Appendix 'N' – Heritage Impact Assessment

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REVISED REPORT

Heritage Impact Assessment

Three Grand River Crossings Schedule B Municipal Class Environmental Assessment, City of Brantford, Ontario

Submitted to:

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Executive Summary

The Executive Summary highlights key points from the report only; for complete information and findings, as well as the limitations, the reader should examine the complete report.

In February 2020, GM BluePlan Engineering Limited (GM BluePlan) retained Golder Associates Ltd. (Golder) on behalf of the City of Brantford (the City) to conduct a Cultural Heritage Evaluation Report (CHER) to support the two-phase Three Grand River Crossings Schedule B Municipal Class Environmental Assessment (EA). The study area for the MCEA included an approximately 800 m long by 150 to 300 m wide portion of the watercourse and banks of the Grand River in downtown Brantford, as well as the three crossings known as Lorne Bridge (built 1923), Brant's Crossing Bridge (1912-13), and the Toronto, Hamilton and Buffalo (TH&B) Crossing Bridge (substructure built in 1893 with superstructure replaced in 1921).

The purpose of the MCEA was to review options to address the bridges deteriorating condition and identify the recommended alternative for each to improve the City's active transportation network. The CHER was initiated as part of the MCEA to identify whether any of the bridges met the *Ontario Regulation 9/06 Criteria for Determining the Cultural Heritage Value or Interest* (*O. Reg. 9/06*) and if a subsequent Heritage Impact Assessment (HIA) was required to inform the short and long-term management for each bridge and the wider study area.

Following guidance developed by the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) and other sources, and the results of research, field investigations, analysis, and evaluation, Golder concluded that the Lorne Bridge, Brant's Crossing Bridge, and the TH&B Crossing Bridge should each be considered built heritage resources since they met multiple criteria of *O. Reg. 9/06*. Additionally, Golder determined that the "Brantford Crossings" corresponding to the study area should be considered a cultural heritage landscape for its association with the historic crossing of the Grand River by Indigenous leader Thayendanegea (Joseph Brant) in 1784, the three surviving bridges, and includes remnants of crossings, rail lines, dams and recreational and institutional land-use dating from the late 19th to 20th century.

Based on these findings, Golder recommended to conduct an HIA to identify the negative impacts the recommended alternatives developed for each bridge may have on the cultural heritage value or interest and heritage attributes of the bridges and their associated cultural heritage landscape. Developed as "Strategy 7", the recommended alternatives for each bridge are:

- Lorne Bridge – Rehabilitate
- Brant's Crossing Bridge – Replace and Raise
- TH&B Crossing Bridge – Minor Rehabilitation and Remove at End of Useful Life

Using guidance developed by the MHSTCI, policies of the City's Official Plan, Canada's Historic Places *Standards and Guidelines for the Conservation of Historic Places in Canada* (2010), and other sources, this HIA describes the heritage policies applicable to new development and provides an understanding of the cultural heritage value or interest and heritage attributes of the built heritage resources and cultural heritage landscapes within the study area. Based on this understanding, the HIA assesses the potential impacts of the recommended alternatives and recommends conservation or mitigation strategies to avoid or reduce adverse effects.

Assessment conducted for this HIA has determined that *without mitigation* the recommended alternatives will result in:

- risk of moderate negative impact to the Lorne Bridge (and associated Brantford Crossings CHL) from construction vibration, potentially leading to partial destruction of the bridge's superstructure
- minor to moderate negative impact through alteration resulting from inappropriate repairs to the Lorne Bridge and Brant's Crossing substructures
- major negative impact to the Brant's Crossing Bridge (and associated Brantford Crossings CHL) through replacement of the superstructure
- a negligible to moderate negative impact to the TH&B Crossing Bridge from deterioration and risk of damage from a potential ice jam event.

Based on these results, Golder recommends that the City consider the following mitigation measures, which will serve to avoid or substantially reduce the identified negative impacts:

Lorne Bridge

Design Phase

- Prepare a Heritage Conservation Plan (HCP) that outlines the measures required to sensitively repair and rehabilitate the Lorne Bridge and how the cultural heritage value or interest (CHVI) and heritage attributes of the structure will be protected, conserved, and enhanced
  - The HCP should include measures to ensure appropriate concrete repair and the gentlest means possible for surface cleaning and provide guidance to ensure the thickening the top of the concrete arches, constructing additional ribs on the interior, and adding fibre-reinforced polymer fabrics to the soffit is compatible with the historic fabric and appearance of the Lorne Bridge

Construction Phase

- Implement site control and communication
  - Clearly mark on project mapping the location of all heritage attributes and communicate this to project personnel prior to mobilization
- Photo-document the work areas prior to any intervention and keep a centralized record of all work performed during the construction phase.
  - This may be aided by initiating a Building Information Modelling (BIM) system
- Create physical buffers
  - Erect temporary fencing or physical barriers near the bifurcated stairs on the north side of the west approach to prevent accidental damage to the features of this heritage attribute
- Monitor for vibration impact during construction
  - Conduct ground vibration monitoring during work on the bridge deck. The monitoring should use a digital seismograph capable of measuring and recording ground vibration intensities in digital format in each of three (3) orthogonal directions. This instrument should also be equipped with a wireless cellular modem for remote access and transmission of data.

  - The installed instrument should be programmed to record continuously, providing peak ground vibration levels at a specified time interval (e.g., 5 minutes) as well as waveform signatures of any ground vibrations exceeding a threshold level that would be determined during monitoring (e.g., between 6-12 mm/s). The instrument should also be programmed to provide a warning should the peak ground vibration level exceed the guideline limits specified. In the event of either a threshold trigger or exceedance warning, data would be retrieved remotely and forwarded to designated recipients.
  - If vibration has exceeded the guideline limits specified, a stop work order should be issued immediately and the bridge substructure promptly inspected for any indication of disruption or damage. If identified, the evidence of disturbance or damage should be documented, then closely monitored during construction for further change in existing conditions. Once work is complete, a post-construction vibration monitoring report or technical memorandum should be prepared to document the condition of the heritage attributes of the substructure and recommend appropriate repairs, if necessary.

Operation Phase

- Add the bridge's heritage attributes into annual inspection and maintenance planning
- As much as is practicable, limit use of de-icing salts in the vicinity of the bifurcated stairs on the north side of the west approach and periodically monitor the condition of this feature's surfaces for impact from salt damage. In the event damage is noted, take immediate action such as treatment with a salt repellant or switch to a calcium or magnesium chloride product.

Brant's Crossing Bridge

Design Phase

- The final design for the replacement bridge incorporates the scale, massing, materials and finishes of the original bridge where possible and appropriate.
- MHSTCI recommends that additional guidelines be included to guide the design for the replacement of the bridge and ensure the replacement bridge is sympathetic to surrounding cultural heritage resources.
- The bridge be documented to the standard outlined according to section 6.3.1.4 of the MTO Environmental Guide for Built Heritage and Cultural Heritage Landscapes (2007).
- Compile a thorough as-built record of the structure with photo-documentation and measured drawings following guidelines such as those developed by the Historic American Engineering Record (HAER)
- The above noted documentation will be deposited with the Municipality's appropriate institutions such as the library, museum and/or archives. When sending the documentation to the institutions, the municipality shall copy MHSTCI on the cover letter.
- Salvage one of the two through trusses and conserve as an interpretive feature in the adjacent parkland, preferably a site on the east side of the Grand River near the Brant's Crossing Bridge substructure and associated with the former LE&N rail line
- Prepare a Heritage Conservation Plan (HCP) that outlines how the CHVI and heritage attributes of the Brant's Crossing Bridge substructure will be protected, conserved, and enhanced.
  - If one truss will be salvaged as an interpretive feature in the adjacent parkland, the HCP should include measures to guide lifting, relocating, siting, installing, and conserving the truss as well as how it will be interpreted. The HCP should also address how the CHVI and heritage attributes of the Brant's Crossing Bridge substructure will be protected, conserved, and enhanced

Construction Phase

- Photo-document the superstructure dismantling, as well as the truss relocation and installation process, if pursued
- Photo-document the substructure work areas prior to any intervention and keep a centralized record of all work performed during the construction phase.
  - This may be aided by initiating a Building Information Modelling (BIM) system
- In keeping with Golder's corporate policies to encourage environmentally sustainable solutions, salvage for re-use as many components of the superstructure as possible

Operation Phase

- Add the bridge's heritage attributes into annual inspection and maintenance planning
- If a truss is relocated to the adjacent parkland, develop a maintenance plan to ensure the truss is conserved over the long-term
- Install a commemorative/interpretative plaque, at or near the crossings, which will outline the history of the crossings/area and incorporate historic photographs. The municipality must consult with the Municipal Heritage Committee and, as appropriate, with Indigenous communities, to develop the plaque within one year after construction.

TH&B Crossing Bridge

Design Phase

- The bridge be documented to the standard outlined according to section 6.3.1.4 of the MTO Environmental Guide for Built Heritage and Cultural Heritage Landscapes (2007).
- Compile a thorough as-built record of the structure with photo-documentation and measured drawings following guidelines such as those developed by the Historic American Engineering Record (HAER)
- The above noted documentation will be deposited with the Municipality's appropriate institutions such as the library, museum and/or archives. When sending the documentation to the institutions, the municipality shall copy MHSTCI on the cover letter.

Construction Phase

- Photo-document the work areas prior to any intervention and keep a centralized record of all work performed during the minor rehabilitation phase.
  - This may be aided by initiating a Building Information Modelling (BIM) system

Operation Phase

- Add the bridge's heritage attributes into annual inspection and maintenance planning
- Should future work in an estimated 10-15 years propose the removal of the bridge, an additional HIA should be completed to evaluate impacts at that time.
- Install a commemorative/interpretative plaque, at or near the crossings, which will outline the history of the crossings/area and incorporate historic photographs. The municipality must consult with the Municipal Heritage Committee and, as appropriate, with Indigenous communities, to develop the plaque within one year after construction.

Brantford Crossings CHL

Design Phase

- Prepare a comprehensive interpretive plan that identifies the themes, locations, key messages, and approaches and methods to convey the significance of the CHL
- Add the small-scale heritage attributes of the CHL into annual inspection and maintenance planning

Provided these mitigation measures are implemented, the overall effects of the recommended alternative will range from no impact to minor negative impact. The bridges and Brantford Crossings cultural heritage landscape will remain publicly accessible and will encourage public appreciation and understanding of the bridges and landscape's cultural heritage value or interest. Further, any negative effects that remain after mitigation will be outweighed by the positive social impacts associated with improving the active transportation network.

If the City commits to implementing the mitigation measures listed above, Golder recommends that the:

- **recommended alternatives be approved as proposed**.

Study Limitations

Golder has prepared this report in a manner consistent with the guidelines developed by the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied, is made.

This report has been prepared for the specific site, design objective, developments and purpose described to Golder Associates Ltd., by GM BluePlan Engineering Limited (the Client). The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder Associates Ltd.'s express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the Client, Golder Associates Ltd. may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder Associates Ltd. The report, all plans, data, drawings and other documents as well as electronic media prepared by Golder Associates Ltd. are considered its professional work product and shall remain the copyright property of Golder Associates Ltd., who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder Associates Ltd. The Client acknowledges the electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client cannot rely upon the electronic media versions of Golder Associates Ltd.'s report or other work products.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project.

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1.0 INTRODUCTION

In February 2020, GM BluePlan Engineering Limited (GM BluePlan) retained Golder Associates Ltd. (Golder) on behalf of the City of Brantford (the City) to conduct a Cultural Heritage Evaluation Report (CHER) to support the two-phase Three Grand River Crossings Schedule B Municipal Class Environmental Assessment (MCEA). The study area for the MCEA included an approximately 800 m long by 150 to 300 m wide portion of the watercourse and banks of the Grand River in downtown Brantford, as well as the three crossings known as Lorne Bridge (built 1923), Brant's Crossing Bridge (1912-13), and the Toronto, Hamilton and Buffalo (TH&B) Crossing Bridge (substructure built in 1893 with superstructure replaced in 1921).

The purpose of the MCEA was to review options to manage the bridges over the short and long term and identify the recommended alternative for each to improve the City's active transportation network. The CHER was initiated to identify whether any of the bridges met the *Ontario Regulation 9/06 Criteria for Determining the Cultural Heritage Value or Interest* (*O. Reg. 9/06*) and if a subsequent Heritage Impact Assessment (HIA) was required to inform the short and long-term management options for each bridge and the wider study area.

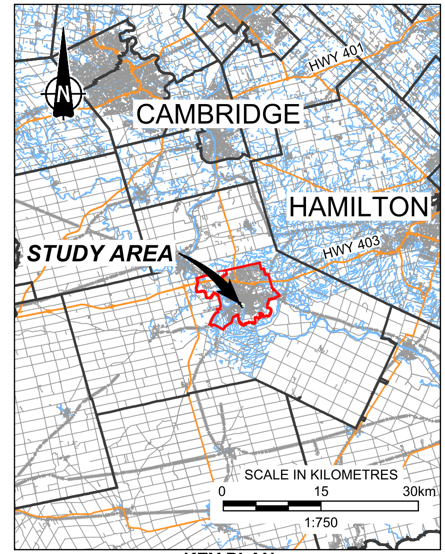
Following guidance developed by the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) and other sources, and the results of research, field investigations, analysis, and evaluation, Golder concluded that the Lorne Bridge, Brant's Crossing Bridge, and the TH&B Crossing Bridge should each be considered built heritage resources since they met multiple criteria of *O. Reg. 9/06*. Additionally, Golder determined that the "Brantford Crossings" corresponding to the study area should be considered a cultural heritage landscape for its association with the historic crossing of the Grand River by Indigenous leader Thayendanegea (Joseph Brant) in 1784, the three surviving bridges, and includes remnants of crossings, rail lines, dams and recreational and institutional land-use dating from the late 19th to 20th century.

Based on these findings, Golder recommended to conduct an HIA to identify the negative impacts the recommended alternatives developed for each bridge may have on the cultural heritage value or interest (CHVI) and heritage attributes of the bridges and their associated cultural heritage landscape.

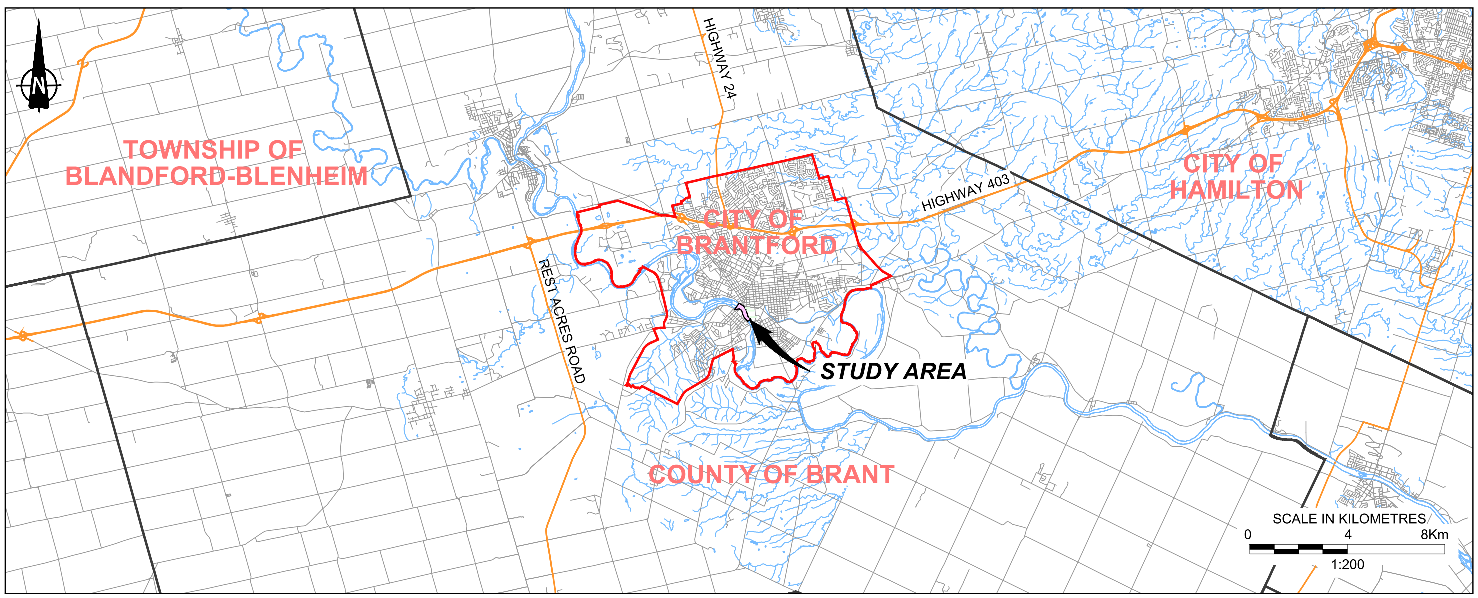
Using guidance developed by the MHSTCI, policies of the City's Official Plan, the Canada's Historic Places *Standards and Guidelines for the Conservation of Historic Places in Canada* (2010), and other sources, this HIA:

- outlines the study's objectives and scope, and the methods used to assess impacts to the built heritage resources and cultural heritage landscape within the study area
- summarizes the international, federal, provincial, and municipal heritage guidance and policies relevant to integrating new development with built heritage resources and cultural heritage landscapes
- provides an understanding of the CHVI of the built heritage resources and cultural heritage landscape within the study area
- describes the recommended alternatives and assesses the potential negative impacts, and
- recommends mitigation measures to ensure that the CHVI and heritage attributes of the built heritage resources and cultural heritage landscapes within the study area are conserved.

AERIAL IMAGERY and OBM MAPPING



KEY PLAN



REGIONAL MAP

LEGEND

– – –	APPROXIMATE STUDY AREA
(red line)	CITY OF BRANTFORD BOUNDARY
(black line)	TOWNSHIP/MUNICIPALITY BOUNDARY
BRANTFORD	TOWNSHIP/MUNICIPALITY

REFERENCE

DRAWING BASED ON MNR LIO, OBTAINED 2019, PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2019;
THE GRAND RIVER CONSERVATION AUTHORITY 2006 ORTHOGRAPHIC IMAGERY;
CANMAP STREETFILES V2008.4.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT
HERITAGE IMPACT ASSESSMENT, THREE GRAND RIVER CROSSINGS ENVIRONMENTAL ASSESSMENT
CITY OF BRANTFORD, ONTARIO

TITLE
LOCATION MAP

GOLDER MEMBER OF WSP

PROJECT No.	19128292	FILE No. 19128292-2001-R01001	
		SCALE AS SHOWN	REV.
CADD	DCH	June 3/21	
CHECK			FIGURE 1

Drawing file: 19128292-2001-R01001.dwg Jun 03, 2021 – 9:33am 0 25mm Original Format is Tabloid 279mm x 432mm Client: Client: GM Blueplan Engineering Limited

2.0 OBJECTIVES, SCOPE, & METHODS

The objectives of this HIA were to:

- identify the negative impacts from the recommended alternatives on the CHVI and heritage attributes of the built heritage resources and cultural heritage landscape within the study area
- consider alternatives to avoid or reduce the identified impacts
- recommend mitigation or conservation measures, where required.

To meet the study's objectives, Golder:

- applied international, federal, provincial, and municipal cultural heritage guidelines and policies to assess the impact of the recommended alternatives on the built heritage resources and cultural heritage landscape within the study area
- developed recommendations for future action based on international, federal, provincial and municipal conservation guidance

The HIA follows the typical process to investigate, evaluate, and assess impacts to built heritage resources and cultural heritage landscapes (Figure 2) and is based on the research, engagement, field investigations, analysis and evaluation results of the CHER, which was completed in February 2021.

Golder has prepared this HIA to follow the requirements outlined in the City Official Plan (Section 9.1.10) and guidance in the MHSTCI *Ontario Heritage Tool Kit: Heritage Resources in the Land Use Planning Process.* Several widely recognized manuals related to determining impacts and conservation approaches to cultural heritage resources were also consulted, including:

- *ICOMOS Guidance on Heritage Impact Assessments for Cultural World Heritage Properties* (ICOMOS 2011)
- *Standards and Guidelines for the Conservation of Historic Places in Canada* (Canada's Historic Places 2010)
- *Heritage Planning: Principles and Process* (Kalman & Létourneau 2020)
- *Well-Preserved: The Ontario Heritage Foundation's Manual of Principles and Practice for Architectural Conservation* (Fram 2003)
- *Guidelines for Landscape and Visual Impact Assessment, Third Edition* (Landscape Institute 2013)
- *The Setting of Heritage Assets: Historic Environment Good Practice Advice in Planning: 3 (2nd Edition)* (Historic England 2017)
- *Setting of Historic Assets in Wales* (Cadw 2017)
- *Informed Conservation: Understanding Historic Buildings and their Landscapes for Conservation* (Clark 2001).

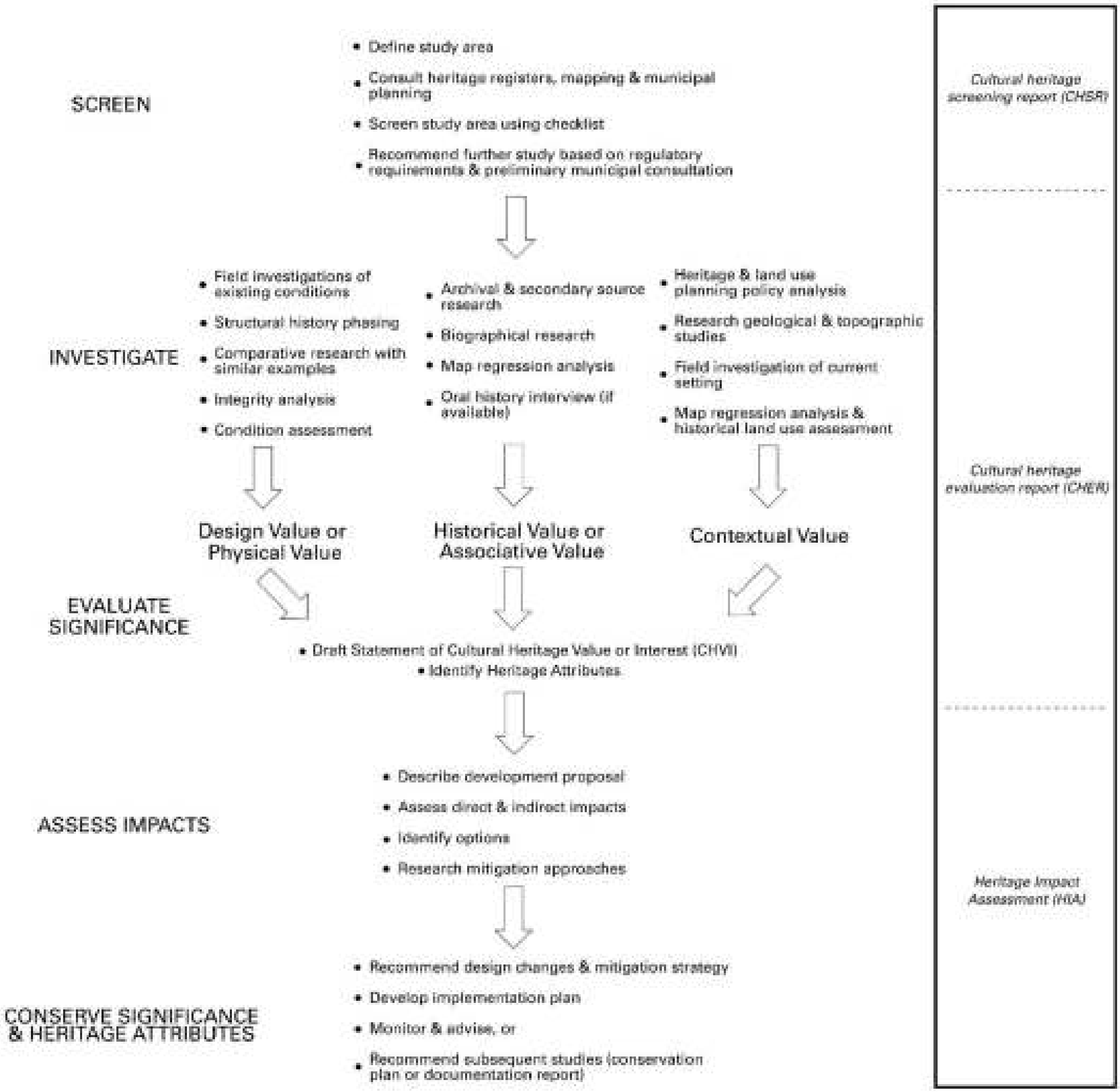


Figure 2: Typical process to investigate a study area, evaluate significance, assess impacts to CHVI and heritage attributes, and mitigate any adverse effects.

3.0 PLANNING, LEGAL AND REGULATORY CONTEXT

Cultural heritage resources are protected and managed through several federal, provincial, and municipal planning and policy regimes. Although these have varying levels of authority, all are considered for decision-making in the cultural heritage environment.

3.1 International & Federal Heritage Policies & Guidance

Canada's national and provincial legislation and policies for cultural heritage are informed by a number of international agreements such as the 1964 *International Charter for the Conservation and Restoration of Monuments and Sites* (*Venice Charter*), 1983 Canadian *Appleton Charter for the Protection and Enhancement of the Built Environment*, and the 1979 (updated 2013) *Australia International Council on Monuments and Sites (ICOMOS) Charter for Places of Cultural Significance* (*Burra Charter*) (Public Works Canada 1994:Vol.1, 1). The latter is important for pioneering "values based" evaluation and management, an approach central to Canadian federal, and provincial and territorial legislation and policies for identifying and conserving cultural heritage.

To provide "fundamental and sound principles and practices that can safeguard historic places" as well as a national response to international agreements such as the *Burra Charter*, in 2004 the federal agency Parks Canada initiated the Canada's Historic Places collaborative partnership with representatives from each province and territory to develop the *Standards and Guidelines for the Conservation of Historic Places in Canada.* This document defines "conservation" as all actions or processes that are aimed at safeguarding the character-defining elements of an historic place to retain its heritage value and extend its physical life", as well as three conservation "treatments" —preservation, rehabilitation, and restoration— to guide intervention on a historic place. Although in theory a single treatment would be selected, nearly all projects involve a combination of all three depending on a variety of factors including level of understanding, practicality, and projected future uses. A key principle explicitly or implicitly repeated in the *Standards and Guidelines for the Conservation of Historic Places in Canada* is minimal intervention, that is, "doing enough, but only enough to meet realistic objectives while protecting heritage values" (CHP 2010:26). On any given project, minimal intervention can mean very little work, or a substantial amount —the degree is based on whatever is required to protect the heritage value of a place. The CHP *Standards and Guidelines* were revised in 2010 and adopted by all provinces and territories except Ontario, although many Ontario municipalities have formally adopted the document.

ICOMOS has also since developed guidance for conducting heritage impact assessments for "Cultural World Heritage Properties" (ICOMOS 2011), and these also provide "best practice" approaches for all historic assets.

3.2 Provincial Legislation, Policies & Guidance

This HIA considers built heritage resources and cultural heritage landscapes in the context of a proposed bridge replacement under the *Environmental Assessment Act* (1990), the *Planning Act* (1990), and O. Reg. 160/02: Standards for Bridges (*Public Transportation and Highway Improvement Act*, R.S.O. 1990, c. P.50).

3.2.1 Environmental Assessment Act & Municipal Class Environmental Assessments

The *Environmental Assessment Act* (EAA) was legislated to ensure that Ontario's environment is protected, conserved, and wisely managed. Under the EAA, "environment" includes not only natural elements such as air, land, water and plant and animal life, but also the "social, economic and cultural conditions that influence the life of humans or a community", and "any building, structure, machine or other device or thing made by humans". To determine the potential environmental effects of new development, the Environmental Assessment (EA) process was created to standardize decision-making. For municipal road, water, and wastewater projects this decision-making is streamlined in the Class EA process, which divides routine activities with predictable environmental effects into four “schedules” (Government of Ontario 2014; MEA 2015). This EA falls under the Schedule B process since it includes “improvements and minor expansions to existing facilities” with “potential for some adverse environmental effects”.

The phases (up to five) and associated actions required for each of these schedules are outlined in the Ontario Municipal Engineers Association (MEA) Manual. Avoidance of cultural heritage resources is the primary mitigation suggested in the manual, although other options suggested including: “employing necessary steps to decrease harmful environmental impacts such as vibration, alterations of water table, etc.” and “record or salvage of information on features to be lost” (Appendix 2 of MEA 2015). In all cases, the “effects should be minimized where possible, and every effort made to mitigate adverse impacts, in accordance with provincial and municipal policies and procedures.” Importantly, the Class EA provides the opportunity to integrate the requirements of the *EAA* with the *Ontario Planning Act* (see below), both of which must be met (MCEA 2015).

3.2.2 The *Planning Act* & Provincial Policy Statement

The Ontario *Planning Act* (1990) and associated *Provincial Policy Statement* 2020 (PPS 2020) mandate heritage conservation in land use planning. Under the *Planning Act*, conservation of “features of significant architectural, cultural, historical, archaeological or scientific interest” are a “matter of provincial interest” and integrates this at the provincial and municipal levels through the PPS 2020. Issued under Section 3 of the *Planning Act*, PPS 2020 recognizes that cultural heritage and archaeological resources “provide important environmental, economic, and social benefits”, and that “encouraging a sense of place, by promoting well-designed built form and cultural planning, and by conserving features that help define character, including *built heritage resources* and *cultural heritage landscapes*” supports long-term economic prosperity (PPS 2020:6,22).

The importance of identifying and evaluating built heritage and cultural heritage landscapes is recognized in two policies of PPS 2020:

- Section 2.6.1 – *Significant built heritage resources* and *significant cultural heritage landscapes* shall be conserved
- Section 2.6.3 – Planning authorities shall not permit *development* and *site alteration* on *adjacent lands* to *protected heritage property* except where the proposed *development* and *site alteration* has been evaluated and it has been demonstrated that the *heritage attributes* of the *protected heritage property* will be conserved

Each of the italicised terms is defined in Section 6.0 of PPS 2020, with those relevant to this report provided below:

- ***Adjacent lands*****:** for the purposes of policy 2.6.3, those lands contiguous to a *protected heritage property* or as otherwise defined in the municipal official plan.
- ***Built heritage resource:*** means a building, structure, monument, installation or any manufactured or constructed part or remnant that contributes to a property’s cultural heritage value or interest as identified by a community, including an Indigenous community. *Built heritage resources* are located on property that may be designated under Parts IV or V of the *Ontario Heritage Act*, or that may be included on local, provincial, federal and/or international registers.
- ***Conserved*****:** means the identification, protection, management and use of built heritage resources, cultural heritage landscapes and archaeological resources in a manner that ensures their cultural heritage value or interest is retained. This may be achieved by the implementation of recommendations set out in a conservation plan, archaeological assessment, and/or heritage impact assessment that has been approved, accepted or adopted by the relevant planning authority and/or decision-maker. Mitigative measures and/or alternative development approaches can be included in these plans and assessments.

- ***Cultural heritage landscape:*** means a defined geographical area that may have been modified by human activity and is identified as having cultural heritage value or interest by a community, including an Indigenous community. The area may include features such as buildings, structures, spaces, views, archaeological sites or natural elements that are valued together for their interrelationship, meaning or association. Cultural heritage landscapes may be properties that have been determined to have cultural heritage value or interest under the *Ontario Heritage Act*; or have been included in on federal and/or international registers, and/or protected through official plan, zoning by-law, or other land use planning mechanisms.
- ***Development*:** means the creation of a new lot, a change in land use, or the construction of buildings and structures requiring approval under the Planning Act.
- ***Heritage attributes:*** the principal features or elements that contribute to a protected heritage property's cultural heritage value or interest, and may include the property's built, constructed, or manufactured elements, as well as natural landforms, vegetation, water features, and its visual setting (e.g., significant views or vistas to or from a protected heritage property).
- ***Protected heritage property:*** property designated under Parts IV, V or VI of the *Ontario Heritage Act*; property subject to a heritage conservation easement under Parts II or IV of the *Ontario Heritage Act*; property identified by the Province and prescribed public bodies as provincial heritage property under the Standards and Guidelines for Conservation of Provincial Heritage Properties; property protected under federal legislation, and UNESCO World Heritage Sites.
- ***Significant*:** means, in regard to cultural heritage and archaeology, resources that have been determined to have cultural heritage value or interest. Processes and criteria for determining cultural heritage value or interest are established by the Province under the authority of the *Ontario Heritage Act*.

The definition for *significant* includes a caveat that "while some significant resources may already be identified and inventoried by official sources, the significance of others can only be determined after evaluation." The criteria for significance established by the Province as well as the need for evaluation is outlined in the following section.

3.2.3 Ontario Heritage Act and Ontario Regulation 9/06

The *Ontario Heritage Act (OHA)* enables the Province and municipalities to conserve significant individual properties and areas. For Provincially owned and administered heritage properties, compliance with the *Standards and Guidelines for the Conservation of Provincial Heritage Properties* is mandatory under Part III of the *OHA* and holds the same authority for ministries and prescribed public bodies as a Management Board or Cabinet directive. For municipalities, Part IV and Part V of the *OHA* enables council to "designate" individual properties (Part IV), or properties within a heritage conservation district (HCD) (Part V), as being of "cultural heritage value or interest" (CHVI). Evaluation for CHVI under the *OHA* (or *significance* under PPS 2020) is guided by *Ontario Regulation 9/06* (*O. Reg. 9/06*), which prescribes the *criteria for determining cultural heritage value or interest*. *O. Reg. 9/06* has three categories of absolute or non-ranked criteria, each with three sub-criteria:

1) The property has ***design value or physical value*** because it:

    i) Is a rare, unique, representative or early example of a style, type, expression, material or construction method;

    ii) Displays a high degree of craftsmanship or artistic merit; or

    iii) Demonstrates a high degree of technical or scientific achievement.

2) The property has ***historic value or associative value*** because it:

   i) Has direct associations with a theme, event, belief, person, activity, organization, or institution that is significant to a community;

   ii) Yields, or has the potential to yield information that contributes to an understanding of a community or culture; or

   iii) Demonstrates or reflects the work or ideas of an architect, artist, builder, designer, or theorist who is significant to a community.

3) The property has ***contextual value*** because it:

   i) Is important in defining, maintaining or supporting the character of an area;

   ii) Is physically, functionally, visually or historically linked to its surroundings; or

   iii) Is a landmark.

A property needs to meet only one criterion of *O. Reg. 9/06* to be considered for designation under Part IV of the *OHA*. If found to meet one or more criterion, the property's CHVI is then described with a Statement of Cultural Heritage Value or Interest (SCHVI) that includes a brief property description, a succinct statement of the property's cultural heritage value or interest, and a list of its heritage attributes. In the *OHA* heritage attributes are defined slightly differently to the PPS 2020 and directly linked to real property[1]; therefore, in most cases a property's CHVI applies to the entire land parcel, not just individual buildings or structures.

Once a municipal council decides to designate a property, it is recognized through by-law and added to a "Register" maintained by the municipal clerk. A municipality may also "list" a property on the Register to indicate it as having potential cultural heritage value or interest.

3.2.4 Provincial Heritage Guidance

1.1.1 Environmental Assessment Act & Municipal Class Environmental Assessments

The *Environmental Assessment Act* (EAA) was legislated to ensure that Ontario's environment is protected, conserved, and wisely managed. Under the EAA, "environment" includes not only natural elements such as air, land, water and plant and animal life, but also the "social, economic and cultural conditions that influence the life of humans or a community", and "any building, structure, machine or other device or thing made by humans". To determine the potential environmental effects of new development, the Environmental Assessment (EA) process was created to standardize decision-making. For the municipal road, water, and wastewater projects this decision-making is streamlined in the Class EA process, which divides routine activities with predictable environmental effects into four "schedules" (Government of Ontario 2014; MEA 2015). This EA falls under the Schedule B process since it includes "improvements and minor expansions to existing facilities" with "potential for some adverse environmental effects".

The phases (up to five) and associated actions required for each of these schedules are outlined in the Ontario Municipal Engineers Association (MEA) Manual. A step within Phase 2 of a Class EA is to prepare a description and inventory of the "natural, social and economic environments", which includes built heritage resources and cultural heritage landscapes. This inventory is compiled through searching federal, provincial, and municipal registers or databases of previously identified built heritage resources and cultural heritage landscapes, but also through evaluation using criteria for significance established by the Province.

[1] The OHA definition "heritage attributes means, in relation to real property, and to the buildings and structures on the real property, the attributes of the property, buildings and structures that contribute to their cultural heritage value or interest."

To assist in identifying cultural heritage constraints and whether further study is required for bridge projects, the MEA developed the *Municipal Heritage Bridges Cultural, Heritage and Archaeological Resources Assessment Checklist* (Revised, 2014). This checklist first confirms the correct Class EA schedule before asking a series of questions about a bridge's date of construction, its type, its heritage planning context, and whether it is adjacent to known built heritage resources or cultural heritage landscapes. The next steps are recommended depending on a "yes" or "no" response for each question. This checklist is currently under review and intended primarily to determine if a Schedule A project will require a CHER or HIA; if not, the checklist provides documentation of due diligence in the project filing. The checklist is similar in scope to the Ministry of Heritage, Sport, Tourism and Culture Industries (MHTSCI) *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes: A Checklist for the Non-Specialist* (2016) (see below), which is applied for Schedule A+, B and C projects. A copy of the completed Municipal Class EA's associated checklist for municipal bridges (Municipal Heritage Bridges Cultural, Heritage and Archaeological Resources Assessment Checklist Revised April 11, 2014) can be found in the previously completed CHER.

Avoidance of cultural heritage resources is the primary mitigation suggested in the manual, although other options suggested including: "employing necessary steps to decrease harmful environmental impacts such as vibration, alterations of water table, etc." and "record or salvage of information on features to be lost" (Appendix 2 of MEA 2015). In all cases, the "effects should be minimized where possible, and every effort made to mitigate adverse impacts, in accordance with provincial and municipal policies and procedures." Importantly, the Class EA provides the opportunity to integrate the requirements of the *EAA* with the *Ontario Planning Act* (see below), both of which must be met (MCEA 2015).

3.2.4.1 Ministry of Heritage, Sport, Tourism and Culture Industries

For provincial properties, heritage planning must comply with the MHSTCI *Standards and Guidelines for the Conservation of Provincial Heritage Properties* (MHSTCI *Standards and Guidelines*). Though not applicable to private or municipal projects, the MHSTCI *Standards and Guidelines* provides "best practice" approaches for evaluating cultural heritage resources not under provincial jurisdiction. For heritage impact assessments, *Information Bulletin 3: Heritage Impact Assessments for Provincial Heritage Properties* (MHSTCI *Info Bulletin 3*, 2017) of the *Standards and Guidelines for the Conservation of Provincial Heritage Properties* advises on the contents and possible strategies.

To advise municipalities, organizations, and individuals on heritage protection and conservation, the Province, through the MHSTCI, has developed a series of guidance products called the *Ontario Heritage Tool Kit* series.

Of these, *Heritage Resources in the Land Use Planning Process* (MHSTCI 2006) provides an outline for the contents of an HIA, which it defines as:

> is a study to determine if any cultural heritage resources (including those previously identified and those found as part of the site assessment) …are impacted by a specific proposed development or site alteration. It can also demonstrate how the cultural heritage resource will be conserved in the context of redevelopment or site alteration. Mitigative or avoidance measures or alternative development or site alteration approaches may be recommended.

Heritage Resources in the Land Use Planning Process also provides advice on how to organize the sections of an HIA, although municipalities may draft their own terms of reference.

Determining the optimal conservation strategy where an impact is identified is further guided by the MHSTCI *Eight Guiding Principles in the Conservation of Historic Properties* (2007):

1) **Documentary evidence** – restoration should not be based on conjecture
2) **Original location** – do not move buildings unless there is no other means to save them since any change in site diminishes heritage value considerably
3) **Historic material** – follow "minimal intervention" and repair or conserve building materials rather than replace them
4) **Original fabric** – repair with like materials
5) **Building history** – do not destroy later additions to reproduce a single period
6) **Reversibility** – any alterations should be reversible
7) **Legibility** – new work should be distinguishable from old
8) **Maintenance** – historic places should be continually maintained

The *Ontario Heritage Tool Kit* partially, but not entirely, supersedes earlier MHSTCI advice that was produced primarily for environmental assessments. Considerations to help determine the limits of the "affected area" and describe effects is provided in greater detail in the *Guidelines on the Man-Made Heritage Component of Environmental Assessments* (1980:7), while the terms used to describe the nature or extent of negative impacts were later comprehensively defined in the *Guideline for Preparing the Cultural Heritage Resource Component of Environmental Assessments* (1992:3-7).

3.3 Municipal Heritage Policies

3.3.1 City of Brantford Official Plan

The City's *Official Plan* (consolidated to include all amendments to 2019) informs decisions on issues such as future land use, physical development, growth, and change within the City limits. In Section 6.2.10, the *Official Plan* lists its goal and objective for cultural heritage and archaeology; respectively, these are to "sustain, conserve and enhance significant built environments", and "identify, inventory and conserve lands, cultural heritage landscapes, buildings, structures and sites of historic, architectural and archaeological values."

Section 9.0 in the *Official Plan* outlines the City's policies for cultural heritage and archaeology and includes general policies as well as those for Heritage Conservation Districts (Section 9.2), Designation of Cultural Heritage Resources (9.3), Inventory of Heritage Resources (9.4), Heritage Incentives (9.5), The Grand River as a Canadian Heritage River (9.8), and Archaeological Resources (9.9).[2]

Under Section 9.1 are the City's general policies for cultural heritage and the requirements for impact assessments. The policies relevant to this HIA are:

- 9.1.2 The City encourages the responsible management of cultural heritage resources
- 9.1.3 The City shall seek to conserve cultural heritage resources

[2] Section 9.6 and 9.7 have been deleted.

- 9.1.5 Conservation of areas, sites, buildings or structures of historical, architectural or archaeological merit will be encouraged throughout the City, where feasible.
- 9.1.7 All City owned heritage resources will be conserved and maintained in a good state of repair.
- 9.1.10 Applications for development of a property designated under the terms and conditions of the Ontario Heritage Act will be required to include a Heritage Impact Statement[3] prepared by a qualified heritage conservation professional. A Heritage Impact Statement may also be required on a property that is listed in the City's Heritage Inventory or where development is proposed adjacent to a known heritage resource. The requirement may also apply to unknown or recorded heritage resources that are discovered during the development application stage or construction. A Heritage Impact Statement is a study to determine the impacts to known and potential heritage resources within a defined area. The study results in a report which identifies all known heritage resources, provides a detailed site history and physical description of the heritage resource, photo-documents the as-found interior and exterior of the resource; evaluates the significance of the resource(s); outlines the proposed development; assesses the impact of the proposal on the resources(s) and makes recommendations toward mitigative measures that would minimize negative impacts.
- 9.1.11 The City will prepare guidelines to provide direction under which circumstances a Heritage Impact Assessment may be required and the scope of the Heritage Impact Assessment

The City has not yet developed guidelines for an HIA, but this report complies with Section 9.1.10.

A new Official Plan was approved by Council on 26 January 2021, but as of writing is still pending approval by the Province.

3.3.2 Waterfront Master Plan

The Waterfront Master Plan (WMP 2010) provides policy guidance for waterfront areas of the City, including the Three Grand River Crossings and adjacent park land. Part 4 of the WMP addresses cultural heritage within the waterfront areas, setting out three key principles to be considered within the planning area:

- Protect and interpret the pre-contact history and role of the Grand River corridor.
- Enhance connections between the Grand River and areas of cultural heritage value or interest in Brantford.
- Conserve and interpret areas of cultural heritage value or interest.

Specific policies relating to the study area, or each bridge were not addressed in the WMP.

[3] While Section 9.1.10 uses the term "Heritage Impact Statement", Section 9.1.11 refers to the same type of study as a "Heritage Impact Assessment". The latter term is used for this report since it is used consistently in the new 2021 Official Plan (though pending approval).

4.0 UNDERSTANDING OF CULTURAL HERITAGE VALUE OR INTEREST

Understanding a built heritage resource or cultural heritage landscape includes not only being able to trace its history, but also its overall cultural heritage value or interest and what elements tangibly reflect that significance. As mentioned above, in Ontario cultural heritage value or interest is summarized through the SCHVI, which includes a “Description” (where the resource is located), its “Heritage Value” (why a resource is important) and its “Heritage Attributes” (what elements demonstrate the heritage value).

Since an HIA must be based on a clear understanding of significance and sensitivity to change (Bond & Worthing 2016:160), the SCHVI for the Lorne Bridge, Brant’s Crossing Bridge, TH&B Bridge, and Brantford Crossings CHL developed for the CHER are reproduced in the following subsections.

4.1 Lorne Bridge

Description of Property

The Lorne Bridge is a four-span arched and simply supported beam bridge composed of three arched open spandrel deck spans, and one girder approach span. It carries Colborne Street across the Grand River in the downtown core of the City of Brantford and lies to the north of the Brant’s Crossing rail bridge.

Statement of Cultural Heritage Value or Interest

The Lorne Bridge has cultural heritage value or interest for its design or physical value, historical or associative value, and for its contextual value. The last in a long line of crossings in this location that date as early as the 1830s, the Lorne Bridge was built in 1923 to replace the 1878 Warren Truss bridge named for then Governor General of Canada the Marquess of Lorne. The reinforced concrete, open spandrel construction of the second Lorne Bridge is one of only four in the province dating prior to 1930 and the only one with three spans. Despite major reconstruction work in 1980, the craftsmanship in the bridge’s execution by the Port Arthur Cement Company is evident in the long service of the Lorne Bridge, which now sustains live loads that exceed the specifications for which it was designed.

The Bridge has historical value for its direct association with Brantford-born City Engineer Francis Porter Adams, who was well respected for not only designing the Lorne Bridge but also for his work to complete many other critical infrastructure projects in the City during his tenure from 1920 to his death in 1941. It is also directly associated with the long history of bridge building in the community, with Brantford’s development as a prosperous industrial centre in the early 20th century, and with the City’s sense of civic pride.

The Bridge’s prominence, relationship to the Grand River National Heritage River and nearby Brant’s Crossing and TH&B Crossing bridges, and its classical design combined with industrial aesthetic of smooth concrete all contribute to its contextual value, and it is considered to be one of the City’s most important landmarks.

Heritage Attributes

Four-span bridge with:

- three arch spans combined with a simply supported beam approach span
- construction in reinforced concrete in three different grades that have been smoothed and do not mimic masonry
- flattened arches with open spandrels
- concrete piers and abutments scaled to the form of the bridge

- bifurcated stairs on the north side of the west approach featuring a denticulated cornice, thick square newels, and a balustrade with low chamfered and moulded handrail and “Renaissance” balusters
- clear, wide vistas of the Grand River and Brant’s Crossing and TH&B Crossing bridges

North elevation of the Lorne Bridge

4.2 Brant’s Crossing Bridge

Description of Property – Brant’s Crossing Bridge

Brant’s Crossing Bridge is a four-span simply supported beam bridge with two pony plate girder approach spans and two 6-panel through Pratt truss frame centre spans. It carries the former Grand Trunk Railway line across the Grand River, immediately southwest of the downtown core of the City of Brantford and lies between the Lorne Bridge to the north and TH&B Crossing Bridge to the south.

Statement of Cultural Heritage Value or Interest

The Brant’s Crossing Bridge has cultural heritage value or interest for its design or physical value, historical or associative value, and for its contextual value. Erected by the Grand Trunk Railway between 1912 and 1913, the bridge was to carry the freight and passenger line across the Grand River, servicing both the industrial area of nearby Eagle’s Nest and facilitate transport to surrounding communities. Its rivetted steel Pratt and girder construction is representative of rail bridges of the time, though now structures of this age and type are increasingly rare in Ontario, especially in the municipality and surrounding area; it is also one of only three surviving examples in the province that combines girder and Pratt truss spans. Its concrete substructure represents a relatively early adoption of concrete for bridge construction in Ontario, and the survival of the bridge virtually intact over 100 years of heavy water and ice flow suggests it was built to a high degree of craftsmanship.

The Bridge has historical value for its direct association with the Grand Trunk Railway, who played a significant role in the development of Ontario from the 1850s onward and were recognised for the quality of their bridges and stations. It is also directly associated with Brantford’s development as a prosperous industrial centre from the late 19th century to late 20th century.

The bridge’s prominence, relationship to the Grand River Canadian Heritage River and nearby Lorne and TH&B Crossing bridges, and its industrial aesthetic of rivetted steel and concrete, all contribute to its contextual value, and it is considered to be a local landmark.

Heritage Attributes

Four-span simple supported beam bridge with:

- substructure with three curved end concrete piers and concrete abutments with wing walls

- superstructure composed of two pony plate girder approach spans and two 6-panel through Pratt truss frame centre spans, with some members exhibiting bulb angles
- pedimented portal bracing on the west span
- deck with closely spaced wood ties with surviving sections of rail track
- clear, wide vistas of the Grand River and Lorne and TH&B Crossing bridges

Brant's Crossing Bridge, North Elevation

4.3 TH&B Crossing Bridge

Description of Property – The Brantford Toronto, Hamilton, and Buffalo (TH&B) Crossing Bridge

The TH&B Crossing Bridge is a four-span simple supported beam bridge with four identical girder spans. It carries the former TH&B Railway line across the Grand River and lies southwest of the downtown core of the City of Brantford between the Brant's Crossing Bridge to the north and BSAR Bridge to the south.

Statement of Cultural Heritage Value or Interest

The TH&B Crossing Bridge has cultural heritage value or interest for its design or physical value, historical or associative value, and for its contextual value. Erected by the Dominion Bridge Works Company in 1893, the bridge was to carry a freight and passenger line across the Grand River, servicing both the industrial area of nearby Eagle's Nest and facilitate transport to surrounding communities. Its original substructure survives in its masonry west abutment and rivetted steel caisson pier bents, the latter of which is rare in Ontario rail bridge construction. In 1921, its three Pratt through truss and one pony girder spans were replaced with four pony girder spans, which after a century remain virtually unaltered. This girder construction is representative of rail bridges of the time, yet the number of surviving examples with four or more spans is increasingly rare in Ontario, especially in the municipality and the surrounding area. The survival of the bridge's substructure over 127 years of heavy water and ice flow suggests the bridge was built to a high degree of craftsmanship.

The bridge has historical value for its direct association with the TH&B Railway, who played a significant role in Brantford's development from the late 19th century to the mid-20th century, and with the Dominion Bridge Works Company, who were nationally renowned for their bridge construction and for their highly skilled Mohawk riveters. It is also directly associated with Brantford's development as a prosperous industrial centre in the late 19th century and early 20th century.

The bridge's prominence, relationship to the Grand River Canadian Heritage River and nearby Lorne and Brant's Crossing bridges and TH&B station, as well as its industrial aesthetic of rivetted steel, ashlar masonry, and concrete all contribute to its contextual value, and it is considered to be a local landmark.

Heritage Attributes

Four-span simple supported beam bridge with:

- substructure with rivetted metal caisson pier bents and east stone masonry abutment
- superstructure composed of four identical pony plate girder spans
- deck with closely spaced wood ties
- clear, wide vistas of the Grand River and Lorne and Brant's Crossing bridges

TH&B Crossing Bridge, North Elevation

4.4 Brantford Crossings CHL

Description – Brantford Crossings Cultural Heritage Landscape

The Brantford Crossings cultural heritage landscape is centrally located in the City of Brantford and is an approximately 1 km section of the Grand River that extends from immediately north of the Veterans Memorial Parkway (formerly Brantford Southern Access Road [BSAR]) Bridge in the south to north of the Lorne Bridge in the north. It is widest in the north (approximately 400 m) where it includes Lorne Park and the Sergeant William Merrifield VC Armoury on the west and east sides of the river, respectively, and narrows to 160 m wide on the south and bound by Fordview Trail on the west and the Dike Trail on the east.

Statement of Cultural Heritage Value or Interest

The Brantford Crossings is an evolved cultural heritage landscape with design or physical value, historical or associative value, and contextual value. With its surviving four-span girder Toronto, Hamilton and Buffalo (TH&B) Crossing Bridge, four-span girder and Pratt through truss Brant's Crossing Bridge, concrete open spandrel Lorne Bridge, and small scale concrete features such as the remains of a dam spillway and abutments of the Lake Erie and Northern Railway Bridge (LE&N) Bridge, the cultural heritage landscape is a rare and representative example of a late 19th century to early 20th century industrial urban landscape, one that often featured multiple rail and road crossings built in different forms and primarily constructed in metal and concrete.

In addition to its association with Brantford's development as an industrial centre in southern Ontario, and its role in permanently linking the east and west sides of Brantford since at least the 1840s, the Brantford Crossings area has direct associations with the ford that Joseph Brant used to cross the Grand River in 1784 to establish the Six Nations of the Grand River settlement, and for which the community was named in 1825, and as a crossing for Indigenous people stretching back many centuries.

Its contextual value lies in its central location in the City of Brantford, and role in defining the character, maintaining and supporting the character of this Grand River community. Visually, physically, functionally, and historically it reflects the long human use of the Grand River at this location as a crossing point, transportation corridor, and recreational area, and one connecting the industrial, commercial, and residential core of Brantford with surrounding communities and areas. With its surviving bridges and associated rail, road, and pedestrian transportation features, its recreational areas such as Lorne Park and Jubilee Terrace Park, and prominent historical sites such as the Sergeant William Merrifield VC Armoury and Brant County War Memorial, the Brantford Crossings is a community landmark.

Heritage Attributes

Major built features and properties including the:

- Lorne Bridge
- Brant's Crossing Bridge
- Toronto, Hamilton and Buffalo (TH&B) Crossing Bridge
- Sergeant William Merrifield VC Armoury and Jubilee Terrace Park
- Brant County War Memorial

Small scale features including the:

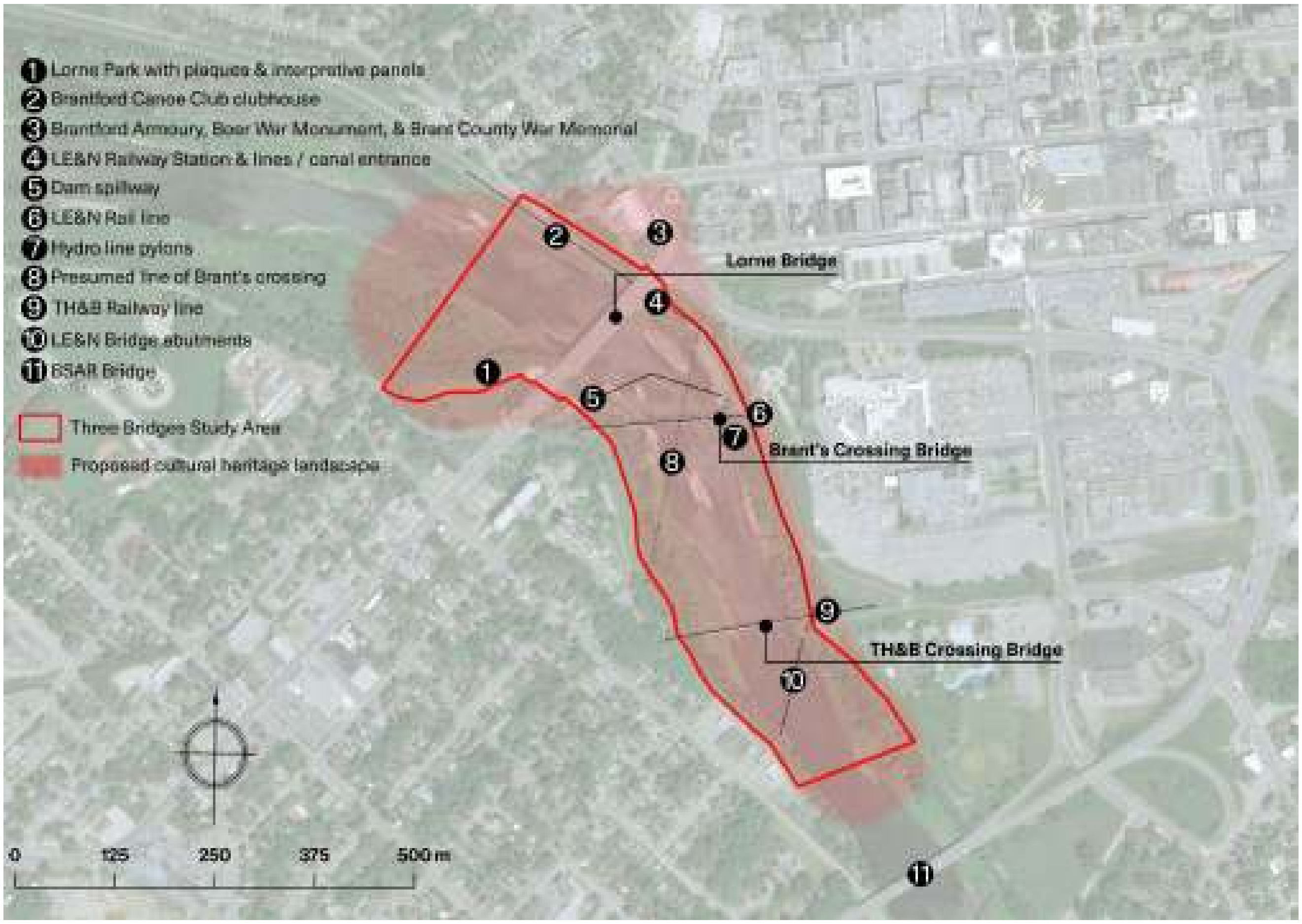
- Boer War Monument
- Concrete retaining walls and former rail lines of the B&H Electric Railway station and lines, and LE&N rail line
- Concrete dam spillway, hydro pylons, and Lake Erie and Northern Railway (LE&N) Bridge abutments
- Former locations of the Mohawk Canal and Brantford Canoe Club clubhouse
- Lorne Park with historical monuments
- Pedestrian trails either side of the river, most of which correspond to former rail lines

Natural features including:

- The width, flow, and seasonally changing water level of the Grand River Canadian Heritage River
- Trees, brush, and tall grasses lining the riverbanks
- Topography of low riverbanks rising to flat terraces either side of the river

Views including:

- Inter-visible views of the three bridges, dam spillway, Brantford and Hamilton (B&H) Electric Railway and LE&N station retaining walls, LE&N Bridge abutments, and river corridor
- Vistas from the north incorporating the Sergeant William Merrifield VC Armoury, river course, and three bridges, and Lorne Park
- Vistas from the south incorporating the Brant County War Memorial, Sergeant William Merrifield VC Armoury, three bridges and river corridor



Brantford Crossings CHL (Bing aerial imagery)

5.0 DESCRIPTION OF EXISTING CONDITIONS

5.1 Lorne Bridge

5.1.1 Setting

The general character around Lorne Bridge is urban, with primarily mid-rise institutional and commercial land use on the east side and urban park and low to mid-rise residential and commercial on the west side (Figure 3 and Figure 4). The topography is flat at both approaches, with steep but low banks at the river's edge. On the east, south of the bridge, is exposed and terraced rock, while on the west the bank slope is covered in trees.

Vegetation is thicker and taller on the west and extends a distance to the north and south, while the east side is predominately grassed with widely spaced trees and low trees along the bank. Within the channel are long islands, that have some vegetation growth that shift and change seasonally.

The Bridge, which is oriented northeast-southwest, is the most northerly of crossings in the study area and is approximately 100 m north from the Brant's Crossing Bridge on the west, and approximately 180 m north on the east. It is also approximately 400 m upriver from the TH&B Crossing Bridge.

Immediately east of the bridge is the four-way junction of Colborne Street West, Colborne Street, Icomm Drive and Brant Avenue (Figure 5 and Figure 6). The east terminus also borders Jubilee Terrace Park and the Brantford Armoury property. Crossing under the east span is the former LE&N/CNR Line, now converted to the SC Johnson and Dike Trail pedestrian routes. Passing through the pedestrian underpass on the west approach is Fordview Trail, which connects Fordview Park southwest of the bridge with Lorne Park northwest of the bridge. The nearest intersection on the west is at Colborne Street West and Gilkison Street, approximately 240 m west of the bridge (Figure 7 and Figure 8). Colborne Street West as it is carried over the bridge is two lanes westbound, and three lanes eastbound with an additional lane turning south onto Icomm Drive.

Views to the north are expansive and dominated by the river and tree covered flood plain and extends nearly a kilometer northwest before the river is divided in two channels by Kerby Island and turns to the northwest (Figure 9). The path of the former LE&N line can be traced for a distance north before it also turns northeast to follow the path of the river, and to the northeast there are clear views of the Brantford Armoury and Boer War monument. Views to the south are equally as expansive and offer clear views of the Brant's Crossing bridge in the foreground, and the TH&B Crossing Bridge and BSAR Bridge in the middle views (Figure 10). The mid-rise residential (west) and Civic Centre (east) are also clearly visible.

Figure 3: View of the Lorne Bridge facing north from the east bank

Figure 4: View of the Lorne Bridge facing south from the east bank.

Figure 5: View facing west of the east approach

Figure 6: View east from the Lorne Bridge

Figure 7: View facing east of the west approach

Figure 8: View west from the Lorne Bridge

Figure 9: Vista facing north from the Lorne Bridge, with the Brantford Armoury at far right

Figure 10: Vista facing south from the Lorne Bridge

5.1.2 Lorne Bridge

The structure that carries Colborne Street West over the Grand River can be characterized as a fixed, rigid frame reinforced concrete, three-span open-spandrel arched deck bridge (the Lorne Bridge) combined with a fixed, rigid frame reinforced concrete single-span and simply supported flat beam box or girder deck rail overbridge (the Lorne Bridge Girder Span) (Figure 11 and Figure 12). The subject bridge is not included on the City of Brantford Heritage Register. The latter span, and the west approach span with pedestrian underpass, has created issues when determining the overall length of the Lorne Bridge. As recorded in the 2017 OSIM report, the arched bridge is 130.5 m (428 feet) long and 22.9 m (75 feet) wide, with a roadway width of 17.4 m (57 feet), and its outer span lengths are 41.7 m (136 feet 10 inches) with the centre span measuring 46.9 m (153 feet 10 inches). The girder overbridge is recorded separately as 19.8 m (64 feet 11 ½ inches), for an overall combined length of 150.3 m (493 feet 1 inch).

However, the 1923 plans record the total length as 500 feet (152.4 m), the width as 58 feet (17.7 m), the outer spans as 130 feet (39.6 m) and centre span as 140 feet (42.7 m). A 1969 report provides the same widths for the spans, but the width (pavement and sidewalks) as 59 feet (18 m) and the length as 400 feet (121.9 m) (J.D. Lee Engineering Ltd. 1969:1). This is further confused by a 1992 report, which lists the bridge as 124.4 m long (McCormick Rankin 1992:1).

The reasons for these dimension discrepancies are unknown but probably a result of the Bridge being measured from different structural landmarks at each point in time as well as advances in technology such as laser distance measurement. This has had little effect on its management although it is interesting that such a major and prominent public work should have no consistent documentation.

Figure 11: North elevation of the Lorne Bridge

Figure 12: South elevation of the Lorne Bridge

5.1.2.1 Substructure

Supporting the Lorne Bridge Girder Span on the east approach is a simple front wall and conventional closed cast-in-place concrete abutment with vertical wing walls that extend to the north and south and retain a wide approach embankment (Figure 13). The longer south wing wall angles slightly to the east before terminating while the north wall is short, and its coping descends to ground level. The bearing shelf and ballast wall is set back a distance from the front wall and cannot be seen from ground level. The bearings are elastomeric pads, one for each of the seven girders.

The Lorne Bridge Girder Span's west abutment also forms the east abutment for the arch span of the Lorne Bridge. It is also conventional closed and cast-in-place concrete and there are two low wing walls running north and south from the east face that retain the former rail line. On this face is a narrow bearing shelf crenulated to match the girders, and the ballast wall is set back only a short distance from the face (Figure 14). There are no bearings. On the west face the abutment supports the thrust of the wide arch rib or bottom chord of the Lorne Bridge directly, without an impost (Figure 15).

At their base, or outside walls, Pier No.1 (west) and Pier No. 2 (east) of the Lorne Bridge are approximately 8.4 m wide, 19.5 m long, and stand 12.5 m high (Figure 16 and Figure 17). The upper portions of the piers, or inside walls, extend between each arch span to the superstructure and are narrower in both dimensions, measuring 3.65 m wide by 16.6 m long (north-south). Portions of the inside walls extend past the arches, forming an engaged column or pilaster. All construction is solid shaft, cast-in-place concrete and the outer walls have symmetrical curved ends on the upstream and downstream sides with minimal batter. On their sides the outer walls of the piers also have an impost at the spring of the arch (Figure 18).

The three arch spans of the Lorne Bridge each have wide arch ribs or bottom chords over which are 16 spandrel columns per arch. There are no spandrel arches to form an arcade.

Running through the west approach embankment is a concrete pedestrian underpass with asphalt surface, flat arch headwall and short concrete wing walls extending at an acute angle from the entrances (Figure 19 and Figure 20).

Figure 13: The Lorne Bridge Girder Span that forms the east approach of the Lorne Bridge

Figure 14: Narrow crenulated bearing shelf on the east side of Lorne Bridge east abutment, where it supports the girder of the Lorne Bridge Girder Span

Figure 15: North side of the east abutment of the Lorne Bridge

Figure 16: View west of the downriver sides of Pier No. 1 and Pier No. 2

Figure 17: View west of the upriver sides of Pier No. 1 and Pier No. 2

Figure 18: Spring of the arch at Pier No. 1

Figure 19: South headwall and wing walls of the concrete pedestrian underpass

Figure 20: North headwall and wing walls of the concrete pedestrian underpass

5.1.2.2 Superstructure

The superstructure over the arched spans of the Lorne Bridge and the Lorne Bridge Girder Span is a solid and thin concrete slab deck with a chamfered soffit and a slight rise in the centre that cambers to the east and west (Figure 21). Either side of the asphalt wearing surface are low cast-in-place concrete parapet walls with single railings, which are either aluminium post and panel or hot dip galvanized. Another aluminium post and panel railings runs along the outside edges of the deck, and there is a cast-in-place concrete sidewalk between the railing and parapet wall on both the north and south (Figure 22). Expansion joints are at either end of the girder span, and over the east and west abutments.

There are two plaques on the east approach. The one mounted on the concrete terminus of the north railing commemorates the original construction in 1924, while the other on the concrete terminus of the south railing was installed for the 1980 reconstruction (Figure 23).

Pedestrian access to the deck on the north side of the west approach adjacent to Lorne Park is via a bifurcated concrete stairs with low chamfered and moulded handrail, stylized “Renaissance” balusters and tall and chamfered outer strings (Figure 24). The outer face of the landing has a denticulated cornice, and the thick square newels have a chamfered and moulded cap, chamfered corners, and a thick pedestal (Figure 25). From the main landing, straight stairs parallel to the road ascend to a half-pace landing that opens onto the sidewalk on the deck (Figure 26).

Access from the south side of the west approach is via a set of concrete straight stairs with half-pace landing, while access on the east is only on the north side and via a set of straight stairs.

Figure 21: View west from the east abutment of the solid and thin concrete slab deck with chamfered soffit

Figure 22: View east from near the centre of the bridge of the deck camber from the east and west, low cast-in-place concrete parapet walls with single railings either side of the asphalt wearing surface, and cast-in-place concrete sidewalk with aluminium post and panel railings

Figure 23: Plaques commemorating the Lorne Bridge construction and reconstruction (left from Francis Porter Adams, Great War Centenary Association)

Figure 24: Bifurcated concrete stairs on the north side of the west approach, facing south from Lorne Park

Figure 25: Outer face of the landing with denticulated cornice, thick square newels, and low chamfered and moulded handrail with "Renaissance" balusters

Figure 26: Half-pace landing at the west approach deck with thick square newels with chamfered and moulded caps, chamfered corners, and thick pedestals

5.2 Brant's Crossing Bridge

5.2.1 Setting

The general character around Brant's Crossing Bridge is urban, though it is surrounded on its east and west approaches by urban parkland with high-rise residential structures to the west (Figure 27 to Figure 29). To the immediate east is the Brantford Skate Plaza, and beyond lies the Elements Brantford Casino. The surrounding topography is mainly flat to the west, south, and southeast, with a significant slope down from the north and northeast toward the river. The vegetation on both sides is a mix of primarily deciduous trees, with some conifers intermixed within the adjacent park areas.

The rail line that used to cross this bridge has since been pulled up on both sides of the bridge and adjacent on the east and west are recreational areas and walking paths. The eastern approach to the bridge is paved with stones and includes a sitting area with benches, beyond which is the pavilion for the Brantford Skate Park (Figure 30). The western approach is reached via a walking path that runs along the riverbank north beyond Lorne Bridge, and south to the TH&B Crossing Bridge (Figure 31). To the north on the east bank of the river is terraced stone (Figure 33).

The bridge is oriented east-west and situated at the northern end of a relatively straight section of the river, at a point of a slight bend from a southeasterly to a southerly flow. It is a prominent feature of views from the north and south due to its tall through truss spans and iron construction (Figure 28). Views of the bridge from the east and west beyond the banks are generally obscured by vegetation in the riparian zone and in adjacent parkland;

however, the bridge is appropriately visible from the Brant's Crossing entrance off Icomm Drive to the northeast (Figure 32). Views up-river from the bridge are of the Lorne Bridge, Brantford Armoury, and Brant County War Memorial (Figure 33) while those downriver are of the TH&B Crossing Bridge and BSAR Bridge beyond (Figure 34).

Figure 27: Setting of Brant's Crossing Bridge, facing southwest from the east bank

Figure 28: Setting of Brant's Crossing Bridge, facing south from the Lorne Bridge

Figure 29: Setting of Brant's Crossing Bridge, facing north from the TH&B Crossing Bridge

Figure 30: East approach to Brant's Crossing, with stone paving and seating area

Figure 31: West approach to Brant’s Crossing

Figure 32: View from the Brant's Crossing entrance off Icomm Drive, facing southwest.

Figure 33: View upriver of the Lorne Bridge (left), Brantford Armoury (centre right) and Brant County War Memorial (far right) with terracing and the former rail lines in the foreground right.

Figure 34: View downriver of the TH&B Crossing Bridge

5.2.2 Brant’s Crossing Bridge

The structure that carries the former Brantford-Tilsonburg Grand Trunk Railway line, today part of the Trans-Canada Trail, over the Grand River can be characterized as a fixed, four-span simply supported bridge with two flat beam through girder or pony plate girder approach spans and two through trussed frame centre spans (Figure 35 and Figure 36). The subject bridge is not included on the City of Brantford Heritage Register.

Overall, the Bridge is 121.4 m and 5.8 m wide, with a trackway width of 2.5 m. As recorded in the 2017 OSIM report, the approach spans measure 23.3 m (76 feet 6 inches) long, while the centre spans are 37.4 m long (122 feet 8 inches). The 1911 plan and elevations also record the approach spans as 23.3 m, and the centre spans as marginally larger 37.7 m (123 feet 10 inches), but the 1934 elevations produced by the CNR have the east approach span as 23.5 m (77 feet 4 inches), the west approach as 23.4 m (76 feet 9 inches), the west centre span as 37.8 m (124 feet) and the east centre span as 38 m (124 feet 9 inches).

Like for the Lorne Bridge, the reasons for the discrepancies in the recorded dimensions are unknown but likely result from the Bridge being measured from different structural landmarks at each point in time use advances in measurement technology. Also like the Lorne Bridge, this has had little effect on management of the Brant’s Crossing Bridge, but it is interesting here too that such major and prominent engineered structure should have no consistent documentation.

Figure 35: North elevation of the Brant’s Crossing Bridge

Figure 36: South elevation of the Brant’s Crossing Bridge

5.2.2.1 Substructure

Supporting the Bridge at its approaches are simple front wall and conventional closed cast-in-place concrete abutments. The east abutment has short cast-in-place concrete wing walls that stand vertically and angle toward the embankment before terminating with a section that is parallel with the Bridge. Both the wing walls and ballast wall are backfilled to below the coping level with ballast rubble that lines the sides of the approach embankment. For the west abutment, the wing walls meet the front wall at a more acute angle and backfill is to the level of the coping for the wings and ballast wall (Figure 37).

There are three piers each approximately 9.5 m wide, 3 m thick, and standing 7 m high. They are solid shaft cast-in-place concrete, with curved ends and moderate batter on the upstream side, and flat face with minor batter on the downstream side (Figure 38 and Figure 39); an exception is the west pier (No. 3), which has a steeper batter than the others on the downstream side (Figure 40). The pier foundations stand on exposed bedrock in the riverbed.

Figure 37: Front wall and ballast wall of the west abutment

Figure 38: Upriver side of the piers, facing southwest

Figure 39: Downriver sides of the piers, facing northwest

Figure 40: Downriver and east side of Pier No. 3

5.2.2.2 Superstructure

Since the Bridge post-dates 1890, it can be assumed that all framing members are steel rather than cast or wrought iron. The approach spans have their bottom flange plates on fixed bearings, which are trapezoidal cast and perforated block support shoes resting directly on the bearing shelf, and are supported laterally by four transverse beams or cross girders on gusset plates, each with lateral cross bracing (Figure 41). Above this are two stringers linked by both the transverse beams and short intermediate lattice trusses, over which are closely spaced wood ties (Figure 42).

The webs for both approach spans are formed of fifteen riveted girder web plates with vertical stiffeners on the exterior and triangular stiffeners on the deck side, with narrower web plates at each end where the top flange plate curves to meet the bottom flange plate (Figure 43). Remnants of the rail track are still extant on the deck of the west approach span (Figure 44).

Resting on and bolted to the piers with wide and fluted cast block support shoes are the centre spans, both of which are six-panel Pratt through trusses modified with diagonal bracing between the base of the hip verticals and the inclined end posts (Figure 45 to Figure 47). Both the top and bottom chords are latticed on their lower sides, as are the struts and top lateral bracing, and the top chords are further supported by sway bracing (Figure 48). In contrast to the thin hip verticals, the vertical posts and diagonals are robust I-bars and all inclined post, post, and diagonal connections are rivetted with gusset plates (Figure 49 and Figure 50). An exception is the connection between the end floor beams and the bottom chords, which appear to be pinned. All floor beams have crossed lateral bracing, and the stringers have short intermediate trusses between the floor beams (Figure 50). The centre spans are identical except for their portals; while the west span has a pedimented strut and sheet portal bracing, the east span has only sheet portal bracing (Figure 51 and Figure 52). The database entry for the Bridge in Historicbridges.org also notes that “the cover plate at the base on the end post for the western span ends in a curved detail, while the cover plate for the eastern span lacks the curved end" and that on both spans a "number of the truss members have a rolled angle in them whose outside edge ends in a ribbed detail…called 'bulb angles'". While the latter bulb angles can be seen, the curved end cover plates were not observed during field investigations and may only be visible when the Bridge is fully accessible.

The deck is closely spaced wood ties, over which are the track sections, corrugated pipe utility corridor, and the planked walkway with aluminium stringers and aluminium post and chain-link balustrade. On the upriver sides of both approach spans are large, perforated plates that appear to prevent access to the corrugated pipe utility corridor (Lance Brown 2020: pers. comm; Ken Chrysler 2020: pers. comm.) (Figure 53). Between the spans on the downriver side is a triangular platform formed with two lateral members and on either side are four-panel webs with vertical web stiffeners. This has been made into a viewing platform for the pedestrian walkway.

Figure 41: West approach girder span (includes some camera distortion).

Figure 42: Construction visible on the underside of the west girder including the fixed bearings, transverse beams or cross girders on gusset plates, and lateral cross bracing. Above this can be seen the two stringers with transverse beams and short intermediate lattice trusses, which are capped by closely spaced wood ties.

Figure 43: Riveted girder web plates with vertical stiffeners on the east approach span

Figure 44: Remnants of the rail track (centre right) on the deck of the west approach span

Figure 45: West and south sides of the west Pratt through truss span

Figure 46: South side of the west Pratt through truss span

Figure 47: West and south sides of the east Pratt through truss span

Figure 48: Detail of the end post of the west span showing the connection with the top chord, sway bracing, vertical post and diagonal and plating at the portal

Figure 49: Gusset plates at the diagonal and vertical post, and the wood ties of the deck

Figure 50: Detail of the west span construction showing the bottom chord with crossed lateral bracing, stringers with short intermediate trusses and lateral cross bracing on gusset plates

Figure 51: West portal of the west span

Figure 52: East portal of the east Pratt through truss span

Figure 53: Decking and utility corridor (with metal access barrier) at the east approach

5.3 TH&B Crossing Bridge

5.3.1 Setting

The general character around the TH&B Crossing Bridge is urban, with low to midrise commercial and urban park land use on the east side and urban park and low to mid-rise residential and commercial on the west side (Figure 54 and Figure 55). The topography is flat at both approaches, with steep but low banks at the river's edge (Figure 56 and Figure 57). Both banks are covered in trees or tall grasses and there are no areas of exposed bedrock. Around the east abutment and concrete pier sediment has been deposited and is covered in tall grass.

The bridge, which runs east-west, is the southern-most crossing in the study area, and is approximately 270 m south from the Brant's Crossing Bridge on the north, approximately 400 m downriver from the Lorne Bridge, and 375 m upriver from the BSAR Bridge.

The east approach is immediately northwest of the junction between the north-south and east-west routes of the SC Johnson and Dike pedestrian trails. The east approach also borders Earl Haig Park and the Brant & District Civic Centre. At the west approach is the north-south running Fordview Trail.

Views to the north are expansive, and include the wide channel of the tree-lined river and the Brant's Crossing Bridge, the Lorne Bridge, as well as the Brantford Armoury and the Brant County War Memorial (Figure 58). Views to the south are not as expansive due to the BSAR Bridge and the curve of the river to the southwest approximately 500 m to the south (Figure 59).

Figure 54: Setting of the TH&B Crossing Bridge, facing south from the west bank below Brant's Crossing Bridge

Figure 55: Setting of the TH&B Crossing Bridge, facing north from the BSAR Bridge

Figure 56: East approach to the TH&B Crossing Bridge, facing west

Figure 57: West approach to the TH&B Crossing Bridge, facing east

Figure 58: View facing north from the TH&B Crossing Bridge of Brant's Crossing Bridge (foreground), Lorne Bridge (centre), Brantford Armoury (right), and Brant County War Memorial (far right)

Figure 59: View facing south from the TH&B Crossing Bridge of the BSAR Bridge

5.3.2 TH&B Crossing Bridge

The structure that carries the former TH&B line, today part of the Fordview public trail, over the Grand River can be characterized as a fixed, four-span simply supported bridge with four flat beam through girder or pony plate girders (Figure 60 and Figure 61). The subject bridge is not included on the City of Brantford Heritage Register. Overall, the bridge is 124.8 m (409 feet 6 inches) long and 5.8 m (19 feet) wide, with a trackway width of 5.4 m (17 feet 8 inches). As recorded in the 2017 OSIM report, all spans measure 30.7 m (100 feet 9 inches) long. However, the CP Rail Record —which shows only the three western most spans— lists the dimensions as east to west 101 feet 9 inches, 102 feet, and 101 feet 9 inches with a width of 17 feet 6 inches.

Figure 60: North elevation of the TH&B Crossing Bridge

Figure 61: South elevation of the TH&B Crossing Bridge

5.3.2.1 Substructure

At its west approach, the TH&B Crossing Bridge is supported by a simple front wall and conventional closed cast-in-place concrete abutment (Figure 62). Short, vertical and cast-in-place concrete wing walls extend into the bank perpendicular to the front wall. Long and frogged concrete masonry unit blocks crudely mortared with Portland cement have been used to extend the north wing. Both the bearing shelf and bridge seat have projecting concrete slabs with quarter-round moulding on their top outer margin (Figure 63).

The east abutment also is a simple front wall and conventional closed type but is constructed in rusticated ashlar masonry to a slight batter (Figure 64). Also, unlike the west abutment, the front wall has a cordon and the bearing shelf is narrower, with a thin coping in either concrete or thin stone slabs. The bridge seat on the west abutment has a stone coping with rounded top margin. Concrete has been used to repair two sections of the front wall —the full height of the south corner and top-most corner of the north corner and has been scored to match the masonry coursing (Figure 65). Photographs from 2002 show the east abutment is backed by wood cribbing (Figure 65).

There are three piers, two of which are concrete-filled riveted iron or steel caissons or bents and one in cast-in-place concrete. The concrete pier is the furthest west, has a sharp nose with relatively steep batter and iron or steel cut break on its upriver side (Figure 67). It is topped by a projecting concrete slab with quarter-round top margin, and overall measures 8.85 m long, 3.8 m wide, and stands 5.45 m high. The two easterly pier bents stand 6.05 m high, are 7.2 m long overall, and each caisson is 2.10 m in diameter (Figure 68 and Figure 69). Each caisson is faced with rounded panels connected with rivetted strips, and are connected to each other at their mid and upper section by a web wall with top and bottom flanges and by a capping beam of seven I-beams with the interstices filled with concrete. The pier foundations stand on exposed dolostone bedrock in the riverbed.

Figure 62: View facing southwest of the west abutment and pier

Figure 63: View facing east of the west abutment of the TH&B Crossing Bridge

Figure 64: View facing north of the east abutment of the TH&B Crossing Bridge

Figure 65: Wood cribbing at the east approach (Photo by Charles Cooper, Collection of Brant Railway Heritage Society)

Figure 66: View facing southeast of the east abutment with ashlar construction and concrete repairs

Figure 67: View facing south of the concrete pier

Figure 68: View facing southeast of the metal pier bents

Figure 69: View facing south of the central TH&B Crossing Bridge pier bent caissons

5.3.2.2 Superstructure

Since the superstructure elements post-date 1890, it can be assumed that all framing members are steel rather than cast or wrought iron. The bottom flange plates of the approach spans have pinned fixed bearings that are bolted to steel plates on the bearing shelf (Figure 70). The bottom flange plates of the mid spans over the pier bents rest directly on the capping beams, while the bearings on the concrete pier are fixed steel plates. Between the bottom flange plates are two stringers, which are linked to the flange plates by transverse beams or cross girders on gusset plates and lateral cross bracing. Over the stringers are closely spaced square wood ties.

The webs for all spans are formed of 14 riveted girder web plates with vertical stiffeners on the exterior and triangular stiffeners on the deck side, with adjoining vertical flanges over the piers (Figure 71 to Figure 73). Unlike on the exterior sides, in some places the interior construction varies in riveting pattern and stiffener dimensions (Figure 74).

The deck is a planked walkway and on the top flange on the downriver side is a small diameter conduit that runs to aluminium light standards mounted on U-shaped steel plates (Figure 75).

Figure 70: Capping beam over the central pier bent, which supports the girder composed of bottom flange plates and stringers linked by transverse beams or cross girders on gusset plates, all with lateral cross bracing.

Figure 71: View facing west of the girder spans

Figure 72: View facing northwest of the girder spans

Figure 73: Interior side of the girders, showing the top flange plate and rectangular and triangular vertical web stiffeners

Figure 74: Joint between the west approach span and centre west span showing varying construction

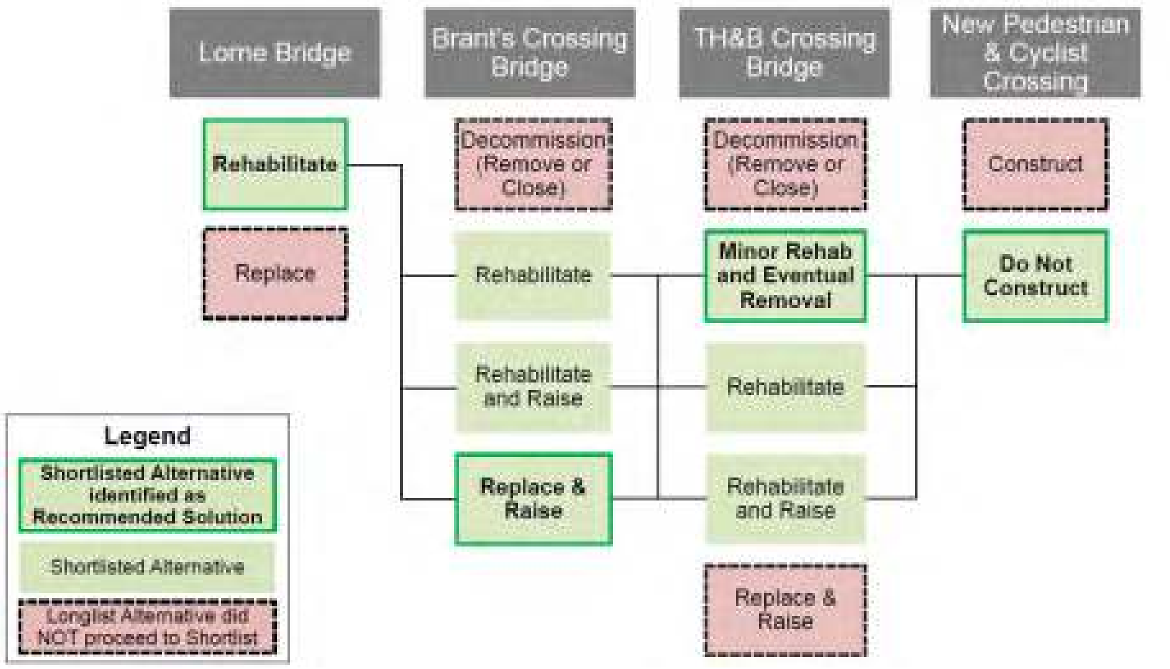
Figure 75: Conduit and aluminium light standard mounts on the top flange plate

6.0 IMPACT ASSESSMENT

6.1 Description and Purpose of Proposed Project

The Three Grand River Crossings MCEA was initiated to "identify long-term, holistic solutions" to address the deteriorating condition, "age-related concerns", and risk flooding damage or loss at each bridge site as well as ways to improve pedestrian, cyclist and vehicular connectivity in the study area. The EA study is intended to identify the short and long-term plans for the three Grand River Bridges. The study will include determining the feasibility of removing the winter load limit on Lorne Bridge and the need for one or both of the TH&B River Crossing and Brant's Crossing Bridges based on an assessment of the technical, social and environmental factors, including impacts to the active transportation network and the risks of future flooding events of the Grand River.

The following alternatives were evaluated, including commissioning studies to investigate the social (which included the CHER), natural, technical, and economic environments:



The evaluation process, involving public engagement, identified the recommended alternative for each bridge and the study area as a whole (APPENDIX A). The following recommended alternatives were identified:

- **Lorne Bridge – Rehabilitate**
- **Brant's Crossing Bridge – Replace and Raise**
- **TH&B Crossing Bridge – Minor Rehabilitation and Remove at End of Useful Life**

Developed as "Strategy 7", a description of the recommended alternatives, with activities with potential impacts, for each bridge follows.

6.1.1 Lorne Bridge Description of Proposed Work

The recommended alternative identified for the Lorne Bridge is to rehabilitate the structure in its current form and appearance and remove the 30-tonne winter load limit. The details of the rehabilitation would be confirmed in detailed design but predicted to include:

- spot repairs involving concrete removals and patch repairs and crack injection throughout the superstructure and substructure (abutments, piers, arches, barriers, etc.)
- abrasive cleaning of reinforcing steel
- bridge deck waterproofing

Pending the results of load limit testing, the bridge may also require strengthening as part of the rehabilitation works. Strengthening the bridge would include:

- thickening the top of the concrete arch,
- constructing additional ribs on the interior
- adding fibre-reinforced polymer fabrics to the soffit.

No work is planned for the bifurcated concrete stairs (considered a heritage attribute) on the north side of the west approach with its denticulated cornice, thick square newels, and balustrade.

6.1.2 Brant's Crossing Bridge Description of Proposed Work

At Brant's Crossing Bridge, the recommended alternative to raise and replace will involve:

- removing the existing steel superstructure, the existing steel superstructure replaced with a new superstructure to convey pedestrian and cyclist traffic over the Grand River.
- major repairs to the concrete substructure, including adding additional height to account for flooding events
- installing a new steel superstructure on the repaired substructure
  - the new superstructure would be four new prefabricated steel trusses similar in appearance to the existing through trusses (Figure 76 and Figure 77).
- adding a staircase and ramp at the east and west approaches to provide access to the raised superstructure.

Figure 76: Example of a prefabricated steel through truss pedestrian bridge (courtesy GM BluePlan)

Figure 77: View from the deck of an example of a prefabricated steel through truss pedestrian bridge (courtesy GM BluePlan)

6.1.3 TH&B Crossing Bridge Description of Proposed Work

The recommended alternative identified for the TH&B Crossing Bridge is to carry out minor rehabilitation and retain the structure in its current form and appearance until some future point when the superstructure is removed (circa 2031).

- Minor rehabilitation to maintain the structure for approximately 10 to 15 years with the intent of eventually removing the steel superstructure.
- Minor rehabilitation would include replacing the existing deck and other minor repairs.
- Existing foundations would remain in place following the removal of the superstructure

6.1.4 Approach

When determining the effects a development or site alteration may have on known or identified built heritage resources or cultural heritage landscapes, the MHSTCI *Heritage Resources in the Land Use Planning Process* advises that the following "negative impacts" be considered:

- ***Destruction*** of any, or part of any, significant heritage attributes, or features[4]
- ***Alteration*** that is not sympathetic, or is incompatible, with the historic fabric and appearance[5]

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[4] This is used as an example of a *direct* impact in the MHSCTI *Info Bulletin 3.*

[5] A *direct* impact in the MHSCTI *Info Bulletin 3*.

- ***Shadows*** created that alter the appearance of a heritage attribute or change the viability of a natural feature or plantings, such as a garden[6]
- ***Isolation*** of a heritage attribute from its surrounding environment, context or a significant relationship[7]
- ***Direct or indirect obstruction*** of significant views or vistas within, from, or of built and natural features[8]
- ***A change in land use*** such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces[9]
- ***Land disturbances*** such as a change in grade that alters soils, and drainage patterns that adversely affect a cultural heritage resource[10]

Other potential impacts may also be considered such as encroachment or construction vibration.

Historical structures, particularly those built in masonry, are susceptible to damage from vibration caused by pavement breakers, plate compactors, utility excavations, and increased heavy vehicle travel in the immediate vicinity. Like any structure, they are also threatened by collisions with heavy machinery, subsidence from utility line failures, or excessive dust (Randal 2001:3-6).

Although the MHSTCI' *Heritage Resources in the Land Use Planning Process* identifies types of impact, it does not advise on how to describe their nature or extent. For this the MHSTCI *Guideline for Preparing the Cultural Heritage Resource Component of Environmental Assessments* (1990:8) provides criteria of:

- ***Magnitude*** - amount of physical alteration or destruction that can be expected
- ***Severity*** - the irreversibility or reversibility of an impact
- ***Duration*** - the length of time an adverse impact persists
- ***Frequency*** - the number of times an impact can be expected
- ***Range*** - the spatial distribution, widespread or site specific, of an adverse impact
- ***Diversity*** - the number of different kinds of activities to affect a heritage resource

Since advice to describe magnitude is not included in the MHSTCI' *Guideline* or any other Canadian guidance, the ranking provided in the ICOMOS *Guidance on Heritage Impact Assessments for Cultural World Heritage Properties* (ICOMOS 2011: Appendix 3B) is adapted here. While developed specifically for World Heritage Sites, it is based on a general methodology for measuring the nature and extent of impact to cultural resources in urban and rural contexts developed for the UK Highways Agency *Design Manual for Roads and Bridges* [DMRB]*: Volume 11*, HA 208/07 (2007: A6/11) (Bond & Worthing 2016:166-167) and aligns with approaches developed by

[6] An *indirect* impact in the MHSCTI *Info Bulletin 3*.

[7] An *indirect* impact in the MHSCTI *Info Bulletin 3*.

[8] An example of a *direct* and *indirect* impact in the MHSCTI *Info Bulletin 3*. It is a direct impact when significant views or vistas within, from or of built and natural features are obstructed, and an indirect impact when "a significant view of or from the property from a key vantage point is obstructed".

[9] A *direct* impact in the MHSCTI *Info Bulletin 3*.

[10] In the MHSTCI *Heritage Resources in the Land Use Planning Process* this refers only to archaeological resources but in the MHSCTI *Info Bulletin 3* this is an example of a *direct* impact to "provincial heritage property, including archaeological resources".

other national agencies such as the Irish Environmental Protection Agency (reproduced in Kalman & Létourneau 2020:390) and New Zealand Transport Agency (2015).

The ICOMOS impact assessment ranking is:

- **Major**
  - Change to key historic building elements, such that the resource is totally altered.
  - Comprehensive changes to the setting.
- **Moderate**
  - Changes to many key historic building elements, such that the resource is significantly modified.
  - Changes to the setting of an historic building, such that it is significantly modified.
- **Minor**
  - Change to key historic building elements, such that the asset is slightly different.
  - Change to the setting of an historic building, such that it is noticeably changed.
- **Negligible**
  - Slight changes to historic building elements or setting that hardly affect it.
- **No impact**
  - No change to fabric or setting.

These approaches have been combined to assess the impacts of the Project on the CHVI and heritage attributes of the bridges and the cultural heritage landscape.

For bridges, including municipal bridges, the process, and the options to be considered are the ones in Section 4.3 of the Ontario Heritage Bridge Guidelines (MTO, 2008). The options are regarded as appropriate in managing interventions on heritage bridges. They are arranged according to level or degree of intervention from minimum to maximum. They are to be applied in rank order such that Option 1 must be shown to be non-viable, before Option 2 can be considered and so on. There are eight options to consider and, all other alternatives having been considered, consider removal or demolition as a last resort.

6.2 Impact Assessment

6.2.1 Lorne Bridge Impact Assessment

The impacts of the recommended alternative on the CHVI and heritage attributes of the Lorne Bridge are assessed in Table 1.

Table 1: Impact assessment and summary of impact to the Lorne Bridge with, and without, mitigation measures

Negative Impact Example	Analysis of impact	Summary of impact *without* mitigation	Summary of impact *with* mitigation
***Destruction** of any, or part of any, significant heritage attributes, or features*	Without mitigation, the recommended alternative will potentially destroy significant heritage attributes or features of the Lorne Bridge through construction vibration. Work to repair portions of the superstructure, as well as associated heavy equipment operation, may result in localized cracking and spalling in the substructure and bifurcated stairs on the north side of the west approach, which are considered heritage attributes of the bridge. Depending on the severity of damage, these effects would range from minor to moderate impacts to the bridge's CHVI and heritage attributes that are reversible, occur once over a short period of time, and potentially widespread. During the operation phase, significant heritage attributes or features of the Lorne Bridge may be destroyed through extensive use of de-icing salts. Build-up of salts applied to historical reinforced concrete can lead to scaling, cracking, and spalling, particularly the "horizontal surfaces of pedestrian walkways and balconies [that] are often unprotected by coatings and can be over-generously salted in winter" (English Heritage 2018:97,88). This damage can in turn expose the steel reinforcing, leading to electrochemical corrosion that leads to further cracking and spalling through expansion (English Heritage 2018:97,88). Without mitigation, de-icing of the bifurcated stairs, considered a heritage attribute, could result in effects that range from minor to moderate impacts to the bridge's CHVI and heritage attributes that are irreversible, occur continually over a long period of time, and site-specific. However, with appropriate measures implemented during construction and operation, the potential negative impacts from construction vibration and de-icing salts will be avoided, with resulting "no impact" to the CHVI and heritage attributes of the Lorne Bridge.	Minor to moderate direct impacts from construction vibration that are irreversible, occur once over a short period of time and is potentially widespread. Minor to moderate impacts from de-icing salts that are irreversible, occur continually over a long period of time, and site-specific.	By implementing the mitigation measures recommended in Section 6.5.1, the potential negative impacts from construction vibration and de-icing salts will be avoided, resulting in no impact.
***Alteration** that is not sympathetic, or is incompatible, with the historic fabric and appearance*	Without mitigation, the recommended alternative will potentially result in alteration that is not sympathetic, or is incompatible, with the historic fabric or appearance of the bridge. Crack repairs using inappropriate materials or methods may lead to sharp visual contrasts between the original fabric and new material (Figure 78), while inappropriate cleaning methods may damage the concrete surfaces (English Heritage 2018:148, 192; Macdonald & Gonçalves 2020:7). If widespread, these interventions will create an appearance that is not sympathetic to the bridge's original appearance, with effects ranging from minor to moderate impacts that are reversible, would occur once yet remain over a long period of time, and potentially widespread. Without mitigation, thickening the top of the concrete arches, constructing additional ribs on the interior, and adding fibre-reinforced polymer fabrics to the soffit will result in an alteration that is not sympathetic, or is incompatible, with the historic fabric or appearance of the bridge. Although the spandrel columns at the arch crowns were added as part of the 1980 rehabilitation effort (Figure 79) and not considered heritage attributes, there is potential that the proposed work at the crowns will be visually intrusive and incompatible with the bridge's substructure, which is considered a heritage attribute. Unsympathetic work at the crowns could result in minor to moderate impacts from alteration that are reversible, will occur once yet remain over a long period of time, and are site-specific. However, with appropriate mitigation approaches, materials, and repairs, the potential negative effects listed above will be avoided, resulting in no impact to the CHVI and heritage attributes of the Lorne Bridge.	Minor to moderate direct impacts from inappropriate crack repairs that are reversible, will occur once yet remain over a long period of time, and are potentially widespread. Minor to moderate direct impacts from inappropriate cleaning methods that are irreversible, occur once yet remain over a long period of time, and are potentially widespread. Minor to moderate direct impacts from incompatible work at the crown of the arches that are reversible, will occur once yet remain over a long period of time, and are site-specific.	By implementing the mitigation measures recommended in Section 6.5.1, the potential negative impacts from inappropriate crack repairs and cleaning, and incompatible work at the arch crowns will be avoided, resulting in no impact.

Negative Impact Example	Analysis of impact	Summary of impact *without* mitigation	Summary of impact *with* mitigation
Shadows *created that alter the appearance of a heritage attribute or change the viability of a natural feature or plantings, such as a garden*	Since the recommended alternative will involve only stabilization and repair of the Lorne Bridge, no new shadows will be created that alter the appearance of the bridge's heritage attributes.	No impact.	No mitigation recommended.
Isolation *of a heritage attribute from its surrounding environment, context or a significant relationship*	Since the work proposed for the Lorne Bridge will be limited to stabilization and repair of the existing structure, the recommended alternative will not result in any heritage attributes of the bridge becoming isolated from their surrounding environment, context, or significant relationship.	No impact.	No mitigation required.
Direct or indirect obstruction *of significant views or vistas within, from, or of built and natural features*	The recommended alternative is limited to stabilization and repair of the existing structure, with no new construction that would directly or indirectly obstruct significant view or vistas within, from, or of built and natural (i.e., the Grand River) features associated with the Lorne Bridge.	No impact.	No mitigation recommended.
A change in land use *such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces*	The recommended alternative will continue the bridge's current use as a crossing for motor vehicles and pedestrians. Therefore, there will be no change in land use.	No impact.	No mitigation recommended.
Land disturbances *such as a change in grade that alters soils, and drainage patterns that adversely affect a cultural heritage resource*	The recommended alternative, which is limited to stabilization and repair of the existing structure, is unlikely to result in land disturbances that alter the soils or drainage and negatively affect the CHVI or heritage attributes of the Lorne Bridge.	No impact.	No mitigation recommended.

Figure 78: Example of an inappropriate crack repair, Montrose Bridge, Scotland (English Heritage 2018:182)

Figure 79: Comparison of the original and current Lorne Bridge configurations, with blue shading indicating where the new spandrel columns were added to the crown of the arches in 1980 (top image, the Lorne Bridge in 1924, Toronto Public Library – Toronto Star Archives)

6.2.2 Brant's Crossing Bridge Impact Assessment

The impacts of the recommended alternative on the CHVI and heritage attributes of the Brant's Crossing Bridge are assessed in Table 2.

Table 2: Impact assessment and summary of impact to the Brant's Crossing Bridge with, and without, mitigation measures

Negative Impact Example	Analysis of impact	Summary of impact *without* mitigation	Summary of impact *with* mitigation
***Destruction** of any, or part of any, significant heritage attributes, or features*	Without mitigation, the recommended alternative will potentially destroy a substantial proportion of the bridge's significant heritage attributes or features. Removal of the superstructure, which is considered a key heritage attribute of the bridge, will result in a major negative impact that is irreversible, will occur once over a short period of time, and is widespread. With appropriate mitigation, the effects of replacing the superstructure will be reduced to a minor impact that is irreversible, will occur once over a short period of time, and is widespread. If one of the through trusses is relocated to adjacent parkland (see Recommendations, Section 6.5.2), it will serve to encourage public interaction with the structure and its engineering heritage, while re-establishing the crossing as an active transportation link also provides opportunities to interpret the history and cultural heritage value or interest of the crossing. Under the recommended alternative, the bridge's substructure —considered a heritage attribute— will remain *in situ* to support the new pedestrian spans, and work during the construction phase is not predicted to cause vibration levels that risk destruction of this component of the bridge.	Major direct impact from removal of the superstructure that is irreversible, will occur once over a short period of time, and is widespread.	By implementing the mitigation measures recommended in Section 6.5.2, the negative effect will be reduced to a minor direct impact that is irreversible, will occur once over a short period of time, and is widespread.
***Alteration** that is not sympathetic, or is incompatible, with the historic fabric and appearance*	Without mitigation, the repairs to the substructure proposed as part of the recommended alternative will potentially result in alteration that is not sympathetic or is incompatible with the historic fabric or appearance of the bridge. Crack repairs using inappropriate materials or methods may lead to sharp visual contrasts between the original fabric and new material (Figure 78), while inappropriate cleaning methods may damage the concrete surfaces (English Heritage 2018:148, 192; Macdonald & Gonçalves 2020:7). If widespread, these interventions will create an appearance that is not sympathetic to the bridge's original appearance, with effects ranging from negligible to minor impacts (given the visibility of the bridge's substructure features) that are reversible, would occur once yet remain over a long period of time, and site-specific. With appropriate mitigation approaches, materials, and repairs, this negative effect will be avoided, resulting in no impact to the substructure as a heritage attribute of the Brant's Crossing Bridge. Use of steel through trusses to replace all spans of the superstructure as currently proposed would potentially be sympathetic and compatible with the historic fabric or appearance of the bridge, not only in its current form but also earlier iterations of the crossing in the 19th century, when three through trusses were in use (Figure 80). However, if inappropriate design elements are selected (e.g., tubular framing that is round in cross-section, enclosed roof) there is potential for negative impacts from alteration ranging from minor to major impact that is reversible, would occur once yet remain over a long period of time, and potentially widespread.	Negligible to minor impact from repairs to the substructure that is reversible, occur once yet remain over a long period of time, and site-specific. Minor to major impact from incompatible superstructure replacement that is reversible, would occur once yet remain over a long period of time, and is potentially widespread.	By implementing the mitigation measures recommended in Section 6.5.2, the potential negative impacts from inappropriate crack repairs and cleaning will be avoided, resulting in no impact. Implementing the mitigation measures recommended in Section 6.5.2 will reduce the effect of the superstructure replacement to a minor impact that is reversible, would occur once yet remain over a long period of time, and is potentially widespread.
***Shadows** created that alter the appearance of a heritage attribute or change the viability of a natural feature or plantings, such as a garden*	Raising the existing abutments and piers and installing four prefabricated through trusses as the new superstructure is not predicted to create new shadows that will alter the appearance of the substructure (considered a heritage attribute) beyond a negligible extent. These new shadows are irreversible, permanent, and would occur many times annually over a long period of time.	Negligible indirect impacts that are reversible, permanent, and would occur many times annually over a long period of time.	No mitigation recommended as the magnitude of impact is negligible.

Negative Impact Example	Analysis of impact	Summary of impact *without* mitigation	Summary of impact *with* mitigation
Isolation *of a heritage attribute from its surrounding environment, context or a significant relationship*	Since the recommended alternative is to re-establish a pedestrian crossing on the existing substructure, this heritage attribute will not be isolated from its surrounding environment, context, or significant relationship. If one of the through trusses is salvaged but the conservation recommendations outlined in Section 6.5.2 are not followed, there is potential that this heritage attribute will be isolated from its current surrounding environment or context and its significant relationship with the Grand River will be severed. This would result in a major indirect impact that is reversible, would occur once yet potentially remain over a long period of time, and is site-specific. With mitigation this impact would be reduced to a minor impact that is reversible, would occur once yet remain over a long period of time, and is site-specific.	No impact resulting from re-establishing the pedestrian crossing. Major indirect impact from salvage of a truss without conservation that is reversible, would occur once yet potentially remain over a long period of time, and is site-specific.	No mitigation required to re-establish the pedestrian crossing. By implementing the mitigation measures recommended in Section 6.5.2, salvage of a truss with conservation would result in a minor indirect impact that is reversible, would occur once yet remain over a long period of time, and is site-specific.
Direct or indirect obstruction *of significant views or vistas within, from, or of built and natural features*	The recommended alternative to install four through trusses on the existing substructure would not directly or indirectly obstruct significant view or vistas within, from, or of built and natural (i.e., the Grand River) features associated with the Brant's Crossing Bridge. The substructure, which will be retained, will remain visible, and views from the new superstructure will replicate those of the existing conditions.	No impact.	No mitigation required.
A change in land use *such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces*	The recommended alternative will re-establish use of the bridge as a crossing for pedestrians. Therefore, there will be no change in land use.	No impact.	No mitigation required.
Land disturbances *such as a change in grade that alters soils, and drainage patterns that adversely affect a cultural heritage resource*	The recommended alternative to raise and repair the substructure and replace the superstructure is unlikely to result in land disturbances that alter the soils or drainage and negatively affect the superstructure as a heritage attribute of the Brant's Crossing Bridge.	No impact.	No mitigation required.

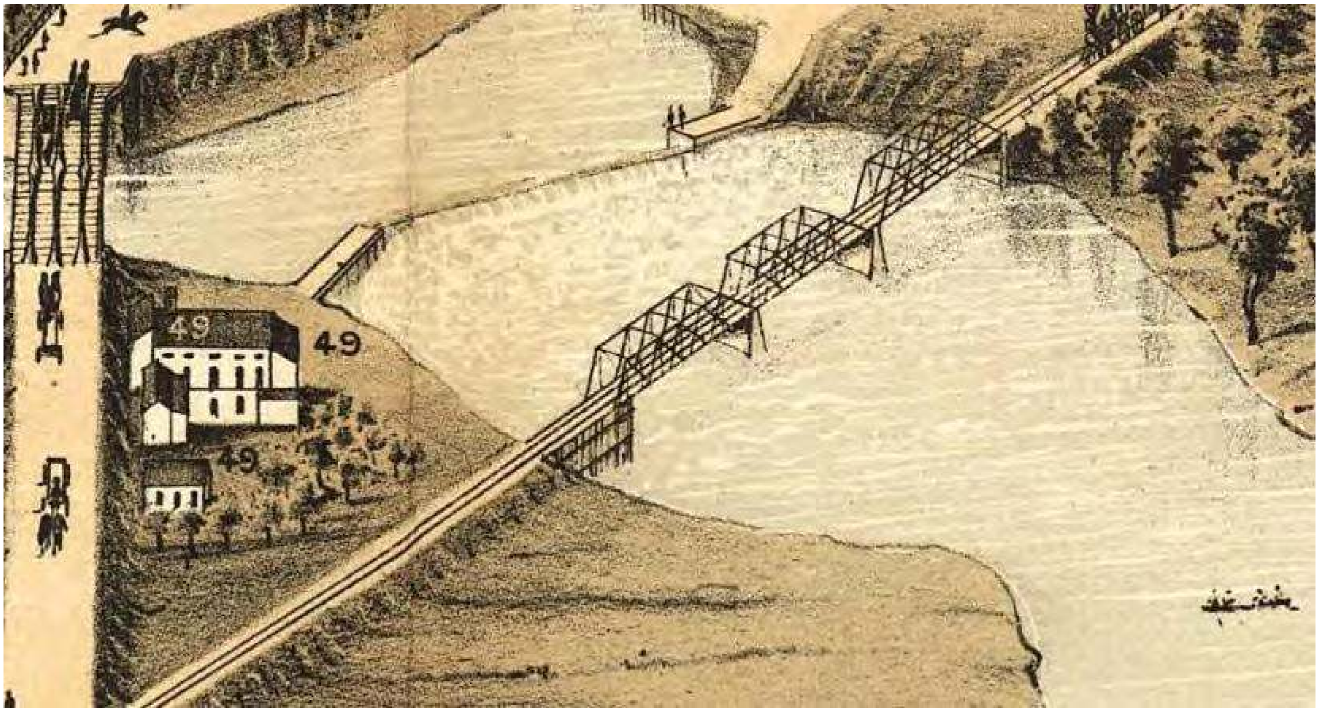

Figure 80: Detail from the 1875 *Bird's Eye View* depicting the three span BN&PB Railway Bridge at the Brant's Crossing site

6.2.3 TH&B Crossing Bridge Impact Assessment

The impacts of the recommended alternative on the CHVI and heritage attributes of the TH&B Crossing Bridge are assessed in Table 3.

Table 3: Impact assessment and summary of impact to the TH&B Crossing Bridge with, and without, mitigation measures

Negative Impact Example	Analysis of impact	Summary of impact *without* mitigation	Summary of impact *with* mitigation
Destruction *of any, or part of any, significant heritage attributes, or features*	Minor rehabilitation as proposed under the recommended alternative will not directly result in destruction of any significant heritage attributes or features of the TH&B Bridge. However, since the rehabilitation effort will be limited in scope, and does not include ice jam prevention measures or raising the bridge above the maximum flood height, there is potential that over time the bridge will be subject to further deterioration or damage, eventually resulting in destruction of the bridge's heritage attributes. These effects are predicted to range from negligible to moderate impacts over the next ten years that are irreversible, will occur continually and in a diverse number of ways over a long period of time, and are potentially widespread. With mitigation, the negative effects will be reduced to negligible to minor impacts that are irreversible, occur continually in a diverse number of ways over a long period of time, and are potentially widespread.	Negligible to moderate direct impacts from limited rehabilitation that are irreversible, would occur continually in a diverse number of ways over a long period of time, and potentially widespread.	Implementing the mitigation measures recommended in Section 6.5.2 at this time will reduce the effects from negligible to minor impacts that are irreversible, would occur continually in a diverse number of ways over a long period of time, and potentially widespread.
Alteration *that is not sympathetic, or is incompatible, with the historic fabric and appearance*	Since only minor rehabilitation is proposed under the recommended alternative, there will be no alterations that are not sympathetic, or incompatible with the current historic fabric or appearance of the bridge.	No impact.	No mitigation required.
Shadows *created that alter the appearance of a heritage attribute or change the viability of a natural feature or plantings, such as a garden*	Minor rehabilitation as proposed under the recommended alternative will not cast any new shadows that alter the appearance of the bridge's heritage attributes.	No impact.	No mitigation required.
Isolation *of a heritage attribute from its surrounding environment, context or a significant relationship*	Since only minor rehabilitation is proposed under the recommended alternative, no heritage attributes of the bridge will be isolated from their surrounding environment, context, or significant relationship.	No impact.	No mitigation required.
Direct or indirect obstruction *of significant views or vistas within, from, or of built and natural features*	Minor rehabilitation as proposed under the recommended alternative will not directly or indirectly obstruct significant view or vistas within, from, or of built and natural (i.e., the Grand River) features associated with the TH&B Crossing Bridge.	No impact.	No mitigation required.
A change in land use *such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces*	Although there will be no public access, the recommended alternative will continue the bridge's current status as a crossing and therefore no impact from a change in land use.	No impact.	No mitigation required.
Land disturbances *such as a change in grade that alters soils, and drainage patterns that adversely affect a cultural heritage resource*	Minor rehabilitation as proposed under the recommended alternative is unlikely to result in land disturbances that alter soils or drainage and negatively impact the CHVI or heritage attributes of the TH&B Bridge.	No impact.	No mitigation required.

6.2.4 Brantford Crossings CHL Impact Assessment

The cumulative impacts of the recommended alternatives for each bridge on the CHVI and heritage attributes of the Brantford Crossings CHL are assessed in Table 4.

Table 4: Impact assessment and summary of impact to the Brantford Crossings CHL with, and without, mitigation measures

Negative Impact Example	Analysis of impact	Summary of impact *without* mitigation	Summary of impact *with* mitigation
Destruction *of any, or part of any, significant heritage attributes, or features*	Without mitigation, the recommended alternatives will potentially destroy the substructure of the Lorne Bridge, and the superstructure of Brant's Crossing Bridge, both of which are considered significant heritage attributes or features of the CHL. While the impact to Lorne Bridge can be avoided with mitigation, the proposed removal of the Brant's Crossing Bridge superstructure represents an overall major negative impact to the CHL that is irreversible, will occur once over a short period of time and is site-specific. The minor rehabilitation planned for the TH&B Bridge will have no impact on the CHL in the short term, though may increase to a moderate impact (e.g., partial loss through an ice jam impact) in the long term that is irreversible, would once over a short period of time, and site-specific. However, with appropriate mitigations implemented for all three bridges, the effects on the CHL will be reduced to a minor impact that is irreversible, will occur once over a short period of time, and site-specific to the Brant's Crossing Bridge superstructure.	Major direct impact to the CHL from potential destruction of the Lorne Bridge through construction vibration that is irreversible, will occur once over a short period of time, and site-specific. Major direct impact to the CHL from removal of the Brant's Crossing Bridge superstructure that is irreversible, will occur once over a short period of time, and site-specific.	By implementing the mitigation measures recommended in Section 6.4, the negative effect on the CHL through vibration impact to the Lorne Bridge will be avoided, resulting in no impact. By implementing the mitigation measures recommended in Section 6.4, the negative effect on the CHL through removal of Brant's Crossing Bridge superstructure will be reduced to a minor direct impact that is irreversible, will occur once over a short period of time, and is site-specific.
Alteration *that is not sympathetic, or is incompatible, with the historic fabric and appearance*	Without mitigation, the recommended alternatives for repairing and rehabilitating the Lorne Bridge and Brant's Crossing Bridge substructures will have a negligible impact to the CHL that is reversible, would occur once over a short period of time, and site-specific. With appropriate mitigation, the impact of repair works to the two bridges would be reduced to no impact. However, replacing the superstructure at Brant's Crossing Bridge without mitigation could result in an alteration that is not sympathetic, or is incompatible with the historic fabric or appearance of the CHL. This impact could be as high in magnitude as moderate, and would be reversible, would occur once yet continue over a long period of time, and be site-specific. With appropriate mitigation, the impact to the CHL from replacing the Brant's Crossing Bridge superstructure would be reduced to a minor impact that is reversible, would occur once yet continue over a long period of time, and be site-specific.	Negligible impact to the CHL through repairing and rehabilitating the Lorne Bridge and Brant's Crossing Bridge substructures that is reversible, occur once yet continue over a long period of time and is site-specific. Minor to moderate impact to the CHL through incompatible replacement of the Brant's Crossing Bridge superstructure that is reversible, would occur once yet continue over a long period of time, and is site-specific.	Implementing the mitigation measures recommended in Section 6.4 will reduce the impact from alteration through repairing and rehabilitating the Lorne Bridge and Brant's Crossing Bridge substructures to no impact. By implementing the mitigation measures recommended in Section 6.4, the negative effect through alteration of replacing the Brant's Crossing Bridge superstructure will be reduced to a minor direct impact that is irreversible, would occur once yet continue over a long period of time, and is site-specific.
Shadows *created that alter the appearance of a heritage attribute or change the viability of a natural feature or plantings, such as a garden*	None of the recommended alternatives will create shadows that alter the appearance of the CHL as a whole, nor any of its individual heritage attributes.	No impact.	No mitigation required.
Isolation *of a heritage attribute from its surrounding environment, context or a significant relationship*	None of the recommended alternatives will not isolate any heritage attributes of the CHL from their surrounding environment, context, or significant relationship.	No impact.	No mitigation required.
Direct or indirect obstruction *of significant views or vistas within, from, or of built and natural features*	The recommended alternatives will not directly nor indirectly obstruct significant view or vistas within, from, or of built and natural (i.e., the Grand River) features associated with the CHL. Views from the Lorne and TH&B Bridges of the Brant's Crossing Bridge will be altered, but not obstructed, and the Brant's Crossing substructure will remain a feature of these views from the other bridges.	No impact.	No mitigation required.

Negative Impact Example	Analysis of impact	Summary of impact *without* mitigation	Summary of impact *with* mitigation
A change in land use *such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces*	The recommended alternatives will re-establish and enhance use of the CHL for pedestrian, active transportation, and motor vehicle users. Therefore, there will be no change in land use.	No impact.	No mitigation required.
Land disturbances *such as a change in grade that alters soils, and drainage patterns that adversely affect a cultural heritage resource*	The recommended alternatives are not predicted to result in land disturbances that alter the soils and drainage that adversely affect any heritage attributes of the CHL.	No impact.	No mitigation required.

6.2.5 Results of the Impact Assessment

The impact assessment for this HIA has determined that *without mitigation* the recommended alternatives will potentially result in several negative impacts ranging in magnitude from negligible to major. The most significant of these are:

- risk of moderate direct impact to the Lorne Bridge (and associated Brantford Crossings CHL) from construction vibration, potentially leading to partial destruction of the bridge's substructure
- risk of moderate direct impact to the Lorne Bridge from work at the arch crowns, potentially leading to an incompatible alteration to the bridge's substructure
- minor to moderate direct impact to the Lorne Bridge and Brant's Crossing substructures from repairs, potentially leading to incompatible alterations to the substructure of each bridge
- major direct impact to the Brant's Crossing Bridge (and associated Brantford Crossings CHL) through replacement of the superstructure
- risk of major indirect impact to a through truss of the Brant's Crossing Bridge through isolation if salvaged but not conserved in the adjacent parkland
- a negligible to moderate direct impact to the TH&B Crossing Bridge from deterioration and risk of damage from a potential ice jam event.

6.3 Considered Alternatives and Mitigation Measures

When adverse impacts are expected from proposed site alteration, alternatives and mitigation measures should be considered to manage the site alteration in a way that will not adversely affect built heritage resources and cultural heritage landscapes. The preferred heritage approach for the protection of resources is retention *in situ* and the preservation of the material integrity to the maximum extent possible, as public safety allows.

In situations where the nature of site alteration is such that adverse impacts are unavoidable, it is possible to implement mitigative conservation strategies that lessen the adverse effects to the built heritage resources and cultural heritage landscapes. Conservation options are outlined in the *Ontario Heritage Bridge Guidelines* (OHBG) (MTO, 2008), regarded as current best practice for conserving heritage bridges in Ontario. While the OHBG's are intended for use in the assessment of provincially-owned structures and are not directly applicable in the municipal context, they ensure that heritage concerns and appropriate mitigation options are considered.

6.3.1 Alternatives, Mitigation And Conservation Options Analysis

Consistent with the eight conservation options of the OHBG, regarded as appropriate in managing interventions to heritage bridges, and considered in rank order according to the level or degree of intervention from minimum to maximum, Golder has presented the results of impact assessment based on the preferred option being carried forward as part of the MCEA Study and the observed structural condition of the bridge (Golder, 2019).

Below, the results of the consideration of alternatives and mitigation alternatives based on the OHBG conservation options are presented.

Table 5: OHBG Impact Assessment of Lorne Bridge

OHBG CONSERVATION OPTIONS	ADVANTAGE	DISADVANTAGE	COMMENTS
1) Retention of existing bridge with no major modifications undertaken	This option is consistent with the principle of minimal intervention and would retain all of the bridge's heritage attributes in the short-term.	This option would pose a significant public safety concern in the long-term.	This option would likely result in the deterioration of the bridge's heritage attributes, and the eventual closure of the bridge. This option is not a viable option.
2) Retention of existing bridge and restoration of missing or deteriorated elements where physical or documentary evidence (e.g. photographs or drawings) can be used for their design	This conservation option involves little change to the original fabric of the structure, and repairs made based on the historic record.	This option does not address the need to remove the 30-tonne winter limit currently placed on the bridge. Load limit testing may indicate additional modification is required.	As proposed, the recommended alternative is consistent with this option, should load limit testing determine no additional strengthening is required, however, the bridge may also require strengthening as part of the rehabilitation works. This option alone will not be viable should additional strengthening be required to remove the 30-tonne winter load limit, to meet contemporary technical and safety requirements.
3) Retention of existing bridge with sympathetic modification	This option is consistent with the principle of preservation of material to its highest integrity and would maintain some heritage attributes of the bridge. As proposed, modifications to remove the 30-tonne winter load may be required to meet contemporary technical and safety requirements.	Without mitigation, this option will potentially result in alteration that is not sympathetic, or is incompatible, with the historic fabric or appearance of the bridge.	This approach is consistent with the recommended alternative should additional strengthening be required to remove the 30-tonne winter load limit, to meet contemporary technical and safety requirements.
4) Retention of existing bridge with a sympathetically designed new structure in proximity	This option is consistent with the principle of minimal intervention and would retain all the heritage attributes of the bridge. Without intervention, the existing structure will deteriorate resulting in negative impacts to the CHVI of the bridge.	This conservation option is not required, as retention with sympathetic modification (Option 3) is possible. In addition, this option is not viable due to the expense of constructing a new bridge.	This option is not viable due to the expense of maintaining the existing bridge, acquiring additional property and building a new sympathetically designed structure. It is also not required, as Option 3 is viable and is a preferred option. .

OHBG CONSERVATION OPTIONS	ADVANTAGE	DISADVANTAGE	COMMENTS
5) Retention of existing bridge no longer in use for vehicular purposes but adapted for a new use. For example, prohibiting vehicles or restricting truck traffic or adapting for pedestrian walkways, cycle paths, scenic viewing, etc.	This option is consistent with the principle of minimal intervention and would retain all the heritage attributes of the bridge in the short term.	This conservation option is not required, as retention with sympathetic modification (Option 3) is possible. This conservation option alters the use of the bridge from a vehicular bridge to a pedestrian bridge. A pedestrian bridge already exists at the site (Brant's Crossing) and is not required.	This option is not viable and not required, as Option 3 is viable and is a preferred option.
6) Retention of existing bridge as a heritage monument for viewing purposes only	This conservation option retains the bridge *in situ* and retains its scale and massing.	This conservation option is not required, as retention with sympathetic modification (Option 3) is possible.	This option is not viable and not required, as Option 3 is viable and is a preferred option.
7) Relocation of smaller, lighter single span bridges to an appropriate new site for continued use (see 4) or adaptive re-use (see 5)	This option is consistent with the principle of preservation of material to its highest integrity and would maintain most of the bridge's heritage attributes. Given the bridge's concrete construction, moving the bridge intact may not be feasible.	Relocating the bridge would remove its contextual relationship with the crossing. This conservation option is not required, as retention with sympathetic modification (Option 3) is possible.	This option is not viable and not required, as Option 3 is viable and is a preferred option.
8) Bridge removal and replacement with a sympathetically designed structure: **a) Where possible, salvage elements/ members of the bridge for incorporation into a new structure or for future conservation work or displays;** **b) Undertake full recording and documentation of existing structure**	This option allows for the continuance of some contextual and aesthetic features of the bridge, where all other conservation options have been ruled out. This option is only to be considered where no other option is feasible.	Built heritage resources are finite, meaning once gone, they are gone forever. Demolition would result in the loss of all the bridge's heritage attributes. This conservation option is not required, as retention with sympathetic modification (Option 3) is possible.	This option is not viable and not required, as Option 3 is viable and is a preferred option.

Table 6: OHBG Impact Assessment of Brant's Crossing Bridge

OHBG CONSERVATION OPTIONS	ADVANTAGE	DISADVANTAGE	COMMENTS
1) Retention of existing bridge with no major modifications undertaken	This option is consistent with the principle of minimal intervention and would retain all of the bridge's heritage attributes in the short-term.	This option would pose a significant public safety concern in the long-term., and would threaten heritage attributes without intervention.	This option would likely result in the deterioration of the bridge's heritage attributes, and the eventual closure of the bridge.
2) Retention of existing bridge and restoration of missing or deteriorated elements where physical or documentary evidence (e.g. photographs or drawings) can be used for their design	This conservation option involves little change to the original fabric of the structure, and repairs made based on the historic record. This option is also consistent with the County of Wellington Official Plan policy 4.1.5.	This option does not address the bridge's functional/operational deficiencies. A hydrographic assessment (ERI 2021), which determined that at its current elevation "the Brant's Crossing Bridge does not meet design criteria for flooding and ice jamming events in the Grand River; this is evidenced by water and ice rising to the underside of the bridge in recent flooding events (2018 the most recent)"; this poses a risk to public safety (GM BluePlan personal communication, May 2021).	This option is not viable due to concerns related to flooding and ice jamming, and will not meet contemporary technical and safety requirements.
3) Retention of existing bridge with sympathetic modification	This option is consistent with the principle of preservation of material to its highest integrity and would maintain some heritage attributes of the bridge.	The Enhanced Inspection Report, 2018, which details the poor state of repair of the bridge's superstructure and the significant structural investment required to maintain the crossing. The extent of these repairs could reduce the heritage integrity of the superstructure as some badly corroded components would need to be replaced in new steel. A new bridge within the existing was considered as a possibility, but in addition to the structural challenges it would significantly limit the useable pathway over the bridge.	The recommended alternative to replace the Brant's Crossing Bridge superstructure with sympathetic and compatible prefabricated steel trusses outweighs the residual negative impacts since it conserves the historical BN&PB Railway and Grand Trunk Railway crossing site, adaptively re-uses the bridge's substructure, and provides positive social impacts through improvement of the City's active transportation network.

OHBG CONSERVATION OPTIONS	ADVANTAGE	DISADVANTAGE	COMMENTS
4) Retention of existing bridge with a sympathetically designed new structure in proximity	This option is consistent with the principle of minimal intervention and would retain all the heritage attributes of the bridge. Without intervention, the existing structure will deteriorate resulting in negative impacts to the CHVI of the bridge.	This conservation option is not required, as retention with sympathetic modification (Option 3) is possible. In addition, this option is not viable due to the expense of constructing a new bridge.	This option is not viable due to the expense of maintaining the existing bridge, acquiring additional property and building a new sympathetically designed structure. Additionally, the flooding and ice risks remain, even if the bridge is not used. It is also not required, as Option 3 is viable and is a preferred option.
5) Retention of existing bridge no longer in use for vehicular purposes but adapted for a new use. For example, prohibiting vehicles or restricting truck traffic or adapting for pedestrian walkways, cycle paths, scenic viewing, etc.	This option is consistent with the principle of minimal intervention and would retain all the heritage attributes of the bridge in the short term.	This conservation option is not required, as retention with sympathetic modification (Option 3) is possible. This bridge is already a pedestrian bridge.	This option is not viable and not required, as Option 3 is viable and is a preferred option.
6) Retention of existing bridge as a heritage monument for viewing purposes only	This conservation option retains the bridge in situ and retains its scale and massing.	This conservation option is not required, as retention with sympathetic modification (Option 3) is possible.	This option is not viable and not required, as Option 3 is viable and is a preferred option.
7) Relocation of smaller, lighter single span bridges to an appropriate new site for continued use (see 4) or adaptive re-use (see 5)	This option is consistent with the principle of preservation of material to its highest integrity and would maintain most of the bridge's heritage attributes.	Relocating the bridge would remove its contextual relationship with the crossing. This conservation option is not required, as retention with sympathetic modification (Option 3) is possible.	This option is not viable and not required, as Option 3 is viable and is a preferred option.
8) Bridge removal and replacement with a sympathetically designed structure: a) Where possible, salvage elements/ members of the bridge for incorporation into a new structure or for future conservation work or displays; b) Undertake full recording and documentation of existing structure	This option allows for the continuance of some contextual and aesthetic features of the bridge, where all other conservation options have been ruled out. This option is only to be considered where no other option is feasible.	Built heritage resources are finite, meaning once gone, they are gone forever. Demolition would result in the loss of all the bridge's heritage attributes. This conservation option is not required, as retention with sympathetic modification (Option 3) is possible.	This option is not viable and not required, as Option 3 is viable and is a preferred option.

Table 7: OHBG Impact Assessment of TH&B Crossing Bridge

OHBG CONSERVATION OPTIONS	ADVANTAGE	DISADVANTAGE	COMMENTS
1) Retention of existing bridge with no major modifications undertaken	This option is consistent with the principle of minimal intervention and would retain all of the bridge's heritage attributes in the short-term.	Given the bridge's current state of disrepair, this option would pose a significant public safety concern in the long-term.	This option would likely result in the deterioration of the bridge's heritage attributes, and the eventual closure of the bridge.
2) Retention of existing bridge and restoration of missing or deteriorated elements where physical or documentary evidence (e.g. photographs or drawings) can be used for their design	This conservation option retains the bridge's heritage attributes over the short term, is consistent with the identified recommended alternative, involves little change to the original fabric of the structure, and repairs made based on the historic record.	Over the long term the solution is less optimal since it neither arrests the bridge's decay nor takes action to prevent the superstructure from full or partial loss through an ice jam event. Nevertheless, it does commit to retaining the superstructure, which is considered a key heritage attribute dating to the late 19th century,and reflects an increasingly acceptable "curated decay" approach for cultural heritage that recognizes not all resources can be practically preserved. This approach also recognizes that opportunities to understand and appreciate aspects of tangible cultural heritage can be gained through passively observing decline rather than embarking on extensive and potentially inauthentic rehabilitation or restoration projects.	This option is consistent with the recommended alternative, no additional mitigation is required.
3) Retention of existing bridge with sympathetic modification	This option is consistent with the principle of preservation of material to its highest integrity and would maintain some heritage attributes of the bridge.	This conservation option is not required, as retention with sympathetic restoration (Option 2) is possible.	This conservation option is not required, as retention with sympathetic modification (Option 2) is possible.
4) Retention of existing bridge with a sympathetically designed new structure in proximity	This option is consistent with the principle of minimal intervention and would retain all the heritage attributes of the bridge. Without intervention, the existing structure will deteriorate resulting in negative impacts to the CHVI of the bridge.	This conservation option is not required, as retention with sympathetic restoration (Option 2) is possible.	This option is not viable due to the expense of maintaining the existing bridge, acquiring additional property and building a new sympathetically designed structure. Additionally, the flooding and ice risks remain, even if the bridge is not used. It is also not required, as Option 2 is viable and is a preferred option.

OHBG CONSERVATION OPTIONS	ADVANTAGE	DISADVANTAGE	COMMENTS
5) Retention of existing bridge no longer in use for vehicular purposes but adapted for a new use. For example, prohibiting vehicles or restricting truck traffic or adapting for pedestrian walkways, cycle paths, scenic viewing, etc.	This option is consistent with the principle of minimal intervention and would retain all the heritage attributes of the bridge in the short term.	This conservation option is not required, as retention with sympathetic restoration (Option 2) is possible. This bridge is already a pedestrian bridge.	This option is not viable and not required, as Option 2 is viable and is a preferred option.
6) Retention of existing bridge as a heritage monument for viewing purposes only	This conservation option retains the bridge in situ and retains its scale and massing.	This conservation option is not required, as retention with sympathetic restoration (Option 2) is possible.	This option is not viable and not required, as Option 2 is viable and is a preferred option.
7) Relocation of smaller, lighter single span bridges to an appropriate new site for continued use (see 4) or adaptive re-use (see 5)	This option is consistent with the principle of preservation of material to its highest integrity and would maintain most of the bridge's heritage attributes.	Relocating the bridge would remove its contextual relationship with the crossing. This conservation option is not required, as retention with sympathetic modification (Option 2) is possible.	This option is not viable and not required, as Option 2 is viable and is a preferred option.
8) Bridge removal and replacement with a sympathetically designed structure: a) Where possible, salvage elements/ members of the bridge for incorporation into a new structure or for future conservation work or displays; b) Undertake full recording and documentation of existing structure	This option allows for the continuance of some contextual and aesthetic features of the bridge, where all other conservation options have been ruled out. This option is only to be considered where no other option is feasible. This option may be considered at a later date, following the useful life of the bridge, in an estimated 10 to 15 years.	Built heritage resources are finite, meaning once gone, they are gone forever. Demolition would result in the loss of all the bridge's heritage attributes. This conservation option is not required, as retention with sympathetic restoration (Option 2) is possible.	This option is not viable and not required, as Option 2 is viable and is a preferred option. The proposed maintenance work will maintain the structure for approximately 10 to 15 years, after which time an additional HIA should be completed for any removal or demolition proposed.

6.3.2 Results of the Consideration of Alternatives and Mitigation Recommendations

For the first three identified impacts, all negative effects can be fully mitigated. For the Lorne Bridge and Brant's Crossing Bridge substructures, undertaking sensitive repair and rehabilitation, Option 3 of the OHBG Impact Assessment, as part of the recommended alternative will meet the principles outlined in both the MHSTCI *Eight Guiding Principles in the Conservation of Historic Properties* and the standards of the Canada's Historic Places *Standards and Guidelines for the Conservation of Historic Places in Canada.* Therefore, no alternatives were considered to avoid these impacts.

For the Brant's Crossing Bridge, numerous options were rigorously considered as part of the alternatives evaluation (APPENDIX A). These were informed by the Enhanced Inspection Report from 2018, which details the poor state of repair for the bridge's superstructure and the significant structural investment required to maintain the crossing (APPENDIX B). The extent of these repairs could reduce the heritage integrity of the superstructure as some badly corroded components would need to be replaced in new steel. A new bridge within the existing was considered as a possibility, but in addition to the structural challenges it would significantly limit the useable pathway over the bridge.

The alternatives evaluation was also informed by a hydrographic assessment (ERI 2021), which determined that at its current elevation "the Brant's Crossing Bridge does not meet design criteria for flooding and ice jamming events in the Grand River; this is evidenced by water and ice rising to the underside of the bridge in recent flooding events (2018 the most recent)"; this poses a risk to public safety (GM BluePlan personal communication, May 2021).

Even if the Brant's Crossing Bridge was raised —an effort involving significant structural challenges as well as risk of damage to superstructure and substructure— and substantial repairs were attempted, the aging steel bridge may still deteriorate to the point where it would become unsafe for active transportation. By this point, the bridge's original fabric could be so deteriorated that it would not survive a relocation and repurposing.

For these reasons, the recommended alternative, Option 3 of the OHBG Impact Assessment, to replace the Brant's Crossing Bridge superstructure elements with sympathetic and compatible prefabricated steel trusses outweighs the residual negative impacts since it conserves the historical BN&PB Railway and Grand Trunk Railway crossing site, adaptively re-uses the bridge's substructure, and provides positive social impacts through improvement of the City's active transportation network.

For the TH&B Crossing Bridge, the recommended alternative, Option 2 of the OHBG Impact Assessment, follows in the short term the principles of the MHSTCI *Eight Guiding Principles in the Conservation of Historic Properties* and standards of the Canada's Historic Places *Standards and Guidelines for the Conservation of Historic Places in Canada*. Over the long term the solution is less optimal since it neither arrests the bridge's decay nor takes action to prevent the superstructure from full or partial loss through an ice jam event. Nevertheless, it does commit to retaining the superstructure, which is considered a key heritage attribute dating to the late 19th century, and reflects an increasingly acceptable "curated decay" approach for cultural heritage that recognizes not all resources can be practically preserved. This approach also recognizes that opportunities to understand and appreciate aspects of tangible cultural heritage can be gained through passively observing decline rather than embarking on extensive and potentially inauthentic rehabilitation or restoration projects (Desilvey 2017). Therefore, no other alternatives were considered to avoid the impacts identified for the TH&B Crossing Bridge. Should removal of the bridge be proposed in 10-15 years, an additional HIA should be completed to assess impacts at that time.

6.4 Summary of Community Engagement

Table 8 provides a summary of the results of community engagement regarding the cultural heritage interests, concerns and/or impacts used to inform this HIA.

Table 8: Results of community engagement

Contact	Request	Response
Patrick Vusir CPT Planner, Long Range Planning City of Brantford	May 15, 2020 – Meeting request via email and to confirm all available information sources identified by the City were provided to GM BluePlan. June 10 – Inquired via email if the City had a copy of the Heritage Resources Centre (University of Waterloo) *Lorne Bridge Designation Report* 2009	May 21 – Remote meeting. Discussed sources provided to GM BluePlan, other possible sources and suggested to contact Lance Brown at TH&B Historical Society May 25 – provided relevant historical and secondary sources including the 2016 *Cultural Heritage Landscape Feasibility Study for the Mohawk Canal and Alfred Watts Hydrogenerating Station Ruins*. Patrick also noted that there was no additional material on file regarding Indigenous land use in the study area during the historical period, nor information on City engineer Frank P. Adams. June 9 – provided the 1923 and 1979 drawings for the Lorne Bridge. June 10 – responded that there were no electronic copies of the *Lorne Bridge Designation Report* on file at the City
Canadian Industrial Heritage Centre (CIHC), Brantford	May 15 – general request via email for information on the three bridges in the study area	May 26 – email response from Jean Farquharson with advice to contact Bill Darfler (CIHC director and local historian)
Lance Brown, Archivist, TH&B Historical Society	May 25 – request for general information on the TH&B Crossing Bridge June 2 – July 2 – follow-up correspondence re: information provided May 28	May 28 – Provided summaries of the Grand River Bridge and Locks Bridge and CN Rail elevation and section drawings of both structures. June 2, June 2 – responses to follow up questions
William Darfler CIHC director and local historian	May 26 – request for meeting	May 26 – Remote meeting. Discussed Brant's Ford and importance of local physiography to understand crossings. Suggested contacting Jack Jackowetz and Ruth Lefler.

Contact	Request	Response
Jack Jackowetz, Artist and local historian	May 26 – request for general information on study area May 27-July 17 – follow-up email correspondence re: information provided	May 27 – Provided via email historical summaries of the Brantford, Norfolk & Port Burwell Railway, Toronto, Hamilton & Buffalo Railway, and Lorne Bridge. May 29 – provided historical photograph of the Lake Erie and Northern (LE&N)/ Canadian National Railway (CNR) Crossing sent by Ken Chrysler (Brant Railway Heritage Society) June 29 – provided 1919 aerial image of the study area June 17 – relayed permission from Ken Chrysler to use selected images posted on the Brant Railway Heritage Society
Ruth Lefler Local historian	May 26 – request for general information on study area	May 30 – response that only information in collection about the three bridges is limited to what is found in local books June 1 – upon request provided text of “Walking Tour Around the Armoury and Jubilee Terrace Park” published in the *Brantford Expositor.*
Nathan Etherington Program & Community Coordinator Brant Museum & Archives 57 Charlotte Street Brantford	June 4 – request via email for sources and citations for information presented in the “Three Bridges” powerpoint presentation provided to GM BluePlan.	June 4 – remote meeting to discuss information request. June 11 – follow up email with further sources
Dr. Michael Drescher, Associate Professor School of Planning, Academic Officer Undergraduate; School of Planning Director; Heritage Resources Centre, Faculty of Environment, University of Waterloo	June 5, 2020 – request via email for a copy of the *Lorne Bridge Designation Report*, 2009	June 16 – Responded that the report was authored by individuals who no longer with the HRC and that a physical copy is not accessible at the University of Waterloo due to the pandemic.
PIC #1	June 17th 2020 - Online	Due to the COVID-19 pandemic, the City hosted a virtual PIC. This first PIC provided an overview of the project, including the Environmental Assessment (EA) process, alternative solutions being considered, and criteria used to evaluate the alternatives.

Contact	Request	Response
PIC #2	March and April 2021 - Online	Due to the COVID-19 pandemic, PIC 2 was held virtually. This PIC presented the existing conditions, evaluation of alternative solutions, and the recommended solution. Virtual Public Information Centre 2 Schedule ▪ Thursday, March 18, 2021 at 3:00 p.m. – Presentation slides posted ▪ Thursday, April 1, 2021 at 6:00 p.m. – Virtual live PIC #2 ▪ Thursday, April 1, 2021 to Thursday, April 15, 2021 – Two-week question submission period ▪ Thursday, April 22, 2021 at 3:00 p.m. – Frequently Asked Questions (FAQ) document posted
PIC # 3	October and November 2021	Due to the COVID-19 pandemic, PIC 3 was held virtually. This PIC presented the existing conditions, evaluation of alternative solutions, and the recommended solution. This PIC's Frequently Asked Questions are available for review. Virtual Public Information Centre 3 Schedule ▪ Thursday, October 14, 2021 at 3:00 p.m. – Presentation slides posted ▪ Thursday, October 21, 2021 at 6:00 p.m. – Virtual live PIC #3 ▪ Thursday, November 4, 2021 – Question submission period ends ▪ Thursday, November 11, 2021 at 3:00 p.m. – Frequently Asked Questions (FAQ) document posted

6.5 Recommendations

To avoid or substantially reduce the identified negative impacts identified in Section 6.3.2, Golder recommends the following mitigation measures for each bridge to be implemented at the design, construction, or operation phases:

6.5.1 Lorne Bridge

Design Phase

- Prepare a Heritage Conservation Plan (HCP) that outlines the measures required to sensitively repair and rehabilitate the Lorne Bridge and how the CHVI and heritage attributes of the structure will be protected, conserved, and enhanced
  - The HCP should include measures to ensure appropriate concrete repair and the gentlest means possible for surface cleaning and provide guidance to ensure the thickening the top of the concrete arches, constructing additional ribs on the interior, and adding fibre-reinforced polymer fabrics to the soffit is compatible with the historic fabric and appearance of the Lorne Bridge.

Construction Phase

- Implement site control and communication
  - Clearly mark on project mapping the location of all heritage attributes and communicate this to project personnel prior to mobilization
- Photo-document the work areas prior to any intervention and keep a centralized record of all work performed during the construction phase.
  - This may be aided by initiating a Building Information Modelling (BIM) system
- Create physical buffers
  - Erect temporary fencing or physical barriers near the bifurcated stairs on the north side of the west approach to prevent accidental damage to the features of this heritage attribute
- Monitor for vibration impact during construction
  - Conduct ground vibration monitoring during work on the bridge deck. The monitoring should use a digital seismograph capable of measuring and recording ground vibration intensities in digital format in each of three (3) orthogonal directions. This instrument should also be equipped with a wireless cellular modem for remote access and transmission of data.
  - The installed instrument should be programmed to record continuously, providing peak ground vibration levels at a specified time interval (e.g., 5 minutes) as well as waveform signatures of any ground vibrations exceeding a threshold level that would be determined during monitoring (e.g., between 6-12 mm/s). The instrument should also be programmed to provide a warning should the peak ground vibration level exceed the guideline limits specified. In the event of either a threshold trigger or exceedance warning, data would be retrieved remotely and forwarded to designated recipients.
  - If vibration has exceeded the guideline limits specified, a stop work order should be issued immediately and the bridge substructure promptly inspected for any indication of disruption or damage. If identified, the evidence of disturbance or damage should be documented, then closely monitored during construction for further change in existing conditions. Once work is complete, a post-construction vibration monitoring report or technical memorandum should be prepared to document the condition of the heritage attributes of the substructure and recommend appropriate repairs, if necessary.

Operation Phase

- Add the bridge's heritage attributes into annual inspection and maintenance planning
- As much as is practicable, limit use of de-icing salts in the vicinity of the bifurcated stairs on the north side of the west approach and periodically monitor the condition of this feature's surfaces for impact from salt damage. In the event damage is noted, take immediate action such as treatment with a salt repellant or switch to a calcium or magnesium chloride product.

6.5.2 Brant's Crossing Bridge

Design Phase

- Compile a thorough as-built record of the structure with photo-documentation and measured drawings following guidelines such as those developed by the Historic American Engineering Record (HAER)
- Design the replacement superstructure to be compatible (but not mimic) in scale and material with the existing Brant's Crossing Bridge
  - The new spans should be steel through trusses built in square components similar to those in Figure 76 and Figure 77.
- Salvage one of the two through trusses and conserve as an interpretive feature in the adjacent parkland, preferably a site on the east side of the Grand River near the Brant's Crossing Bridge substructure and associated with the former LE&N rail line
  - If one of the trusses is relocated and conserved, it will provide a tangible means to present the story of Brantford's historical river crossings by Indigenous and later settlers, the City's industrial heritage including reference to the role of Indigenous craftsmen in the "high steel" trades (potentially linked to the TH&B Bridge), and to introduce the principles of bridge engineering (cf. Lutenegger 2019). Similar bridge relocation and conservation efforts have been undertaken around the world, including in Canada and the United States, where they have served to encouraged public interaction with a historical structure and greater understanding of engineering heritage (see Figure 81). By relocating the truss to a site near the Brant's Crossing Bridge substructure the risk of indirect impact through isolation will be reduced.
- Prepare a Heritage Conservation Plan (HCP) that outlines measures to guide lifting, relocating, siting, installing, and conserving the truss as well as how it will be interpreted. The HCP should also address how the CHVI and heritage attributes of the Brant's Crossing Bridge substructure will be protected, conserved, and enhanced.

Construction Phase

- Photo-document the superstructure dismantling, as well as the truss relocation and installation process, if pursued
- Photo-document the substructure work areas prior to any intervention and keep a centralized record of all work performed during the construction phase.
  - This may be aided by initiating a Building Information Modelling (BIM) system
- In keeping with Golder's corporate policies to encourage environmentally sustainable solutions, salvage for re-use as many components of the superstructure as possible

Operation Phase

- Add the bridge’s heritage attributes into annual inspection and maintenance planning
- If a truss is relocated to the adjacent parkland, develop a maintenance plan to ensure the truss is conserved over the long-term

Figure 81: Example of a relocated truss bridge. The Swansea Slip Bridge in Swansea, Wales dates to 1914 and was relocated intact to a public park in 2004 (Dalling 2018)

6.5.3 TH&B Crossing Bridge

Design Phase

- Compile a thorough as-built record of the structure with photo-documentation and measured drawings following guidelines such as those developed by the Historic American Engineering Record (HAER)

Construction Phase

- Photo-document the work areas prior to any intervention and keep a centralized record of all work performed during the minor rehabilitation phase.
  - This may be aided by initiating a Building Information Modelling (BIM) system

Operation Phase

- Add the bridge’s heritage attributes into annual inspection and maintenance planning

6.5.4 Brantford Crossings CHL

Design Phase

- Prepare a comprehensive interpretive plan that identifies the themes, locations, key messages, and approaches and methods to convey the significance of the CHL
- Add the small-scale heritage attributes of the CHL into annual inspection and maintenance planning

7.0 SUMMARY STATEMENT

Following applicable federal, provincial, and municipal guidance combined with analysis conducted for a comprehensive CHER, this HIA has assessed the potential impacts of the recommended alternatives on the Lorne Bridge, Brant's Crossing Bridge, and TH&B Crossing Bridge, as well as the Brantford Bridges CHL. It has determined that without mitigation the recommended alternatives will potentially result in a variety of negative impacts ranging in magnitude from negligible to major, which are summarized in Section 6.3. To avoid or reduce these adverse effects, Golder has recommended that the City implement a number of conservation or mitigation strategies, outlined in Section 6.3.2.

If the City commits to implement these mitigation strategies, Golder recommends that:

- **the recommended alternatives be approved as currently proposed.**

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Signature Page

We trust that this report meets your current needs. If you have any questions, or if we may be of further assistance, please contact the undersigned.

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APPENDIX A

The Grand River Crossings Municipal Class EA – Virtual Public Information Centre Presentation, City of Brantford, April 2021

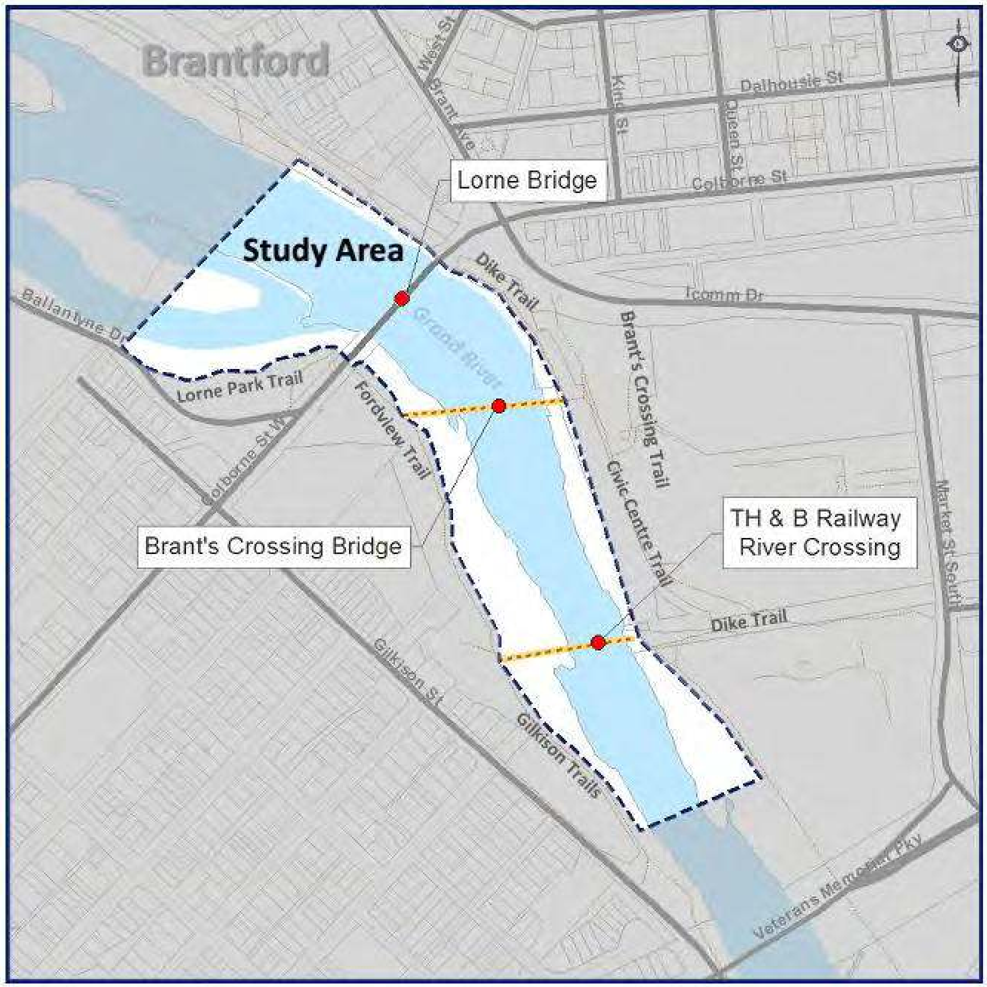
CITY OF BRANTFORD

THREE GRAND RIVER CROSSINGS

MUNICIPAL CLASS EA

Virtual Public Information Centre
April 2021

Project Overview and Background



The City of Brantford is conducting a Municipal Class Environmental Assessment (MCEA) to review alternatives for three bridges over the Grand River, including the Lorne Bridge, Brant's Crossing Bridge and the TH&B Crossing Bridge.

The purpose of this Virtual Public Information Centre (PIC) is to present the existing conditions, evaluation, and recommended solution and offer an opportunity for interested parties to review and provide comments to the Project Team.

Information of the Project Study Area is available at:

www.brantford.ca/threegrandrivercrossings

Project Overview and Background

Municipal Class Environmental Assessment Process

- This study is being undertaken as a Schedule "B" Municipal Class Environmental Assessment.
  - Two phase planning process under the Ontario EA Act.
  - Primary goal is to minimize, mitigate, or avoid impacts on the community and surrounding environment.

Phase 1:
Problem or Opportunity

1. Identify problem and/or opportunity.
2. Issue Notice of Study Commencement.

Phase 2:
Alternative Solutions

1. Develop alternative solutions to the problem and/or opportunity.
2. Public Information Centre #1.
3. Inventory natural, social, and economic environments.
4. Evaluate alternative solutions
5. Identify recommended solutions
6. Select recommended solution.
7. **Public Information Centre #2.**
8. Review and confirm choice of schedule.

We are here

Description of Existing Structures

Lorne Bridge

- Three unique structures, the oldest of which was originally built in 1924
- No formal cycling lane in the roadway and cyclists typically share the sidewalk with pedestrians
- Requires 30 tonne load limit in winter months
- Requires major structural repairs to maintain the crossing

Brant's Crossing Bridge

- Originally built in 1912 to convey railway traffic and has been converted to carry pedestrian traffic
- Closed since February 2018 following a flooding and ice jam event
- Minor rehabilitation required to open the bridge; however, to remain open beyond approximately 3-5 years, major structural repairs are necessary

TH&B Crossing Bridge

- Originally built in 1893 as a rail crossing bridge but has been converted to carry pedestrian and cyclist traffic
- Was temporarily closed following 2018 ice jam event but later reopened following a structural investigation
- For this structure to remain open beyond approximately 5-10 years, major repairs are necessary

More information about the existing structures is available at:

www.brantford.ca/threegrandrivercrossings

Project Triggers and Objectives

This Class EA study was initiated to identify long-term, holistic solutions to address:

- Deteriorating condition and age-related concerns of the existing structures; and
- Pedestrian, cyclist and vehicular connectivity needs, including those in the Transportation Master Plan.

This Class EA study will:

- Consider a reasonable range of appropriately planned potential solutions;
- Consider potential impacts to social, natural, technical and economic environments;
- Select a preferred solution through a transparent decision-making process; and,
- Encourage public participation throughout the process.

Problem / Opportunity Statement

A) Problem:

- Structural investigations have identified the need for structural repairs to each of the Three Grand River Crossings.

B) Opportunity:

- The City plans to identify the short and long-term plans for the three Grand River crossings. The study will include determining the feasibility of removing the winter load limit on Lorne Bridge and the need for one or both of the TH&B Crossing Bridge and Brant's Crossing Bridge based on an assessment of the technical, economic, social and natural environmental factors, including impacts to the active transportation network and the risks of future flooding events of the Grand River.

Existing Conditions – Archaeology & Cultural Heritage

Archaeological Assessment

- Previously disturbed; no further assessment required
- Marine Archaeology Assessment recommended prior to development impacts
- 19th Century Grand River course; permanently wet; no further assessment required
- Stage 2 Archaeological Assessment recommended prior to development impacts

Cultural Heritage Landscape Features

1. Lorne Park with Plaques and interpretive panels
2. Brantford Canoe Club Clubhouses
3. Brantford Armoury, Boer War Monument, & Brant County War Memorial
4. LE&N Railway Station & lines / canal entrance
5. Dam spillway
6. LE&N Rail line
7. Hydro line pylons
8. Presumed line of Brant's crossing
9. TH&B Railway line
10. LE&N Bridge abutments
11. BSAR Bridge (Veteran's Memorial Parkway Bridge)

Existing Conditions – Natural Environment

Vegetative Communities

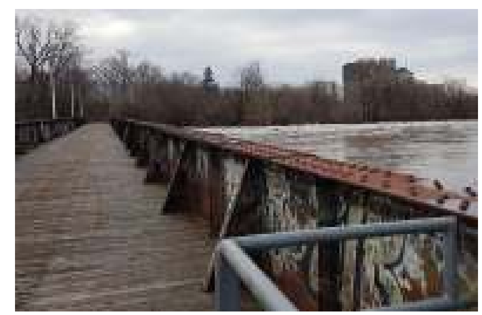
Summary of Natural Environment Features

Natural Environment Feature	Description
Significant Valleyland / Environmental Control Policy Area	• Grand River valleyland
Significant Wildlife Habitat	• Habitat for monarch and common nighthawk – marsh (MAM-2, MAM2-9) • Habitat for eastern wood-pewee – Lowland Deciduous Forest (FOD7) • Habitat for snapping turtle – Grand River • Regional wildlife corridor – Grand River valleyland • Regionally significant Waterfowl Winter Concentration Area – Grand River
Species at Risk – Endangered or Threatened	• Habitat for tri-colored bat (endangered) – Lowland Deciduous Forest (FOD7) • Habitat for queensnake (endangered) and eastern small-footed myotis (endangered) – Grand River and banks • Habitat for little brown myotis (endangered) and chimney swift (threatened) – structures within study area of Lorne Bridge and TH&B Crossing Bridge
Grand River Conservation Authority (GRCA) Regulated Areas	• Grand River • Unevaluated wetland (MAM2-2)
Fish Habitat	• Grand River

Existing Conditions – Hydraulic Impact Study

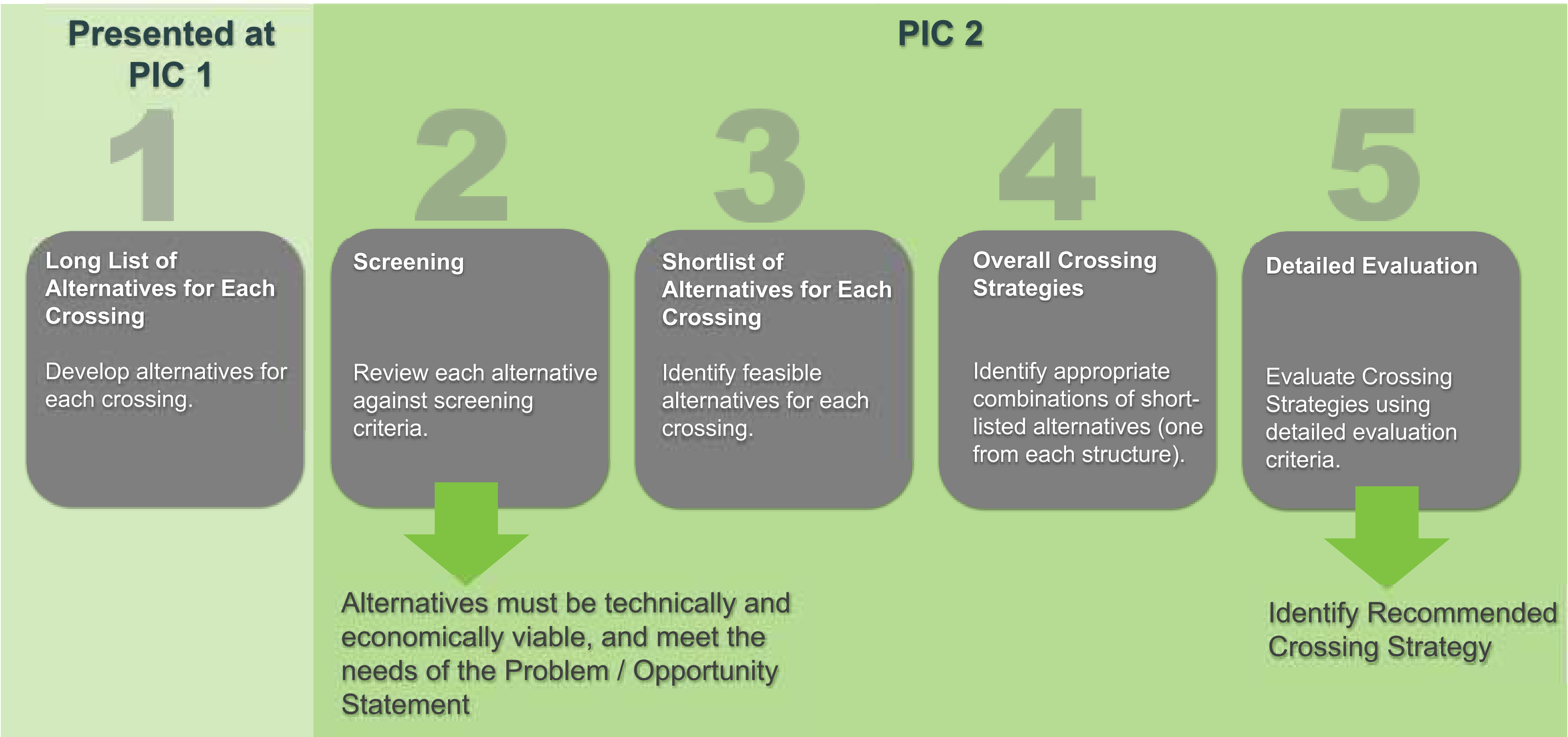
What are the impacts of ice jams and flooding events on each of the crossings?

- A Hydraulic Impact Study was completed to review the flood behaviour of the Grand River in the vicinity of the three existing bridge crossings and to identify opportunities to enhance hydraulic function of each crossing.
- The Hydraulic Impact Study concluded that:
  - The **Lorne Bridge** meets hydraulic evaluation criteria under both 100-year return period for open water flow and ice jam events. No hydraulic improvement opportunities were present.
  - Both **Brant's Crossing and TH&B Crossing Bridges** are acceptable under 10-year return period open flow events, but not under ice jam conditions. Opportunity to enhance hydraulic performance during ice jam events by raising each bridge by approximately 0.8 m.



Photos from the 2018 Ice Jam Event

Alternative Solutions – Evaluation Framework



Shortlisting of Alternatives: Lorne Bridge

Category	Criterion	Rehabilitate	Replace
Social	Property Impacts	↑	↓
	Impacts to Connectivity	↔	↑
	Impacts of Construction	↔	↓
	Public Health & Safety	↔	↑
	Aesthetics	↑	↓
	Cultural Heritage Resources	↑	↓
Natural	Terrestrial Wildlife & Vegetation	↑	↓
	Aquatic Wildlife & Vegetation	↑	↓
Technical	Design	↔	↑
	Transportation	↔	↑
	Constructability	↔	↓
Economic	Initial Capital Cost (2021 Dollars)	$8.3M	$19M to $37M
	Lifecycle Costs (2021 Dollars)	$33M	$45M to $87M
Summary		Shortlisted	Not Shortlisted

Shortlisted Alternative:
***Rehabilitate* Lorne Bridge**

- Shorter construction duration and requires a smaller construction footprint than replacement, therefore, rehabilitation would pose fewer potential negative impacts to the natural and social environments since the construction would not disturb new areas.
- Estimated to be less costly than replacement.

Note: Rehabilitation will extend the service life of this structure by approximately 25 years, but it will ultimately need to be replaced beyond that time frame. This has been factored in to the 75-year lifecycle cost.

↓	↔	↑
Least Beneficial / Highest Negative Impact	Neutral / Moderate Benefit	Most Beneficial / Lowest Negative Impact

Shortlisting of Alternatives: Lorne Bridge

Category	Criterion	Rehabilitate	Replace
Social	Property Impacts	↑	↓
	Impacts to Connectivity		
	Impacts of Construction		
	Public Health & Safety		
	Aesthetics		
	Cultural Heritage Resources		
Natural	Terrestrial Wildlife & Vegetation	↑	↓
	Aquatic Wildlife & Vegetation		
Technical	Design	↔	↑
	Transportation		
	Constructability		
Economic	Initial Capital Cost (2021 Dollars)	$8.3M	$19M to $37M
	Lifecycle Costs (2021 Dollars)	$33M	$45M to $87M
Summary		Shortlisted	Not Shortlisted

Shortlisting of Alternatives: Brant's Crossing Bridge

Category	Criterion	Decommission		Rehabilitate		Replace & Raise
		Close	Remove	Rehabilitate	Rehabilitate & Raise	
Social	Property Impacts	↔	↔	↔	↔	↔
	Impacts to Connectivity	↓	↓	↔	↔	↑
	Impacts of Construction	↔	↔	↓	↓	↓
	Public Health & Safety	↓	↑	↑	↑	↑
	Aesthetics	↔	↓	↑	↑	↔
	Cultural Heritage Resources	↔	↓	↑	↑	↔
Natural	Terrestrial Wildlife & Vegetation	↑	↔	↔	↔	↔
	Aquatic Wildlife & Vegetation	↑	↓	↔	↔	↔
Technical	Design	↓	↑	↓	↑	↑
	Transportation	↓	↓	↑	↑	↑
	Constructability	↑	↔	↔	↓	↓
Economic	Initial Capital Cost (2021 Dollars)	$0.3M	$0.7M	$1.0M	$2.3M	$3.7M
	Lifecycle Costs (2021 Dollars)	$1.0M	$0.7M	$6.4M	$7.7M	$5.5M
Summary		Not Shortlisted	Not Shortlisted	Shortlisted	Shortlisted	Shortlisted

Shortlisted Alternatives: Both *Rehabilitate* Alternatives and *Replace*

- Maintains connectivity
- Maintains views from the crossing
- Improves public health and safety
- Maintains general aesthetics of the area
- Replacement would allow for delineated pedestrian and cycling lanes over bridge
- Decommission has much smaller initial and lifecycle costs

Shortlisting of Alternatives: Brant's Crossing Bridge

Category	Criterion	Decommission		Rehabilitate		Replace & Raise
		Close	Remove	Rehabilitate	Rehabilitate & Raise	
Social	Property Impacts Impacts to Connectivity Impacts of Construction Public Health & Safety Aesthetics Cultural Heritage Resources	↓	↓	↔	↔	↔
Natural	Terrestrial Wildlife & Vegetation Aquatic Wildlife & Vegetation	↑	↓	↔	↔	↔
Technical	Design Transportation Constructability	↓	↔	↔	↑	↑
Economic	Initial Capital Cost (2021 Dollars)	$0.3M	$0.7M	$1.0M	$2.3M	$3.7M
	Lifecycle Costs (2021 Dollars)	$1.0M	$0.7M	$6.4M	$7.7M	$5.5M
Summary		Not Shortlisted	Not Shortlisted	Shortlisted	Shortlisted	Shortlisted

Shortlisting of Alternatives: TH&B Crossing Bridge

Category	Criterion	Decommission		Rehabilitate			Replace & Raise
		Close	Remove	Minor Rehab and Eventual Removal	Rehabilitate	Rehabilitate & Raise	
Social	Property Impacts	↔	↔	↔	↔	↔	↔
	Impacts to Connectivity	↓	↓	↔	↑	↑	↑
	Impacts of Construction	↔	↔	↔	↓	↓	↓
	Public Health & Safety	↓	↑	↑	↑	↑	↑
	Aesthetics	↔	↓	↔	↑	↑	↑
	Cultural Heritage Resources	↔	↓	↔	↑	↑	↓
Natural	Terrestrial Wildlife & Vegetation	↑	↔	↔	↔	↔	↓
	Aquatic Wildlife & Vegetation	↑	↓	↔	↔	↔	↓
Technical	Design	↓	↑	↑	↓	↑	↑
	Transportation	↓	↓	↔	↑	↑	↑
	Constructability	↑	↔	↑	↔	↓	↓
Economic	Initial Capital Cost (2021 Dollars)	$0.3M	$0.7M	$0.3M	$0.6M	$1.9M	$3.2M
	Lifecycle Costs (2021 Dollars)	$1.0M	$0.7M	$1.0M	$6.4M	$7.8M	$8.1M
Summary		Not Shortlisted	Not Shortlisted	Shortlisted	Shortlisted	Shortlisted	Not Shortlisted

Shortlisted Alternatives: All “*Rehabilitate*” Alternatives

- Shorter construction duration and a smaller construction footprint than replacement.
- Cultural heritage value retained (until future replacement or decommissioning).
- Fewer potential negative impacts to the natural and social environments since the construction would not disturb new areas.

Shortlisting of Alternatives: TH&B Crossing Bridge

Category	Criterion	Decommission		Rehabilitate			Replace & Raise
		Close	Remove	Minor Rehab and Eventual Removal	Rehabilitate	Rehabilitate & Raise	
Social	Property Impacts Impacts to Connectivity Impacts of Construction Public Health & Safety Aesthetics Cultural Heritage Resources	↓	↓	↑	↑	↑	↔
Natural	Terrestrial Wildlife & Vegetation Aquatic Wildlife & Vegetation	↑	↓	↔	↔	↔	↓
Technical	Design Transportation Constructability	↓	↔	↑	↔	↑	↑
Economic	Initial Capital Cost (2021 Dollars)	$0.3M	$0.7M	$0.3M	$0.6M	$1.9M	$3.2M
	Lifecycle Costs (2021 Dollars)	$1.0M	$0.7M	$1.0M	$6.4M	$7.8M	$8.1M
Summary		Not Shortlisted	Not Shortlisted	Shortlisted	Shortlisted	Shortlisted	Not Shortlisted

Shortlisting of Alternatives: New Pedestrian & Cyclist Crossing Bridge

Category	Criterion	Do Not Construct New Crossing	Construct New Crossing
Social	Property Impacts	↔	↔
	Impacts to Connectivity	↔	↔
	Impacts of Construction	↔	↔
	Public Health & Safety	↔	↑
	Aesthetics	↔	↔
	Cultural Heritage Resources	↔	↓
Natural	Terrestrial Wildlife & Vegetation	↑	↓
	Aquatic Wildlife & Vegetation	↑	↓
Technical	Design	↔	↑
	Transportation	↔	↔
	Constructability	↔	↓
Economic	Initial Capital Cost (2021 Dollars)	$0	$4.5M
	Lifecycle Costs (2021 Dollars)	$0	$11M
Summary		Shortlisted	Not Shortlisted

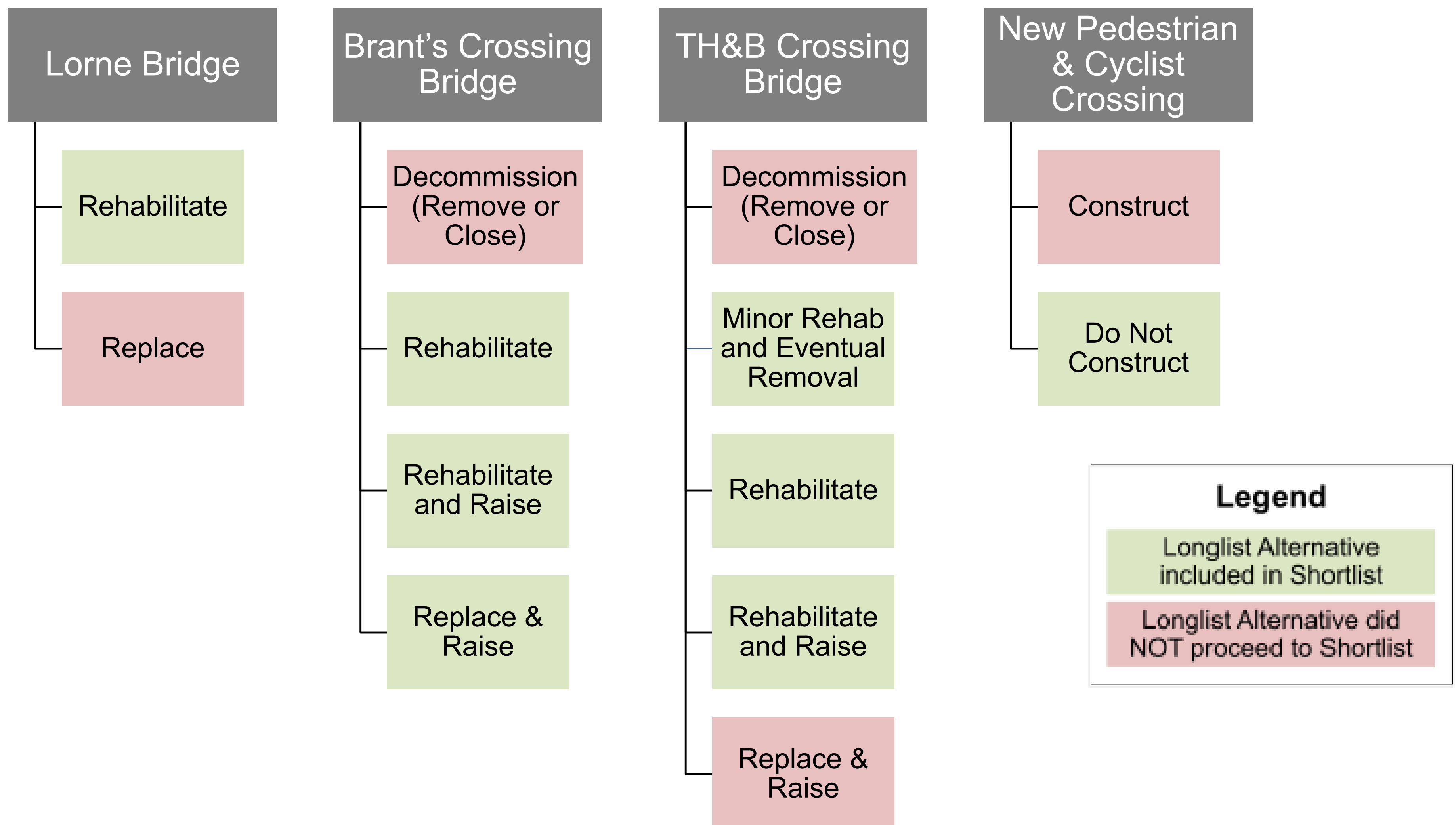
Shortlisted Alternative:
Do Not Construct New Crossing

- Lower impacts related to social, natural, technical, and economic considerations compared to constructing a new crossing

Shortlisting of Alternatives: New Pedestrian & Cyclist Crossing Bridge

Category	Criterion	Do Not Construct New Crossing	Construct New Crossing
Social	Property Impacts	↔	↔
	Impacts to Connectivity		
	Impacts of Construction		
	Public Health & Safety		
	Aesthetics		
	Cultural Heritage Resources		
Natural	Terrestrial Wildlife & Vegetation	↑	↓
	Aquatic Wildlife & Vegetation		
Technical	Design	↔	↔
	Transportation		
	Constructability		
Economic	Initial Capital Cost (2021 Dollars)	$0	$4.5M
	Lifecycle Costs (2021 Dollars)	$0	$11M
Summary		Shortlisted	Not Shortlisted

Alternatives for Each Crossing



Initial Capital and 75-Year Lifecycle Costs for Short-Listed Alternatives

Capital cost estimates listed below are high level, intended to be used for comparison of alternatives only. A more detailed cost estimate will be prepared for the recommended solution toward the end of this Class EA.

Capital Expenditure (2021 $)	**Lorne Bridge**	**Brant's Crossing Bridge**			**TH&B Crossing Bridge**		
	Rehabilitate	Rehabilitate	Rehabilitate & Raise	Replace & Raise	Minor Rehab and Eventual Removal	Rehabilitate	Rehabilitate & Raise
Year 0 (Initial Capital)	$8.3M	$1.0M	$2.3M	$3.7M	$0.3M	$0.6M	$1.9M
Year 25	+ $3.7M (Rehabilitation)	+$4.5M (Replacement)	+$4.5M (Replacement)	$0.3M (Rehabilitation)	+$0.7M (Removal at Year 15)	+$1.0M (Rehabilitation)	+$1.0M (Rehabilitation)
Year 50	+ $19M or + $37M* (Replacement)	+$0.5M	+$0.5M	$1.0M (Rehabilitation)	N/A	+$4.5M (Replacement)	+$4.5M (Replacement)
Year 75	+ $2M or + $4M* (Rehabilitation)	N/A (Maintenance Only)	N/A (Maintenance Only)	$0.5M (Rehabilitation)	N/A	N/A (Maintenance Only)	N/A (Maintenance Only)

*The existing structure is estimated to require replacement at approximately year 50; the lower cost option would be to replace with a standard girder bridge, and higher cost option would be to replace with a gateway or arch bridge

Detailed Evaluation of Overall Crossing Strategy Alternatives

Overall Crossing Strategy Alternative	Lorne Bridge	Brant's Crossing Bridge	TH&B Crossing Bridge	New Bridge Crossing	Cost (2021$)		Is the Overall Crossing Strategy Alternative Feasible?	
					Initial Capital	Lifecycle		
1	Rehabilitate	Rehabilitate	Minor Rehab and Eventual Removal	Do Nothing	$9.6M	$40M	**YES**	Carried forward to evaluation.
2	Rehabilitate	Rehabilitate	Rehabilitate	Do Nothing	$9.9M	$46M	**YES**	Carried forward to evaluation.
3	Rehabilitate	Rehabilitate	Rehab & Raise	Do Nothing	$11M	$47M	**NO**	Not carried forward to evaluation due to issues with hydraulics*.
4	Rehabilitate	Rehab & Raise	Minor Rehab and Eventual Removal	Do Nothing	$11M	$41M	**YES**	Carried forward to evaluation.
5	Rehabilitate	Rehab & Raise	Rehabilitate	Do Nothing	$11M	$47M	**NO**	Not carried forward to evaluation due to issues with hydraulics*.
6	Rehabilitate	Rehab & Raise	Rehab & Raise	Do Nothing	$12M	$48M	**YES**	Carried forward to evaluation.
7	Rehabilitate	Replace & Raise	Minor Rehab and Eventual Removal	Do Nothing	$12M	$39M	**YES**	Carried forward to evaluation.
8	Rehabilitate	Replace & Raise	Rehabilitate	Do Nothing	$13M	$45M	**NO**	Not carried forward to evaluation due to issues with hydraulics*.
9	Rehabilitate	Replace & Raise	Rehab & Raise	Do Nothing	$14M	$46M	**NO**	Not carried forward to evaluation due to high cost considerations.

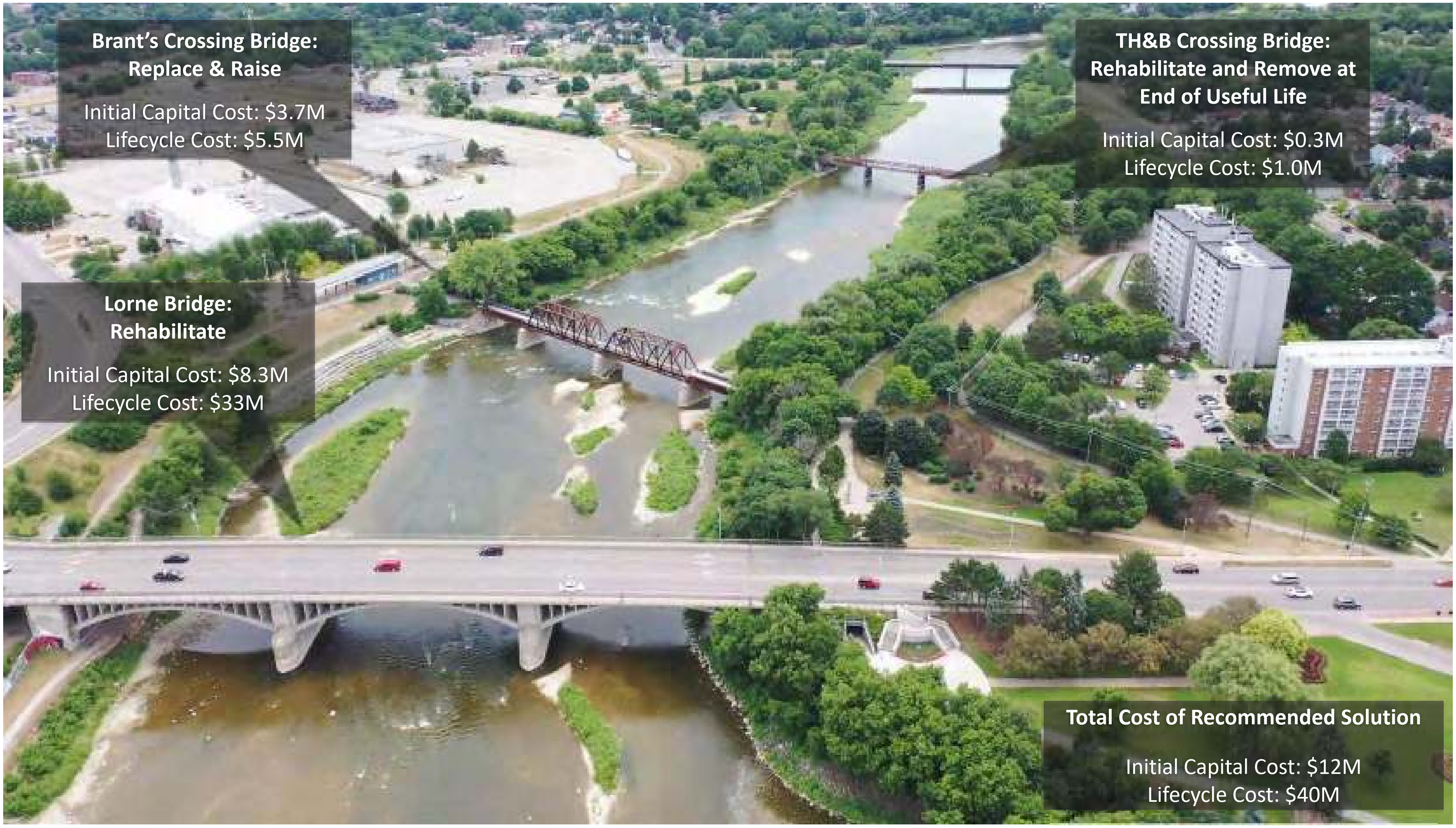
Rehabilitating Lorne Bridge is common among all Crossing Strategy Alternatives and, therefore, the comparative evaluation of strategies will focus on Brant's and TH&B Crossing Bridges.

* Keeping one of the pedestrian bridges at its existing elevation but raising the other would not reduce concerns related to ice jamming since the lower of the two bridges would continue to limit the flow.

Detailed Evaluation of Crossing Strategy Alternatives

Category		Strategy 1	Strategy 2	Strategy 4	Strategy 6	Strategy 7
	Brant's	Rehabilitate without Raising	Rehabilitate without Raising	Rehabilitate & Raise	Rehabilitate & Raise	Replace & Raise
	TH&B	Rehabilitate without Raising and Eventual Removal	Rehabilitate without Raising	Rehabilitate without Raising and Eventual Removal	Rehabilitate & Raise	Rehabilitate without Raising and Eventual Removal
Category	Social	• Cultural Heritage impacts following removal of TH&B. • Eventual removal of crossing over the Grand River. • Unable to accommodate dedicated cyclist lane on Brant's and existing TH&B cyclist crossing would ultimately be removed.	• Less disruption of historical/cultural heritage features. • Maintain two pedestrian crossings over the Grand River. • Unable to accommodate dedicated cyclist lane on Brant's.	• Cultural Heritage impacts following removal of TH&B. • Eventual removal of pedestrian crossing over the Grand River. • Unable to accommodate dedicated cyclist lane on Brant's and existing TH&B cyclist crossing would ultimately be removed.	• Less disruption of historical/cultural heritage features. • Maintain two pedestrian crossings over the Grand River. • Unable to accommodate dedicated cyclist lane on Brant's.	• Cultural Heritage impacts following removal of TH&B. • Eventual removal of pedestrian crossing over the Grand River. • Incorporate dedicated cycling lane on Brant's Crossing. • Cultural Heritage effects of removing existing Brant's Crossing Bridge to be mitigated.
		↓	↑	↓	↔	↔
	Natural	• Temporary impacts can be mitigated.	• Temporary impacts can be mitigated.	• Temporary impacts can be mitigated.	• Temporary impacts can be mitigated.	• Temporary impacts can be mitigated.
		↔	↔	↔	↔	↔
	Technical	• Increased risk as crossings would not be raised to meet MTO Design Criteria for the evaluated ice jam events. • Less intensive rehabilitation required for TH&B.	• Increased risk as crossings would not be raised to meet MTO Design Criteria for the evaluated ice jam events.	• Reduced risk as Brant's would be raised to meet MTO Design Criteria for the evaluated ice jam events. Short term risk of TH&B not being raised. • Increased constructability challenges with raising Brant's, but less intensive rehabilitation required for TH&B.	• Reduced risk as crossings would be raised to meet MTO Design Criteria for the evaluated ice jam events. • Increased constructability challenges with raising bridge.	• Reduced risk as Brant's would be raised to meet MTO Design Criteria for the evaluated ice jam events. Short term risk of TH&B not being raised. • Increased constructability challenges with replacing Brant's, but less intensive rehabilitation required for TH&B.
		↔	↓	↑	↔	↑
	Economic (for comparison, costs exclude Lorne Bridge)	• Low initial capital cost. • Low lifecycle cost.	• Low initial capital cost. • High lifecycle cost.	• Average initial capital cost. • Low lifecycle cost.	• Highest initial capital cost. • Highest lifecycle cost.	• High initial capital cost. • Low lifecycle cost.
		Initial Capital Cost: $1.3M Lifecycle Cost: $7.1M	Initial Capital Cost: $1.6M Lifecycle Cost: $13M	Initial Capital Cost: $2.6M Lifecycle Cost: $8.4M	Initial Capital Cost: $4.1M Lifecycle Cost: $15M	Initial Capital Cost: $4.0M Lifecycle Cost: $6.3M
	Summary	↔	↔	↔	↓	↑

Recommended Solution: Strategy 7



Summary of Select Frequently Asked Questions

Can Brant's Crossing Bridge be re-opened soon?

- A minor rehabilitation is required in order to re-open the Brant's Crossing Bridge in the short term and could occur following the outcome of this Environmental Assessment. However, more extensive work is required in order to have the bridge remain open beyond approximately 3 to 5 years.

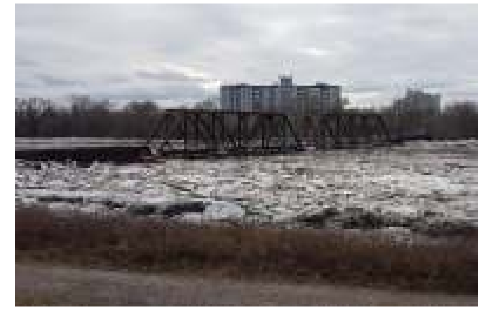
Summary of Select Frequently Asked Questions

What is this history of water or ice levels rising to the underside of the Brant's and TH&B Crossing Bridges?

- According to records back to 1965, river water gauges indicate that in February of 1996 and February 2018 the underside of the bridges were submerged. Additionally, an event in February 1984 was very close to or may actually have risen to the undersides of the bridges.

Summary of Select Frequently Asked Questions

What is a 100-year return period event (or 100-year storm or 100-year flood)? Do they occur only once in 100 years?



Photos from the 2018 Ice Jam Event

- A return period represents the likelihood of a storm event occurring, <u>in any given year</u>. A 100-year return period event has a 1 in 100 chance of occurring, regardless of what happened in the previous year.

- An example would be the chance of pulling the single red jellybean from jar of white jellybeans. The number of total jellybeans in the jar is equal to the return period event referenced. i.e., for a 100-year storm there would be 100 jellybeans in the jar.

Summary of Select Frequently Asked Questions

Would raising Brant's Crossing Bridge and TH&B Crossing Bridge eliminate ice jam issues and risks?

- Raising the two crossings by approximately 0.8 metres reduces the probability of an ice jam event occurring at the bridges to less than 1% in any given year (100-year event).

Summary of Select Frequently Asked Questions

There are concerns with the existing cycling facilities on Lorne Bridge. Can Lorne Bridge accommodate dedicated cycling lanes without reducing vehicular capacity?

- The bridge deck was widened during the construction works in the 1980's and cannot be further widened. Adding dedicated cycling lanes to the bridge would come at the expense of reduced vehicular capacity.

Summary of Select Frequently Asked Questions

There are concerns with the existing shared-use trail under Lorne Bridge, on the east riverbank. Will the trail be improved or realigned?

- Trail alignment and connectivity is being investigated by the City of Brantford, outside of this Class EA. For questions related to the trail, please contact the City of Brantford.

PIC #2 Process

1)	Notice of Public Information Centre #2 first published	March 18, 2021
2)	PIC Presentation posted to project webpage	March 18, 2021
3)	Live Public Information Centre #2 Presentation	April 1, 2021
4)	Public Comment Period	April 1 – April 15, 2021
5)	Question List and FAQs with answers posted to project webpage	April 22, 2021

Next Steps in MCEA Study

Points of Contact

☑	1)	Notice of Study Commencement	March 5, 2020
☑	2)	Public Information Centre #1	May-July, 2020
☑	3)	Public Information Centre #2	April 2021
	4)	Notice of Study Completion	Summer 2021

We Want to Hear from You!

Thank you for participating in the Virtual Public Information Centre.

IF YOU WISH TO SUBMIT COMMENTS OR WOULD LIKE TO BE ADDED TO THE PROJECT MAILING LIST, PLEASE CONTACT:

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100 Wellington Square
Brantford, ON N3T 5R7
519.759.4150 ext. 5426
gbatra@brantford.ca

Jack Turner, P.Eng.
Consultant Project Manager
GM BluePlan Engineering Limited
650 Woodlawn Road West, Block C, Unit 2
Guelph, ON N1K 1B8
519.824.8150 ext. 1237
jack.turner@gmblueplan.ca

Comment Sheets are available at the Three Grand River Crossings website:
www.brantford.ca/threegrandrivercrossings

Comments submitted by **April 15th, 2021** will be considered for the FAQ list posted on April 22, 2021

APPENDIX B

Brant's Crossing Bridge (Structure 104) Enhanced OSIM Summary Report, GM BluePlan, December 2018

Prepared By:

City of Brantford

Brant's Crossing Bridge (Structure 104) Enhanced OSIM Summary Report

GMBP File: 118074

December 2018

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER |LONDON | HAMILTON | GTA
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WWW.GMBLUEPLAN.CA

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APPENDICES

BRANT'S CROSSING BRIDGE (STRUCTURE 104) ENHANCED OSIM SUMMARY REPORT

CITY OF BRANTFORD

DECEMBER 2018

GMBP FILE: 118074

1. INTRODUCTION

GM BluePlan Engineering Limited (GMBP) was retained by the City of Brantford (City) to complete an Enhanced OSIM inspection and summary report of the Brant's Crossing Bridge (Structure 104), located south of Colborne Street West and spanning the Grand River in the City of Brantford. The City requested this inspection in response to flooding and ice jamming events in February of 2018 in order to obtain a more detailed understanding of the condition of the bridge and to estimate costs for rehabilitation or replacement options.

The following is a summary description of the structure based on the results of our Enhanced OSIM inspection. The recommended capital works for rehabilitation and superstructure replacement are summarized below, complete with cost estimates attached. Capital costs have been estimated based on our recent experience in similar bridge construction projects, including recent tender prices received by GMBP, and discussions with suppliers and contractors. The capital cost estimates are presented in 2018 dollar values and do not include HST; however, cost estimates do include associated costs such as engineering design and contingencies. The estimated costs contained in this report should be considered as preliminary, as no pre-design work has been completed that may influence costs of items such as environmental considerations, transportation requirements, geotechnical conditions, regulatory authority requirements, as well as any ancillary work beyond the limits of the bridge.

It should also be noted that projects involving railway bridges converted to pedestrian bridges are quite unique, and can often be difficult to accurately estimate.

1.1 Background

Structure 104 is a four span bridge that was originally designed to convey railway traffic, but has since been converted to a pedestrian bridge to carry pedestrian traffic and a utility crossing across the Grand River. Based on discussions with City staff, the utility crossing is no longer in active service. The superstructure consists of two through truss spans (Spans 2 & 3) and two plate girder spans (Spans 1 & 4). There are no drawings of the superstructure; however, the City provided drawings for the substructure that indicate the piers and abutments are founded on rock using spread footings. The drawings are dated as 1911 and 1912. It should be noted that the west pier is the abutment of a former bridge in this location that was repurposed as a pier. City staff have indicated that this bridge was converted to a pedestrian bridge in approximately 1997.

An ice jam event in the Grand River on February 21, 2018, prompted a preliminary visual inspection that was completed by GMBP. Based on the findings of the preliminary visual inspection, it was recommended that additional inspections be completed in the form of an Enhanced OSIM inspection in order to properly assess the condition of Structure 104 and that the structure be closed due to suspected movements of the superstructure. In order to safely assess all elements of the bridge within an arm's reach, ASI Group Ltd. (ASI) was retained to perform an underwater inspection of the abutment and pier footings and Acuren Group Ltd. (Acuren) was retained to perform a ropes access inspection of all other elements beyond an arm's reach, which included the underside of the structure and top members of the trusses. The ropes access inspection occurred over a period of 4 days from May 28, 2018, to May 31, 2018, and the underwater inspection occurred on June 22, 2018. All inspections were completed under the supervision of Adam Galezowski, P.Eng., of GMBP. Copies of the ASI and Acuren reports are provided in **Appendix A**.

1.2 Nomenclature

For the purpose of this report, all bridge elements have followed a naming convention to inform their location. A sketch of Structure 104 that has adopted this naming convention has been included in **Appendix B**. For definitions of some of the technical terms used in this report refer to **Appendix C**. Steel members in each span generally consist of built-up sections. Refer to **Figure 1** below for the standard terminology used for these built-up sections.

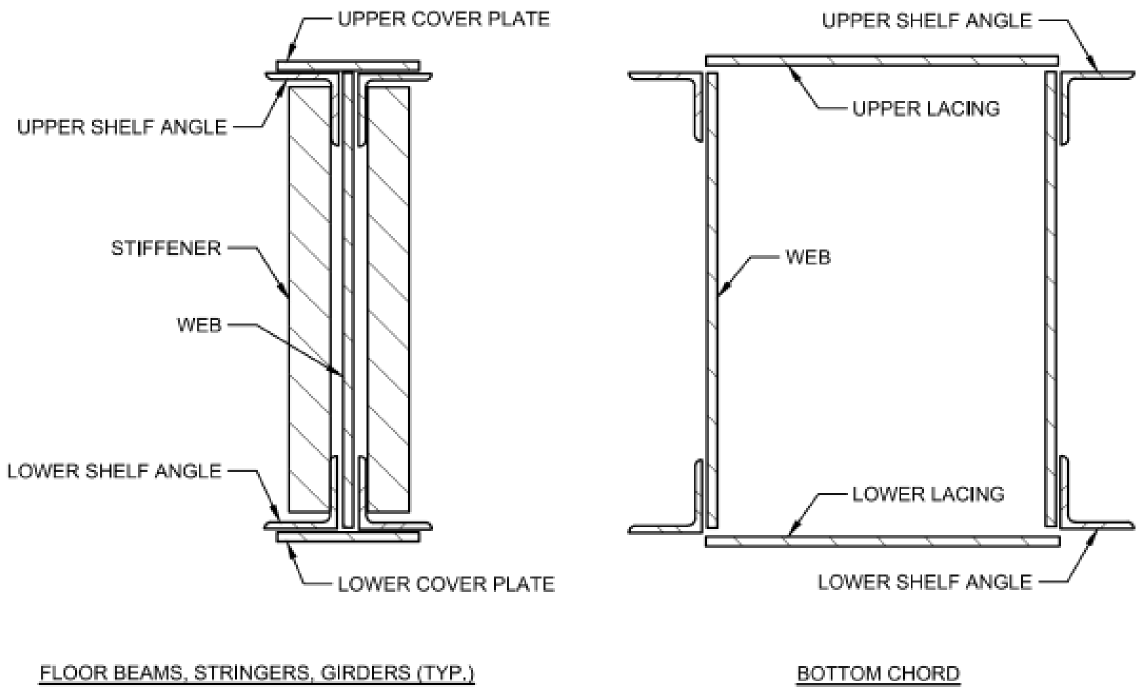


Figure 1: Cross Sections of Typical Built-Up Sections in Structure 104

2. INSPECTION SUMMARY

Table 1 and **Table 2** include a summary of deficiencies observed during the 2018 Enhanced OSIM inspection for the plate girder spans and the truss spans, respectively. The deficiencies have been summarized based on inspection reports provided by ASI and Acuren, as well as our inspector's observations and have been categorized as being major or minor depending on our opinion of their structural significance. Major deficiencies are considered to be critical and should be addressed in the next 1-5 years to maintain the structural integrity of the bridge. Minor deficiencies are not classified as urgent and can be addressed at a later time, though consideration should be given to addressing all deficiencies under one project. Refer to **Appendix D** for photos referenced in the tables below.

Table 1: Plate Girder Spans - Summary of Deficiencies

Structure Element	Observations	Photo Ref#
Abutments/ Wingwalls	Major Deficiencies	
	• Light to severe cracking, spalling and delamination throughout.	G2
	Minor Deficiencies	
	• Minor erosion at water level.	G2
	• Wood blocking beneath floor beam on east abutment.	G3
Abutment Bearings	Major Deficiencies	
	• All bearings appear to be seized.	G4-G5
	• Bearings located on each abutment appear to have shifted as follows: ○ East Abutment – North Bearing: 25mm west ○ East Abutment – South Bearing: 25mm north ○ West Abutment – North Bearing: 40mm south ○ West Abutment – South Bearing: 40mm south Note: In the absence of previous monitoring data, the above bearing movements were determined based on measured deflections of the bearing anchor bolts.	G4
	• Anchor bolts have severe material loss ranging between 10% - 100% at the base of the bolt. Complete section loss of bolts was noted at the west abutment.	G4-G6
Stringers	Major Deficiencies	
	• Very severe isolated corrosion with 40-100% material loss noted in web above lower shelf angles. The very severe material loss is isolated on stringers in Bay 5.	G11
	• Severe corrosion with 40-60% material loss noted in web above lower shelf angles throughout stringers in Bays 1-4.	-
	• Isolated severe corrosion and impact damage on the interior lower shelf angle leg of the north stringer in Bay 5.	G12
	Minor Deficiencies	
	• Stringer stiffeners have 100% material loss isolated at the base of the member. On average, the material loss extends up to 150mm above the lower shelf angle legs.	G11-G12
	• Overall medium to severe corrosion noted throughout upper and lower shelf angles with up to 10% and 30% material loss respectively.	G11-G12

Structure Element	Observations	Photo Ref#
Girders	Major Deficiencies	
	• Very severe isolated corrosion 50-100% material loss noted in web above lower interior shelf angle. The very severe material loss is isolated in the northern girder of the west span in Bay 6 and 7 and measures up to 75mm in height.	G7
	• Severe isolated corrosion with up to 40% material loss noted in the web above lower interior shelf angle in Bay 22.	G8
	• Severe isolated corrosion with up to 100% material loss noted in lower interior shelf angle on girders in the east span, isolated near the abutment. The isolated material loss extends for approximately 600mm from the east abutment bearings.	G9
	Minor Deficiencies	
	• Approximately 60% of exterior girder stiffeners have isolated 100% material loss at the base of the member. The 100% material loss extends up to 150mm above the lower shelf angles.	G10
	• Severe isolated corrosion with up to 100% material loss noted in the web at the connection with the upper and lower shelf angles of the floor beams in both spans.	G15
	• Overall medium to severe corrosion throughout girders with 10-20% material loss noted in upper and lower shelf angles and their connection rivets.	G7-G10
Floor Beams	Minor Deficiencies • Overall medium to severe corrosion throughout with 10-20% material loss isolated on upper and lower shelf angle legs.	-
Intermediate Diaphragms	Minor Deficiencies • Overall light to medium corrosion throughout with up to 10% material loss.	-
Lateral Bracing	Major Deficiencies	
	• Medium to severe corrosion throughout with 100% isolated material loss noted in 9 members in both spans.	G13
	• Medium to severe corrosion with significant areas of 100% material loss noted in 12 connection plates in both spans.	G14

Table 2: Truss Spans - Summary of Deficiencies

Structure Element	Observations	Photo Ref#
Piers	Minor Deficiencies • Light to severe delamination on faces of all piers. • Severe erosion throughout faces of pier footings and isolated areas of severe erosion at the interface of pier footings and pier shaft. • Undermining of the west pier footing for up to 4m on the east face and the entire west face. The maximum depth of scour was 0.7m and 0.4m on the east and west faces, respectively. ○ Based on a review of drawings provided by the City, the west pier is founded on bedrock. It appears the bedrock has eroded in this location.	T2 T2 -

Pier Bearings	Major Deficiencies
	• All bearings appear to be seized.
	• Roller bearings located on the east pier appear to have shifted as follows:
	  ○ East Pier – North Bearing: 65mm south
	  ○ East Pier – South Bearing: 75mm south
	Note: In the absence of previous monitoring data, the above bearing movements were determined based on measured deflections of the bearing anchor bolts.
	Minor Deficiencies
	• Severe corrosion with complete isolated material loss of vertical plates enclosing all roller bearings.
	• Severe corrosion with 20-30% material loss noted at the base of all bearing anchor bolts in west span.
		T3-T4, T7
		T3-T4
		T4
		T3-T4

Bottom Chords	Major Deficiencies • Very severe corrosion with up to 100% material loss isolated on legs of interior and exterior shelf angles near the lateral brace connections. • Severe corrosion with up to 100% material loss noted in lower shelf angle legs above bearings. • Severe corrosion with up to 100% material loss isolated at the lower web (locations: A8 in Bay 6, D8 in Bay 6, D12 in Bay 10, D12 in Bay 11, and D10 in Bay 11).	T5 T6 T7-T9

Structure Element	Observations	Photo Ref#
Verticals	Major Deficiencies	
	• Light to medium corrosion throughout and severe corrosion with 100% material loss isolated at the bottom 200mm of all vertical members.	T8
	Minor Deficiencies	
	• Overall light to medium corrosion with severe corrosion with up to 20% material loss isolated at the bottom inside face of all vertical connection plates, connecting vertical members with bottom chords.	-
Stringers	Minor Deficiencies	
	• Very isolated severe corrosion with 100% material loss noted in web above lower shelf angles. The severe corrosion and material loss is isolated to the south stringer in the east span.	T10
	• Overall light to medium corrosion throughout with 10–30% material loss noted in lower shelf angle legs.	T10
	• Stringer stiffeners have 100% material loss isolated at the base of the member. On average, the material loss extends up to 200mm above the lower shelf angle legs.	T10
Floor Beams	Major Deficiencies	
	• Severe corrosion with up to 60% and 100% material loss noted in the entire lower shelf angle, throughout the full length of the floor beam from A16 to D16.	T11
	Minor Deficiencies	
	• Overall light to severe corrosion with up to 30% overall material loss noted throughout all floor beams. Isolated severe corrosion with up to 40% material loss noted in the lower shelf angle legs near the lateral brace plate connections.	-
Intermediate Diaphragms	Minor Deficiencies	
	• Light to medium corrosion throughout with isolated 100% material loss noted in bottom chords at the connections to the stringers.	T12
Lateral Bracing	Minor Deficiencies	
	• Medium to severe corrosion with significant areas of 100% material loss noted in 10 connection plates in both spans.	-
	• Medium to severe corrosion throughout with 100% isolated material loss noted in 3 members in both spans.	T13
	• Rust packing of up to 50mm between vertical legs of angles.	T14

3. DEFICIENCIES AND CONCERNS

Severe corrosion and material loss was noted throughout steel members of Structure 104. Generally, the areas of severe corrosion noted were located in areas that have a higher exposure to water and chlorides, particularly horizontal surfaces where water and debris is able to sit and accumulate. This is a common issue for steel structures of this design, particularly considering the age of Structure 104. In areas where severe corrosion and material loss is present, a reduction in the capacity of the member is expected. Material loss in main structural members such as girders, stringers, floor beams, verticals and bottom chords are considered to be a major deficiency. Other steel members experiencing severe corrosion and material loss such as intermediate diaphragms and lateral bracing are considered to be secondary structural members. Therefore, we have considered these deficiencies as minor.

We note that Structure 104 was originally designed to convey railway traffic, but has since been converted to a pedestrian bridge that carries pedestrian traffic and a decommissioned utility crossing. Based on preliminary estimates, we anticipate the applied live load has been substantially reduced as compared to the estimated original design live load (assuming Cooper E-40 railway design loading). Conversely, the dead load on the structure has increased since its conversion to a pedestrian bridge with the addition of the pedestrian boardwalk and utility crossing, which were placed on top of the railway track and deck ties. Additionally, the loading effects of maintenance vehicles such as the trackless snow clearing equipment currently used by the City would need to be considered. Without completing a full load limit evaluation for the structure, it is difficult to determine the remaining capacity of each structural element.

Overall, Structure 104 is in fair to poor condition with numerous major deficiencies that should be addressed in 1-5 years. Except for the movement observed in the bearings on the east pier, it does not appear that any of the deficiencies noted were caused by the ice jam events in February of 2018.

To our knowledge, this is the first detailed inspection of Structure 104 since it was converted to a pedestrian bridge in approximately 1997. Therefore, it is difficult to determine the rate of deterioration of the bridge, and its remaining useful service live. Increased frequency of inspections may be warranted to better understand the performance of the structure.

4. EVALUATION OF ALTERNATIVES

We recommend the structure be rehabilitated, replaced or permanently closed in the next 1-5 years to address all major deficiencies. Provided below are additional considerations for the City prior to determining what to do regarding this structure:

- If rehabilitation is preferred, a load limit analysis is recommended to be completed to assess which elements and connections require rehabilitation to support the current pedestrian use of the structure. Based on the results of the analysis, the scope and cost of the rehabilitation may be refined. This may result in a reduced or increased rehabilitation cost estimate. The cost for a load limit analysis is estimated to be approximately $50,000 to $100,000.
- Given the significant capital cost required to rehabilitate, replace or permanently close Structure 104, we recommend the City complete a Schedule ‘B’ or ‘C’ Municipal Class Environmental Assessment (MCEA) to determine the most appropriate alternative for the City to pursue. This is estimated to cost approximately $50,000 to $100,000, and would include, at a minimum, a cultural heritage evaluation report (CHER), heritage impact assessment (HIA), archeological assessment, environmental impact study and hydraulic assessment.

The following summarizes rehabilitation, replacement and removal alternatives for Structure 104. Pre-engineering cost estimates for each alternative have been prepared and presented at the end of this section. Itemized cost estimates are provided in **Appendix D**.

4.1 Alternative 1: Rehabilitation

In this alternative, all major and minor deficiencies would be addressed. Given the limited access to Structure 104, it is expected that the cost to construct temporary work platforms will be substantial as defects are noted throughout the underside of the superstructure. Therefore, although the minor deficiencies do not need to be addressed in the next 1-5 years, we recommend all deficiencies be addressed under one capital works project.

Bearings would likely be replaced with elastomeric bearings similar to Structure 143 (TH&B Pedestrian Crossing) downstream of Structure 104. As shown in the photo below, a cast-in-place concrete bearing seat may be required to compensate for the difference in height of the new bearings. A hydraulic assessment could be considered to determine whether the superstructure should be raised to increase hydraulic capacity. The costs to complete a hydraulic assessment, raise the bridge, potential modifications to the abutment walls and wingwalls, and potential modifications to the approach pathways have not been included in the cost estimate provided in **Appendix D.** We estimate that raising the existing superstructure would greatly increase the complexity and cost of rehabilitation.

Figure 2: Replaced abutment bearing on Bridge 143

Deficient steel members would be reinforced or replaced, where applicable. Prior to the rehabilitation, the City may wish to complete coupon sampling to determine weldability and existing steel strength. The results of the analysis would determine whether reinforcing plates could be welded to the existing steel, or if plates would have to be bolted.

Concrete patch repairs to the abutments and piers have also been included in the scope of work.

The pre-engineering cost estimate provided in **Appendix D** accounts for the rehabilitation of all known minor and major defects. Upon completion of a load limit analysis for the structure, there may be opportunities to reduce the scope and capital cost of rehabilitation.

Based on our experience, a change in hydraulic capacity of the bridge structure would necessitate the completion of a MCEA.

4.2 Alternative 2: Replacement

In this alternative, the existing superstructure would be removed and replaced. To complete removals, construction of temporary pads and access roads to staging areas within the Grand River may be required. For the purposes of this report we have considered the replacement structure to be four prefabricated steel truss bridge spans. The truss bridge spans could bear on existing piers and abutments, provided that concrete patch repairs are completed as required.

A hydraulic assessment should be considered to determine the capacity of the replacement structure and its bearing elevations. One of the benefits of the prefabricated truss system shown in **Figure 3** below is that the underside of the superstructure would be raised by approximately 1.0 m in comparison to the existing structure while maintaining the same deck elevation. Therefore, the bearing elevation would need to increase just to maintain the existing deck elevation. This could be accomplished using similar construction details to those provided in **Figure 2** above. If the hydraulic assessment determines that the deck elevation is to be raised above the current elevations, additional modifications to the abutment walls, wingwalls, and the approach pathways would be required. The costs of these additional modifications have not been included in the pre-engineering cost estimate provided in **Appendix D**.

Based on our experience, a change in hydraulic capacity of the bridge structure would necessitate the completion of a MCEA.

It should be noted that the replacement superstructure types assumed for our estimated capital costs would not represent a sympathetic or replica replacement structure type. Replacement superstructures would be similar to a typical pre-fabricated steel truss structure, similar to the WGP Overhead Trail Bridge (Structure 152) shown below.

Figure 3: Prefabricated steel truss superstructure (Structure 152)

4.3 Alternative 3: Removal/Permanent Closure

In this alternative, the crossing would be closed permanently. The existing superstructure would either remain or be removed. The piers and abutments may also be removed; however, these could possibly be left in place as an indication that a structure once stood there and to mitigate the impacts to the environment from removal activities.

Should the crossing have heritage significance, various options would be considered including, but not limited to, removal of the superstructure for relocation to an adjacent location for a monument or commemorative display at the existing location.

Based on our experience, removal of a bridge would necessitate the completion of a MCEA.

The pre-engineering cost estimate provided in **Appendix D** accounts for the removal of the superstructure; however, it was assumed that the abutments and piers would remain and a commemorative plaque/display would be installed on both sides of the Grand River.

4.4 Other Considerations

Given the proposed scope of work for both rehabilitation and superstructure replacement, the potential change in the hydraulic capacity from superstructure modification and the potential heritage significance of the bridge, the City may wish to consider a MCEA to determine the appropriate means for addressing the deteriorated state of Structure 104 to inform which alternative to move forward to design and construction. We have accounted for a Schedule ‘B’ MCEA as part of our cost estimates. We note that the ultimate decision on schedule should be reviewed as part of the MCEA process.

We have not completed a cultural heritage evaluation of Structure 104; however, we believe there is a strong possibility that the structure has heritage value due to its age, superstructure types, location and views. As part of a MCEA, a Cultural Heritage Evaluation Report will be required to determine whether the structure has any heritage significance.

4.5 Cost Estimates

Table 3 includes a breakdown of the pre-design cost estimate for each alternative listed above. The prices listed below are presented in 2018 dollars and exclude HST, but include engineering at approximately 15% of construction costs and a 25% contingency. A breakdown of each cost can be found attached to this report.

Table 3: Summary of Cost Estimates for Alternatives

Description	Estimated Capital Costs (2018 Dollars)	Estimated Remaining Life Upon Completion of Work
Alternative 1: Rehabilitation	$2,100,000	15-25 years
Alternative 2: Replacement	$2,600,000	75 years
Alternative 3: Removal	$1,100,000	Not Applicable

We note that the estimated cost for rehabilitation listed above is higher than previous estimates provided to the City in our letter dated April 13, 2018. The increase in the cost estimate for rehabilitation can be attributed to the advanced deterioration discovered in numerous elements of the superstructure, which were identified a result of the enhanced OSIM inspection. In comparison to the previous rehabilitation estimate, the following works have been revised or added to the scope of work recommended for rehabilitation:

- Replacement of all bearings;
- Concrete patch repairs to abutment walls, wingwalls and piers;
- Reinforcing or replacement of numerous steel members on the underside of the structure; and,
- Non-construction costs including a MCEA, engineering design and construction administration.

Please note that no design work has been completed that may influence costs of items such as environmental considerations, transportation requirements, geotechnical conditions, regulatory authority requirements, as well as any ancillary work beyond the limits of the bridge.

5. SUMMARY AND RECOMMENDATIONS

GMBP supervised an arm's length inspection of the Brant's Crossing Bridge (Structure 104). This inspection involved ropes access to inspect the superstructure and above-water substructure elements, as well as an underwater investigation to inspect the exposed footings of the abutments and piers. The results of this inspection determined that Structure 104 is in fair to poor condition, and in need of rehabilitative work in order to re-open for pedestrian use.

To re-open the bridge, we recommend that the City consider Alternative 1 or Alternative 2, described above. Given the significant capital cost required to rehabilitate and maintain Structure 104, we recommend the City consider a MCEA to determine the long-term plan for the structure. A load limit evaluation should be included as part of the MCEA to properly assess the scope of work required for rehabilitation.

Further to the recommendations provided above, we strongly suggest that the City ensures the following maintenance procedures are implemented or continued:

- Avoid use of de-icing chemicals, using sand as an alternative
- Regularly cut back and maintain vegetation around the abutments and deck of the structure
- Regularly clean structure of accumulated debris

We thank you for engaging in the services of GM BluePlan Engineering Limited, and trust that this report provides the information that you require at this time. If you have any questions, or if we may be of further assistance, please do not hesitate to contact us.

All of which is respectfully submitted,

GM BLUEPLAN ENGINEERING LIMITED

Per:

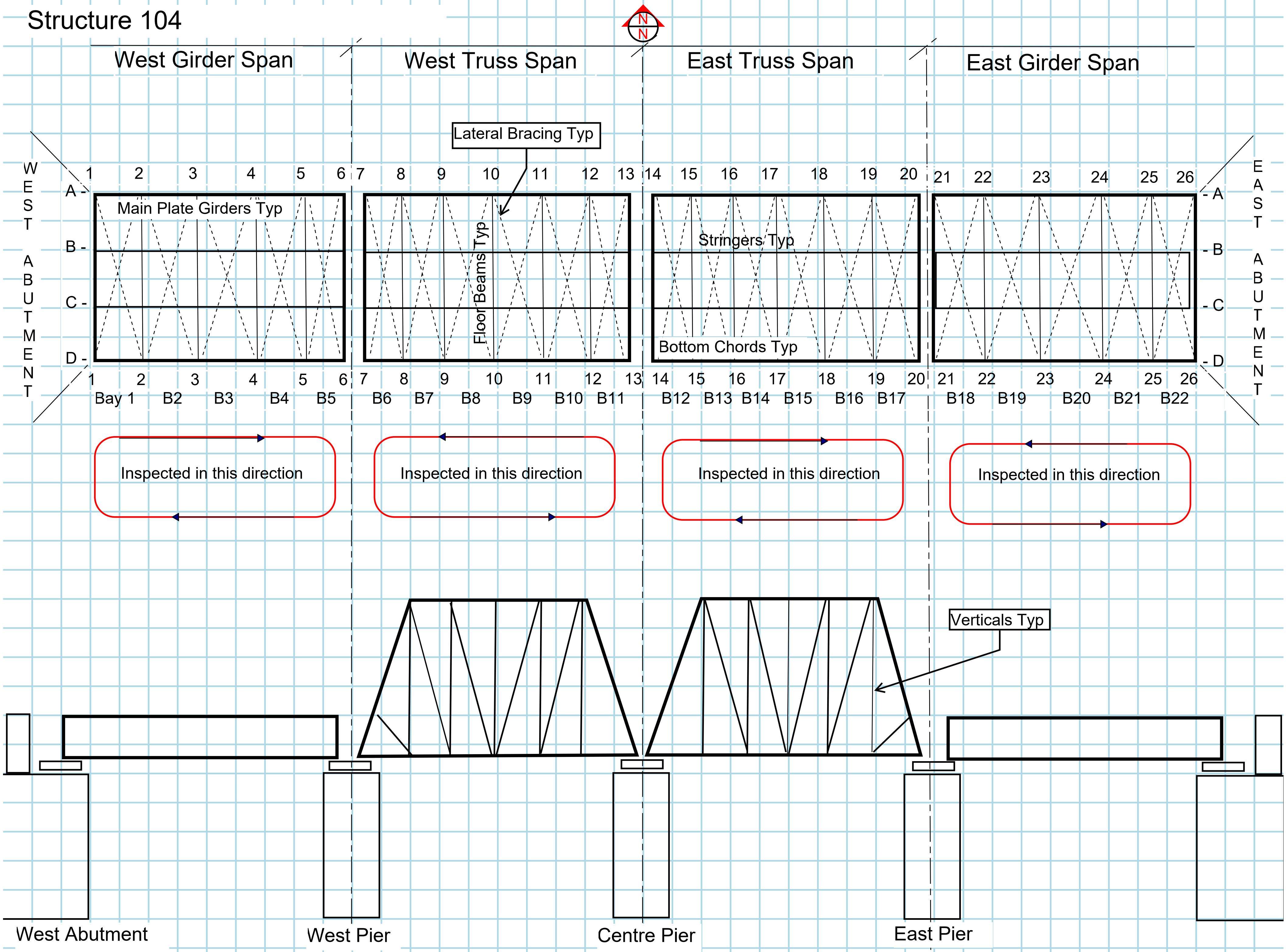
Adam Galezowski, P.Eng.

Per:

Jack Turner, P.Eng.

APPENDIX A:
Structure 104 Sketch - Naming Convention

Structure 104



APPENDIX B:
Glossary of Technical Terms

GLOSSARY OF TECHNICAL TERMS

Concrete Deficiencies

Delamination: A discontinuity of the surface concrete which is substantially separated but not completely detached from concrete below or above it

Spalling: A continuation of the delamination process whereby the actions of external loads, pressures exerted by the corrosion of reinforcement or by the formation of ice in the delaminated area results in the breaking off of the delaminated concrete

Steel Deficiencies

Corrosion: The deterioration of steel by chemical or electro-chemical reaction resulting from exposure to air, moisture, de-icing salts, industrial fumes and other chemicals and contaminants in the environment in which it is placed, also referred to as rust

Material loss: A continuation of corrosion, material loss refers to the percentage of cross sectional area that has corroded away

General Deficiencies

Scour: The removal of material from the stream bed or bank due to the erosive action of moving water in the stream.

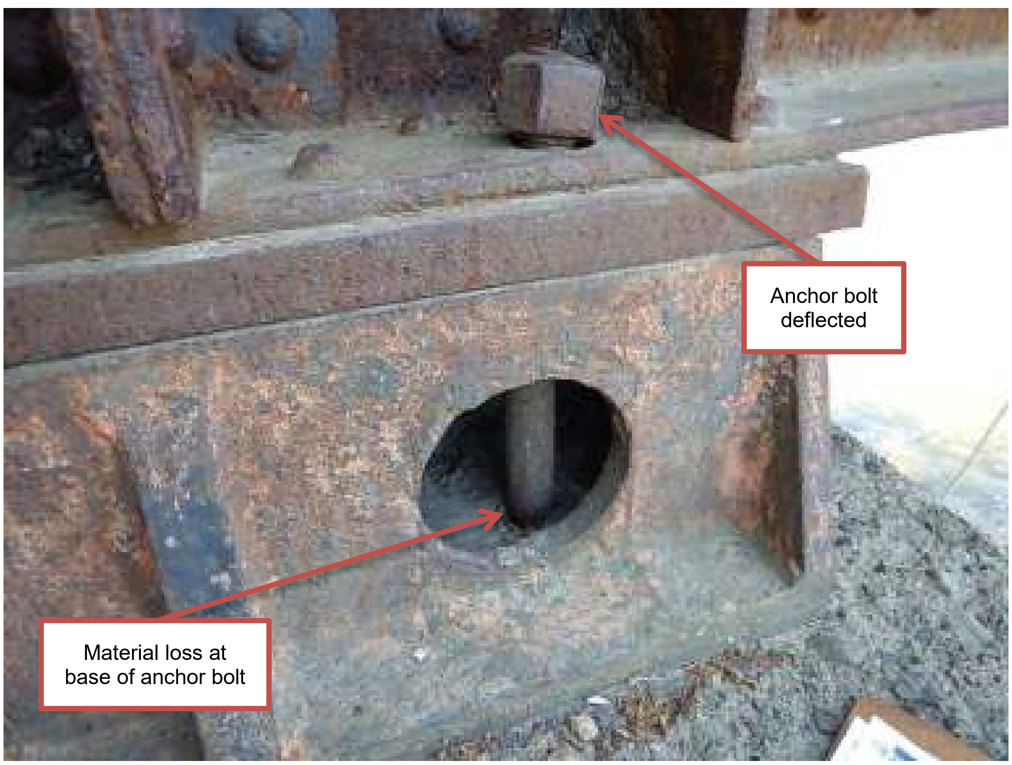
Undermining: The loss in support at the base of a foundation as a result of scour.

APPENDIX C:
Inspection Photos

Photograph G1: North elevation

Photograph G2: East Abutment

Photograph G3: East abutment



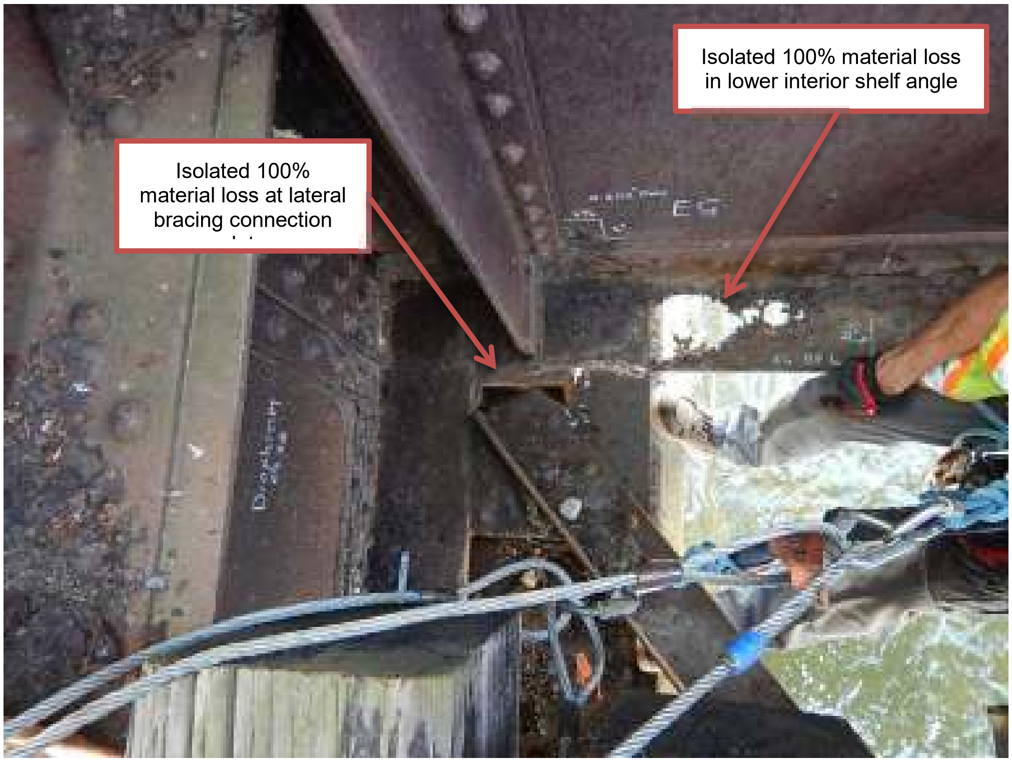
Photograph G4: East abutment, north bearing anchor bolt

Photograph G5: West abutment, south bearing

Photograph G6: West abutment, north bearing anchor bolt

Photograph G7: West span, north girder

Photograph G8: East span, north girder interior



Photograph G9: East span, south girder at east abutment

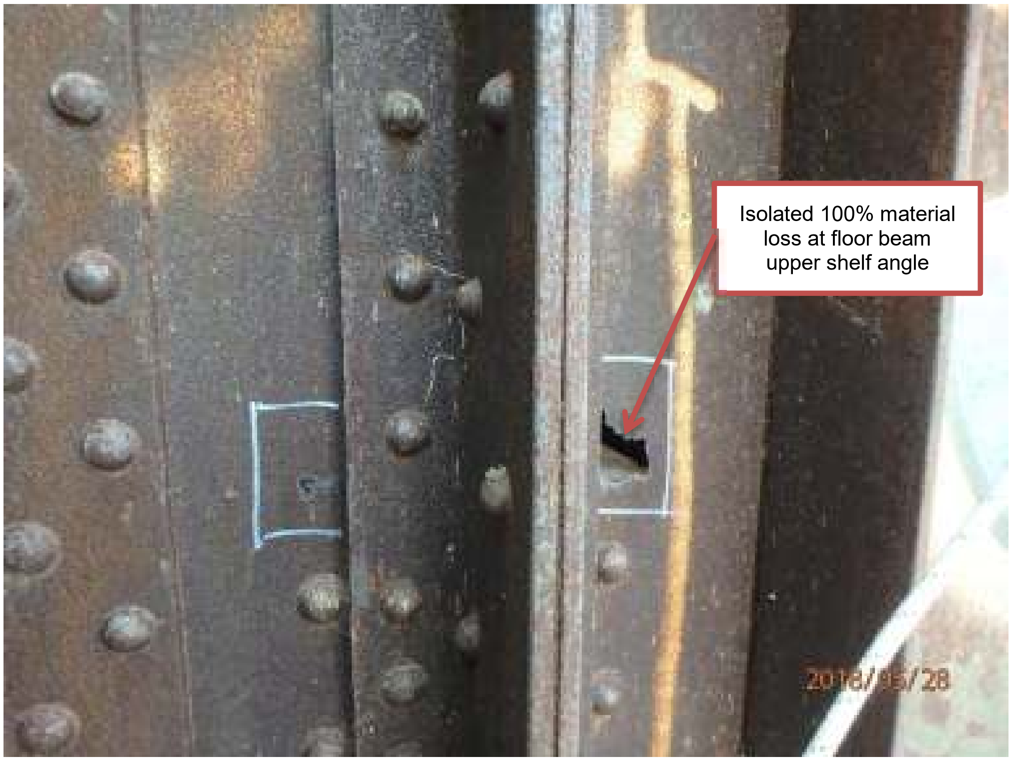
Photograph G10: East span, north girder exterior

Photograph G11: West span, south stringer

Photograph G12: West span, north stringer

Photograph G13: East span, underside

Photograph G14: East span, typical lateral bracing connection plate



Photograph G15: East span, girder web at top of floor beam

Photograph G16: West span underside

Photograph T1: Truss bridge span, south elevation

Photograph T2: West pier

Photograph T3: East pier, north roller bearing

Photograph T4: West pier, north roller bearing

Photograph T5: East truss, bottom chord at lateral brace connection

Photograph T6: Centre pier, southeast bearing

Photograph T7: West truss, north bottom chord (typical material loss)

Photograph T8: Typical vertical connection at bottom chord

Photograph T9: West truss, bottom chord

Photograph T10: East truss, south stringer

Photograph T11: East truss (Floor beam #10)

Photograph T12: East truss, underside

Photograph T13: East truss, lateral bracing

Photograph T14: West truss, lateral bracing

APPENDIX D:
Cost Estimates

STRUCTURE 104 COST ESTIMATE - REHABILITATION					
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL AMOUNT
A	**GENERAL**				
A.1	Mobilization, Demobilization and Miscellaneous Project Costs	100%	L.S.	$ 40,000.00	$ 40,000.00
A.2	Supply and Install Temporary Working Platform	100%	L.S.	$ 300,000.00	$ 300,000.00
A.3	Environmental Protection	100%	L.S.	$ 15,000.00	$ 15,000.00
TOTAL SECTION A					**$ 355,000.00**
B	**GIRDER SPAN REHABILITATION**				
B.1	Temporary Bridge Jacking	100%	L.S.	$ 150,000.00	$ 150,000.00
B.2	Form, Supply and Install Concrete for Bearing Seat	100%	L.S.	$ 20,000.00	$ 20,000.00
B.3	Remove and Replace Existing Girder Bearings	8	each	$ 4,000.00	$ 32,000.00
B.4	Cast In Place Concrete Patch in Abutment Walls and Wingwalls	100%	L.S.	$ 35,000.00	$ 35,000.00
B.5	Reinforce Girder Webs	13.5	m	$ 2,000.00	$ 27,000.00
B.6	Reinforce Stringer Webs	45	m	$ 2,000.00	$ 90,000.00
B.7	Reinforce Girder Lower Shelf Angles	9	m	$ 1,000.00	$ 9,000.00
B.8	Reinforce Stringer Lower Shelf Angles	4.5	m	$ 1,000.00	$ 4,500.00
B.9	Supply and Install New Girder Stiffeners	35	each	$ 500.00	$ 17,500.00
B.10	Supply and Install New Stringer Stiffeners	80	each	$ 500.00	$ 40,000.00
B.11	Supply and Install New Lateral Braces Including Connection Plates	20	each	$ 2,000.00	$ 40,000.00
TOTAL SECTION B					**$ 465,000.00**
C	**TRUSS SPAN REHABILITATION**				
C.1	Temporary Bridge Jacking	100%	L.S.	$ 200,000.00	$ 200,000.00
C.2	Form, Supply and Install Concrete for Bearing Seat	100%	L.S.	$ 20,000.00	$ 20,000.00
C.3	Remove and Replace Existing Truss Bearings	8	each	$ 4,000.00	$ 32,000.00
C.4	Cofferdams and Dewatering around West Pier	100%	L.S.	$ 20,000.00	$ 20,000.00
C.5	Underpinning of West Pier	100%	L.S.	$ 20,000.00	$ 20,000.00
C.6	Cast In Place Concrete Patch in Piers	100%	L.S.	$ 50,000.00	$ 50,000.00
C.7	Reinforce Bottom Chord Webs	5	each	$ 2,000.00	$ 10,000.00
C.8	Reinforce Bottom Chord Lower Shelf Angle Legs at Lateral Brace Connections	24	each	$ 1,000.00	$ 24,000.00
C.9	Reinforce Bottom Chord Lower Shelf Angle Legs at Bearings	3	each	$ 1,500.00	$ 4,500.00
C.10	Reinforce Floor Beam Lower Shelf Angles	1	each	$ 2,500.00	$ 2,500.00
C.11	Reinforce Intermediate Diaphragms at Lower Connection to Stringer	48	each	$ 500.00	$ 24,000.00
C.12	Reinforce Verticals at Bottom Chord	20	each	$ 500.00	$ 10,000.00
C.13	Supply and Install New Vertical Stiffener Plates on Stringers	80	each	$ 500.00	$ 40,000.00
C.14	Supply and Install New Lateral Braces Including Connection Plates	24	each	$ 2,000.00	$ 48,000.00

STRUCTURE 104 COST ESTIMATE - REHABILITATION					
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL AMOUNT
TOTAL SECTION C					**$ 505,000.00**
D	**MISCELLANEOUS COSTS**				
D.1	Remove and Dispose of Abandonned Watermain	100%	L.S.	$ 30,000.00	$ 30,000.00
D.2	Site Restoration	100%	L.S.	$ 4,000.00	$ 4,000.00
D.3	Contingency	100%	L.S.	$ 340,000.00	$ 340,000.00
TOTAL SECTION D					**$ 374,000.00**
E	**NON-CONSTRUCTION COSTS**				
E.1	Engineering Design and Construction Administration	100%	L.S.	$ 200,000.00	$ 200,000.00
E.2	Load Limit Analysis	100%	L.S.	$ 100,000.00	$ 100,000.00
E.3	Municipal Class Environmental Assessment	100%	L.S.	$ 100,000.00	$ 100,000.00
TOTAL SECTION E					**$ 400,000.00**
TOTAL REHABILITATION COST					**$ 2,099,000.00**

STRUCTURE 104 COST ESTIMATE - REPLACEMENT					
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL AMOUNT
A	**CONSTRUCTION COSTS**				
A.1	Mobilization, Bonding, Insurance, Demobilization	100%	L.S.	$150,000.00	$ 150,000.00
A.2	Environmental Protection	100%	L.S.	$20,000.00	$ 20,000.00
A.3	Contractor Layout	100%	L.S.	$10,000.00	$ 10,000.00
A.4	Cofferdams and Dewatering around Piers	100%	L.S.	$40,000.00	$ 40,000.00
A.5	Underpinning of Pier Footings	40	m3	$1,100.00	$ 44,000.00
A.6	Removal of Existing Deck, Railings, Railway Ties and Abandoned Watermain	430	m2	$350.00	$ 150,500.00
A.7	Construction of Temporary Access Paths and Staging Areas in Grand River	100%	L.S.	$150,000.00	$ 150,000.00
A.8	Removal of Existing Superstructure	100%	L.S.	$300,000.00	$ 300,000.00
A.9	Suspended Platforms at Piers	3	each	$15,000.00	$ 45,000.00
A.10	Cast In Place Concrete Patch in Piers	100%	L.S.	$ 50,000.00	$ 50,000.00
A.11	Platforms at Abutments	2	each	$5,000.00	$ 10,000.00
A.12	Cast In Place Concrete Patch in Abutment Walls and Wingwalls	100%	L.S.	$ 35,000.00	$ 35,000.00
A.13	Modifications to Existing Abutments and Piers	100%	L.S.	$15,000.00	$ 15,000.00
A.14	Design and Supply of new Superstructures for end Spans (23.3m)	100%	L.S.	$260,000.00	$ 260,000.00
A.15	Design and Supply of new Superstructures for middle Spans (37.7m)	100%	L.S.	$360,000.00	$ 360,000.00
A.16	Install new Superstructures	100%	L.S.	$150,000.00	$ 150,000.00
A.17	Removal of Temporary Access Paths and Staging Areas in Grand River	100%	L.S.	$20,000.00	$ 20,000.00
A.18	Site Restoration	100%	L.S.	$4,000.00	$ 4,000.00
A.19	Contingency at approximately 25%	100%	L.S.	$ 455,000.00	$ 455,000.00
TOTAL SECTION A					**$ 2,268,500.00**
B	**NON-CONSTRUCTION COSTS**				
B.1	Engineering Design and Construction Administration	100%	L.S.	$200,000.00	$ 200,000.00
B.2	Municipal Class Environmental Assessment	100%	L.S.	$100,000.00	$ 100,000.00
B.3	Approvals (est.)	100%	L.S.	$15,000.00	$ 15,000.00
TOTAL SECTION B					**$ 315,000.00**
TOTAL REPLACEMENT COST					**$ 2,583,500.00**

STRUCTURE 104 COST ESTIMATE - SUPERSTRUCTURE REMOVAL						
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL AMOUNT	
A	**CONSTRUCTION COSTS**					
A.1	Mobilization, Bonding, Insurance, Demobilization	100%	L.S.	$50,000.00	$	50,000.00
A.2	Environmental Protection	100%	L.S.	$10,000.00	$	10,000.00
A.3	Contractor Layout	100%	L.S.	$2,000.00	$	2,000.00
A.4	Removal of Existing Deck, Railings, Railway Ties and Abandoned Watermain	430	m2	$350.00	$	150,500.00
A.5	Construction of Temporary Access Paths and Staging Areas in Grand River	100%	L.S.	$150,000.00	$	150,000.00
A.6	Removal of Existing Superstructure	100%	L.S.	$300,000.00	$	300,000.00
A.7	Removal of Temporary Access Paths and Staging Areas in Grand River	100%	L.S.	$20,000.00	$	20,000.00
A.8	Site Restoration	100%	L.S.	$4,000.00	$	4,000.00
A.9	Contingency at approximately 25%	100%	L.S.	$ 170,000.00	$	170,000.00
TOTAL SECTION A					**$**	**856,500.00**
B	**NON-CONSTRUCTION COSTS**					
B.1	Engineering Design and Construction Administration	100%	L.S.	$100,000.00	$	100,000.00
B.2	Municipal Class Environmental Assessment	100%	L.S.	$100,000.00	$	100,000.00
B.3	Approvals (est.)	100%	L.S.	$15,000.00	$	15,000.00
TOTAL SECTION B					**$**	**215,000.00**
TOTAL SUPERSTRUCTURE REMOVAL COST					**$**	**1,071,500.00**

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