh dominates the landscape at first, with its shallow water and emergent aquatic plants, near continuous overhanging tree canopy and shrub understory. The City's urban landscape then becomes increasingly more visible in the background as boaters pass through the visible cattails. At roughly 1 km north of the Inner Harbour entrance near Belle Island, the project corridor emerges, where the natural landscape evolves into an increasingly urban, more manicured landscape against the backdrop of Belle Island immediately to the south.

Figure 4.4.1: On Water View Looking South (at Buoy S65)

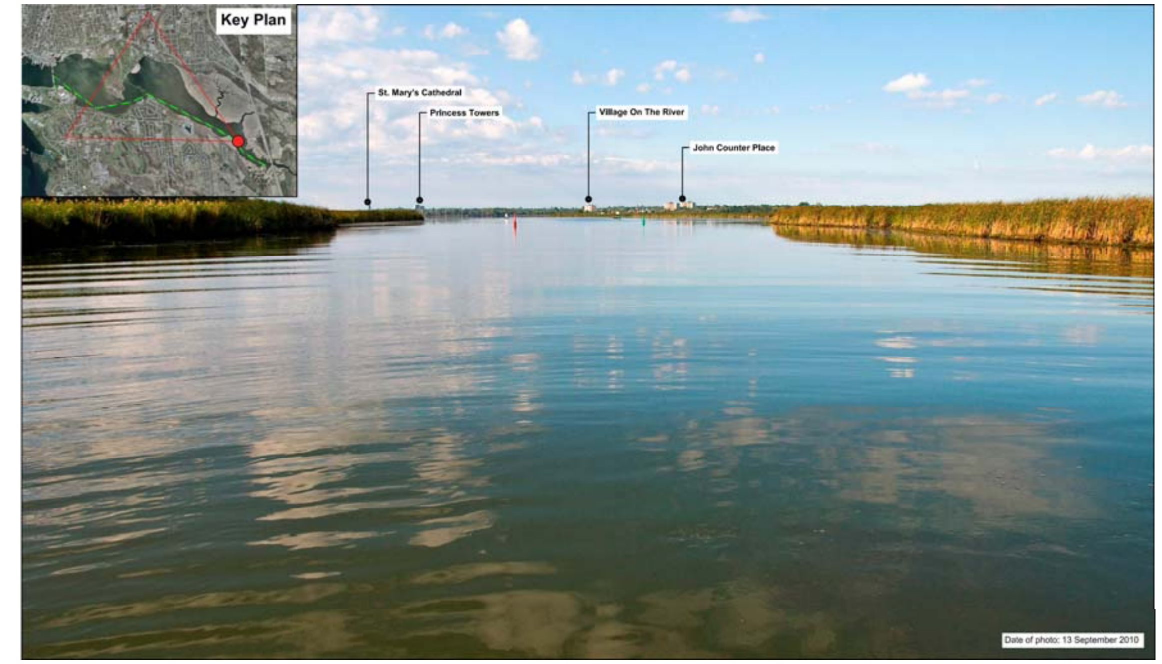


Figure 4.4.2: On Water View Looking South (at Buoy S47)

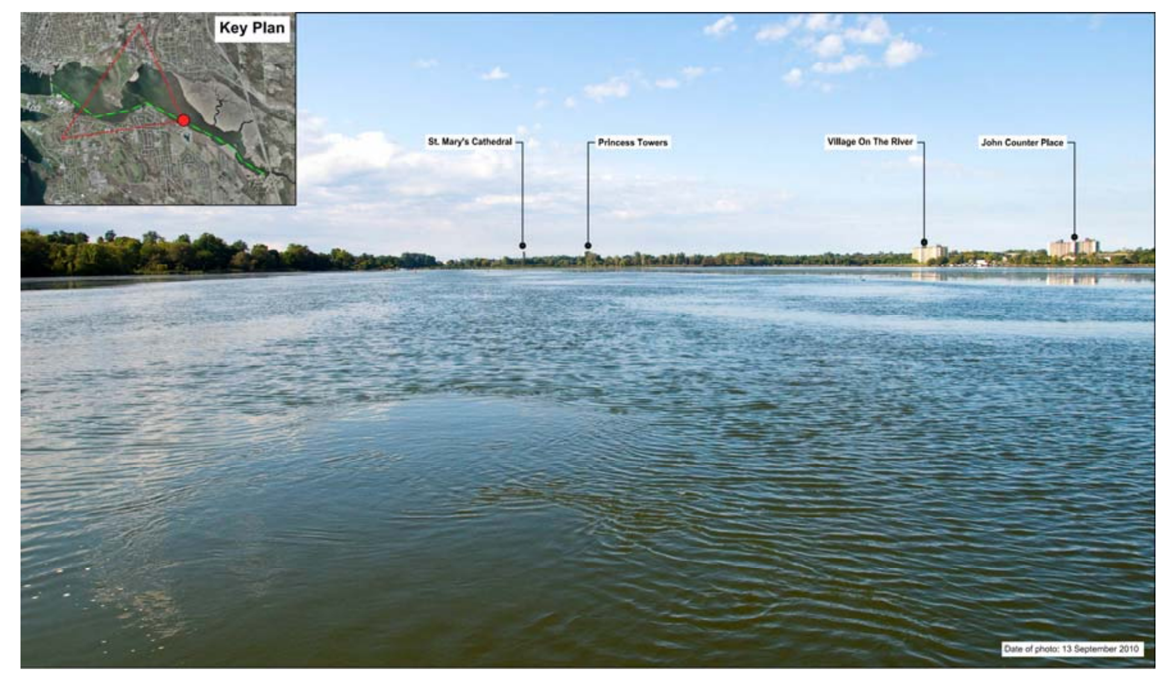


Figure 4.4.3: On Water View Looking South (at Buoy S33)

Views further south of Belle Island are blocked by the tree line along the northern portion of Belle Park and Belle Island as well as by the extension of the eastern shoreline whereon the Gore Road

Library, Point St. Mark residential neighbourhood and Rideau Marina are located. As shown on **Figure 4.4.4,** views of the project corridor are similarly blocked by these features for boaters proceeding from the LaSalle Causeway northward.

Figure 4.4.4: On Water View Looking North (at Buoy S15)

This includes the protected views related to Fort Henry and Kingston fortifications in the southern portion of the DIA area. As shown on **Figure 4.4.5**, views of the Inner Harbour are obscured in the background at Fort Henry, not only by distance but also by the CFB Kingston and RMC facilities in the foreground. Furthermore, the tree line along the southern portion of Belle Park and Belle Island, in conjunction with the proximate extension of the eastern shoreline, blocks views to the project corridor, and the remaining DIA area further north to Highway 401. This context establishes a more limited impacted viewshed as a project design consideration.

Figure 4.4.5: Fort Henry View Looking North

4.5 Archaeological Conditions

This section of the Report highlights archaeological conditions within the DIA area. It is based on background information reviews, liaison with various regulatory bodies and fieldwork activities undertaken during the Class EA. More specific site reconnaissance within the project corridor included:

1. Stage 2 archaeological testing, including focused Stage 3 testing, of the east side lands.
2. A sonar survey of the riverbed to both locate buried objects and prepare a riverbed profile.
3. Extracting riverbed sediment cores at 10 locations by Vibrocoring to determine the potential for marine archaeological resources.
4. Test pitting along both the east and west shorelines.

This assessment has been reviewed during the current project design phase and its relevance to date is re-confirmed.

1. General

Table 4.5.1 highlights the cultural history of the Kingston area.

Table 4.5.1: Cultural Chronology of the Kingston Area		
Period	**Timeframe**	**Description**
Paleo	Circa 12000-10000 Before Present (BP)	The first inhabitants of Ontario lived in small family-based groups, depending on plants and large game animals (moose, deer, caribou, elk) for their food. These nomadic peoples used stone, skin, antler bone, wood, and plant fibres to produce the tools and goods necessary for their survival. A survey of Allen Point along the Rideau Canal system north of Kingston Mills resulted in the identification of a late Paleo point, the first recorded find from this period in Kingston.
Early Archaic	Circa 5000 Before Christ (BC)	Early Archaic peoples produced a greater variety of items than their predecessors. Of particular importance were the dugout canoes and stone tools made by grinding rather than by flaking. The water craft allowed the Early Archaic peoples to travel greater distances, facilitating the exchange of new ideas and goods.
Middle Archaic	Circa 3000 BC	The early people who inhabited Eastern Ontario during the Middle Archaic Period participated in a trade network that spanned the Great Lakes region. For example, copper obtained from the shores of Lake Superior was traded in Eastern Ontario, where it was made into awls, needles, knives, fish hooks, spear points, and bracelets. The earliest recorded human burials in Eastern Ontario date to the Middle Archaic Period.

Table 4.5.1: Cultural Chronology of the Kingston Area		
Period	**Timeframe**	**Description**
Late Archaic	Circa 700 BC	Changes that characterized the Late Archaic Period include increased population size, distinction in social status, and new hunting techniques. Evidence of these changes is the inclusion of trade goods in the burial of selected individuals and tool kits consisting of a variety of projectile point types.
Early Woodland	Circa 300 BC	Peoples living in Eastern Ontario began to use pottery during the Early Woodland Period. Early pots were crudely made, with thick walls and a distinct cord-marked exterior surface. The practice of including grave goods with burials continued, influenced by the Adena Culture, centred in the Ohio River Valley, and the Middlesex tradition, which was focused in New York State.
Middle Woodland	Circa 900 Anno Domini (AD)	During the Middle Woodland Period regionally distinct pottery styles developed, and trade networks began to disintegrate. Ceramic vessels were of a higher quality than previously, and appeared in a greater range of shapes and with a greater variety of decorations. The disintegration of trade networks toward the end of this period coincided with the decline of major cultural influences centred in Ohio and Illinois. Agriculture was introduced to Eastern Ontario towards the end of the Middle Woodland Period. Middle Woodland sites are located throughout the region including the 1000 Islands, the Cataraqui River (Belle Island), the Gananoque River System and along the Napanee River system. Middle Woodland ceramics were recovered in

Table 4.5.1: Cultural Chronology of the Kingston Area

Period	Timeframe	Description
		the excavation of Fort Frontenac suggesting that this was once the location of settlement prior to the arrival of the Europeans.
Late Woodland	Circa 1600 AD	Domesticated plants (corn, beans, and squash) increased in significance as supplements to the more traditional foods such as deer, fish, and wild plants during the Late Woodland Period. Agriculture allowed the Late Woodland Peoples to live in permanent villages. Increasing conflict between groups resulted in the construction of palisades around some of these villages. There is only one identified permanent settlement that can be attributed to this period in the region and it is located in the Cataraqui Creek area. This is a proto Huron or Middleport site. The Kingston Outer Station was a fishing camp utilized throughout the Late Woodland period.
Proto-Historic	Circa 500 to 350 BP	Distinguished by the introduction of European influences prior to the actual settlement of the region. This was a turbulent period for Aboriginal populations in the area. The St. Lawrence Iroquois located just east of the region had been absorbed into other Iroquoian peoples, including the Mohawk, Onondaga and Wendat-Huron, by the time of Champlain's arrival in the area in 1612. The Huron, initially located along the north shore of Lake Ontario, moved to the Lake Simcoe-Georgian Bay area where they too were eventually dispersed in 1649. Fort Frontenac, established in 1673, was the first permanent European settlement in the region. Also established were a series of mission sites along the north shore of Lake Ontario including one in the Napanee area and La Presentation near the present day site of Ogdensberg New York. By the early 18th century, the Iroquois had been driven from the north shore of Lake Ontario by the Mississauga.
Historic	15th Century to Today	Kingston benefited considerably by the presence of the military and developed fairly quickly through the early-to-mid-19th century. The War of 1812 increased activity and development of military property in the region. The potential for shipwrecks and associated marine structures in the area is high.

Given the rich ecological resources of the Cataraqui River and the archaeological evidence found in nearby areas, the DIA area in all likelihood would have been used and periodically inhabited by peoples for the last 10000 years or more. Archaeological evidence of this has yet to be verified and archaeological potential in some areas may have already been removed due to subsequent urban development. Still, since a large percentage of the DIA area remains essentially unaltered, indicators point to virtually the whole DIA area exhibiting high archaeological potential, except for:

1. The land-based features of Belle Park Fairways, the Pittsburgh quarry operation as well as the Rivers Edge and Point St. Mark residential neighbourhoods.

2. The marine-based features associated with the in-water development of the LaSalle Causeway, the HMCS Cataraqui Facility, the Rideau Marina, the Federal dredged sediment disposal site along the north shore of Belle Island, the Canal's navigable channel as well as the existing marine utilities associated with the River Street Pumping Station and Hydro One marine electrical cables within the project corridor.

Areas within the DIA area containing known or potential archaeological resources include the following:

1. Significant archaeological resources are present on both sides of the LaSalle Causeway. Despite the extent of modern developments in that area, intact archaeological remains representing Pre-Contact First Nations, French and British Military Periods (especially at Fort Frontenac, RMC and Fort Henry), and remains relating to subsequent urban development are present.

2. The area between the LaSalle Causeway and Belle Island contains 14 registered Euro-Canadian shipwrecks in its southern portion and intact Euro-Canadian archaeological remains relating to subsequent urban development.

3. Belle Island contains an extensive Middle Woodland Period archaeological settlement site and cemetery. Only two small portions of the island have been archaeologically tested and the archaeological potential of the untested areas is very high. Despite recent developments, portions of the shoreline opposite Belle Island also have a high archaeological potential for Pre-Contact First Nations, Historic First Nations, and Historic Euro-Canadian archaeological sites. The archaeological significance of Belle Island is further reinforced by the 2001 City Council resolution acknowledging Belle Island as a site of significant Aboriginal cultural heritage. This resolution engaged a strategy that was subsequently formalized through negotiation between the City and representatives of local First Nations communities and is embodied in an agreement that was endorsed by City Council in 2006. The framework of the agreement includes a process that would set Belle Island physically apart from the mainland and place Belle Island under the joint ownership of the City and the Mohawk Nation Council of Chiefs.

4. The Kingston Outer Station site north of Belle Island and John Counter Boulevard on the west side of the Cataraqui River contains intact archaeological remains of a Pre-Contact First Nations and Historic First Nations hunting and fishing camp.

5. While other areas north of Belle Island have had minimal development disturbance to date, there is high potential for Pre-Contact and Historic First Nations archaeological remains in this portion of the DIA area.

2. Project Corridor

The more detailed accounting of archaeological conditions within the project corridor is divided into the following three sub-sections:

1. The east side lands.

2. The west side lands.

3. Marine environment.

(A) The East Side Lands

The east side lands, based on the Stage 2 archaeological testing during the Class EA, are typical of what much of the lower Cataraqui River valley must have looked like before modern development. As shown on **Drawing 4.5.1**, from the Cataraqui River shoreline, the land rises in a series of steps, controlled by the horizontally bedded limestone bedrock which underlies the area. Exposed limestone bedrock is present at the shoreline. Proceeding easterly, a foreshore backs on to a steep, 2 m high forested bank. The land to the rear of the bank is generally level. The southern half is heavily forested and the northern half consists of open meadow. The eastern margin of these areas is defined by an abrupt rise in elevation, consisting of a bedrock and talus scarp face. Above the scarp, the terrain is essentially level limestone plain. The Gore Road Library lies on the level plain, between the scarp edge and Highway 15.

As also shown on **Drawing 4.5.1**, there were two areas from which cultural materials were recovered during the Stage 2 archaeological testing:

1. Archaeological Site BbGc-127 which, based on subsequent Stage 3 investigations, identified a small dwelling area or camp, dating to the last decades of the 18th century.

2. A stone survey marker on the south boundary of the Gore Road Library (Lot 10 in the Concession East of the Great Cataraqui River).

(B) The West Side Lands

Visual examination of the west side lands suggests that virtually all lands within the existing road rights-of-way have been disturbed to the extent that any archaeological testing in those areas is almost certain to be futile. On the other hand, the private lands on either side of John Counter

Boulevard do not appear to have been extensively disturbed and may contain areas where archaeological potential still remains. However, since archaeologists have no right of access to conduct archaeological testing on private lands, further assessment of the west side lands continues to be suspended, and will be resumed if the project proceeds to the detail design phase.

(C) Marine Environment

The findings from the marine archaeological fieldwork were as follows:

1. The riverbed is relatively featureless aside from the scour lines caused by boat traffic, which are present near the west shore and at the centre of the river. Mounds were also identified near the navigable channel, which were verified as spoil from previous dredging activities of the channel.
2. The paleo-environment suggests a marsh environment, similar to the existing marsh to the north, wherein small, isolated areas of raised elevations are evident as opposed to a discrete, submerged paleo-shoreline.
3. There was neither evidence of, nor potential for, marine archaeological resources.

4.6 Geo-Environmental Conditions

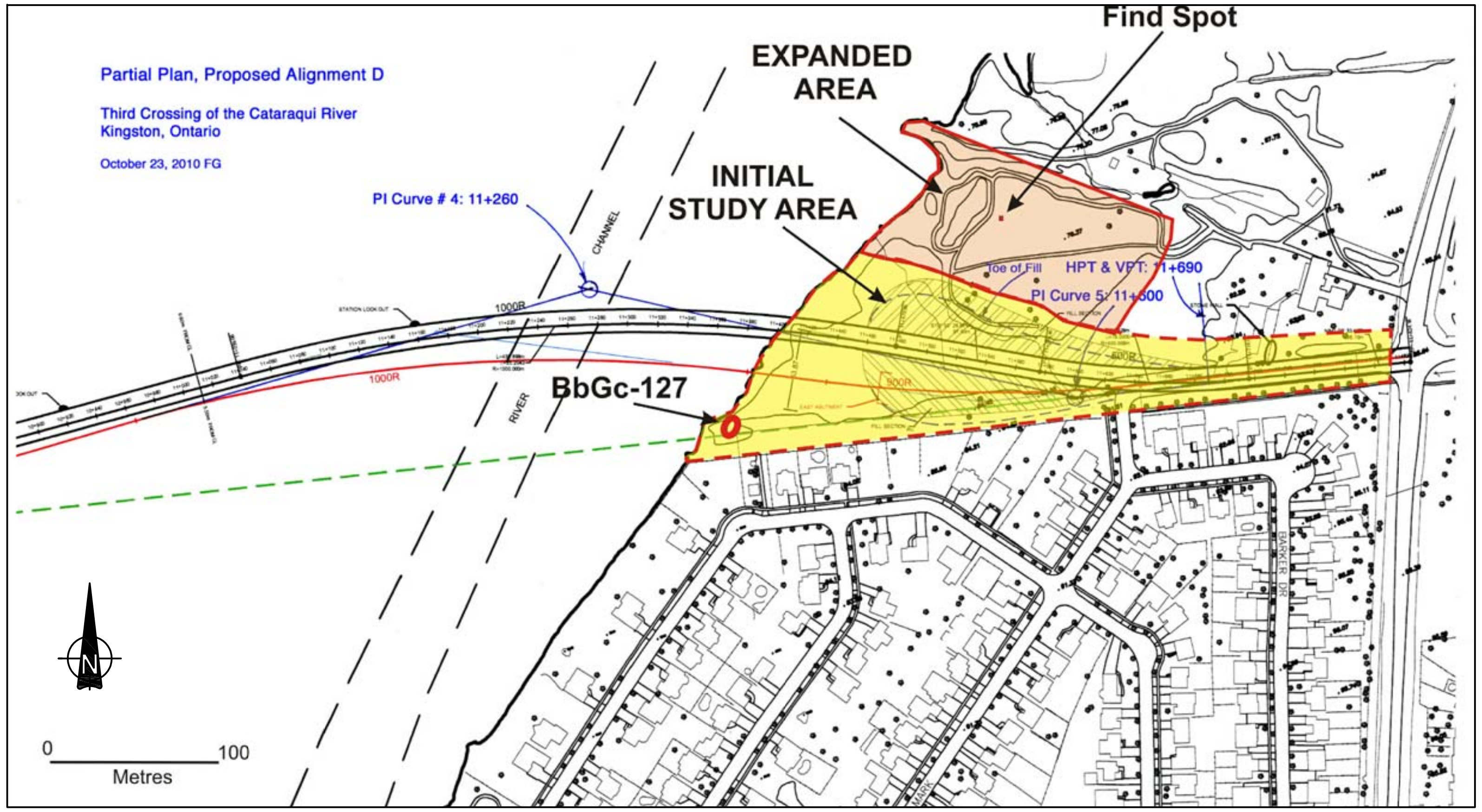
This section of the Report highlights geo-environmental conditions within the DIA area. It is based on background information reviews, liaison with various regulatory bodies and fieldwork activities undertaken during the Class EA and current project design phase. The supporting reports are included in **Appendix E** and **Appendix F**.

1. General

Within the DIA area, there are approximately 750 +/- sites where on-site operations have had spills reported to have either ‘high’ or confirmed environmental impacts (285 +/- sites), ‘medium’ or possible environmental impacts (270 +/- sites), or ‘low’ or no anticipated environmental impacts (200 +/- sites).

Historically, the lands on the west side of the Cataraqui River from the LaSalle Causeway to just north of John Counter Boulevard were more heavily industrialized than in other portions of the DIA area. **Drawing 4.6.1** highlights areas having the highest densities of potential environmental impact. These include:

1. The Downtown area bounded by Brock Street, Barrie Street, North Street and Ontario Street.
2. The Cataraqui Street / Orchard Street / River Street area.
3. Joseph Street between Montreal Street and Patrick Street.
4. Segments of Montreal Street in the downtown area and between Raglan Road and James Street, Stephen Street and Railway Street, John Counter Boulevard and Drennan Street as well as Weller Avenue and Sutherland Drive.
5. Belle Park and its vicinity.
6. Areas bounded by Hickson Avenue, Harvey Street, John Counter Boulevard and Montreal Street.
7. The southwestern portion of the Inner Harbour, where sediment contamination has been found to exceed Provincial and Federal guidelines.



A: FIELDWORK AREA AND SITE BbGc-127 LOCATION

B: FIELDWORK CONDITIONS

THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

EAST SIDE TERRESTRICAL ARCHAEOLOGICAL FIELDWORK AREA, CONDTIONS & RESULTS

Mark Van Buren, P.Eng. *Director of Engineering and Deputy Commissioner*	Dan Franco, P.Eng. *Project Engineer*

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Project No.:	27143
Drawing No.:	4.5.1
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NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

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THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

HIGHEST DENSITY AREAS FOR POTENTIAL ENVIRONMENTAL IMPACT

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Dan Franco, P.Eng.
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J.L.Richards
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Drawing No.:	4.6.1
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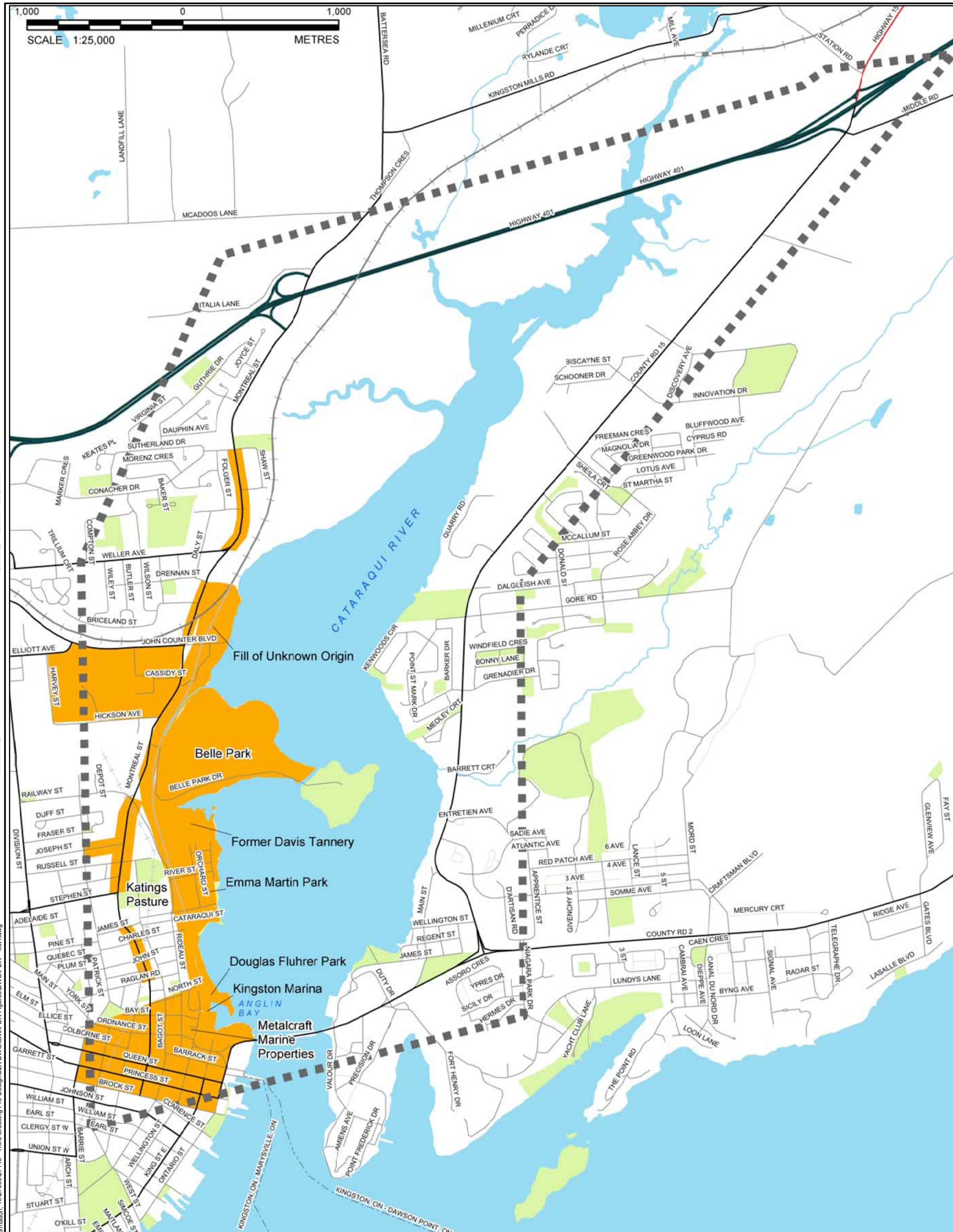


LEGEND

- Expressway
- Major Road
- Local Road
- Ferry Route
- Main Rail Line
- Sidetrack Rail Line
- Abandoned Rail Line
- Areas of Highest Densities of Potential Environmental Impact
- Park / Golf Course / Recreation Area
- Study Area

NOTE

This figure is to be read in conjunction with the accompanying Golder Associates Ltd. report No. 09-1121-0016

REFERENCE

Digital base map data supplied by DMTI Spatial Inc. CANMAP 2007
ProjectionL Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 18

2. Project Corridor

Drawing 4.6.2 and **Drawing 4.6.3** highlight geo-environment findings from a field survey undertaken on June 8, 2016 during the current project design phase:

1. 919 Montreal Street is currently occupied by an automobile collision centre. An above ground storage tank (AST) was formerly present at the collision centre (no longer present based on a visual assessment of the exterior of the building). Due to historical presence of the AST, combined with the on-site land use, this location is considered a Potential Contaminating Activity (PCA). Given the nature of the operation, this PCA is considered to have resulted in an Area of Potential Environmental Concern (APEC).

2. 931 Montreal Street is the former location of B & S Transmission Service. It is possible that this former land use was located on the northeast corner of Montreal Street and John Counter Boulevard. The presence of a former transmission service garage is considered a PCA. Previous information also identifies this property was contaminated by metals and petroleum hydrocarbons but was subsequently remediated and redeveloped. However, impacts may have subsequently migrated on-site (with no remediation), and is therefore considered a potential APEC.

3. A fenced yard was observed at the east end of John Counter Boulevard where it meets the Cataraqui River. The yard contained several drums, an abandoned recreational vehicle, a shipping container and several piles covered with tarps. Drum and vehicle storage is considered a PCA. Since this site is within the proposed laydown area on the west shore, this PCA is considered an APEC.

4. Fill and vent pipes were observed at 630 and 612 John Counter Boulevard indicating the presence (or former presence) of a heating oil storage tank at the residences. The operation of fuel oil storage tanks is considered a PCA, however, it is likely that these storage tanks are ASTs which are more common in residential homes. If the latter applies, this would lower the degree to which the PCA may have resulted in an APEC. But regardless, both PCAs are still considered APECs, since both sites are within the proposed laydown area on the west shore.

5. 603 John Counter Boulevard was previously occupied by a marina. Marinas typically offer fueling services for boats which is considered a PCA. In addition, boat building and repairs at the marina also occurred, which is a PCA. These PCAs are considered an APEC, since the site is within the proposed laydown area on the west shore.

6. Fill of unknown origin may be present under the roadways and is considered a PCA and an APEC. In addition, fill was reportedly placed along the west shoreline and likely associated with the former railway alignment between John Counter Boulevard and the Cataraqui River.

7. Past use of de-icing agents (road salt) along the roadways should be considered a PCA in the context of off-site soil management. However, this is not considered an APEC in terms of in-situ condition.

Geo-environmental sampling was also undertaken in conjunction with the geotechnical investigations highlighted in Section 4.7 of this Report. The sampling was done to confirm potential areas for subsurface impacts that might affect materials management. Soil samples were recovered using split spoon sampling equipment from 12 of the 15 boreholes (BH) that were advanced within the project corridor (BH16-205, BH16-206 and BH16-209 did not recover enough material for analysis)[4]. The results are as follows:

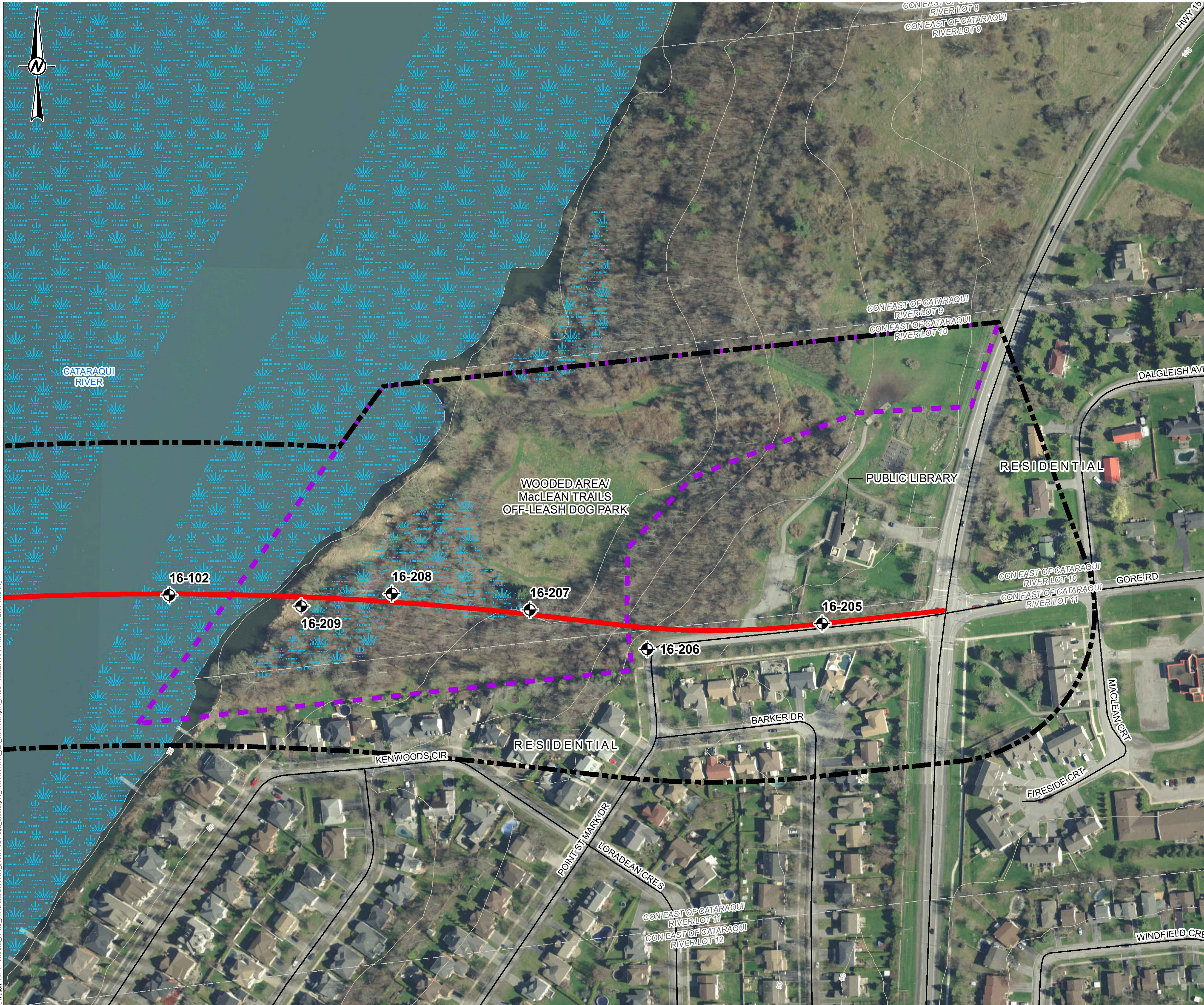
1. Regarding soil samples collected in boreholes from the west abutment area:

    a) All the soil samples exceed 2011 MOECC Table 1 [Full Depth Background Site Condition Standards – Residential / Parkland / Institutional / Industrial / Commercial / Community (R/P/I/I/C/C) Property Use] standards for soil.

    b) Despite the above, select chemical parameters from BH16-203 and BH16-204 meet:

        i. 2011 MOECC Table 3 [Full Depth Generic Site Condition Standards in a Non-potable Groundwater Condition – Residential / Parkland / Institutional (R/P/I) Property Use] standards for soil; and

[4] The management of excavated soil and fill in Ontario is regulated under the Environmental Protection Act, which is managed and enforced by the MOECC. The management of excavated sediments in the Cataraqui River is regulated under the Canadian Environmental Quality Guidelines (CEQGs), which is managed by the Canadian Council of Ministers of the Environment (CCME) and enforced by Parks Canada.



THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

GEO-ENVIRONMENTAL FINDINGS - FIELD SURVEY EAST SHORE

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Dan Franco, P.Eng. — Project Engineer

KINGSTON

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

PARSONS

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Project No.:	27143
Drawing No.:	4.6.2
Sheet No.:	
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No.	Description	By	Date (dd/mm/yy)

LEGEND

- APPROXIMATE BOREHOLE LOCATION
- PROPOSED ALIGNMENT (SITE)
- ROADWAY
- RAILWAY
- WATERCOURSE
- TOPOGRAPHIC CONTOUR, metres
- WETLAND
- LOT FABRIC
- POTENTIAL LAYDOWN AREA
- STUDY AREA

POTENTIALLY CONTAMINATING ACTIVITIES

1. AUTOMOBILE COLLISION CENTRE (FORMER AST)
2. FILL AND VENT PIPES
3. FENCED YARD WITH DRUM AND VEHICLE STORAGE
4. POTENTIAL FUEL STORAGE (AST/UST) FOR MARINA FUELLING
5. FORMER TRANSMISSION SERVICE GARAGE

NOT MAPPED

6. PAST USE OF DE-ICING AGENTS (SALT) ALONG ROADWAYS
7. FILL OF UNKNOWN ORIGIN UNDER ROADWAYS INCLUDING FORMER RAILWAY
8. DREDGED MATERIALS (SEDIMENT QUALITY)

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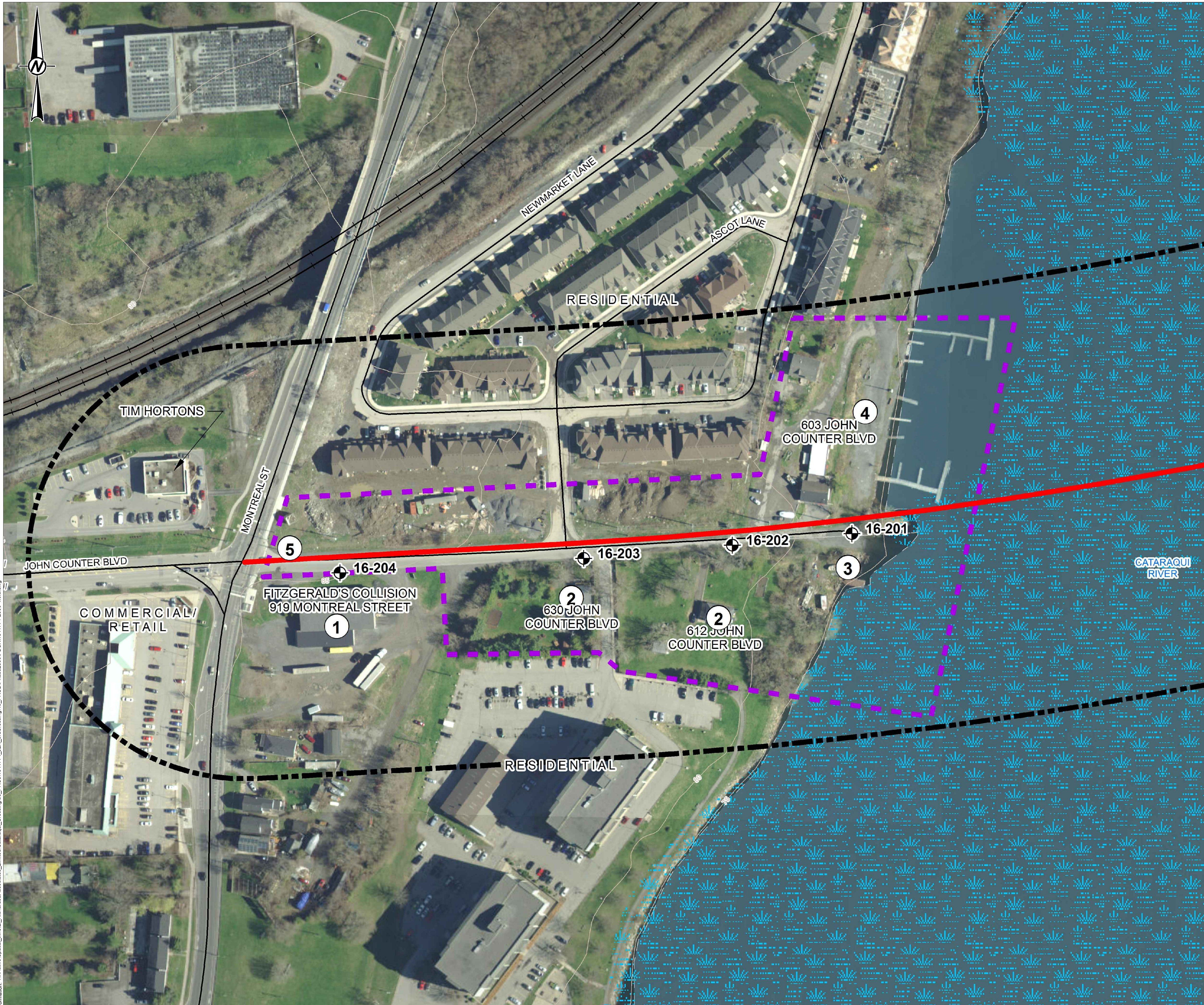

THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

GEO-ENVIRONMENTAL FINDINGS - FIELD SURVEY WEST SHORE

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KINGSTON

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Golder Associates

Project No.: 27143	
Drawing No.: 4.6.3	
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No.	Description	By	Date (dd/mm/yy)

LEGEND

- APPROXIMATE BOREHOLE LOCATION
- PROPOSED ALIGNMENT (SITE)
- ROADWAY
- RAILWAY
- WATERCOURSE
- TOPOGRAPHIC CONTOUR, metres
- WETLAND
- LOT FABRIC
- POTENTIAL LAYDOWN AREA
- STUDY AREA

POTENTIALLY CONTAMINATING ACTIVITIES

1. AUTOMOBILE COLLISION CENTRE (FORMER AST)
2. FILL AND VENT PIPES
3. FENCED YARD WITH DRUM AND VEHICLE STORAGE
4. POTENTIAL FUEL STORAGE (AST/UST) FOR MARINA FUELLING
5. FORMER TRANSMISSION SERVICE GARAGE

NOT MAPPED

6. PAST USE OF DE-ICING AGENTS (SALT) ALONG ROADWAYS
7. FILL OF UNKNOWN ORIGIN UNDER ROADWAYS INCLUDING FORMER RAILWAY
8. DREDGED MATERIALS (SEDIMENT QUALITY)

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ii. 2011 MOECC Table 7 [Generic Site Condition Standards for Shallow Soils in a Non-Potable Ground Water Condition – Industrial / Commercial / Community (I/C/C) Property Use] standards for soil.

Material excavated at these locations during construction could be re-used on-land at the project corridor or within the City's right-of-way network.

c) Select chemical parameters from BH16-202 and BH16-201 exceed MOECC Table 17 and Table 3 (R/P/I) standards but meet MOECC Table 3 (I/C/C) standards. An exception was that MOECC Table 3 (I/C/C) is exceeded for sodium absorption ratio from a depth of 2.29 m to 2.9 m below ground surface (bgs) in BH16-201. Material excavated from this depth at this location during construction would need to be analyzed further (for sodium absorption ratio) for soil management purposes to determine if the exceedance is persistent.

2. Soil samples collected in boreholes from the east abutment area meet 2011 MOECC Table 1 standards for soil. Material excavated at these locations during construction would be considered 'inert fill'.

3. In-river sediment samples were collected from depths of 1.3 m to 2.8 m below the mudline. All sediment samples meet the Canadian Council of Ministers of the Environment (CCME) sediment quality guidelines for probable effects level.

   Should in-river material be brought to land during construction, it would then be considered soil and evaluated under MOECC soil standards. Once on-land, the material would have to be dewatered using such accepted methodologies as settlement ponds, geotubes or filter presses.

   A comparison to the MOECC soil standards demonstrates that the sediment material at depths greater than 1.3 m below the top of the sediment:

   a) Does not meet MOECC Table 1 (R/P/I/I/C/C) standards for metals. Therefore, restrictions would be placed on where disposal could occur.

   b) Meets MOECC Table 3 (I/C/C) standards, and therefore could be used on a Table 3 site elsewhere in the City or re-used on-site following a risk management assessment.

4.7 Geotechnical Conditions

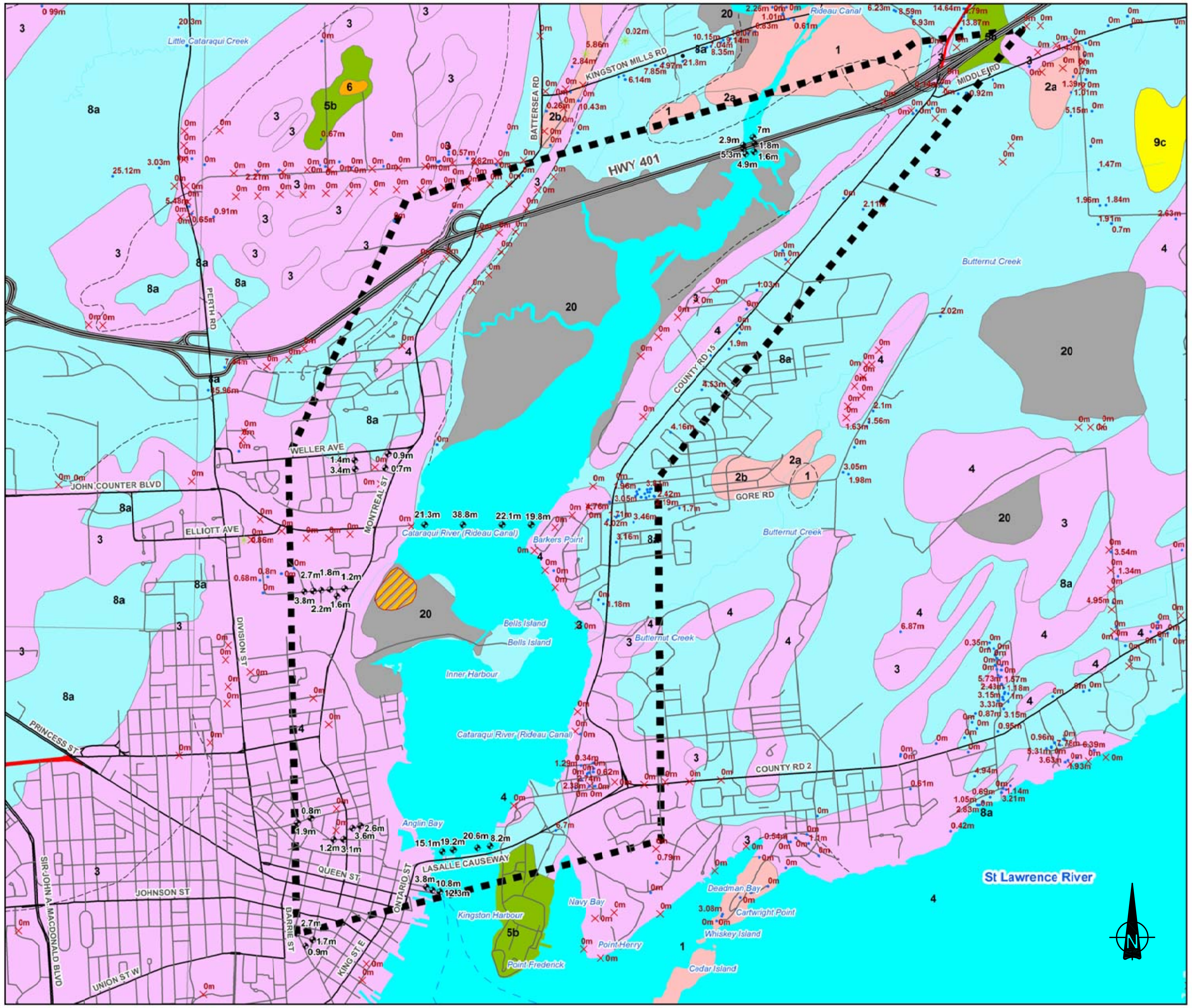
This section of the Report highlights geotechnical conditions within the DIA area. It is based on background information reviews, liaison with various regulatory bodies and fieldwork activities undertaken during the Class EA and current project design phase. The supporting reports are included in **Appendix G**, **Appendix H** and **Appendix I**.

1. General

The DIA area is located in the physiographic region of Southern Ontario known as the Napanee Plain. The Napanee Plain is flat to undulating, and is characterized by relatively shallow soil deposits overlying bedrock. Geologic mapping indicates that the bedrock within the Napanee Plain consists of grey limestone/dolostone of the Gull River Formation, which contains some shale partings and seams.

The overburden soils within the Napanee Plain generally consist of glacial till, although alluvium is present in river and stream valleys. In the southern portion of the Plain, low-lying areas are typically covered with deposits of stratified clay. Water well records indicate that the average depth to bedrock within the Napanee Plain is approximately 2 m. However, in many areas, bedrock outcrops are observed at ground surface, while deeper soil deposits (in the order of 10 m) are present in the northern portion of the Plain and within and adjacent to river valleys throughout the Plain.

As shown on **Drawing 4.7.1**, the DIA area is generally characterized by shallow limestone bedrock. Where overburden is present, it consists mostly of post-glacial silts and clays. Much of the Cataraqui River bank south of Highway 401 and north of Weller Avenue as well as Belle Park (excluding the Federal dredged sediment disposal site along the north shore) are lined with organic deposits. The elevation of the Cataraqui River is at roughly 74.5 m (+/-). The bedrock at either shoreline is at elevation 73 m (+/-) which dips to elevations that vary from 36 m to 55 m (+/-) within the Cataraqui River. This 'bedrock valley' is made up of clay soils and organic deposits.



LEGEND

Data Point - Overburden Thickness (m)

- Outcrops
- Water Wells
- Water Wells Not Reaching Bedrock
- Other
- Borehole
- Major Road
- Minor Road
- Contact - Approximate
- Contact - Observed
- Former Landfill
- Study Area Boundary

- 20 — **Organic deposits**: peat, muck, marl
- 9 — **Coarse-textured glaciolacustrine deposits**: sand, gravel, minor silt and clay
  - 9a: Deltaic deposits
  - 9b: Littoral deposits
  - 9c: Foreshore and basinal deposits
- 8 — **Fine-textured glaciolacustrine deposits**: silt and clay, minor sand and gravel
  - 8a: Massive to well laminated
  - 8b: Interbedded silt and clay and gritty, pebbly flow till and rainout deposits
- 5a — **Till**: Silty sand to sand-textured till on Precambrian terrain
  - 5a: Shield-derived silty to sandy till
- 5b — Stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain
- 5c — Stony, sandy silt to silty sand-textured till on Paleozoic terrain
- 5d — Clay to silt-textured till (derived from glaciolacustrine deposits or shale)
- 5e — Undifferentiated older till may include stratified deposits
- 4 — **Bedrock-drift complex in Paleozoic terrain**
  - 4a: Primary till cover
  - 4b: Primary stratified drift cover
- 3 — **Paleozoic limestone bedrock (Gull River Formation)**
- 2 — **Bedrock-drift complex in Precambrian terrain**
  - 2a: Primary till cover
  - 2b: Primary stratified drift cover
- 1 — **Precambrian bedrock**

NOTE

This figure is to be read in conjunction with the accompanying Golder Associates Ltd. report No. 09-1121-0016

REFERENCE

Produced by Golder Associates Ltd. under License with the Ministry of Northern Development and Mines © Queen's Printer for Ontario, 2009.
Armstrong, D.K. and Dodge, J.E.P. 2007. Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 219
Gao, C., Shirota, J., Kelly, R.I., Brunton, F.R. and van Haaften, S. 2006. Bedrock topography and overburden thickness mapping, southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 207
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 18

750 375 0 750
1:30,000 METRES

THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

GEOTECHNICAL CONDITIONS

KINGSTON

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Dan Franco, P.Eng.
Project Engineer

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Project No.: 27143
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NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

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2. Project Corridor

The geotechnical fieldwork undertaken in the project corridor during the Class EA included a geotechnical subsurface investigation and an electrical resistivity imaging (ERI) survey. As shown on **Drawing 4.7.2**, the bedrock surface appears to be variable across the corridor. The bedrock is exposed or near surface on both sides of the Cataraqui River (at an elevation of 73 m at the east bank and 76 m at the west bank) and then dips to elevations ranging from elevation 30 m to elevation 55 m within the river. Limestone, present on the banks of the river, is underlain by a 3 m to 5 m layer of Shadow Lake shale. The ERI profile indicates that Precambrian rock is likely present beneath the shale across the whole corridor. There are two zones where low resistivity is observed within the bedrock beneath the river, centered at distances of 320 m and 970 m along the survey line. These areas are most likely associated with the Frontenac Axis.

As also shown on **Drawing 4.7.2**, the subsurface conditions of the project corridor consist of overburden soils that vary from limited thickness (2 m to 3 m) at the river banks to about 40 m within the river. Along the banks, the overburden consists of fill over peat over silty clay or glacial till. Within the river, the overburden consists of peat over silty clay.

The geotechnical fieldwork during the Class EA was supplemented by additional fieldwork during the current project design phase. It was carried out from September to October 2016 and included boreholes and Seismic Cone Penetration Tests (SCPTs) that were put down at 15 locations within the river channel and on-land along the east and west approaches. As shown on **Drawing 4.7.3**, the boreholes were advanced at 7 proposed V-pier locations; 1 at each of the 2 proposed abutment locations; and 6 along the approach. SCPTs were put down adjacent to three of the in-water boreholes.

The 2016 fieldwork was carried out in two phases. The first phase included advancement of the in-water boreholes and SCPTs from a barge-mounted drill rig within the river channel. Archaeological monitoring of the in-water boreholes was also carried out with representatives of the Huron Wendat First Nation. The second phase included advancement of the on-land boreholes at the proposed approaches and abutments, as well as geophysical testing consisting of down-hole Vertical Seismic Profiling (VSP) or Multi-Spectral Analysis of Surface Waves (MASW) surveying at the proposed abutment locations.

As also shown on **Drawing 4.7.3**, the bedrock is exposed or near surface on both sides of the Cataraqui River and then dips within the river to elevations ranging from elevation 29 m (encountered at a borehole put down within the western portion of the river channel) to elevation 54 m (encountered at a borehole put down within the eastern portion of the river channel). Sedimentary bedrock is present on-land and consists of dolostone at the west abutment, and limestone at the east abutment. The overburden in the river channel is underlain by metamorphic gneissic bedrock.

Along the banks, the overburden typically consists of fill overlying peat and silty clay to depths of up to about 4.5 m, but typically less than 2 m. Within the river channel, the overburden is up to 46 m deep and consists of several metres of organic river bottom deposits overlying an extensive deposit of silty clay to clay. Glacial till or granular deposits were encountered directly above the underlying bedrock in three of the six in-water boreholes.

In general, the proposed bridge piers will be located within the river channel where the overburden is deep (between 20 and 46 m below the river surface) with the exception of the easternmost pier, where the bedrock is within 1 metre of the existing ground surface. The bridge abutments will be located on-land where the bedrock is within 4.5 m of the existing ground surface.

THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

ELECTRICAL RESISTIVITY IMAGING SURVEY RESULTS

Mark Van Buren, P.Eng. — Director of Engineering and Deputy Commissioner
Dan Franco, P.Eng. — Project Engineer

KINGSTON

J.L.Richards — ENGINEERS · ARCHITECTS · PLANNERS

Project No.:	27143
Drawing No.:	4.7.2
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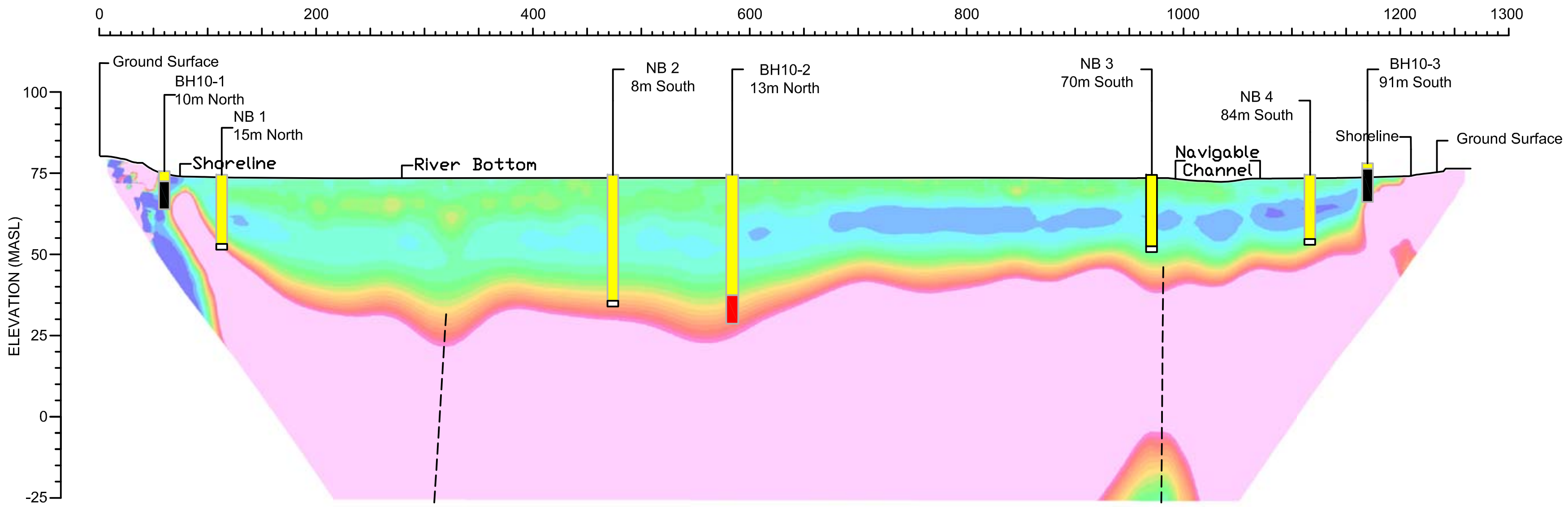
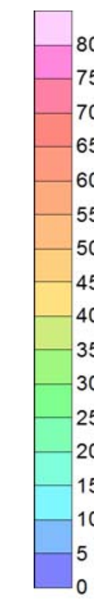
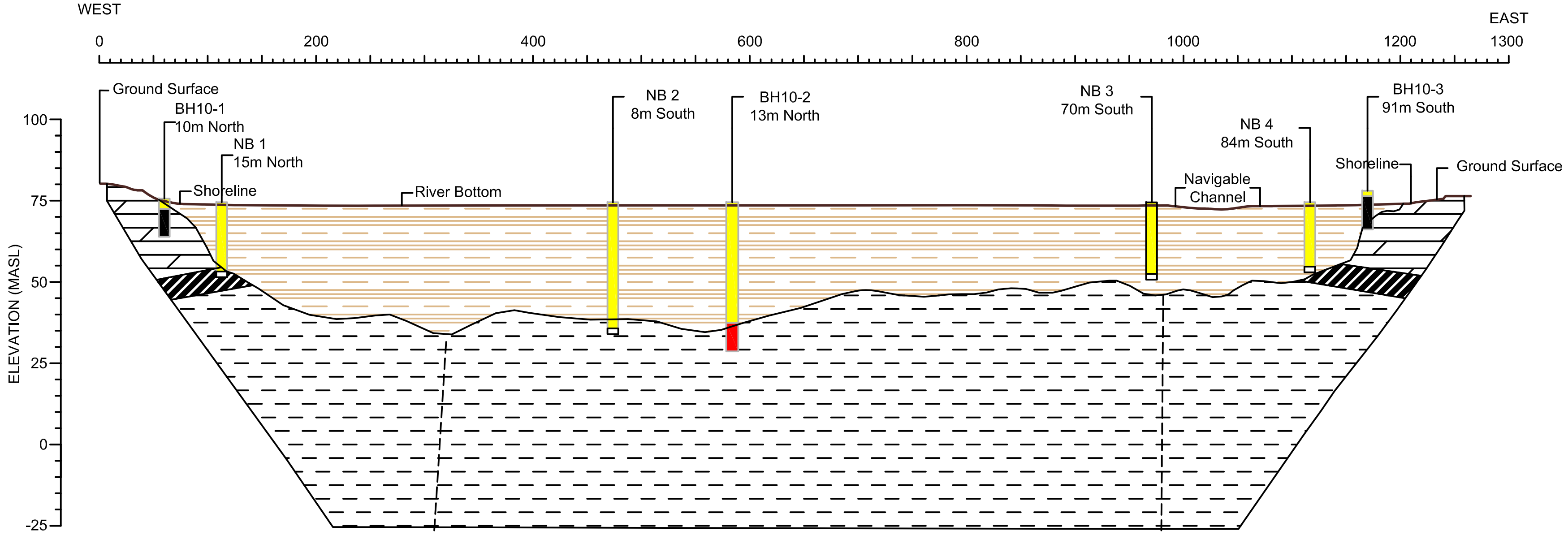
ERI LINE - INTERPRETATION RESULTS





MODEL APPARENT RESISTIVITY (OHM-M)

ERI LINE - INTERPRETATION RESULTS



LEGEND BOREHOLES

- Fill + Silty Clay
- Limestone Bedrock
- Precambrian Bedrock
- Probable Bedrock

LEGEND SECTIONS

- Silty Clay
- Limestone Bedrock
- Shale Bedrock
- Precambrian Bedrock
- Potential faulting zones within the bedrock

NOTES

1. This Figure is to be analyzed in conjunction with the accompanying report.
2. ERI section generated using the Res2D Software Package.
3. Elevations of the ERI lines presented based on GPS data provided by Richards & Associates Ltd.
4. Borehole data provided by Golder Associates Ltd..

100 0 100 200
SCALE 1:5000 METRES

VERTICAL EXAGGERATION = 3X

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LEGEND

- APPROXIMATE BOREHOLE LOCATION, CURRENT INVESTIGATION
- APPROXIMATE BOREHOLE LOCATION, PREVIOUS INVESTIGATION BY GOLDER ASSOCIATES LTD., REPORT NO. 09-1121-0016
- APPROXIMATE DYNAMIC CONE LOCATION, PREVIOUS INVESTIGATION BY STRATA ENGINEERING CORP. (1991)
- APPROXIMATE BOREHOLE LOCATION, PREVIOUS INVESTIGATION BY STRATA ENGINEERING CORP. (1991)

BH 16-101 — BOREHOLE IDENTIFIER

— STRATIGRAPHY

12 — SPT, N VALUE

SUBSURFACE STRATIGRAPHY

WATER	CLAYEY SILT	GLACIAL TILL
ASPHALTIC CONCRETE	SILT	LIMESTONE
FILL	SANDY SILT	DOLOSTONE
TOPSOIL	SILTY SAND	GRANITE
SILTY CLAY to CLAY	SAND AND GRAVEL	GNEISS

NOTE(S)

1. BRIDGE IS STILL UNDER DESIGN AND IS INCLUDED FOR ILLUSTRATION PURPOSES ONLY.

REFERENCE(S)

1. BASE PLAN AND ALIGNMENT SUPPLIED IN ELECTRONIC FORMAT BY PARSONS ON MARCH 29, 2017, FILE NO. 101A1_General_Arrangement.dwg
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83, COORDINATE SYSTEM: UTM ZONE 18, VERTICAL DATUM: CGVD28

THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

GEOTECHNICAL SURVEY - BOREHOLE STRATIGRAPHY

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KINGSTON

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

PARSONS

Golder Associates

Project No.:	27143
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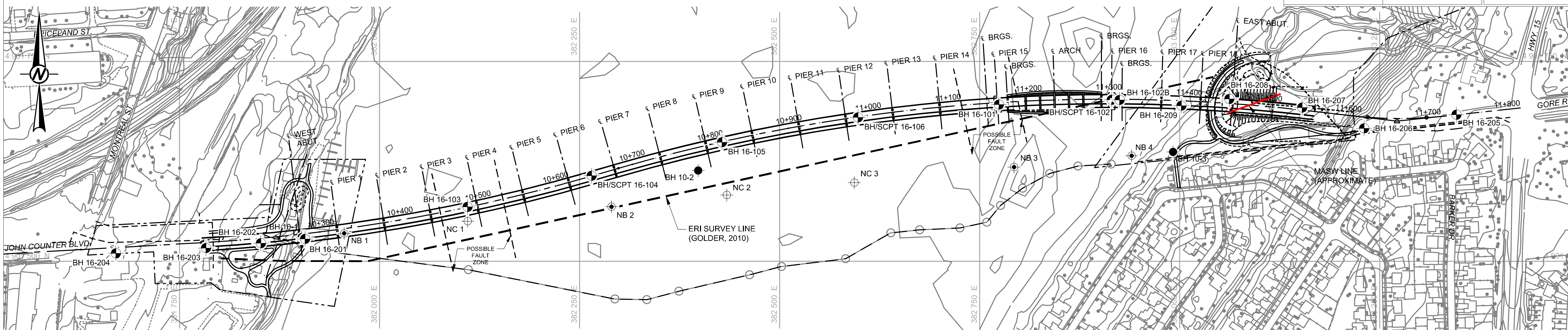
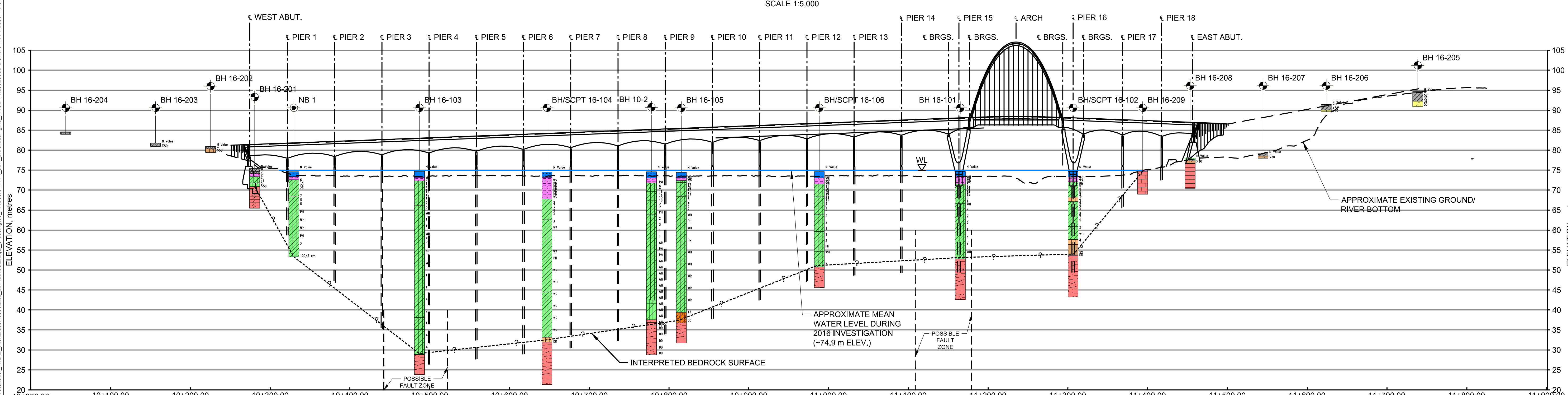


PLAN
SCALE 1:5,000



PROFILE
HORIZ. SCALE 1:5,000
VERT. SCALE 1:1,000

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4.8 River Hydrology and Hydraulics

This section of the Report highlights river hydrology and hydraulic conditions within the DIA area. It is based on background information reviews and liaison with various regulatory bodies undertaken during the Class EA. This assessment has been reviewed during the current project design phase and its relevance to date is re-confirmed.

1. Water Conditions

As noted earlier, the Cataraqui River has a water depth averaging 1.2 m except at the buoyed channel and the southern portion of the Inner Harbour. Water levels are primarily defined by the water levels in Lake Ontario. The Cataraqui River is a slow moving waterbody with flow velocities ranging from negligible to 0.4 m/s.

The historic water levels for Kingston depending on the months of the year are shown in **Figure 4.8.1**. Basic water levels at the site are summarized in **Table 4.8.1**.

The ESR has taken into account variable water levels on Lake Ontario, Cataraqui River discharges, and waves and surges associated with wind setup on the Cataraqui River from both winds from the north and the south. Water levels were also analyzed for both ice and ice free periods. The ESR indicates that:

> "The water level at the proposed crossing is largely a function of the water level in Lake Ontario, and under most typical conditions on the watercourse, can be assumed to be equal to Lake Ontario levels. Under conditions of significant wind or seiches in the Lake however, the water level at the site may be slightly higher or lower than lake levels."

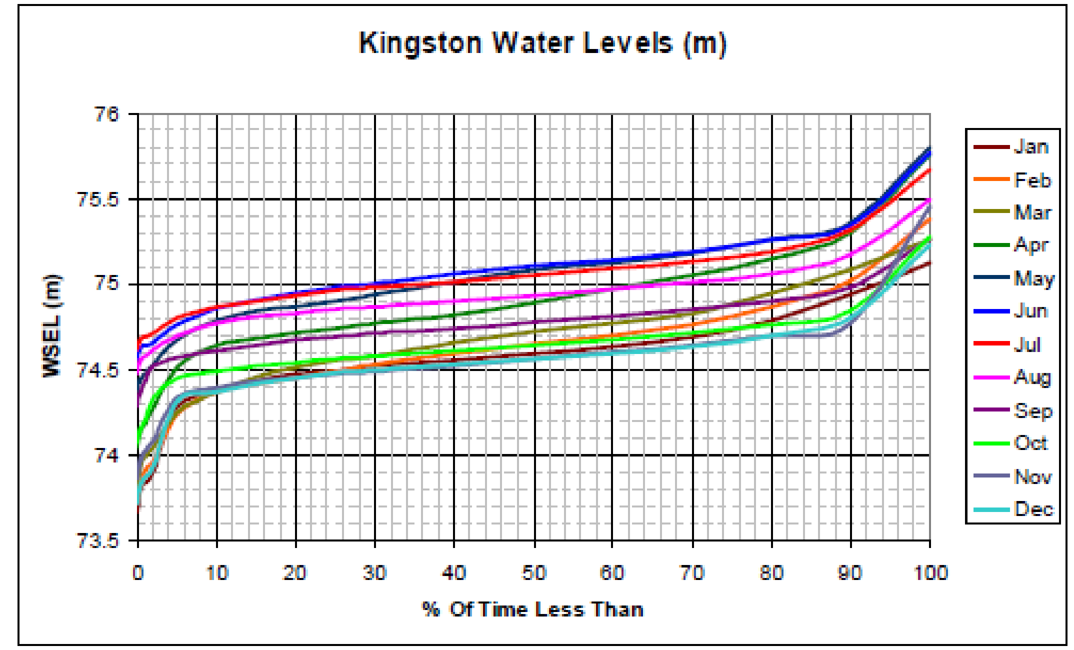

Figure 4.8.1: Historic Water Levels at Kingston

Table 4.8.1: Relevant Site Water Levels		
Condition	**Water Surface Elevation (WSEL)**	**Reference**
Low Water Datum (LWD)	74.16 m	Canadian Hydrographic Service (Lake Ontario)
Average High Water (AHW)	75.26 m	Ministry of Natural Resources (Lake Ontario)
Regulatory Floodplain	76.3 m	CRCA

2. Ice

Winter ice cover is variable from year to year. It is not typically established until mid-to-late December, and can last up to late April. This indicates that thick lake ice does not develop until early February. An analysis of annual measured extremes would suggest that the ice can get as thick as 0.84 m and would have a strength of 1100 kPa under dynamic (100 year) ice conditions. Due to low flow velocity of the river at the project corridor, the ice tends to melt in place. Current speeds of approximately 0.4 m/s should be assumed for dynamic ice loading conditions.

Recommended ranges of water levels for ice conditions at the project corridor are shown in **Table 4.8.2**.

Table 4.8.2: Ice Cover Water Levels (December through April)

Condition	WSEL
Long Term Average (Static Ice)	74.49 m to 74.84 m
Historic Extremes (Static Ice)	73.70 m to 75.61 m
100 Year Extreme (Dynamic Ice)	73.65 m to 75.86 m
Winter Surge Conditions	-0.25 m to +0.47 m

3. Scour

As part of the Class EA, general and local scour estimates were prepared based on the hydraulic modelling and as per CHBDC requirements. Given the width of the watercourse and limited flow-generated velocities at the project corridor, the general scour estimates are in the order of 2 newton / square metre (N/m^2). For local scour, the preliminary estimate during the Class EA suggested a local scour depth allowance of 7.5 m. The ESR notes that this value "… is a preliminary estimate, and should be developed more fully during the detailed design process based on local bed conditions and proposed pier construction and riverbed restoration techniques. The proposed pile-supported piers to bedrock would prevent undermining of the pier footings, but exposure of any significant length of the piles should be accounted for in the structural design considerations, or appropriate scour protection should be provided as required to accommodate structural capacities."

4.9 Traffic

As noted earlier, the ESR recommended a 4-lane bridge would ultimately be required, subject to future monitoring of traffic conditions by the City. The ESR also recommended that all intersections along the east and west approaches should be signalized, with the exception of the John Counter Boulevard-Ascot Lane intersection, which should be two-way stop controlled.

Since the completion of the ESR, the recommended bridge cross-section has been reduced to two vehicle lanes as per the 2015 KTMP and subsequent direction by City Council (Report No. 15-268). The City has also recently updated their Travel Demand Model for the Third Crossing to account for new mode share targets that were established since the completion of the 2015 KTMP.

4.10 Marine Navigation

Marine navigation remains an important feature of the DIA area. As shown earlier on **Drawing 2.1.1**, a navigable channel extends northward from the LaSalle Causeway and into the regulatory limits of the Canal. There is a 6.7 m vertical by 15 m horizontal Federally regulated navigable clearance requirement for the Canal. Direction from Parks Canada states that the vertical clearance of 6.7 m shall be measured above the upper controlled water elevation limit. Given the potential influence of Lake Ontario on the high water elevation in this part of the Cataraqui River, the 6.7 m vertical clearance was measured from the CRCA Regulatory Floodplain elevation of 76.3 m. The navigable channel is officially closed to watercraft from Thanksgiving to Victoria Day.

As shown on **Drawing 4.10.1**, the project corridor also transects an active 7-lane rowing course, which is maintained by the Kingston Rowing Club. Rowing lanes are divided with three northbound lanes on the east side of the navigable channel that are typically used for warm up and four southbound lanes on the west side of the navigable channel which are used for timing and race preparation. The course is 2 km long and rowers require the full length of the course and additional room at either end for deceleration and turning.

THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

ROWING COURSE

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ENGINEERS · ARCHITECTS · PLANNERS

KINGSTON

Project No.: 27143
Drawing No.: 4.10.1
Sheet No.:
Des: Chk'd:
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Utility Circ. No.
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NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

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5.0 CONCEPT OPTION DEVELOPMENT AND ANALYSIS

5.1 Alignment and Profile

The Class EA envisioned horizontal curvature in the bridge in order to enhance user experience, provide architectural enrichment, mitigate impacts on adjacent land uses, and meet geometric and existing terrain constraints.

The conceptual horizontal alignment of the bridge as part of the current project phase has been modified slightly from the ESR to include two relatively large 2200 m radii horizontal curves. This has achieved a normal crown on the bridge deck, and avoided the need for superelevation on the entire structure, based on a roadway design speed of 70 km/hr, and a posted speed of 60 km/hr. A normal crown will also simplify the construction of the deck, as it will remain constant along the entire length of the bridge, and will result in a more efficient superstructure.

Drawing 5.1.1 shows the difference between the recommended horizontal alignment in the ESR (in black) and the conceptual horizontal alignment as part of the current project phase (in red). The east approach is on a 500 m radius horizontal curve which begins immediately east of the bridge abutment and would require up to a 4% superelevation to accommodate the design speed. The west approach does not contain appreciable horizontal curves.

The recommended vertical profile in the ESR rises gently from west-to-east with a high point over the navigable channel. It then drops in elevation before rising on-shore towards Highway 15. There are three vertical curves: one crest near the arch above the navigational channel and one sag curve near each shoreline.

Several options were considered for the vertical profile of the bridge during the current project phase, which are shown on **Drawing 5.1.2**. These options included a constant sloping bridge that rises from west-to-east (similar to the ESR); and a profile that shows a horizontal bridge which then rises up the east riverbank at a constant slope. Upon review of this latter option, there were challenges meeting necessary bridge drainage requirements. As such, a vertical profile based on the recommended vertical profile in the ESR was acknowledged as preferred and its geometry was then further refined.

Vertical profiles that included 1.25% longitudinal slopes and varying lengths of vertical curves were evaluated. Important considerations were ensuring that vertical curve length, deck drainage criteria, vertical clearance and sight lines would meet Provincial design guidelines. Opportunities to reduce the overall bridge height were then investigated, since reducing bridge height would present an opportunity to reduce capital costs (by reducing material costs and construction effort).

Drawing 5.1.3 shows the preferred conceptual vertical profile of the bridge. The low points are designed to be off the bridge to facilitate stormwater management (i.e. collect stormwater on-shore and prevent it from flowing onto the bridge) and to optimize the number of deck drains required on the bridge.

The vertical profile was also governed by the requirements for the navigable channel and rowing lanes as well as the CHBDC which requires that the bridge soffit have a minimum 1 m vertical clearance above the normal water level. The vertical alignment in the ESR had a high point elevation of approximately 92.5 m which occurred on the east side of the arch. As part of the current pre-design work, the vertical profile was refined such that the crest was centered on the arch span. It is considered important to center the vertical curve on the arch span to facilitate design and construction of the arch and to make the arch the focal point of the bridge.

The length of the crest vertical curve is also a key factor in the design as any ‘flat’ areas of the bridge need to be minimized as much as possible to ensure proper stormwater management and drainage. On this basis, a vertical curve of 80 m in length with a 1% road grade from the arch span to the approaches was subsequently carried forward, as shown in **Drawing 5.1.4**.

Upon further design development and constructability review, it was determined that substantial efficiencies can be achieved from lowering the profile and adjusting the grade to 0.75%. These efficiencies could be found primarily by decreasing the height of the v-piers – thereby facilitating their construction – and reduced the approach embankments. One drawback, however, was reducing the leg-length of the v-piers would result in the need for an additional pier in order to maintain girder-span efficiencies. This lower bridge profile included 0.75% grades from the arch span to the approaches and a high point bridge deck elevation of 88.35m (2.8 m lower at the arch-crest). This profile is shown in **Drawing 5.1.5**.

Drawing 5.1.6 compares the 1% longitudinal grade profile to the 0.75% profile. In addition, a comparison matrix was developed between the higher and lower profiles, as shown in **Table 5.1.1** below. The matrix takes into account span arrangement, profile, vertical clearance, differences in cost and constructability of structural steel and v-piers, aesthetics, deck drainage, operation, future maintenance and environmental considerations. The 0.75% profile was carried forward.

THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

ADOPTED HORIZONTAL ALIGNMENT (RED)

Mark Van Buren, P.Eng.
Director of Engineering and Deputy Commissioner

Dan Franco, P.Eng.
Project Engineer

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

PARSONS

KINGSTON

Project No.:	27143
Drawing No.:	5.1.1
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Utility Circ. No.	
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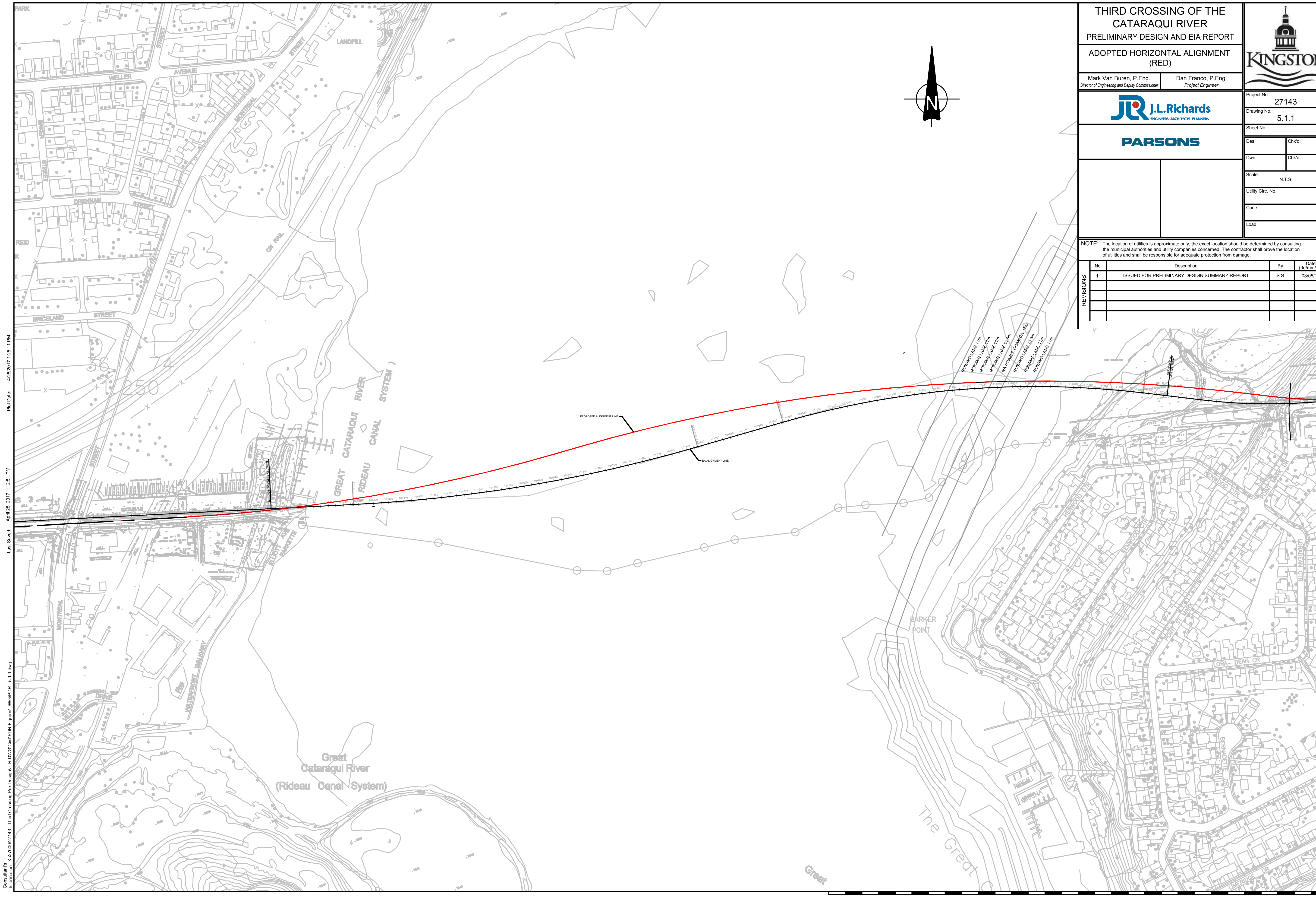

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THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

VERTICAL PROFILE ALTERNATIVES

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Dan Franco, P.Eng.
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KINGSTON

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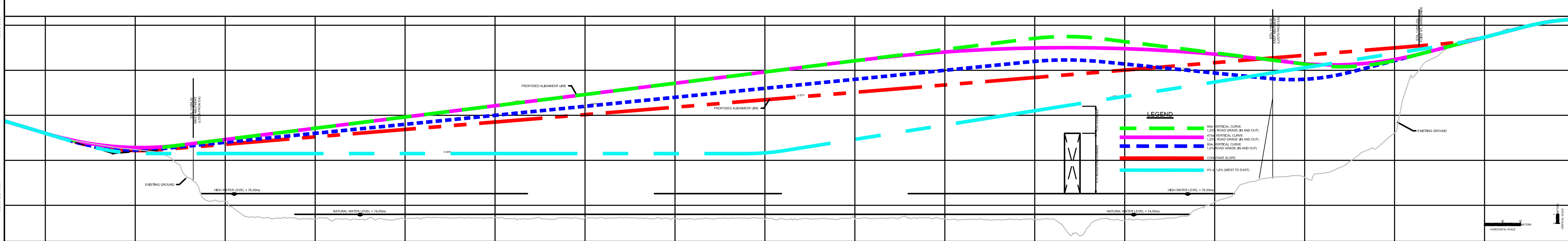

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THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

VERTICAL ALIGNMENT ELEMENTS

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Dan Franco, P.Eng.
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KINGSTON

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PARSONS

Project No.:	27143
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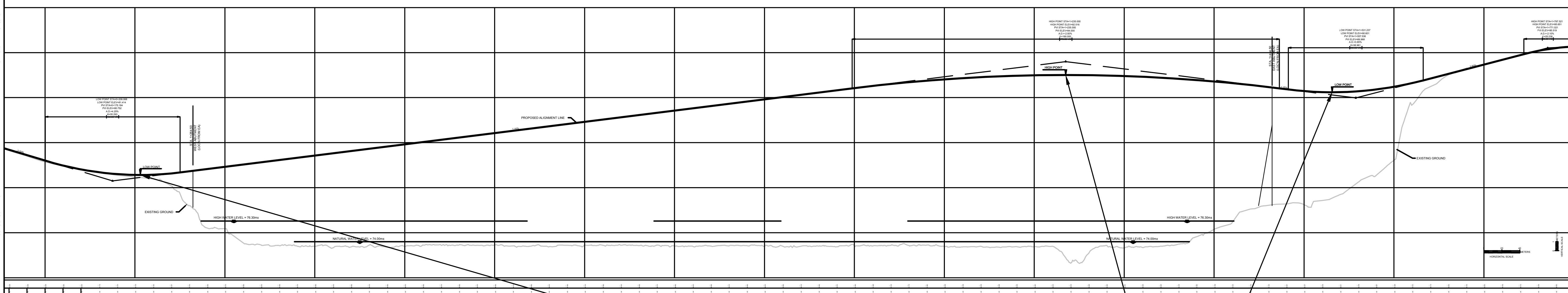

- PROFILE REFINEMENT FROM CLASS EA

<u>KEY VERTICAL CURVE ELEMENTS:</u>
-CURVE LENGTH
-STORMWATER MANAGMENT/DRAINAGE
 (SAGS ON LAND)
 (SHORTENED "FLAT AREAS")

THREE (3) VERTICAL CURVES:
-2 SAGS ON LAND BRIDGE APPROACHES
-1 CREST CENTERED ON BUOYED CHANNEL AT ARCH

THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

PRELIMINARY GENERAL ARRANGEMENT (HIGH PROFILE - 13 SPANS)

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Dan Franco, P.Eng.
Project Engineer

KINGSTON

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PARSONS

Project No.:	27143
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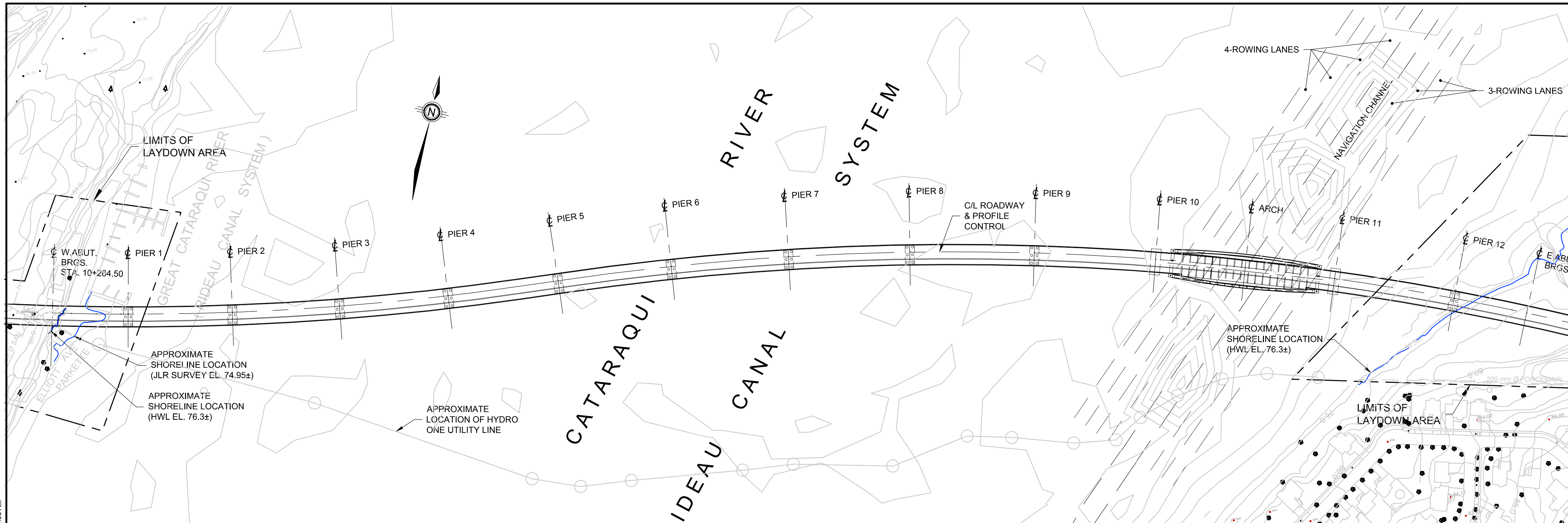

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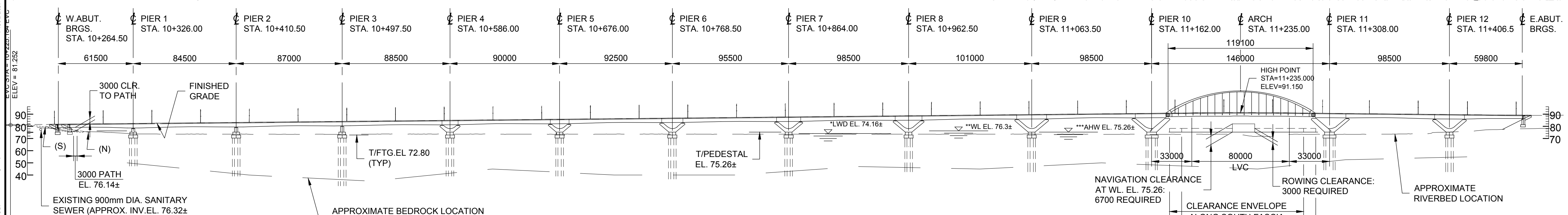

ELEVATION
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NOTE:

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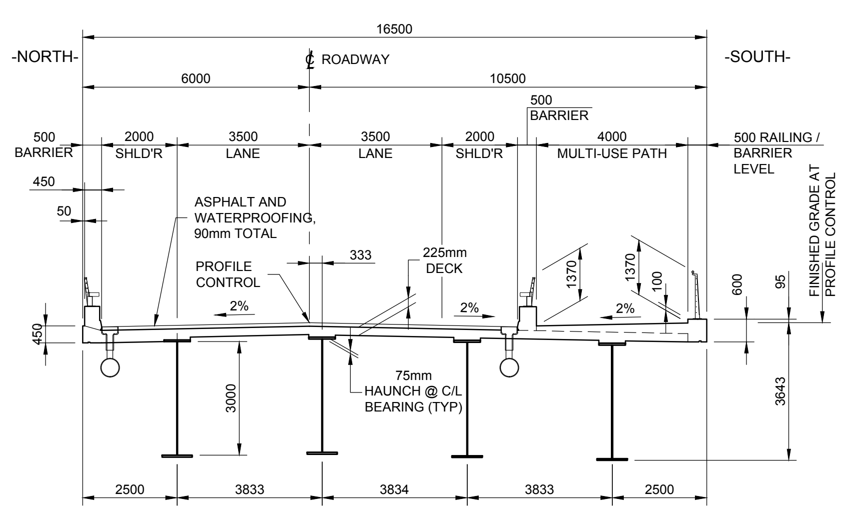
**	AVERAGE HIGH WATER	EL. 75.26	MINISTRY OF NATURAL RESOURCES (LAKE ONTARIO)
***	REGULATORY WATER LEVEL	EL. 76.3	CATARAQUI REGION CONSERVATION AUTHORITY "REGULATORY LIMIT WITHIN THE STUDY AREA"



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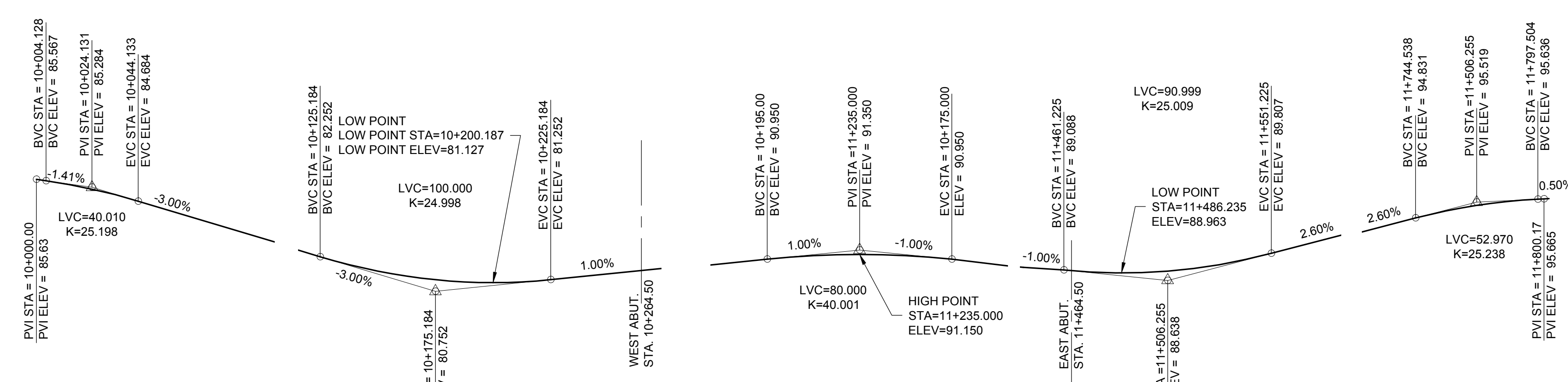

PROFILE THIRD CROSSING
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THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT
PRELIMINARY
GENERAL ARRANGEMENT
(LOWERED PROFILE - 14 SPANS)

Mark Van Buren, P.Eng.
Director of Engineering & Deputy Commissioner

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Load:	CL625ONT

NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

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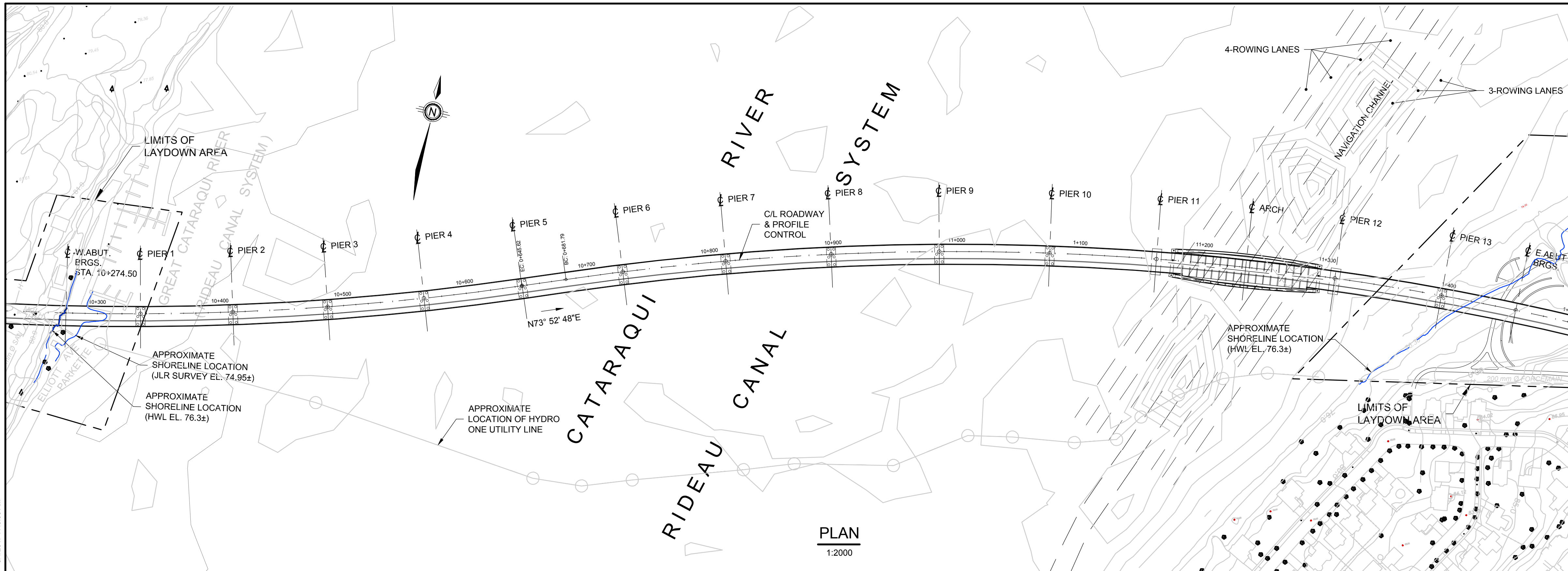
	ISSUED FOR PRELIMINARY DESIGN SUMMARY REPORT	JJA	03/05/2017



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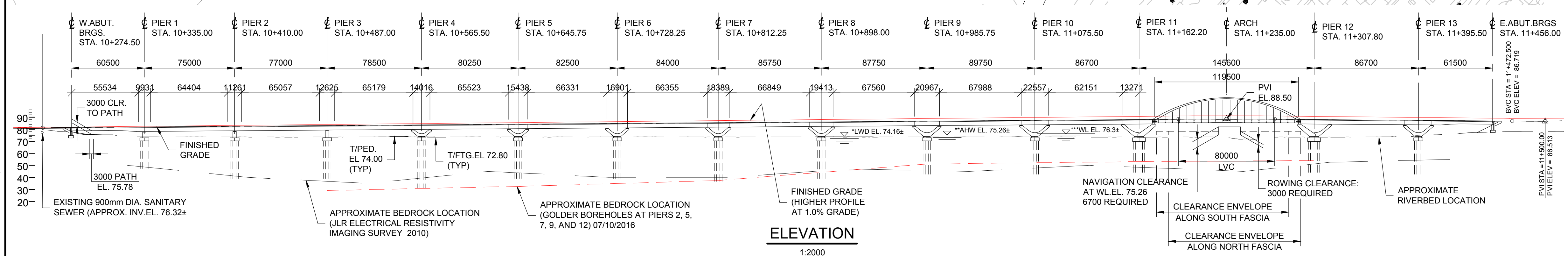

ELEVATION
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NOTE:

*	LOW WATER DATUM	EL. 74.16	CANADIAN HYDORGRAPHIC SERVICE (LAKE ONTARIO)
**	AVERAGE HIGH WATER	EL. 75.26	MINISTRY OF NATURAL RESOURCES (LAKE ONTARIO)
***	REGULATORY WATER LEVEL	EL. 76.3	CATARAQUI REGION CONSERVATION AUTHORITY "REGULATORY LIMIT WITHIN THE STUDY AREA"

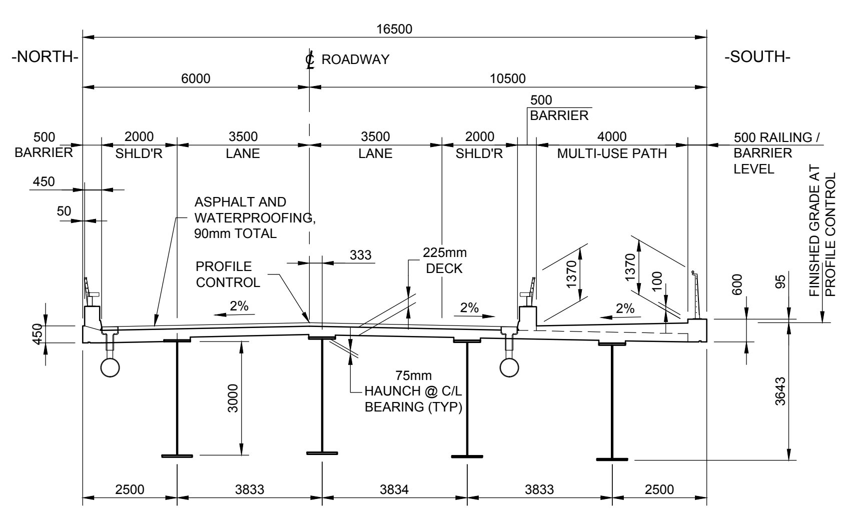

PLATE GIRDERS
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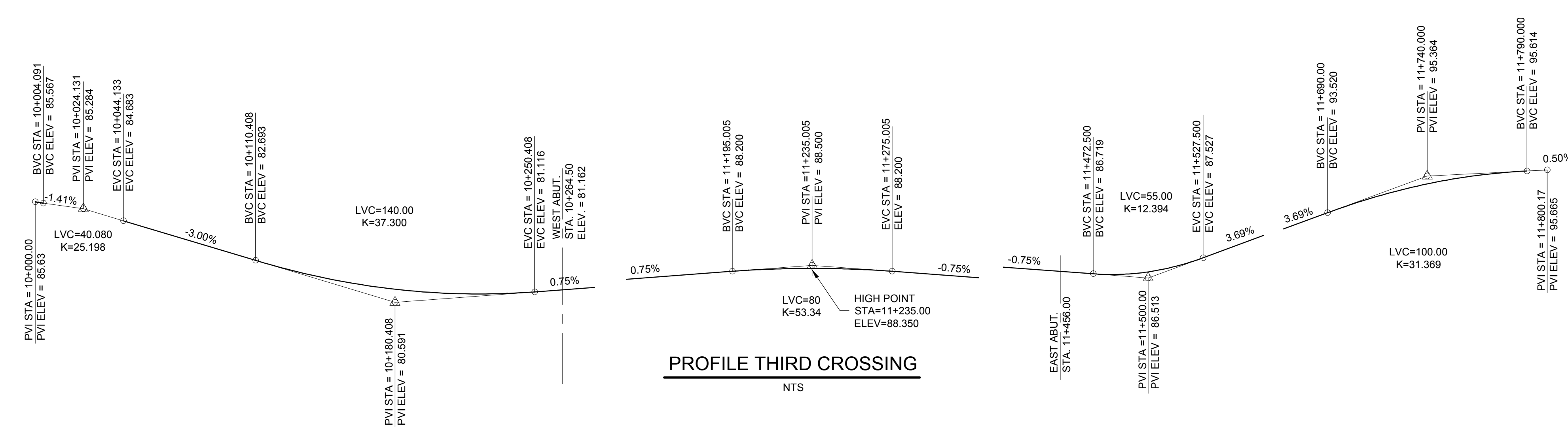

PROFILE THIRD CROSSING
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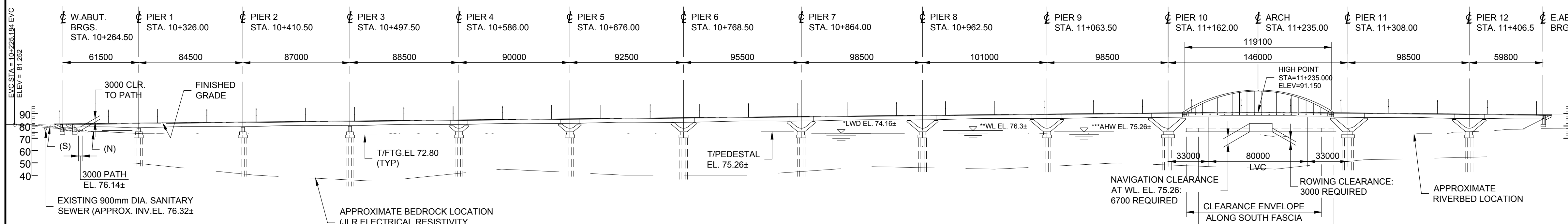

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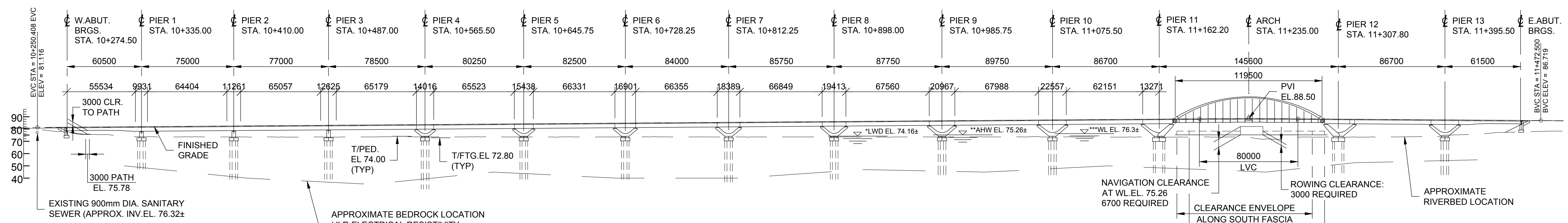

ELEVATION - LOW PROFILE

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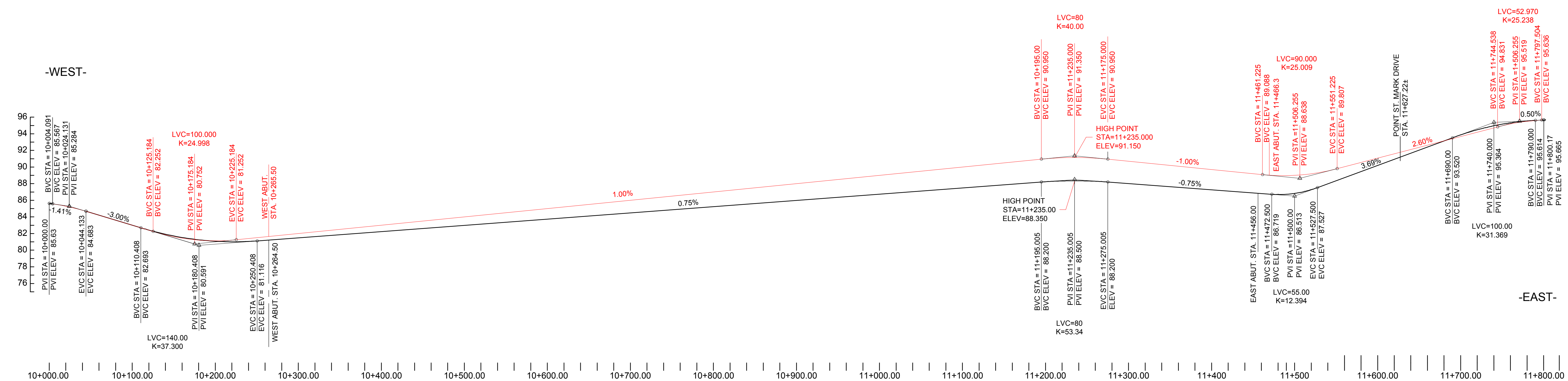

PROFILE THIRD CROSSING

H:1:2500 V:1:25000

THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

COMPARISON OF PROFILE ALTERNATIVES

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PARSONS

Project No.:	27143
Drawing No.:	5.1.6
Sheet No.:	-- of --
Des: JJA	Chk'd: RO
Dwn: KRS	Chk'd: JJA
Scale:	AS NOTED
Utility Circ. No.	---
Code:	CAN/CSA-S6-14
Load:	CL625ONT

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REVISIONS

No.	Description	By	Date (dd/mm/yy)
	ISSUED FOR PRELIMINARY DESIGN SUMMARY REPORT	JJA	03/05/2017

Plot Date: 5/1/2017 7:46:17 AM
Last Saved: Monday, May 01, 2017 7:44:08 AM
Consultant's Information: C:\pw_working\ontario\p004544\dms01335\5.1.6.dwg

Table 5.1.1: Comparison Matrix between Lower and Higher Profiles

Criteria	Sub-Criteria	Higher Profile	Lower Profile
Span Arrangement		10 spans on west side, arch span, 2 spans on east side for a total of 13 spans and 12 v-piers	11 spans on west side, arch span, 2 spans on east side for a total of 14 spans and 13 v-piers
Profile		High Point of 91.15 m at center of arch with 1% grade to abutments	High Point of 88.35 m at center of arch with 0.75% grade to abutments
Navigation Clearance	Minimum 6.7 m above Average High Water (AHW)	When compared to lower profile ~3 m additional clearance for temporary works during construction	-
Structural Steel	Max Span Length	101 m	92.5 m
	Girder Sizes	-	Decreased flange sizes/ shorter webs due to decrease in span lengths
	Cost*	$2.8 Million more	-
V-Piers	Max Height	~12.5 m high	~9.8 m high
	Volume of Concrete – including caissons	~18,250 m^3	~17,650 m^3
	Cost*	Negligible Cost Difference	Negligible Cost Difference
Arch Span		Arch span has a clear span of 119 m	Arch span decreased to 117 m clear span to maintain arch geometry
West Abutment Pathway		3.8 m vertical clearance between the proposed bridge soffit and pathway finished grade at 76.5 m elevation, ~1.2 m above AHW	2.65 m vertical clearance between the proposed bridge soffit and pathway finished grade at 76.1 m elevation, ~0.8 m above AHW
Construction	Mobilization	12 mobilizations for v-pier construction and 13 mobilizations for crane	13 mobilizations for v-pier construction and 14 mobilizations for crane; Smaller crane can be used due to size and weight of girders
	Duration	Increase in construction duration to construct the taller v-piers	Increase in construction duration due to additional mobilization
Aesthetics		Taller v-piers	Shorter v-piers; Both options provide openness under the structure
Deck Drainage	Limiting the spread to the shoulder width only 2 m	Depending on the drain type the number of deck drains required are either: (26 Standard MTO deck drains or 18 Neenah Scuppers) (Longitudinal grade exceeds the minimum CHBDC required grade of 0.5% for deck drainage)	Minimal increase in the number of deck drains (30 Standard MTO deck drains or 18 Neenah Scuppers) (Longitudinal grade exceeds the minimum CHBDC required grade of 0.5% for deck drainage)
Operation and Future Maintenance		Less bearings to maintain but larger jacks will be required to replace the bearings in future; Less but longer and higher piers to maintain	More bearings to maintain One more pier to maintain
Environmental		Smaller river foot print at ~1500 m^2	Larger river foot print at ~1615 m^2 (~8% larger)

* Note: Cost is the difference between the two profile options and not the absolute cost of the elements.

5.2 Cross Section

Defining the overall bridge cross-section width early in the pre-design process was important as it affects the total weight of the structure, the number of traffic lanes on the bridge as well as the superstructure (arch and approach spans) and substructure design and configuration.

The ESR was used as the baseline for comparison of various cross-section width options. A basic cross-section that merges the ESR and the KTMP update recommendations is shown at the top of **Drawing 5.2.1**. It has a total overall outside width of 16.05 m with paved shoulders adjacent to the vehicular traffic lanes.

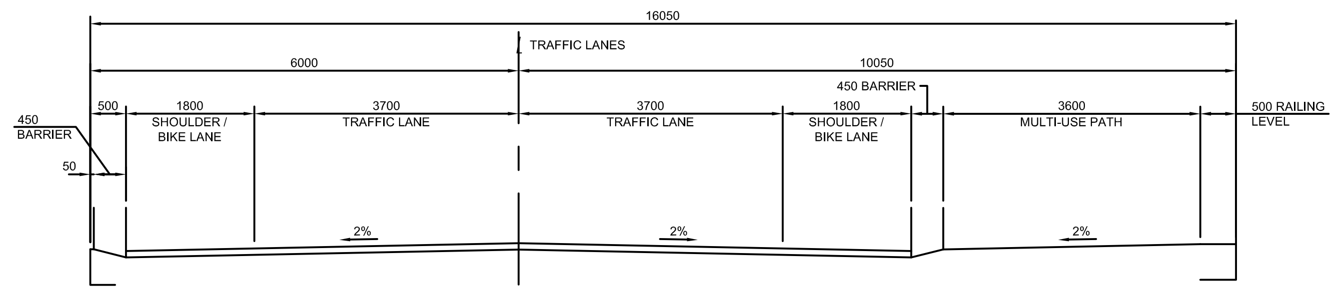
Based on the current design speed and future posted speed for the bridge, the MTO Geometric Design Standards for Ontario Highways was referenced for requirements on vehicular lane widths and side clearance zones (adjacent to the barriers). Assuming these speeds, the lane width is required to be 3.5 m (minimum) to 3.75 m (desirable); and the side clearance (shoulder) is required to be 2 m (where no sidewalk is present). Discussions with City staff indicated a preference for the wider 3.75 m lane width to assist with snow clearing and other maintenance activities. However, the ample 2 m side clearance, combined with encouraging cyclists to use the multi-use path, allows for consideration of a 3.5 m vehicular lane width. This would not compromise the experience or safety of the vehicles since this width also provides additional buffer should there be a vehicle break-down or maintenance vehicle stopped on the bridge. This layout is shown in the center of **Drawing 5.2.1** with a total width of 17.95 m.

Upon review, a 2.5 m to 3 m multi-use path (commonly accepted minimum width exclusive of cycling lanes) in addition to 1.5 m cycling lanes appeared incongruent with the projected use of the project corridor. Providing a combined cycle and multi-use width of 4 m of shareable space would meet accessibility standards and provide for sufficient active transportation space. It also exceeds multi-use path standards of 3 m, which is common in the City. Some additional merits of separating vehicles from cyclists/multi-use path include: segregation of uses (vehicle and non-vehicle); ease of cyclists passing other cyclists on the bridge; ability of cyclists or path users to slow down or pull over and rest on the bridge; and elevated safety and anticipated lower risks of vehicle/bicycle conflicts. An operational consideration is the need to move the cyclist traffic back to their directional side of travel along the road rights-of-way at either end of the bridge. However, this could be managed safely through traffic management provisions at the signalized intersections. As such, the proposed cross section is shown at the bottom of **Drawing 5.2.1**, with a total width of 16.5 m. Additional information on the proposed cross section is discussed in Section 8.2 of this Report.

The decision to design the bridge as a two lane structure with the current configuration of v-piers and an arch would make it cost-prohibitive to widen the structure to a four lane bridge in the future. However, it is possible to provide one additional lane in the future if the interior barrier and multi-use pathway were removed. It is noted that there are minimal options to allow the bridge to expand to a three lane structure. The current configuration that permits a segregated multi-use path area could not be accommodated. A narrow sidewalk and shoulders that could also be used as bicycle lanes would be possible; however, the cross section geometry would not be ideal. Finally, any future widening to accommodate two additional lanes would require a separate structure adjacent to the bridge.

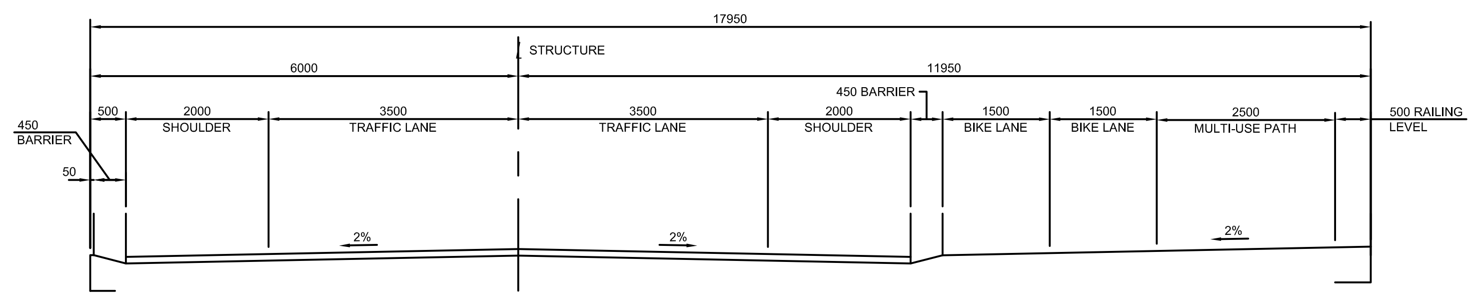
One other consideration for the cross-section of the bridge dealt with roadway cross-fall. As discussed in Section 5.1 of this Report, a consistent cross-fall for the length of the bridge that avoids superelevation was an important factor for construction efficiency. In addition, ensuring that stormwater was captured on the bridge (i.e. did not outlet directly to the watercourse without treatment) was also a factor. Since the bridge was now physically divided, stormwater runoff could be captured at the barriers adjacent to the shoulders on the north and south side of the vehicle lanes. Therefore, the bridge cross section will include a crown on the vehicular portion of the bridge with a 2% cross-fall in either direction towards drains located adjacent to outer concrete barriers.

For the multi-use path, a 2% cross-fall towards the inner barrier was selected. This will allow the stormwater runoff to be collected using drains adjacent to the barrier and will eliminate the need for an additional stormwater pipe running along the multi-use path fascia.



BASIC CROSS SECTION

NTS



MAXIMUM WIDTH CROSS SECTION

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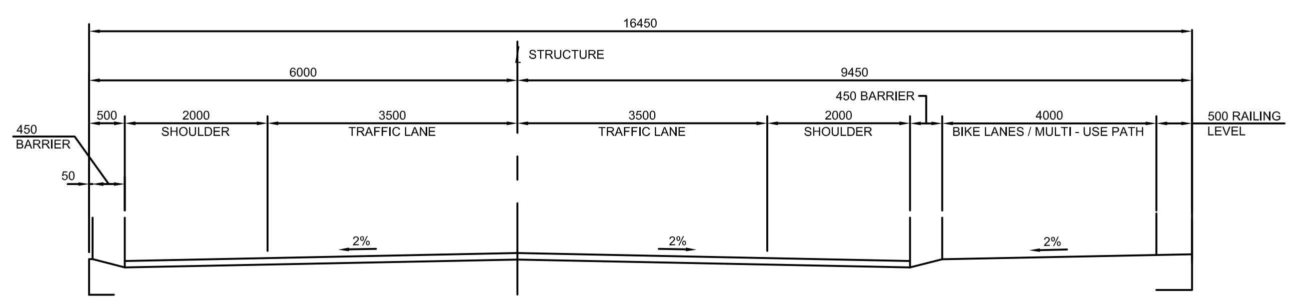

ACCEPTED WIDTH CROSS SECTION

NTS

THIRD CROSSING OF THE CATARAQU1 RIVER

PRELIMINARY DESIGN AND EIA REPORT

FUNCTIONAL CROSS SECTIONS

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Dan Franco, P.Eng.
Project Engineer

KINGSTON

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

PARSONS

Project No.:	27143
Drawing No.:	5.2.1
Sheet No.:	
Des:	Chk'd:
Dwn:	Chk'd:
Scale:	N.T.S.
Utility Circ. No.	
Code:	
Load:	

NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

No.	Description	By	Date (dd/mm/yy)
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The approaches of the bridge will include standard urban cross-sections with concrete curb and gutter and formalized stormwater management. Painted hatch/gore markings and/or a raised concrete median will generally separate eastbound and westbound traffic and, where required by traffic demands, the road cross section is wider within the approaches where turning and merging lanes are necessary. Paved shoulders that continue from adjacent roadways and enter the corridor will continue with a minimum width of 1.5 m. Transitioning active transportation users from either side of the road to promote use of the multi-use path on the south side of the bridge is expected at the intersections on both bridge approaches. Multi-use path connections from the bridge to adjacent pathway networks on Highway 15 on the east approach and John Counter Boulevard on the west approach will be accommodated within the project corridor.

5.3 Structural Options

Based on the ESR, a bridge supported on v-piers with an arch span over the navigable channel and adjacent rowing lanes is the preferred option.

5.3.1 Approach Spans

Several options were considered for the superstructure of the approach spans, including: concrete precast girders, concrete post-tensioned segmental boxes, steel plate girders, and trapezoidal box girders.

The use of concrete girders / boxes for the superstructure was eliminated as an option for the following reasons:

1. It has a higher weight-to-strength ratio than steel girders, which would increase the dead load and effectively result in larger foundations, and also introduce larger seismic loading in the case of a seismic event.

2. Concrete girders would require larger cranes to erect the girders.

3. Cold weather would affect any segmental construction that requires cast-in-place concrete to join pre-cast segments.

The use of steel girders for the superstructure is the preferred option for the following reasons:

1. It significantly reduces the weight of the structure, which is advantageous when considering seismic forces.

2. Steel girders provide a high degree of redundancy between spans.

3. Steel girders reduce construction time due to Contractor familiarity, especially in comparison to segmental post-tensioned concrete box construction and hence, effect potential cost savings.

Two different steel girder cross-sections were considered for the structure: three box girders (see **Figure 5.3.1**); and four plate girders (see **Figure 5.3.2**). **Table 5.3.1.1** compares the box girder and the plate girder options. The use of plate girders is the preferred option due to: the lower weight of steel required; the minimal interference with drainage pipes; the placement of the v-pier ties; the ease of fabrication and erection; and associated economic efficiencies.

Table 5.3.1.1: Comparison between Box Girders and Plate Girders

Criteria	Box Girders	Plate Girders
Weight of Steel	~5000 tonnes	~4700 tonnes
Girder Depth	2.6 m	3 m
Girder Width	Varies from 2.8 m to 4.8 m	0.7 m to 0.8 m
Number of Bearings	2 or 4 per pier	4 per pier
Erection	Box Girders are more stable during erection	Plate Girders have to be erected in pairs and should be braced during erection
Transportation	Non-Routine Oversize / Overweight Loads	Routine Oversize / Overweight Loads
Drainage	Deck Drains will be located within box girders and/or drainage pipes will have to pass through box girder, which is not allowed by the CHBDC without approval. Potential issues if pipe freezes and bursts. Durability issue having pipe inside box girder.	Minimal interference with drainage pipes
Coating Area	Only exterior surface would require a 3-coat system	Larger surface area for coating

Table 5.3.1.1: Comparison between Box Girders and Plate Girders

V-Pier Configuration	Large wall type v-pier	Two separate v-piers
Cost	More expensive due to the additional weight of steel required and fabrication complexity	Less expensive

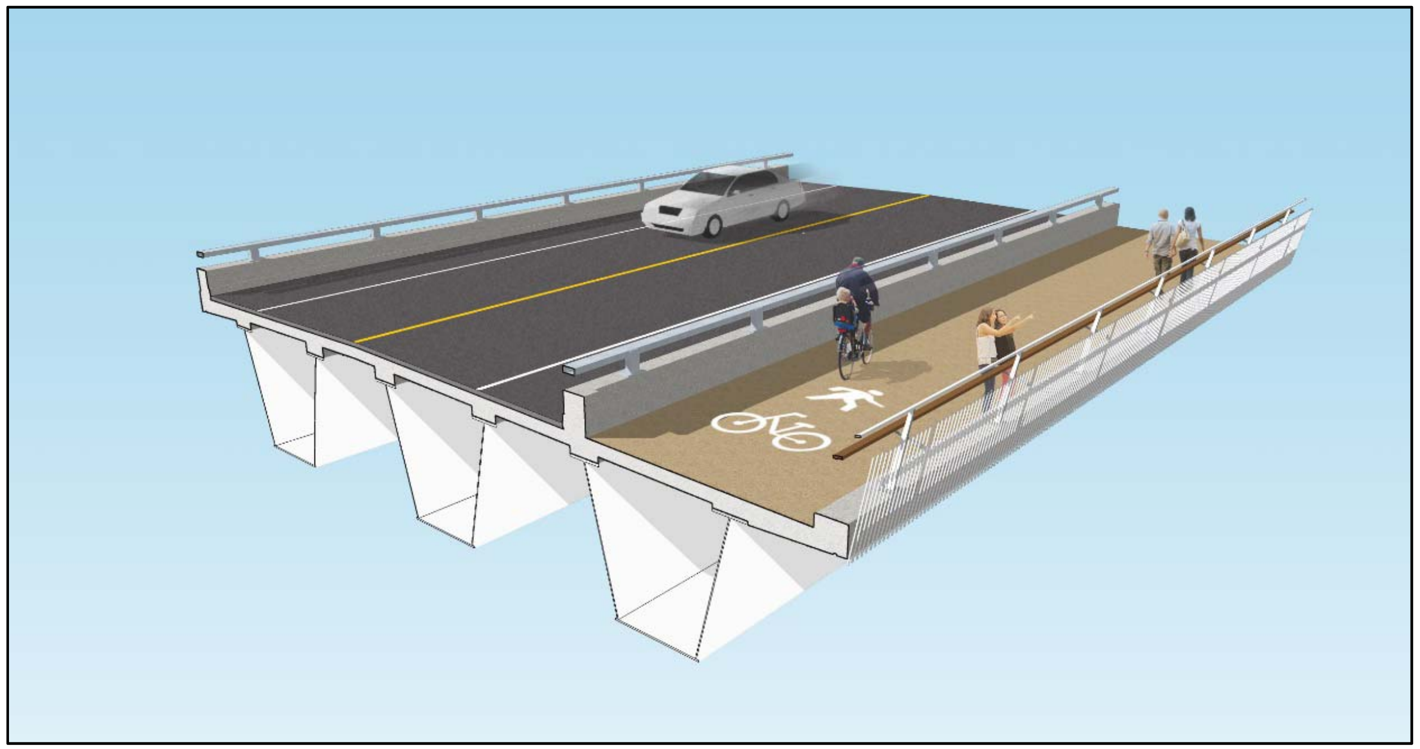


Figure 5.3.1: Three Box Girder Option

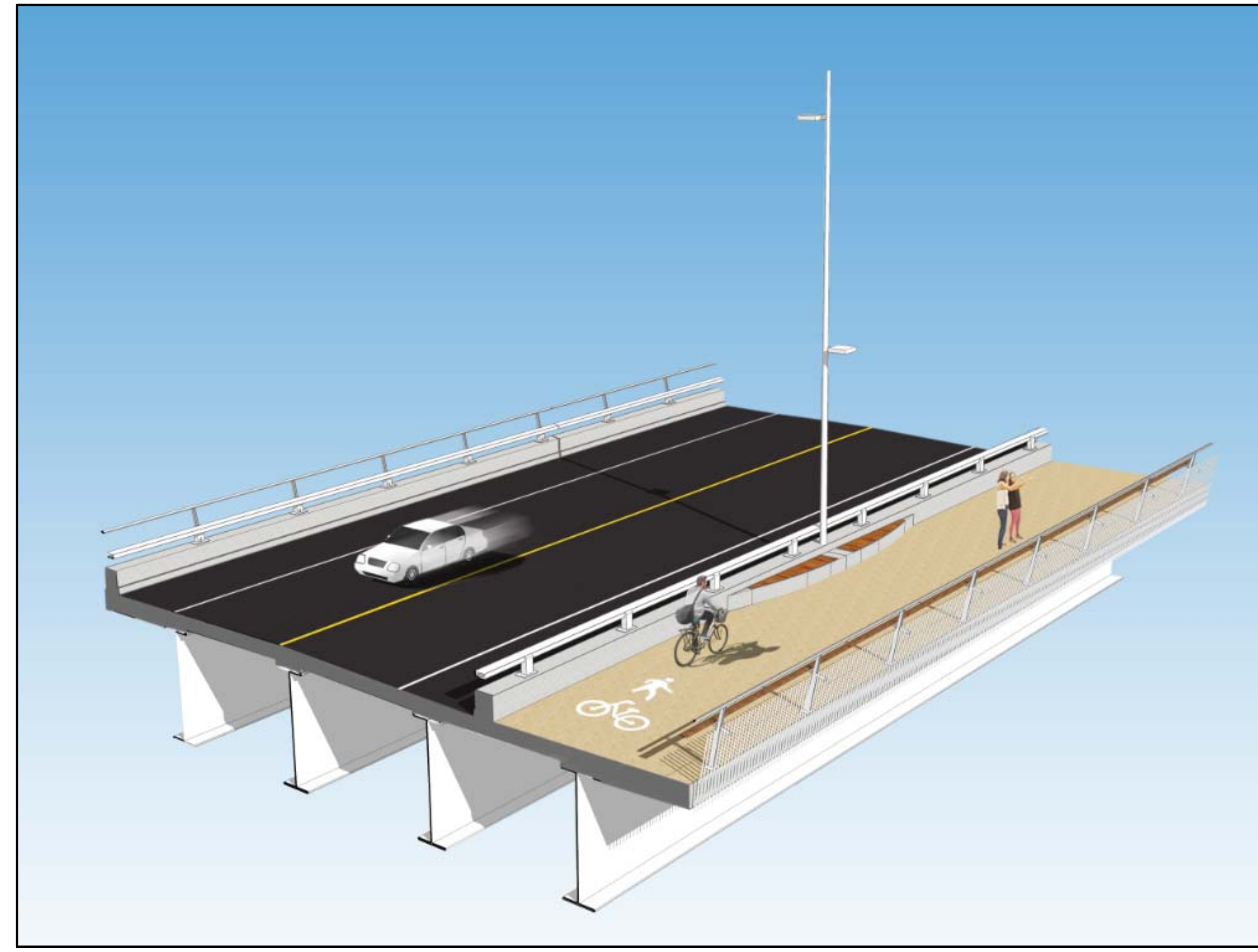
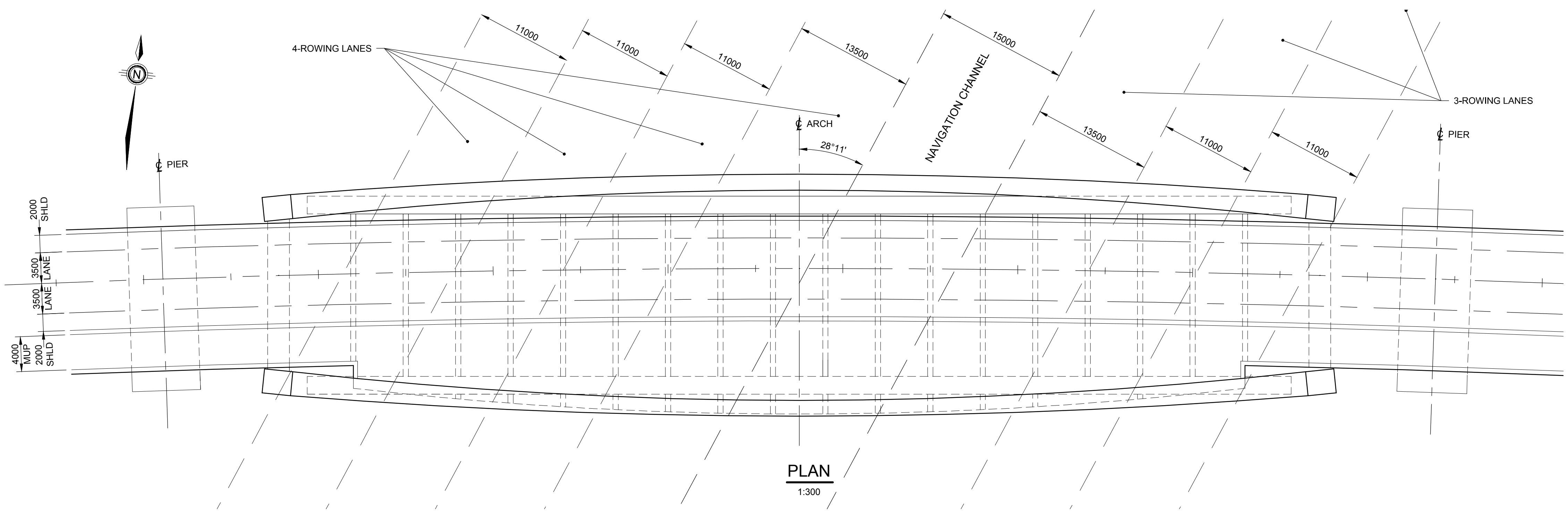


Figure 5.3.2: Four Plate Girder Option

5.3.2 Arch Span

The minimum clear span between the piers for the arch is dictated by the envelope for the navigable channel and adjacent rowing lanes, which is approximately 137 m due to the 28° skew of the channel to the arch span as shown in **Drawing 5.3.2.1**. The span to height ratio of the arch was dictated by structural efficiencies and aesthetics.

The arch has to be tall enough to be the focal point of the bridge, but not so tall as to negatively impact views of the Cataraqui River. A span-to-height ratio of 6:1 was used with a rise of ~20 m and a span length of ~117 m.



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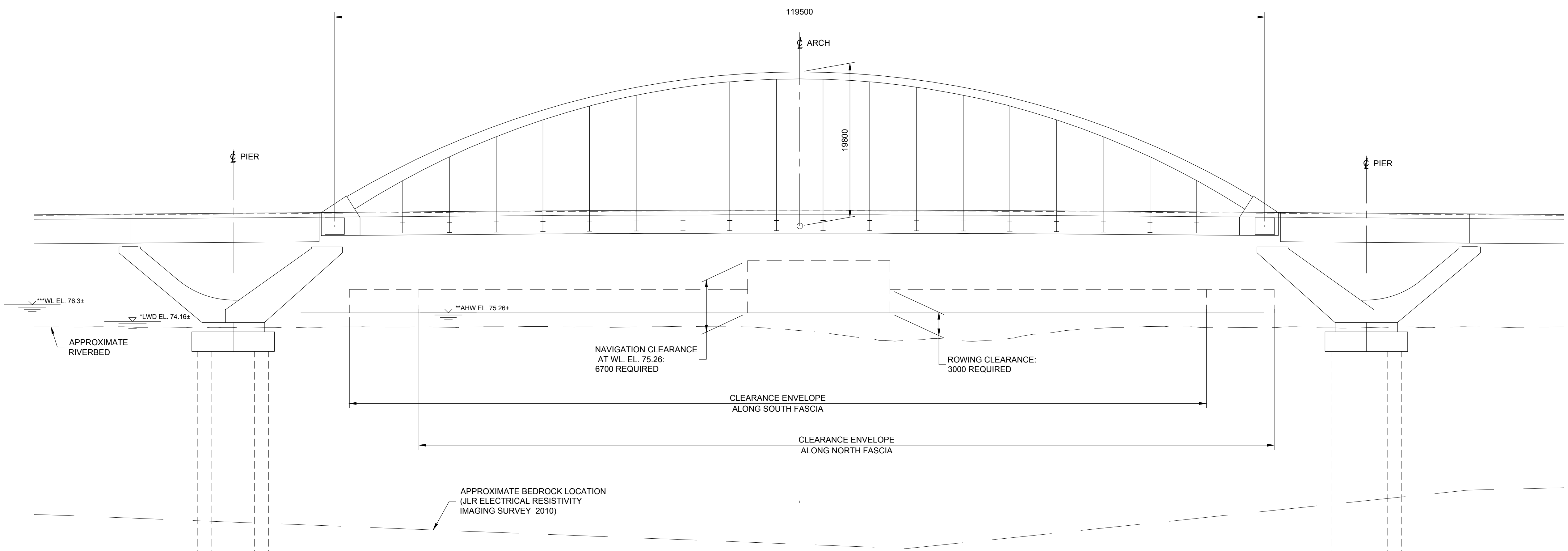

ELEVATION
1:300

THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

ARRANGEMENT OF ARCH SPAN OVER NAVIGATION CHANNEL

KINGSTON

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Dan Franco, P.Eng.
Project Engineer

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PARSONS

Project No.:	27143
Drawing No.:	5.3.2.1
Sheet No.:	-- of --
Des: JJA	Chk'd: RO
Dwn: KRS	Chk'd: JJA
Scale:	AS NOTED
Utility Circ. No.	----
Code:	CAN/CSA-S6-14
Load:	CL625ONT

NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

REVISIONS

No.	Description	By	Date (dd/mm/yy)
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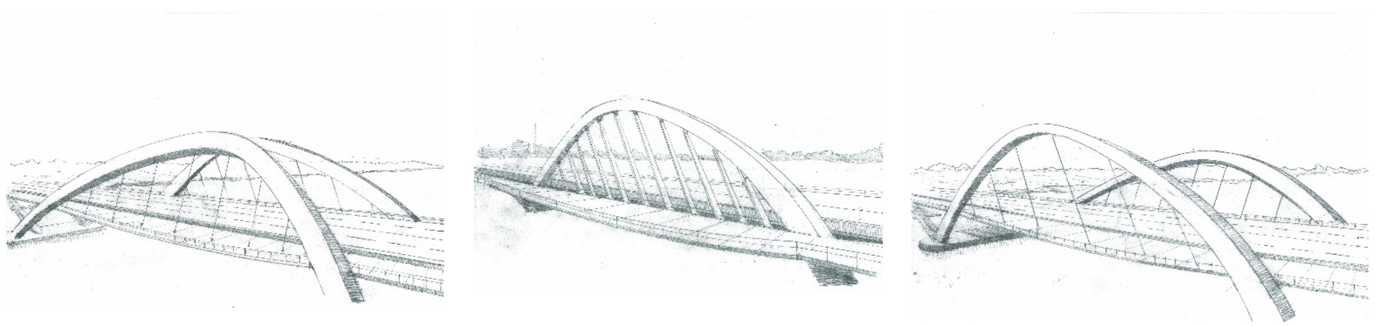
Consultant's Information: C:\pw_working\ontario\p004544\dms01335\5.3.2.1.dwg

There are multiple different types of arches that can be considered for the bridge (see **Figure 5.3.3**). However, based on the perched nature of the arch-support, the lateral thrust from the arch needs to be minimized such that large lateral forces are not transferred to the substructure. Accordingly, an in-plane longitudinal tie will be utilized to accommodate the thrust. Tied arches and network tied arches were both investigated as viable arch options for the bridge.



Inclined Inwards Arch Chords | *Single Chord Arch* | *Inclined Outwards Arch Chords*

Figure 5.3.3: Arch Concept Sketches

It is worth noting that the main difference with a network arch from a conventional one is the hangers for a network arch are inclined and intersect each other, as shown in **Figure 5.3.4**. A tied arch is the preferred option, as the cost savings associated with the reduction of the arch members is not significant enough to justify the additional cables required for the network tied arch.

Figure 5.3.4: Network Tied Arch (Hastings Bridge)

Figure 5.3.5 shows the main components of the arch. The arch ribs support the deck grillage by hangers, and are tied together from one end to the other using a tie. The deck grillage is comprised of transverse floorbeams at the hanger locations, and longitudinal stringers in between. The concrete deck will be supported on the grillage.

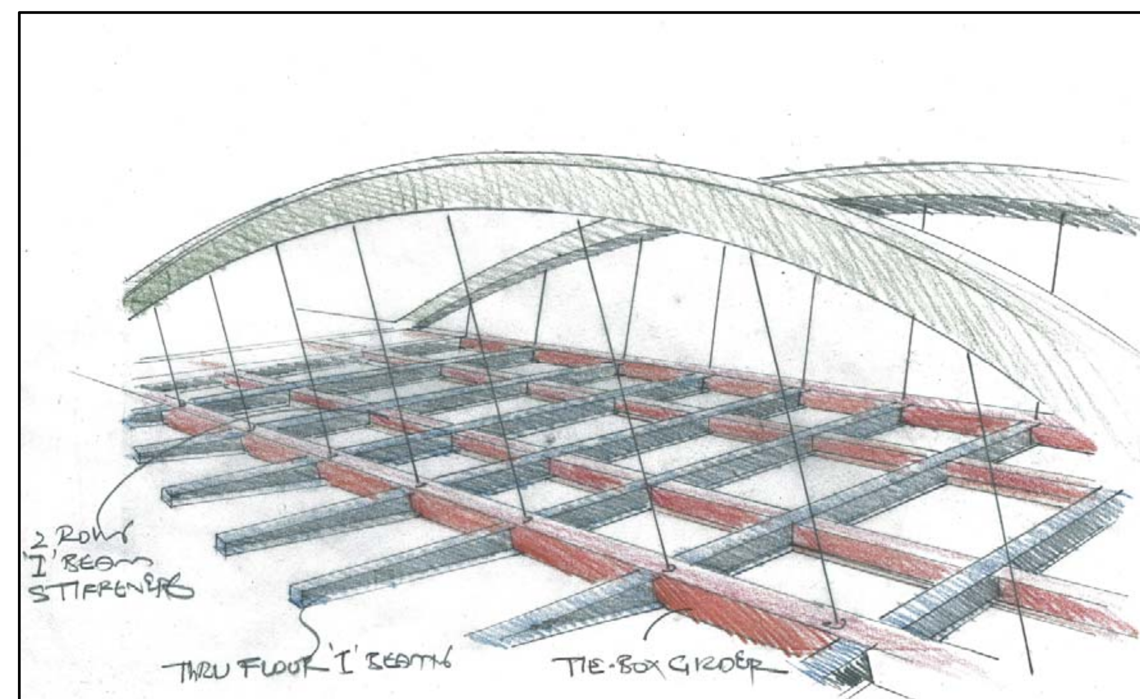


Figure 5.3.5: Artist Rendering of Tied Arch Main Components

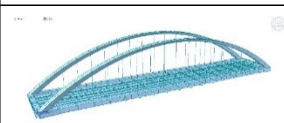
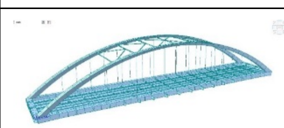
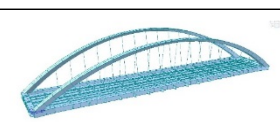
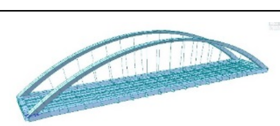
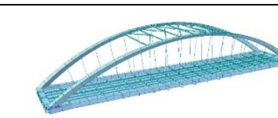
5.3.3 Arch Geometry

The following structural aspects were considered for the arch geometry:

1. Inclination of arch chords: inclined 10° outwards, vertical, and inclined 10° inwards.
2. Bracing system: braced arches or free standing.
3. Orientation of cables: vertical or flared.
4. Span-to-height ratio: optimized at a ratio of 6:1.

Multiple parametric models were created using these structural aspects to determine their effect on the structural behaviour and design of the arch. The steel weights of the various options were compared, as shown in **Table 5.3.3.1**.

Table 5.3.3.1: Comparison of Arch Geometry Concepts

Option	Description	Isometric View	Total Mass (Tonnes)	% of Total Mass Compared to Option 1
1	Vertical Arches with Vertical Cables		1673	100%
2	Braced Vertical Arches with Vertical Cables		1234	74%
3	Inclined Outward Arches with Vertical Cables		1673	100%
4	Vertical Arches with Flared Cables		1673	100%
5	Braced Vertical Arches with Flared Cables		1234	74%
6	Inclined Outward Arches with Flared Cables		1673	100%
7	Inclined Inward Arches with Flared Cables		1180	71%
8	Braced Inclined Outward Arches with Vertical Cables		1392	83%

Highlights of this evaluation are as follows:

1. The use of bracing significantly reduces the weight of steel in the arches (up to 25%), as it reduces the lateral deflection of the arches.
2. The use of either vertical or flared cables has no significant difference on the structural behaviour of the arches.
3. The inclination of up to 10° outwards of the arch ribs has little effect on the overall weight of the arch, as compared to the vertical arch ribs.
4. The inclined inward arches would have to be set further away from the roadway to ensure they would not impact the vehicular envelope required for the traffic lanes, which would increase the width of the piers and the size of the v-piers.
5. There structural differences between the vertical and 10° inclined outwards arches are negligible.
6. There was consensus, based on internal City-Project Team and TAC discussions, that the inclined outward arches are more aesthetically pleasing. As such, Option 8 – the braced, inclined outward arches with vertical cables – is the preferred option.

Two arch rib configurations are currently being considered:

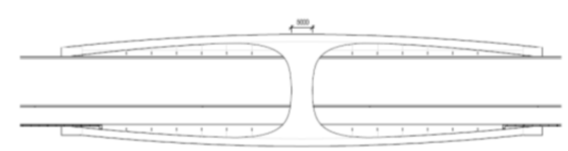
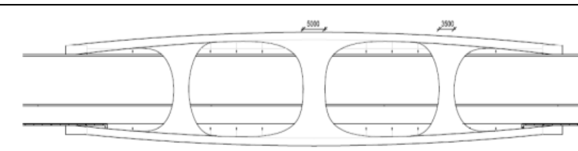
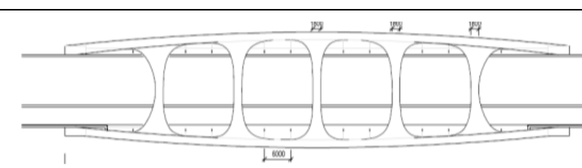
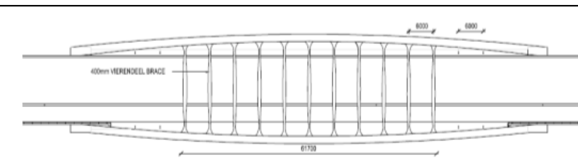
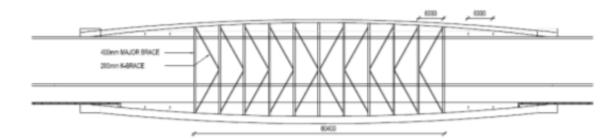
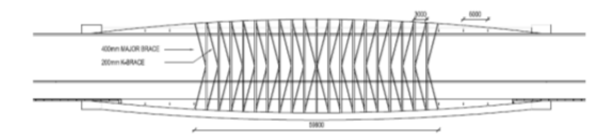
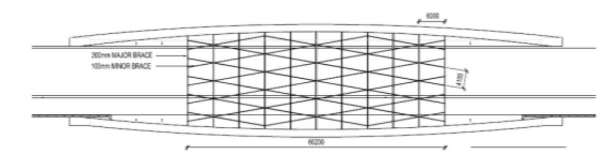
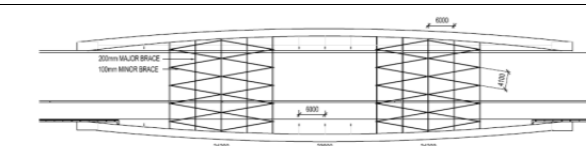
1. The first option is for the rib to be a constant width of 2000 mm and varying depth, as shown in **Drawing 5.3.3.1**. Keeping a constant width would allow for the flanges to remain square which simplifies fabrication.

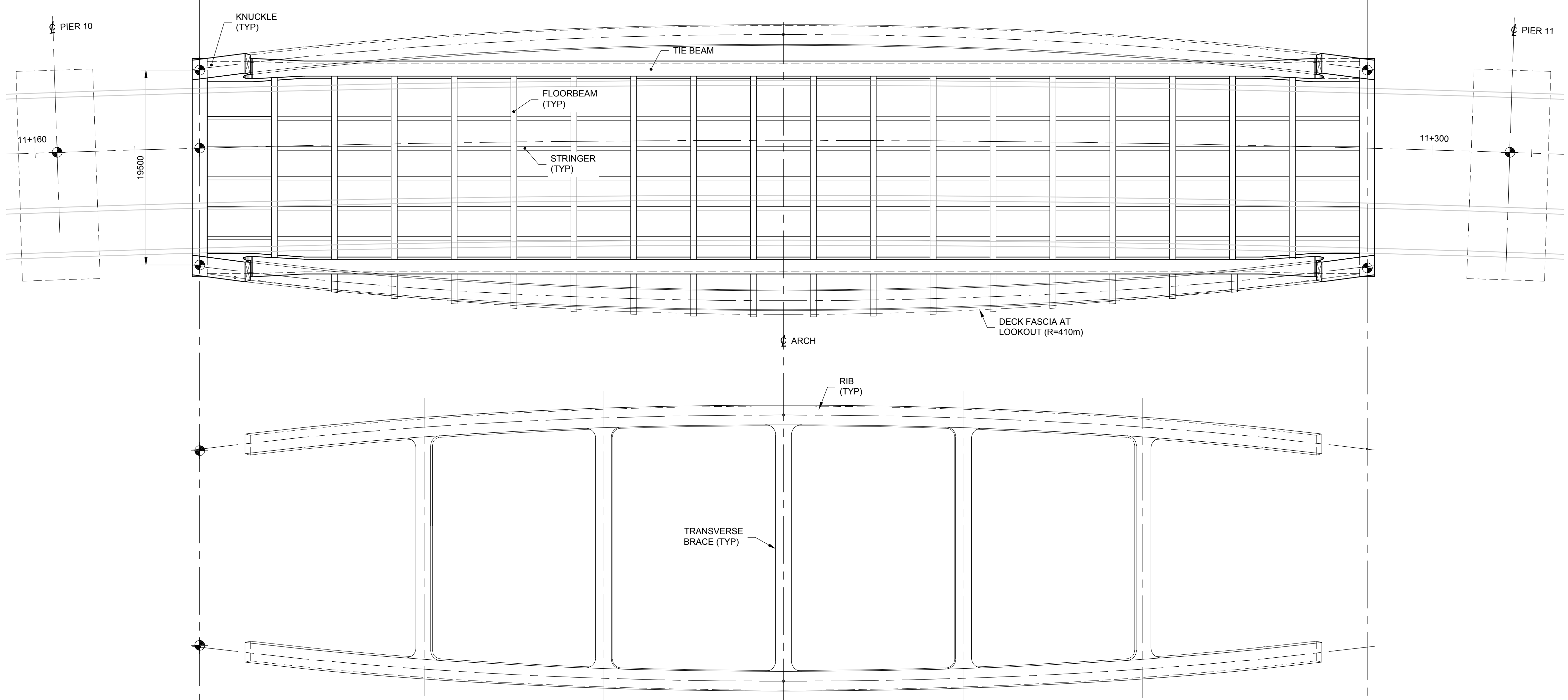
2. The second option is for the rib to vary in width from 2000 mm at the knuckle to 1200 mm at the crown of the arch and varying depth, as shown in **Drawing 5.3.3.2**. Having the rib tapered in both directions decreases the weight of steel required, but increases the complexity of fabrication.

5.3.4 Arch Bracing

The bracing of the arches reduces the lateral deflection of the arches which in turn decreases the size of the arch ribs. Multiple bracing options were evaluated, as shown in **Table 5.3.4.1**.

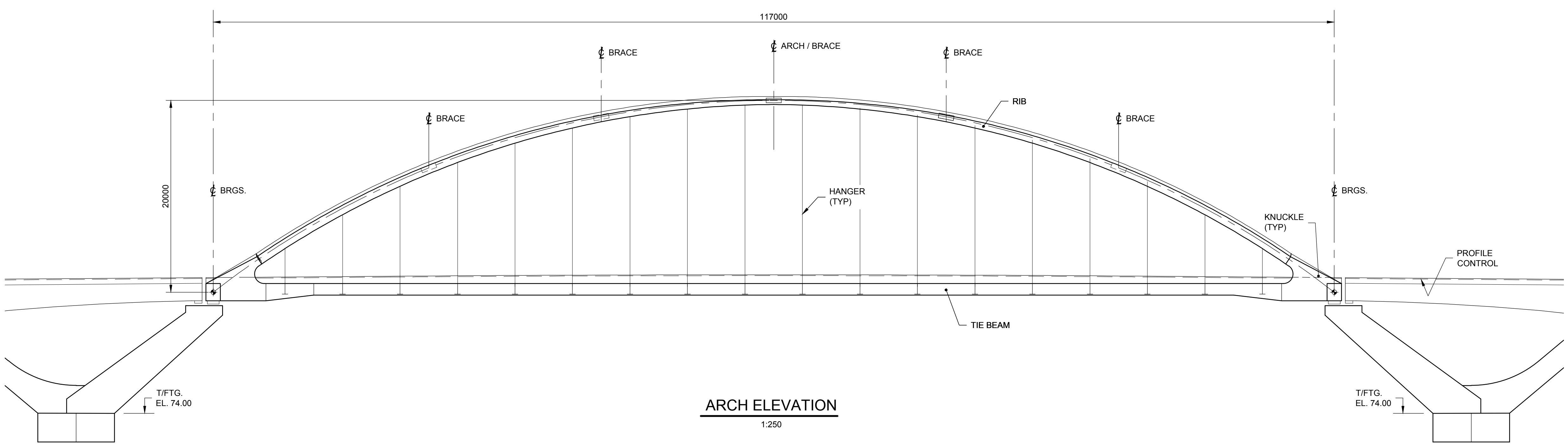
Table 5.3.4.1: Arch Bracing Options

Option	Description	Isometric View
1	Single Shell	
2	Triple Shell	
3	Quintuple Shell	
4	Vierendeel Truss	
5	K-Brace	
6	K-Brace	
7	Solid Weave	
8	Dual Weave	



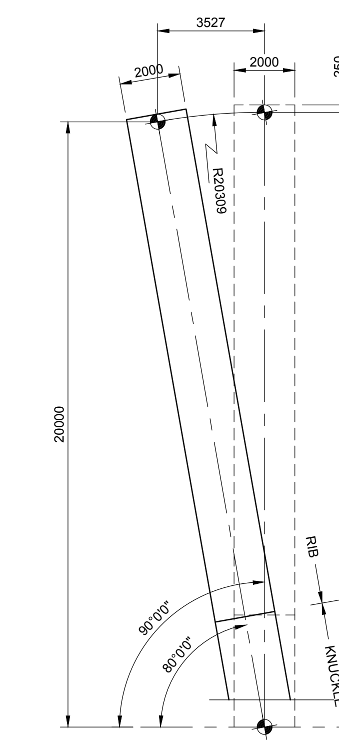
ARCH PLAN

1:250



ARCH ELEVATION

1:250



RIB INCLINATION

1:125

THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

PRELIMINARY ARCH LAYOUT
RIBS TAPERED VERTICALLY

Mark Van Buren, P.Eng.
Director of Engineering & Deputy Commissioner

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KINGSTON

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

PARSONS

Project No.: 27143

Drawing No.: 5.3.3.1

Sheet No.: -- of ---

Des: JJA | Chk'd: RO

Dwn: KRS | Chk'd: JJA

Scale: AS NOTED

Utility Circ. No. -----

Code: CAN/CSA-S6-14

Load: CL625ONT

NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

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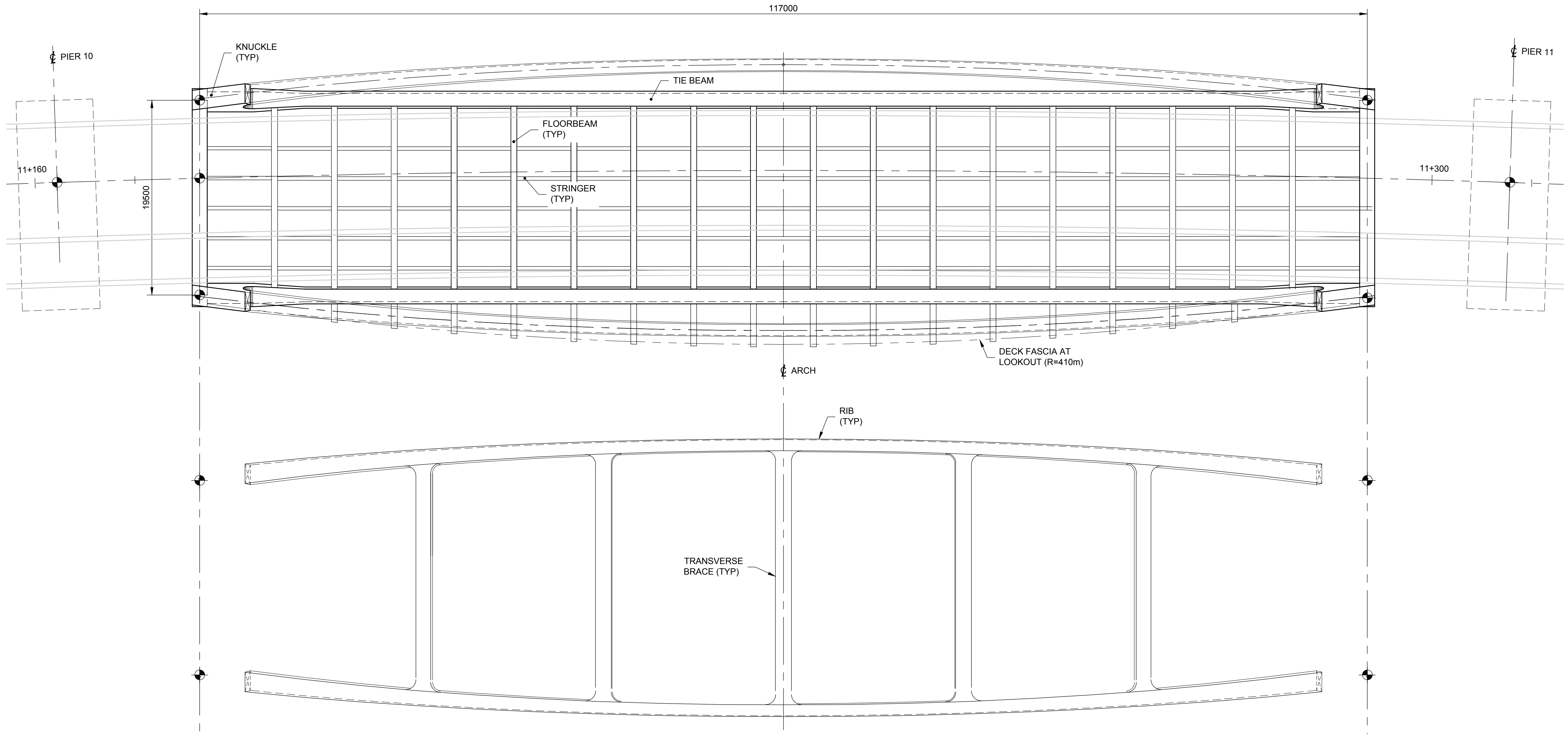

ARCH PLAN

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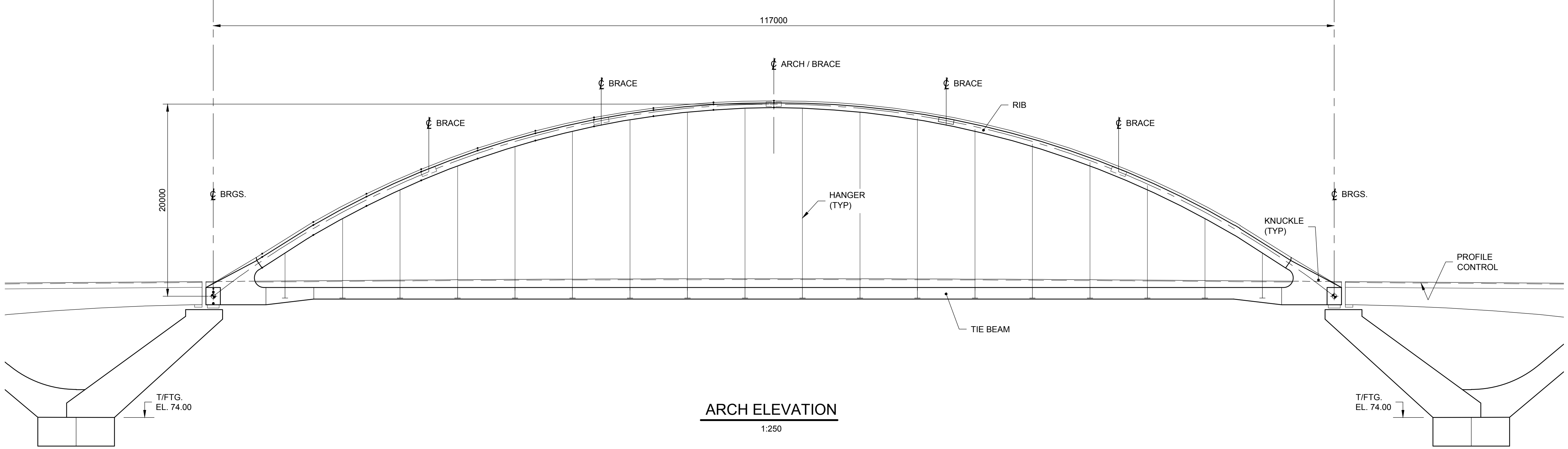

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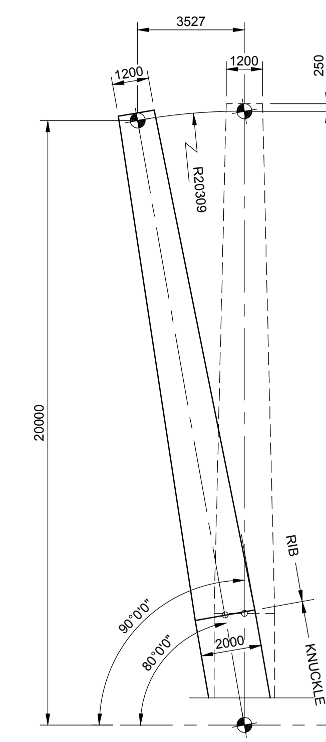

RIB INCLINATION

1:125

THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

PRELIMINARY ARCH LAYOUT
RIB TAPERED BOTH WAYS

Mark Van Buren, P.Eng. — Director of Engineering & Deputy Commissioner
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PARSONS

Project No.:	27143
Drawing No.:	5.3.3.2
Sheet No.:	-- of ---
Des.: JJA	Chk'd: RO
Dwn: KRS	Chk'd: JJA
Scale:	AS NOTED
Utility Circ. No.	-----
Code:	CAN/CSA-S6-14
Load:	CL625ONT

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REVISIONS

No.	Description	By	Date (dd/mm/yy)
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Highlights of this evaluation are as follows:

1. The single shell and triple shell options were eliminated as they do not provide efficient arch designs.

2. The K-Brace and the Weave options were eliminated due to the number of connections that would be required. In addition, due to the arch geometry, each brace would be different and would add complexity to the fabrication.

3. There was consensus, based on internal City-Project Team and TAC discussions, that a combination of the Quintuple Shell and the Vierendeel Truss is the preferred option. Having five lateral braces connecting the arch ribs provides the optimal structural support without having excessive amount of bracing.

   The braces will be shaped similar to the Vierendeel Truss but will have less straight portions and more flare at the connection to the arch rib, as shown in **Figure 5.3.6**.

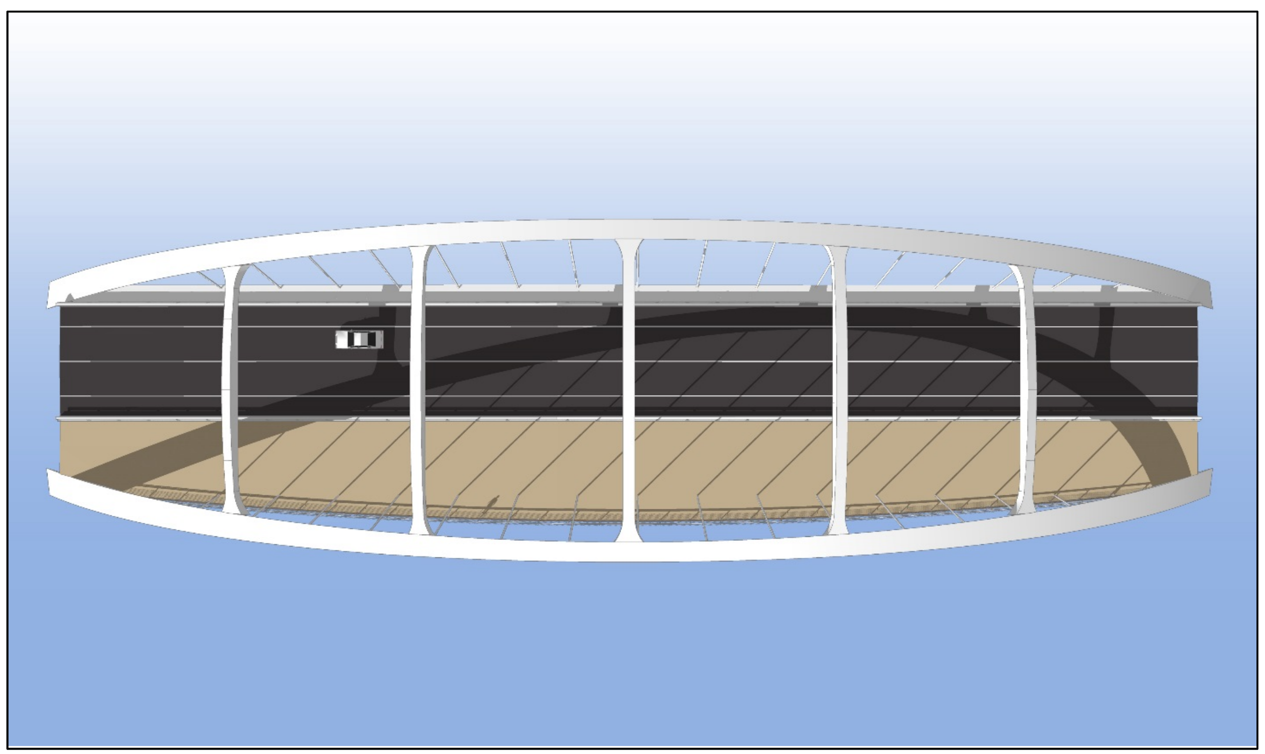


Figure 5.3.6: Preferred Bracing Option

5.3.5 Arch Hangars

Two different hanger options were considered: wire ropes; and multi-strand hangers. The use of multi-strand hangers is the preferred option, as they are more durable, and have triple corrosion protection (whereas wire ropes are only galvanized).

The anchorages for the hangers will be designed to allow for ease of cable/hanger replacement as well as hanger force adjustment, if required.

5.3.6 Structural Steel Coating

There are multiple coating options available to preserve the structural steel. Three options considered for the bridge were:

1. A three-coat system consisting of a zinc primer, an epoxy mid-coat and a urethane top coat over all the structural steel.

2. Metallization of the structural steel.

3. Use of Atmospheric Corrosion Resistant steel.

A coating system would be applied in the shop and then touched-up after erection and at the field splices. The benefits of using a coating system are that the colour of the structural steel can be changed to appease the architectural look of the bridge; and a three-coat coating system has an average service life of 25 to 30 years. At that time, an access platform will be constructed with an environmental protection enclosure in order to sand blast the existing coating off of the structural steel down to base metal and apply a new three-coat system.

Metallizing consists of coating the structural steel in a thin layer of zinc or aluminum to act as a sacrificial layer to protect the underlying structural steel. Metallizing can occur in a shop or in the field as it is spray-applied. Metallizing has a higher initial cost than a three-coat system but it has a lower life cycle cost, since it is more durable. Using metallization over a three-coat system adds an additional 5 years to its average service life. It is standard practice to apply a layer of coating on top of the metallization to provide further protection and change the colour.

Atmospheric Corrosion Resistant (ACR) Steel, often known as weathering steel, is approximately four times more resistant to corrosion than plain carbon steels. ACR steel forms a rust patina which inhibits further corrosion of the structural steel. ACR steel will have a rust colour and is generally uncoated, except for the girder ends in the vicinity of the expansion joints.

A combination of these methods could be used to provide additional protection in corrosion prone areas such as the exterior girders and the ends of the girders at the expansion joints. Four different options were considered for the bridge approach span structural steel:

1. Three-coat system.
2. Metallization and one coat system.
3. ACR steel.
4. ACR steel and one coat system on exterior girders.

An evaluation matrix was prepared to compare the different alternatives as shown in **Table 5.3.6.1**.

Table 5.3.6.1: Evaluation Matrix for Structural Steel Coating Option*

Criteria		Three-Coat System	Metallization and One Coat System	ACR Steel	ACR Steel with one coat system on exterior girders
Initial Cost	Structural Steel	$12.9M	$12.9M	$13.8M	$13.8M
	Coating	$3.8M	$5.3M + $1.5M = $6.8M	N/A	$0.3M
	Total	$16.7M	$19.7M	$13.8M	$14.1M
Estimate Service Life		25-30 years	30-35 years	100 years	1. 100 years for steel 2. 25 to 30 years for coating
Aesthetics		1. Can paint it a specific colour	1. Can paint it a specific colour	1. Structural Steel will be a rust colour due to patina	1. Exterior girders will be painted a specific colour 2. Interior girders will be a rust colour due to the patina
Maintenance		1. Localized coating repairs 2. Full coating removal and replacement at end of service life.	1. Localized coating repairs 2. Full coating removal and replacement at end of service life.	1. No maintenance	1. Localized coating repairs on exterior girders 2. No maintenance on interior girders 3. Overcoat on exterior girders at end of service life

* Only evaluates the approach span structural steel.

5.3.7 V-Piers

The ESR recommended v-piers as they would reduce the number of footings by half; and with two legs, they would reduce the superstructure spans and would also result in a shallower superstructure. As such, both concrete and steel v-piers were considered during the current project phase.

Steel v-piers are rigid steel structures that are integral with the superstructure. Steel v-piers require a tall concrete pedestal in marine environments to prevent contact between the water and the structural steel. If the steel v-piers are integral with the steel superstructure, the bearings would be located at the base of the v-pier on the concrete pedestal.

Steel v-piers are more complex to design and fabricate, as each pier would be different. In addition, steel v-piers still require a concrete pedestal to be built in order to support them. However, steel v-piers are lighter than concrete v-piers, which decreases the dead load on the foundations. Integral steel v-piers were used for Champlain Bridge, as shown in **Figure 5.3.7**.

Figure 5.3.7: Steel V-Piers (Champlain Bridge)

Concrete v-piers can either be cast-in-place or made of precast sections. Concrete v-piers may utilize a tie to balance the inclined loading in the v-pier legs. The ties can be either a steel section or post-tensioned concrete beam that is anchored into the v-pier legs. The bearings for concrete v-piers may be located at the top of the v-pier legs, since the pier is not integral with the superstructure.

Concrete v-piers are considerably heavier than steel v-piers, but the use of hollow precast concrete sections can significantly reduce their weight. This approach was used on the Woodrow Wilson Bridge, as shown in **Figure 5.3.8**.

Figure 5.3.8: Concrete V-Piers (Woodrow Wilson Bridge)

The use of concrete v-piers is the preferred option due to the fact that the steel v-piers have bearings at the base which could be a durability issue with the varying water levels. As noted above, a tall concrete pedestal would still be required at each pier location for the steel v-piers; therefore, there is limited savings in the schedule by having the steel v-piers fabricated off-site. In addition, the steel v-piers would require larger bearings which are more difficult to maintain and replace in the future.

Four different v-pier options were considered, as shown on **Drawing 5.3.6.1**. A comparison of these options is provided in **Table 5.3.6.1**.

Table 5.3.6.1: Comparison of V-Pier Options

Criteria	Option 1	Option 2	Option 3	Option 4
Description	2 separate v-piers with 2 tie-beams	2 v-piers connected with a header beam and 1 tie-beam	2 v-piers connected with a header beam and 2 tie-beams	Wall type v-pier with 2 tie beams
Advantages	1. Simplest to construct 2. Open and transparent pier design	1. Open and transparent pier design	1. Open and transparent pier design	1. Easy to construct 2. Aesthetically pleasing in elevation
Disadvantages		1. Header beam increases complexity of construction and overall weight of pier 2. Forces in single tie-beam would be large and create difficulties with header beam design	1. Header beam increases complexity of construction and overall weight of pier	1. Substantially more concrete than other options. 2. Increased load on footing 3. Single v-pier will look bulky from the view along the bridge.
Comparative Cost	$	$$$	$$	$$

Option 1 is the preferred option, as it is simpler to construct, more economical and structurally viable, and provides a more open and transparent pier design.

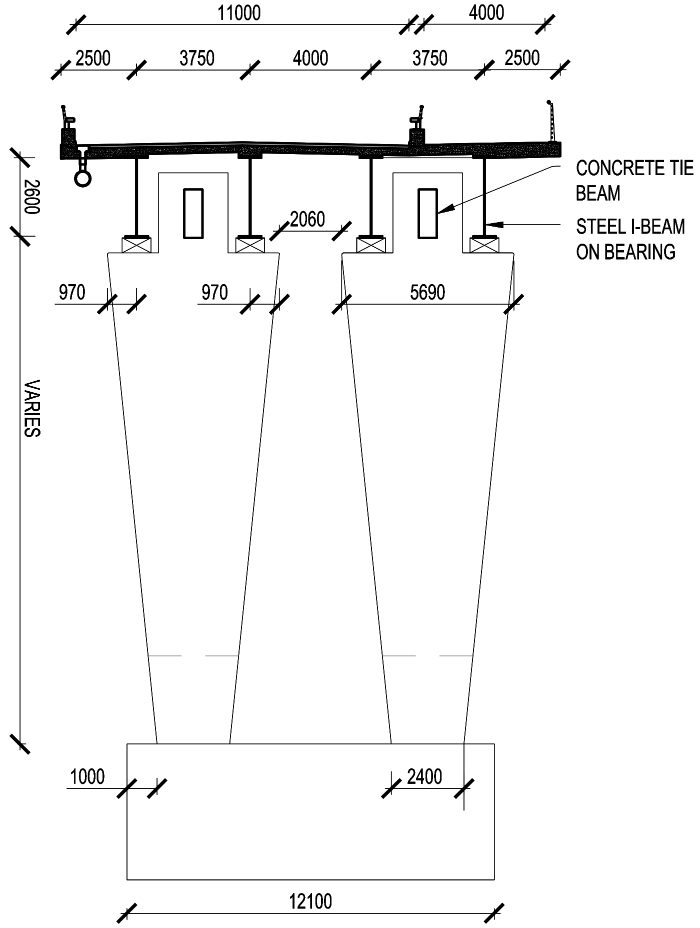
Based on the geotechnical investigation, four different foundation options were investigated to determine the most practical and cost effective method of supporting the structure. A comparison of these options is provided in **Table 5.3.6.2**. The footing layout for each different caisson and pile option is provided in **Drawing 5.3.6.2**.

Table 5.3.6.2: Comparison of Foundation Options*

Option	Description	Details	Estimated Total Comparative Cost for All Piers
1	2100 mm dia. Caissons	4 caissons per pier. Steel liner seated 4.2 m into bedrock, reinforcing cage and cast-in-place concrete full length of caisson	~$15.4M
2	914 mm dia. Pipe Piles	16 to 24 pipe piles per pier. Pile seated into bedrock, reinforcing cage and cast-in-place concrete in top section of the pile to create fixity with foundation	~$11.1M
3	1067 mm dia. Pipe Piles	12 to 18 pipe piles per pier. Pile seated into bedrock, reinforcing cage and cast-in-place concrete in top section of the pile to create fixity with foundation	~$13.8M
4	3000 mm dia. Caissons	2 caissons per pier. Steel liner seated 6 m into bedrock, reinforcing cage and cast-in-place concrete full length of caisson	~$15.5M

* Notes:

1. The estimated comparative cost is based on Ice Loading at Low Water elevation of 73.0 m.
2. The use of steel H-Piles was also considered, but it was not carried forward as each pier would require a significant amount of battered piles to resist the lateral forces adding constructability complexities that would compound risk, given the driving conditions, depth to competent bedrock and poor overburden soil conditions.



OPTION 1 - TWO TIE BEAMS

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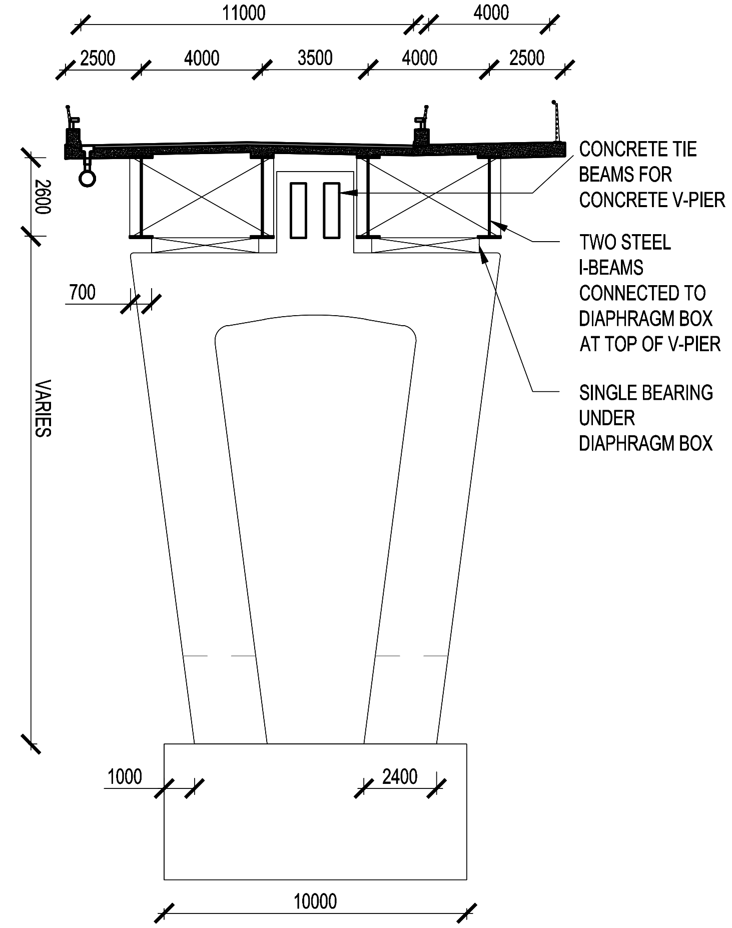
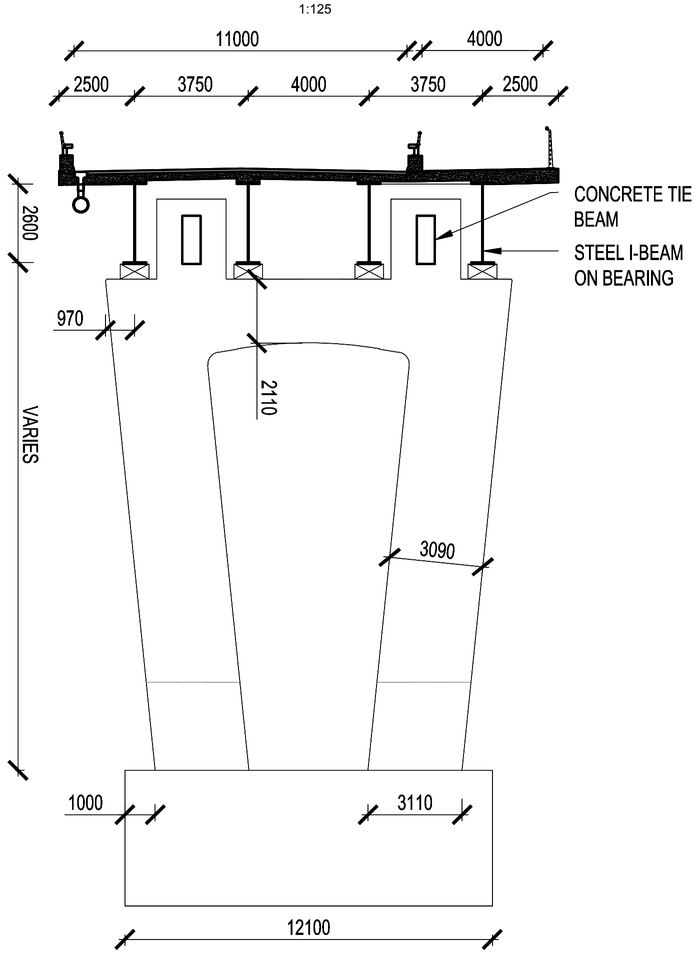


OPTION 2 - ONE TIE BEAM WITH HEADER BEAM

1:125



OPTION 3 - TWO TIE BEAMS WITH HEADER BEAM

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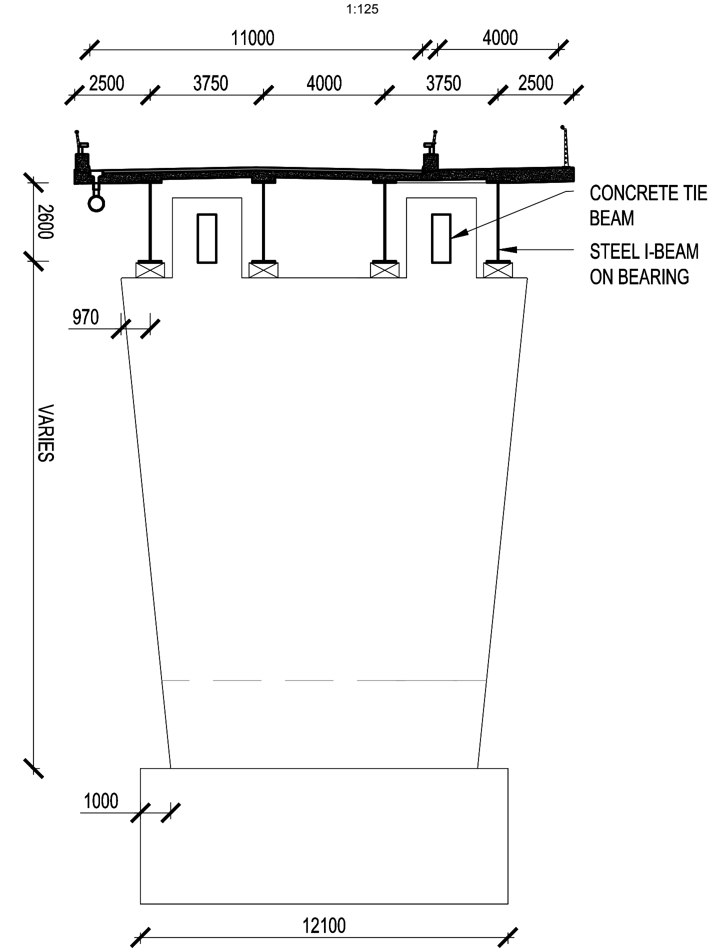

OPTION 4 - TWO TIE BEAMS WITH WALL PIER

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THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT

CONCRETE V-PIER OPTIONS

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Dan Franco, P.Eng. — Project Engineer

KINGSTON

J.L.Richards — ENGINEERS · ARCHITECTS · PLANNERS

PARSONS

Project No.: 27143
Drawing No.: 5.3.6.1
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Des: JJA — Chk'd: RO
Dwn: KRS — Chk'd: JJA
Scale: AS NOTED
Utility Circ. No. ----
Code: CAN/CSA-S6-14
Load: CL625ONT

NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

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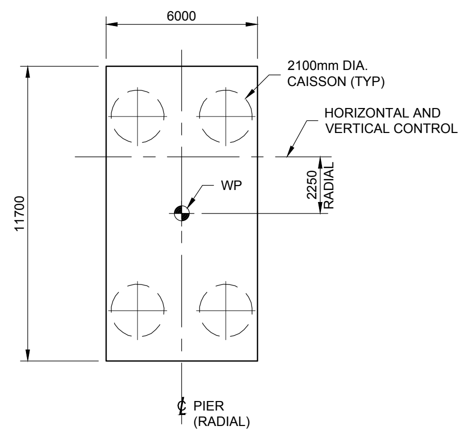

PIER FOUNDATION OPTION 1

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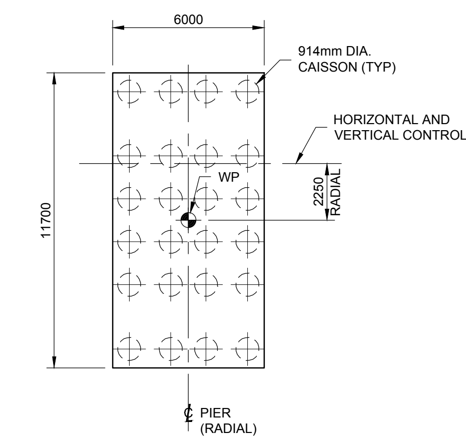

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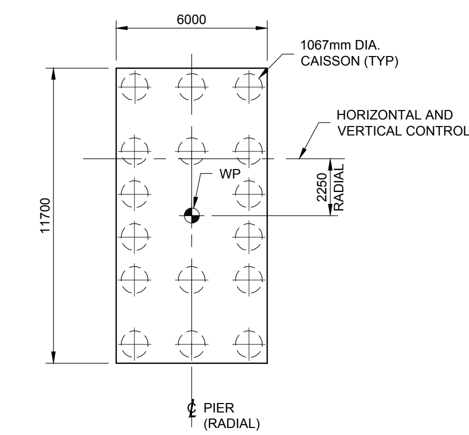

PIER FOUNDATION OPTION 3

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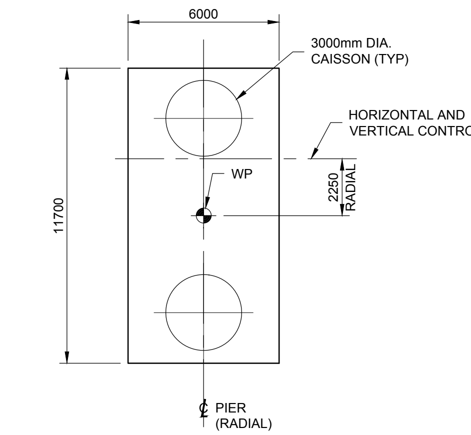

PIER FOUNDATION OPTION 4

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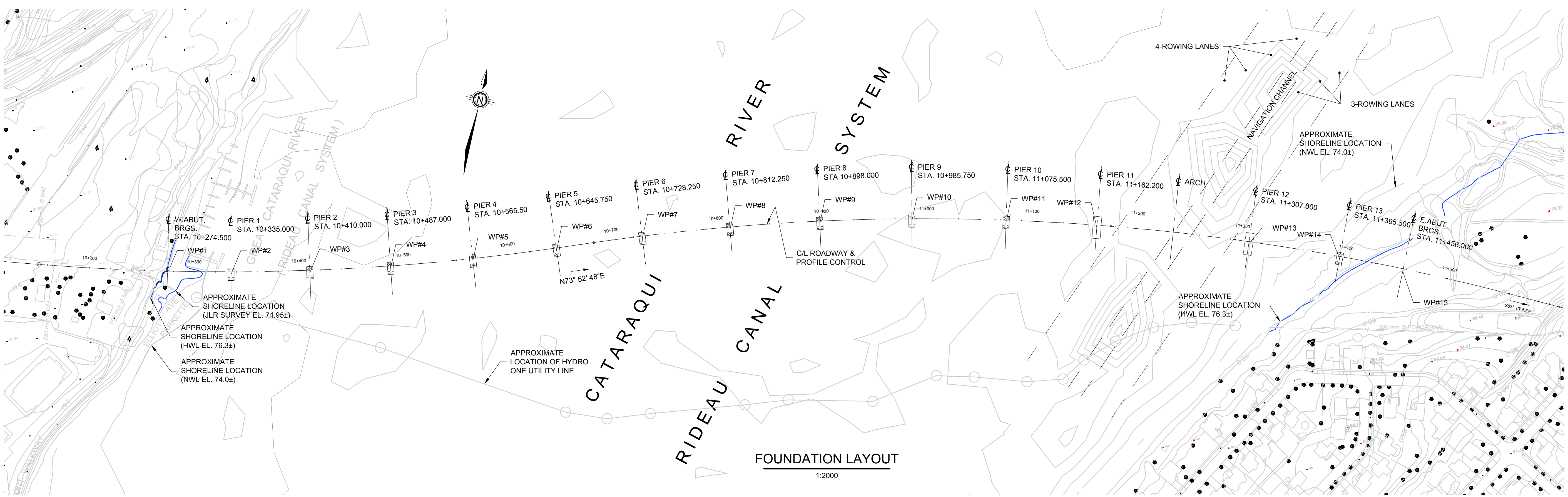

FOUNDATION LAYOUT

1:2000

THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

FOUNDATION OPTIONS AND LAYOUT (V-PIERS)

Mark Van Buren, P.Eng.
Director of Engineering & Deputy Commissioner

Dan Franco, P.Eng.
Project Engineer

Project No.:	27134
Drawing No.:	5.3.6.2
Sheet No.:	-- of --
Des: JJA	Chk'd: RO
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Scale:	AS NOTED
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The lateral design of the deep foundation is governed by the ice loading. Two different ice loads at two different elevations are being considered, based on the effective ice strength as described earlier in this Report. The effects on the foundation design, based on the different ice loading for the caisson options, are provided in **Table 5.3.6.3.** The foundation design is currently based on an ice crushing strength of 1100 kPa at the low water elevation of 73.0 m.

Table 5.3.6.3: Effects of Ice Level on Large Diameter Caissons				
Ice Level (Top of Ice Elevation)	**Option 1**		**Option 4**	
	1100 kPa	**700 kPa**	**1100 kPa**	**700 kPa**
High (74.9 m)	6 - 2100 mm ϕ Caissons	4 - 1800 mm ϕ Caissons	2 - 3800 mm ϕ Caissons	2 - 3000 mm ϕ Caissons
Low (73.0 m)	4 - 2100 mm ϕ Caissons	4 - 1800 mm ϕ Caissons	2 - 3000 mm ϕ Caissons	2 - 3000 mm ϕ Caissons

The preferred foundation option will be dependent on: the above parametric analysis; the results of the geotechnical investigation; the construction duration of each of the above options; the availability of pile driving equipment locally; and the scour mitigation measures required. At present, both the pipe piles and caissons options will be carried forward for further design refinement.

5.4 Deck Drainage

The vertical profile of the bridge allows the stormwater to actively drain from the middle of the arch to the approaches. Drains along the curb lines will collect the stormwater which will be piped to a stormwater management facility on-land.

An option of treating the stormwater on the bridge so that it can be directly discharged into the river was investigated. But it was determined that there is not a viable solution that could treat the stormwater for all the constituents within the confines of the bridge that can be easily maintained.

Rainfall data obtained from ECCC was used to calculate the rainfall intensity for the City. The MTO Highway Drainage Design Standards was used to specify the design criteria for the flow spread which stated that the design storm with a minimum return period of ten years shall be used to calculate the flow spread and that the maximum lateral spread distance shall be such that a minimum of 2.5 m of the lane adjacent to the median barrier or curb remains clear of any flooding.

It was determined, in addition to the MTO Standards, that a flow spread that is restricted to only the shoulders of the bridge (meaning a flow spread of 2 m for a design storm with a minimum return period of 10 years) and a bicycle friendly option (which would allow for 0.5 m width free of stormwater on the shoulder for a design storm with a minimum return period of 2 years and 5 years) should be analyzed as well.

Two different deck drains were used in the flow spread analysis:

1. Ontario Provincial Standard Drawing (OPSD) 3340.150 Deck Drain: 1 m by 0.23 m grate with the long side of the drain located adjacent to the barrier and parallel to the flow.
2. Neenah Enterprise Incorporated (Neenah) R-4014-B1 Series Scupper Drain: 1.1 m by 0.4 m grate with the short side of the drain adjacent to the barrier and the long side perpendicular to the flow.

Based on the design criteria, the spread flow analysis was run for a longitudinal grade of 1% and 0.75% for the two deck drain options, and which are further based on the two vertical profile options. This analysis is summarized in **Table 5.4.1**.

Table 5.4.1: Comparison of Deck Drain Types

	1% Longitudinal Grade				0.75% Longitudinal Grade			
Deck Drain Types	**OPSD 3340.150**		**R-4014-B1**		**OPSD 3340.150**		**R-4014-B1**	
	West	East	West	East	West	East	West	East
MTO – 3.5 m flow spread, 10 years	5	0	3	0				
2 m flow spread, 10 years	12	1	8	1	13	2	8	1
Bike Friendly – 1.5 m flow spread, 2 years	11	2	8	1	11	2	8	2
Bike Friendly – 1.5 m flow spread, 5 years	15	3	11	2	15	3	11	2

For the multi-use pathway, two options were considered: the first, having a minimum of 1.5 m clear of flooding; and the second, having a minimum of 2.5 m clear of flooding. The number of deck drains required for a 1% longitudinal grade for the multi-use path is summarized in **Table 5.4.2**.

Table 5.4.2: Comparison of Deck Drain Types for the Multi-Use Path

	1% Longitudinal Grade			
Deck Drain Types	**OPSD 3340.150**		**R-4014-B1**	
	West	East	West	East
Minimum 1.5 m clear of flooding	5	0	3	0
Minimum 2.5 m clear of flooding	13	2	10	2

Based on the current cross-section configuration:

1. For both the 1% longitudinal grade and the 0.75% longitudinal grade, two drainage pipes are required: one on the north side of the road collecting the stormwater from the north side of the roadway; and one on the south side that collects the stormwater from the south side of the road and the multi-use pathway.

2. For the 1% longitudinal grade, a 375 mm pipe is required on the north side of the bridge and a 450 mm pipe on the south side.

3. For the 0.75% longitudinal grade, the pipe on the south side has to be upgraded to a 525 mm diameter pipe and the pipe on the north side can remain as 375 mm diameter.

4. Arch drainage can either be intercepted via deck drains ahead of the expansion joints and piped through the joint, or intercepted using a trough system at the joint. The former option of intercepting the flow ahead of the joint is recommended.

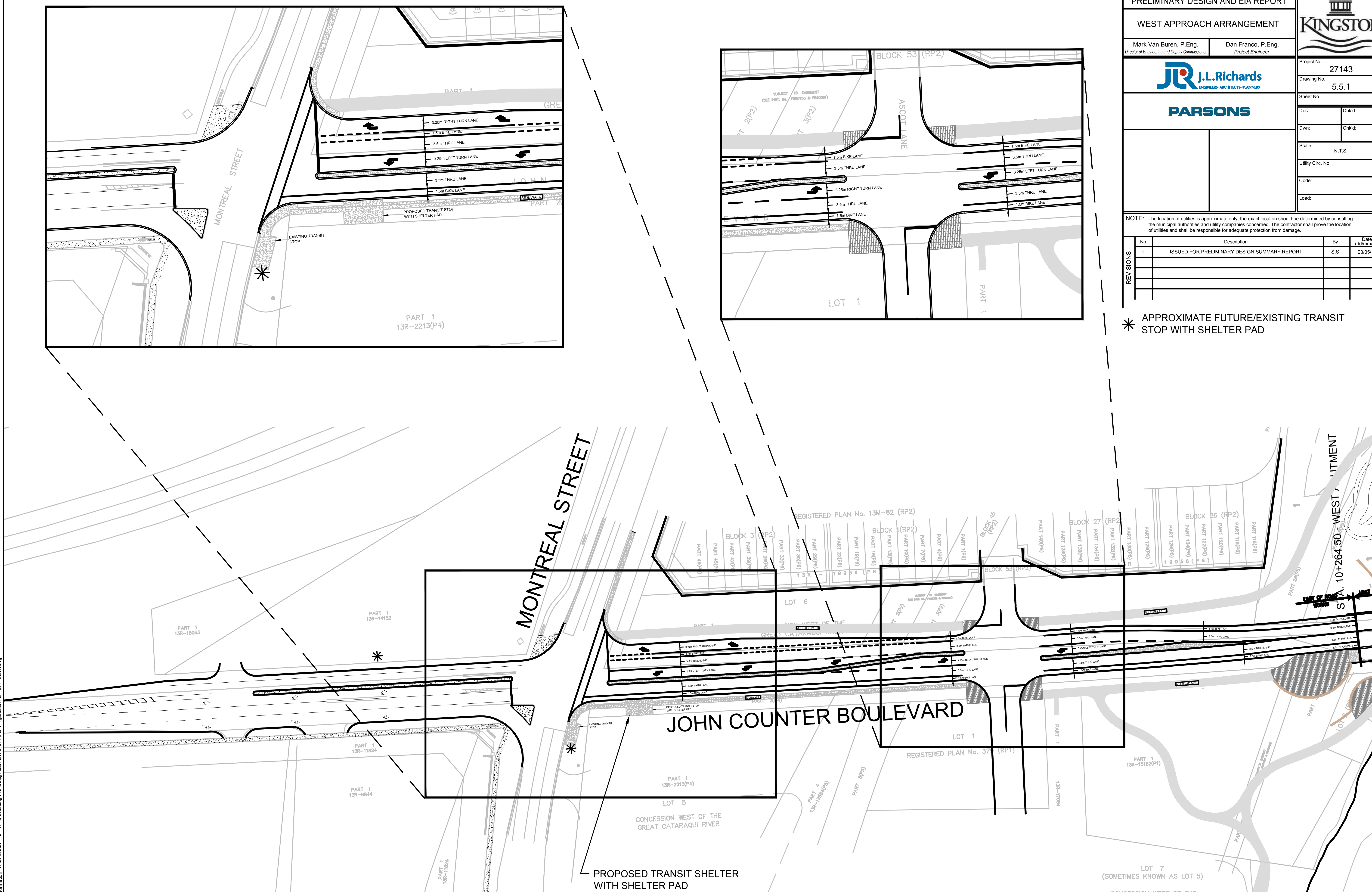
There was consensus, based on internal City-Project Team and TAC discussions, that the key criteria for the deck drainage is the 2 m flow spread based on the 10 year design for the traffic lanes, a 1.5 m allowable flow spread based on a five year storm event for the bike friendly traffic lanes and 1.5 m flow spread for a 10 year design storm for the multi-use pathway.

5.5 Arrangement of Approaches

The 2-lane bridge will be integrated into the existing road network on-shore: John Counter Boulevard on the west; and Gore Road on the east. Affected intersections will also require reconfiguration to accommodate related turning movements and queued vehicles.

At the west approach, two intersections along John Counter Boulevard are within the project corridor: Montreal Street and Ascot Lane. Montreal Street is considered a major intersection, in that it has existing signalization and will require modification. Ascot Lane is considered a minor intersection and is currently un-signalized.

The west approach arrangement is shown in **Drawing 5.5.1**. There is opportunity to reconfigure Ascot Lane as a perpendicular intersection to John Counter Boulevard. There may also be merit to upgrade this intersection in the future to include signalization in order to allow both cyclists and pedestrians to cross at the intersection on the west side of the bridge as well as to service turning traffic into and out of the reconfigured intersection as shown in **Drawing 5.5.2**.



THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

WEST APPROACH ARRANGEMENT

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Director of Engineering and Deputy Commissioner

Dan Franco, P.Eng.
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J.L.Richards ENGINEERS-ARCHITECTS-PLANNERS

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Project No.: 27143

Drawing No.: 5.5.1

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Utility Circ. No.

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NOTE: The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

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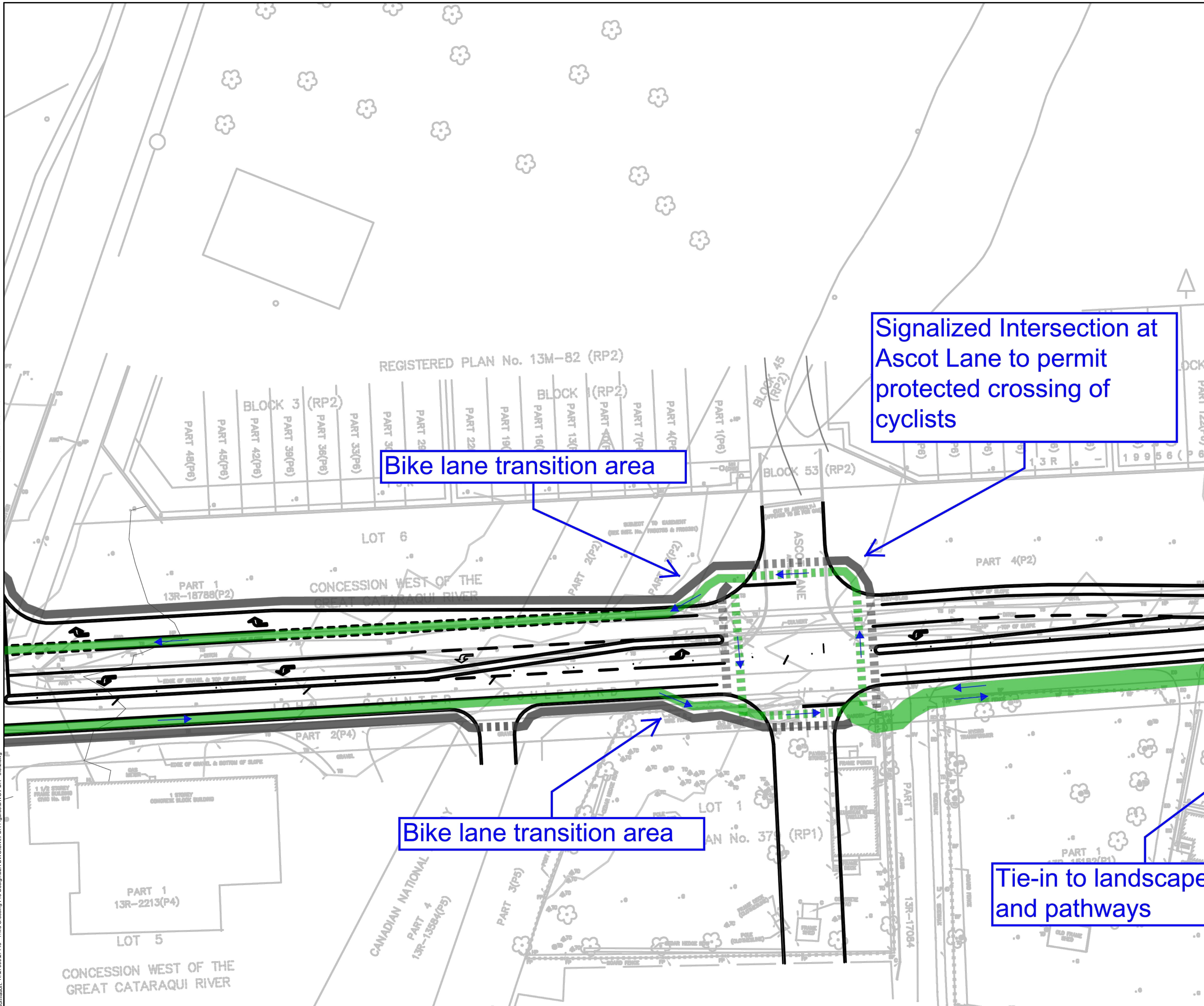
* APPROXIMATE FUTURE/EXISTING TRANSIT STOP WITH SHELTER PAD



THIRD CROSSING OF THE CATARAQUI RIVER
PRELIMINARY DESIGN AND EIA REPORT
INTEGRATION OF CYCLING AND MUP INFRASTRUCTURE

Mark Van Buren, P.Eng. — Director of Engineering and Deputy Commissioner
Dan Franco, P.Eng. — Project Engineer

KINGSTON
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Project No.: 27143
Drawing No.: 5.5.2
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At the east approach, two intersections along Gore Road are within the project corridor: Highway 15 and Point St. Mark Drive. Highway 15 is considered a major intersection, in that it has existing signalization. The Highway 15 corridor from Highway 2 (south) to Highway 401 (north) is currently part of a Class EA and Preliminary Design Study which, when implemented, will see the corridor (or portions thereof) expanded to four vehicular lanes plus cycling, pedestrian and multi-use path infrastructure. Point St. Mark Drive is considered a minor intersection and is currently un-signalized. As per the ESR, the existing entrance to the Gore Road Library will be reconfigured to align with Point St. Mark Drive at a new signalized intersection. The east approach is shown on **Drawing 5.5.3**.

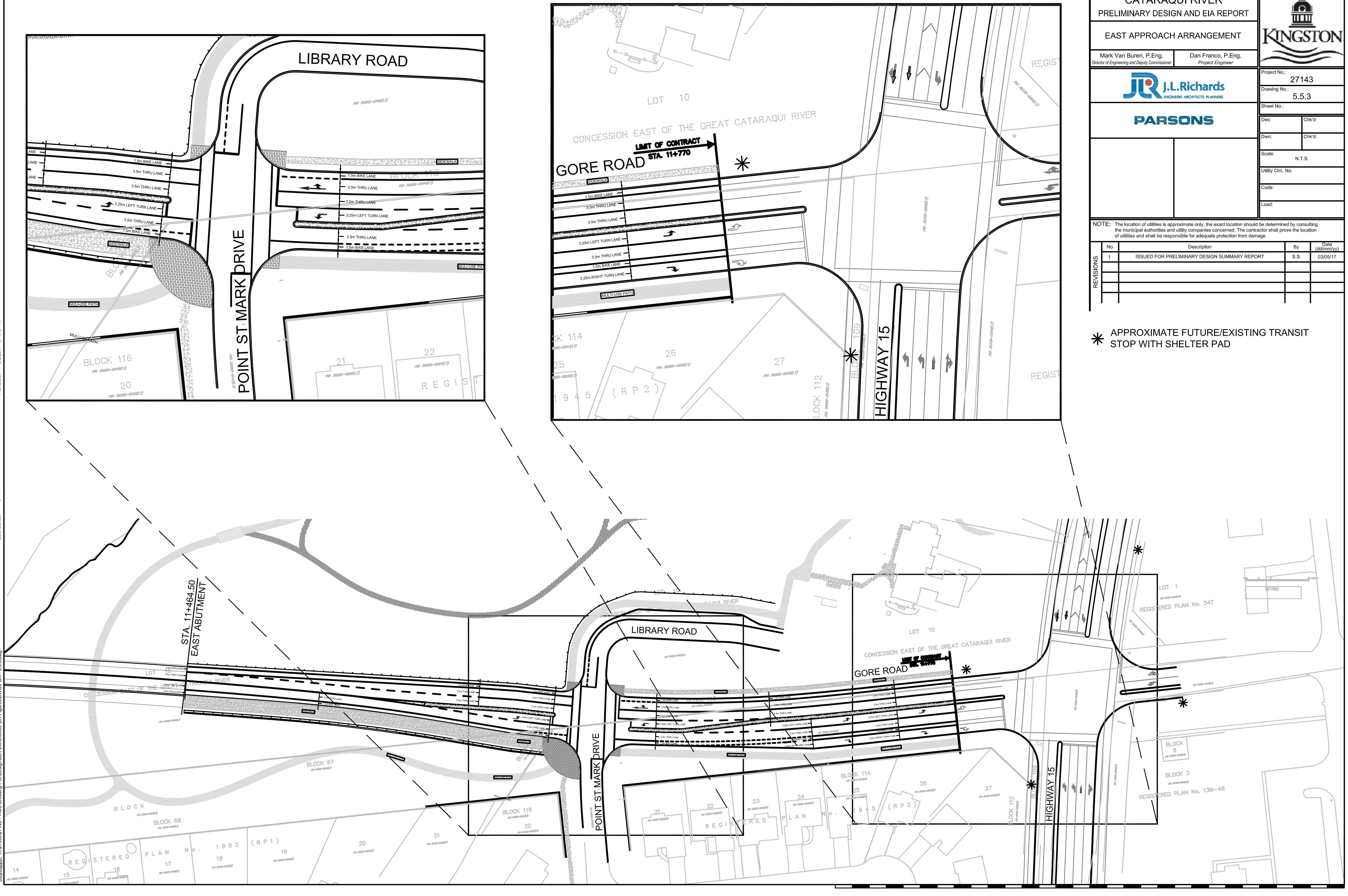
Kingston Transit was consulted to discuss future transit service within the project corridor. It was noted that the 2017-2021 Kingston Transit Business Plan (KTBP) was being prepared, but it was not expected to indicate any service for the project corridor, since the bridge would not be built within the planning horizon of the KTBP. Kingston Transit recognizes the opportunity for east-west routes that will be incorporated along the project corridor in the future. As such, Kingston Transit has made the following suggestions to accommodate future transit planning considerations along and adjacent to the project corridor:

1. Mid-block stops are not ideal for transit riders unless there is a specific mid-block destination being served. Transit stops are generally placed on the far side of an intersection and proximate to the intersection. This allows riders to use cross-walks.
2. Bus bays or 'laybys' are not generally used along a bus route unless the bus stop is at a location where the bus is expected to idle for several minutes. In certain circumstances, dedicated discharge lanes for transit are used to provide priority to transit vehicles at intersections.
3. Intersection improvements at Montreal Street and John Counter Boulevard are welcome, since the current layout is not ideal for pedestrian circulation. A future eastbound transit stop location is currently shown near the Montreal Street intersection, as shown on **Drawing 5.5.1**. Other potential transit stop locations near the Montreal Street and Highway 15 intersections are shown conceptually on **Drawing 5.5.1 and Drawing 5.5.3** and will be confirmed at a later date.

5.6 Innovation Considerations

Key innovative features which are being evaluated during the current project phase include:

1. Flexibility in the design of the superstructure to allow different erection methods for the arch and the approach spans, depending on the means and methods of the Contractor.
2. Designing the arch components from completely sealed components to enhance the long term life and durability of the structure.
3. Bridge Service Life considerations, which will evaluate the overall life cycle of the asset so that the initial design ensures optimized performance and related operations / maintenance / rehabilitation costs in tandem.
4. Structural health monitoring systems (SHMS) or 'smart bridge' technologies, which are increasingly being discussed in bridge design, particularly for long-span arch structures. While the ability to assess a bridge more frequently and (potentially) more proactively offers promise, the perceived benefits must be weighed against: the City's larger ITS infrastructure and capacity to process and evaluate generated data; and the actionable nature of the data generated and the durability of monitoring system themselves versus an 'early-age' performance / condition assessment.
5. A hanger system comprised of multi-strand cables and anchorages with adjustment nuts, which would enable quick and easy adjustment (and replacement) of the cable forces throughout the life of the bridge.
6. The use for stainless steel / galvanized and GFRP reinforcing steel rather than non-coated carbon steel in areas prone to high corrosion.
7. Consideration for a coating system that extends the coating life including a four coat system and the potential metalizing of the arch components.
8. Providing adequate concrete cover, the use of stainless steel, and/or galvanized reinforcing steel in the deck to extend its life and enhance durability.
9. The use of LED light fixtures, which would significantly reduce energy consumption, and last longer than any other known lighting system.
10. Paying close attention to aesthetics both globally and in detail to create a structurally sound engineered and aesthetically pleasing bridge, with the optimum in sustainable features.
11. Consideration for de-icing and anti-icing systems.
12. Consideration for Renewable Energy Generation in the form of solar electricity.



THIRD CROSSING OF THE CATARAQUI RIVER

PRELIMINARY DESIGN AND EIA REPORT

EAST APPROACH ARRANGEMENT

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Project No.:	27143
Drawing No.:	5.5.3
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✳ APPROXIMATE FUTURE/EXISTING TRANSIT STOP WITH SHELTER PAD

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